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INTERNATIONAL COOPERATION FOR DEVELOPMENT: A SHARED GLOBAL VISION INTEGRATING HEALTH, LIFESTYLES AND ANTHROPOLOGY

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Dedico la mia tesi di dottorato a mia mamma, alla mia famiglia, a Valentina, Gabriele, Francesco e a tutti coloro che credono in me.

THESIS ABSTRACT

According to the WHO definition, health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. In an interconnected world, it is now more essential than ever to envision and implement a new systemic vision that focuses on how humans can engage in healthy behaviors, or lifestyles, while thriving sustainably and in harmony with planet Earth and the species that inhabit it.

While the origin of the concept of lifestyle has psychological and sociological roots (Alfred Adler, 1870-1937), understood as the framework of values, principles and attitudes that an individual develops in the early years of life and that influence his behavior, personality and choices throughout his existence, today this term has taken on a cross-cutting meaning that reaches into medicine and the life sciences.

In fact, according to the Istituto Superiore di Sanità (a technical-scientific body of the Italian National Health Service), lifestyles, understood as those behaviours that individuals assume in their daily lives (diet, physical activity, alcohol, smoking, etc.), and placed in an environmental, cultural and socioeconomic context, significantly affect the health, quality of life and longevity of the individual.

Their relevance in the sphere of prevention and health promotion, even as a valuable tool to accompany treatment, raises some insights and questions in the face of the epidemiological data of today's societies, which are characterized by the increase of chronic diseases (resulting from the combination of genetic, physiological, environmental and behavioural factors) and the risk of epidemics on a global scale.

Nonetheless, because of the increasing burden of chronic diseases even in developing countries-such as in Africa, the place where this research takes place-an analysis of lifestyle-related predictive factors and how they may also influence other physiological and health indicators can become a crucial precursor action in such contexts.

An analysis under a holistic perspective of lifestyles and the health indicators associated with them, which can enhance cultural and contextual differences may prove to be one of the innovative strategies to reactivate and engage generations and talents, to attract new contributions, re-interpreting today's conception of well-being, between tradition and innovation.

Through this study, the result of a collaboration between the University of Brescia (It), Icahn School of Medicine at Mount Sinai in New York City (USA) and Moi University in Eldoret (Ke), an initial analysis was conducted on the lifestyles of an indigenous ancestral population, the Maasai of Laikipia County in Kenya.

The research project named “Longitudinal, observational and comparative study of how rural and urban lifestyles influence health indicators among members of a selected pastoralist community in Kenya” is a scientific and anthropological research initiative under the umbrella of Global Health, which is the result of an international synergy of faculty and researchers from academic institutions, businesses and third sector entities.

The goal is the monitoring of various health indicators related to lifestyles-core elements of mental and physical well-being and prevention of chronic disease risk factors-through wearable technologies, one of the latest frontiers for digital-personalized health and telemedicine.

Indigenous peoples, repositories of millennia-old knowledge based on sharing and harmony with the natural environment, are a bulwark for ecosystem preservation, climate change mitigation and sustainability, on which the very survival and prosperity of our planet depends.

The project takes place in the area of Nanyuki, a town in the foothills of Mount Kenya, a habitat of unspoiled beauty and extraordinary wealth of natural biodiversity.

The experience has represented an extraordinary platform for dialogue and expression between cultures, inclusive research and experimentation on how science can connect different countries, contributing to international cooperation for sustainable development.

ABSTRACT- VERSIONE IN LINGUA ITALIANA

Secondo la definizione dell'OMS, la salute è uno stato di completo benessere fisico, mentale e sociale e non solo assenza di malattia o infermità. In un mondo interconnesso, è ora più che mai essenziale immaginare ed implementare una nuova visione sistemica che si concentri su come gli esseri umani possano assumere comportamenti, o stili di vita sani, prosperando in modo sostenibile ed in armonia con il pianeta Terra e le specie che lo abitano.

Se l'origine del concetto di stile di vita (in inglese *lifestyle*) ha radici psicologiche e sociologiche (Alfred Adler, 1870-1937), inteso come il quadro di valori, principi e atteggiamenti che un individuo sviluppa nei primi anni di vita e che influenzano il suo comportamento, la sua personalità e le sue scelte lungo tutta la sua esistenza, oggi questo termine ha assunto un'accezione trasversale che giunge alla medicina ed alle scienze della vita.

Infatti, secondo l'Istituto Superiore di Sanità (organo tecnico-scientifico del Servizio sanitario nazionale italiano) gli stili di vita, intesi come quei comportamenti che gli individui assumono nella quotidianità (alimentazione, attività fisica, alcol, fumo, ecc.), ed inseriti in un contesto ambientale, culturale e socioeconomico, incidono in modo significativo sulla salute, qualità di vita e longevità dell'individuo.

La loro rilevanza nella sfera della prevenzione e promozione della salute, finanche come valido strumento di affiancamento alle cure, pone alcuni spunti e interrogativi di fronte ai dati epidemiologici delle società odierne, caratterizzate dall'aumento di patologie croniche (che risultano dalla combinazione di fattori genetici, fisiologici, ambientali e comportamentali) e dal rischio di epidemie su scala mondiale.

Nondimeno, a causa del crescente peso delle patologie croniche anche nei paesi in via di sviluppo - come ad esempio in Africa, luogo in si svolge questa ricerca – un'analisi dei fattori predittivi legati agli stili di vita e di come questi possano influenzare anche altri indicatori fisiologici e di salute, può diventare un'azione precorritrice determinante in tali contesti.

Un'analisi sotto una prospettiva olistica degli stili di vita e degli indicatori di salute essi associati, che sappia valorizzare le differenze culturali e di contesto può rivelarsi come una delle strategie innovative per riattivare e coinvolgere generazioni e talenti, per attrarre contributi nuovi, re-interpretando la concezione odierna di benessere, fra tradizione ed innovazione.

Attraverso questo studio, frutto di una collaborazione fra Università degli Studi di Brescia (It), Icahn School of Medicine at Mount Sinai di New York City (USA) e la Moi University di Eldoret (Ke) è stata condotta una prima analisi sugli stili di vita di una popolazione ancestrale indigena, i Maasai della contea di Laikipia in Kenya.

Il progetto dal nome “Studio longitudinale, osservazionale e comparativo su come gli stili di vita rurali e urbani influenzano gli indicatori di salute tra i membri di una comunità pastorale selezionata in Kenya”, è un’iniziativa di ricerca scientifica ed antropologica nell’ambito della Global Health, che nasce da una sinergia internazionale di docenti e ricercatori provenienti da istituzioni accademiche, imprese ed enti del terzo settore.

L’obiettivo è il monitoraggio di diversi indicatori di salute relativi agli stili di vita - elementi fondamentali per il benessere psicofisico e la prevenzione dei fattori di rischio delle malattie croniche – attraverso le tecnologie indossabili, una delle più recenti frontiere per la salute digitale e personalizzata, e la telemedicina.

Le popolazioni indigene, depositarie di un sapere millenario fondato sulla condivisione e sull’armonia con l’ambiente naturale, rappresentano un baluardo per la salvaguardia degli ecosistemi, la mitigazione del cambiamento climatico e la sostenibilità, da cui dipende la stessa sopravvivenza e prosperità del nostro pianeta.

Il progetto si svolge nell’area di Nanyuki, città alle pendici del Monte Kenya, habitat dalla bellezza incontaminata e straordinaria ricchezza di biodiversità naturale.

L’esperienza si configura come una straordinaria piattaforma di dialogo ed espressione fra culture, di ricerca inclusiva e di sperimentazione su come la scienza possa connettere paesi diversi, contribuendo alla cooperazione internazionale per lo sviluppo sostenibile.

Summary

1. INTERNATIONAL COOPERATION

1.1 A personal reflection

There's a river in Africa.
It begins in Kaptagat forest as Kaptagat River, changes names to Kipsinende river, merges with Chepkoilel river to become Sosiani, then drains into River Yala that goes into Lake Victoria.
The outlet of Lake Victoria is River Nile which drains into the Mediterranean.
That's Sosiani river.
Made by the basic elements for life, its watery nature allows it to follow its path, nurture lands, and by overcoming anything which hinders it, to finally reach its destination.
This water unifies and connects, that's its quintessence.
Our anthropocentric world, which today appears fragmented and dominated by compartmentalization, can learn and benefit from recognizing the deep interconnection and interdependence of all things, as well as understanding how every small part of the system influences the whole. In the mosaic of cultures, traditions, experiences, and histories that shape our world, humanity realizes its essence through togetherness, growing through the ability to coexist, share, and belong to something greater. This is where International Cooperation plays a crucial role. Life itself is possible because of the cooperation of atoms within cells, then through and with others. An interesting concept related to this is emergent behavior, where the interaction and arrangement of individual parts—rather than the parts themselves—determine the functioning of a complex system. Families, groups, societies, economies, and nations exemplify this principle. The whole cannot simply be explained as the sum of its parts; rather, it emerges through a higher level of interaction, where the "me" becomes "us" and true completion and realization arise from the dynamics of complexity. The achievement of a shared, greater good can also be attained through a vision that intertwines the human factor—its uniqueness and potential—with the contributions, talents, and dreams of the community and all levels of society, especially those who are voiceless, marginalized, or forgotten. In other words, it is a process of reclaiming the wisdom that blends heritage with innovation, harmony with the extraordinary diversity of nature, and sustainable living. This vision fosters a renewed human spirit, a collective will, and civic energy dedicated to nurturing the well-being of people while keeping our planet alive and thriving.

There is a word from African culture, "Ubuntu," which means "I am because we are." It embodies the awareness of mutual interaction, synergy, and reciprocity—values that extend to acts of kindness, empathy, and support for one another. It reflects the deep ties that have bound the human spirit, all living beings, and the natural world since the beginning of time.
As expressed in a sentiment that merges the thoughts of Nelson Mandela and former U.S. President Barack Obama:

"It is the recognition that we are all bound together in ways that are invisible to the eye; that there is a oneness to humanity; that we achieve ourselves by sharing ourselves with others and caring for those around us."

How can we truly embody this sense of coexistence and belonging? How can we implement a new, shared way of living—one that fuels generosity, kindness, and truth; that fosters reconciliation with the beauty of our planet; and that encourages us to care for humanity and all living beings in our common home?

Even quantum physics speaks to this deep interconnection through the concept of quantum entanglement—a phenomenon in which two or more particles become so correlated that the state of one cannot be described independently of the others, even when separated by vast distances. This effect, famously dubbed "spooky action at a distance," appears to create an instantaneous influence across space, challenging classical notions of causality and locality.

Furthermore, neuroscience studies are revealing how human brains synchronize during social interactions and cooperative tasks, leading to a "we mode." This phenomenon can be observed in group activities such as dance, chanting, rhythm, and marching, where individuals align their movements and emotions, fostering a deep sense of connection and unity.

How can we awaken creativity, lateral thinking, and motivation—the forces that help us recognize our belonging to something greater than ourselves? How can we embrace the idea that science, culture, and faith all contribute to humanity through the pursuit of truth?
Only by adopting a holistic vision—one that integrates these elements—can we spark both personal and collective transformation. This change begins by supporting, educating, and uplifting one another, eventually evolving into what is known as systems change.
But how can we implement such change if we fail to uncover and embrace acts of humanity, compassion, and empathy? These profound emotions—our deepest feelings of aliveness—are the catalysts of true transformation.

In other words, how do we cultivate a shared sense of purpose—one that can lead humanity toward a new and extraordinary future, where no one is left behind?

“Ex Africa sempre aliquid novi”. There’s always something new from Africa (Pliny the elder, 23 a.C. - 79 a.C.).

1.2 International cooperation and international cooperation for development

International cooperation can be defined as the multifaceted, synergic actions that countries make to address global challenges and achieve common goals.

This shall encompass the sharing of resources, knowledge, and financial mechanisms to manage the challenges of this time, such as health, peace keeping, climate and environmental issues, capital investments, governance, etc.

International cooperation is the way through which countries team up, with strategies that vary from education, diplomacy, culture, social sciences, economics, technology, for the implementation of sustainable development, and for ensuring equity and fairness in the global context.

International cooperation sometimes risks to be conceptualized as a general, masterplan, one of the superstructures that are distant from citizen daily lives; instead, it represents the basic strategy, the under structure, the foundation of how our daily lives go on, nevertheless the country or the walk of life: thats’ the way our societies prosper and thrive.

Let’s think about that: gas, oil, food, energy, resources: every country in the world interacts and share through import or export the essential assets that make each of them survive and prosper.

The Cinfo organization (Centre d’information, de conseil et de formation pour les professions de la coopération internationale), among the main bodies in the global network for international cooperations, defines it as an uncommon sector that is multi-faceted and dynamic.

International cooperation encompasses all professional activities aimed at supporting people in need and promoting economic, social and cultural development around the globe.

International cooperation covers the fields of humanitarian aid, development cooperation and peace promotion. Once clearly distinct, activities in these fields are now converging, often making the boundaries between them unclear.

Humanitarian aid provides emergency assistance in acute and deteriorating natural disasters and violent conflict. It is primarily concerned with the safety and protection of victims and creating basic, interim state and civil society structures.

Humanitarian aid tends to work in the short-term and under time constraints. However, there is an increase in long-term engagements in chronic conflicts for the purpose of early identification of risk and prevention. Examples include establishing early warning systems and training emergency services.

Development cooperation aims to reduce poverty and foster sustainable development. It is based on partnerships and active at the local, regional and global levels.

In contrast to humanitarian aid, which intervenes with emergency assistance during conflicts and natural disaster, development cooperation addresses long-term, structural change. However, it often still operates in fragile contexts.

The primary goal of economic cooperation and development is to support economically, socially and environmentally sustainable growth, thereby alleviating poverty and inequity, creating new jobs, and increasing productivity. Central measures include integrating partner countries into the global economy and strengthening the competitiveness of their domestic markets.

Promoting peace and human security establishes or reinforces the basic conditions required for sustainable development. Promoting peace includes both military and civilian measures. Civilian peacebuilding involves such measures as supporting fair and transparent elections, strengthening human rights, developing police institutions that work closely with citizens, and building an independent judiciary. It also includes negotiation processes at the governmental level. Some community-sector actors also support peacebuilding initiatives[1s].

1.2.1 Premises and historical notes

All these diversified activities point toward the concept of development. Over the past quarter of a century, real incomes in developing countries have almost doubled. Child mortality has fallen by half and the number of people receiving a basic education has risen sharply. Nowadays, two-thirds of all states are elected democracies. These success stories, which, in no small measure, are the result of development cooperation, contrast sharply with media reports of famine, epidemics and conflicts. It is those reports that remind us that there are no simple solutions to ensure global peace and prosperity. The problems associated with development are always complex and can never be attributed to any single cause or solved by stand-alone measures[1b]. In order to gain a clearer understanding of the term “development cooperation”, we must first clarify the meaning of “development”, which has evolved over the decades. As our understanding of development has changed, so too has the focus of development cooperation. Development issues first became widely discussed in the 1950s and 1960s, in the wake of decolonialisation in Africa and the ambitious aid programmes launched by the United Nations. Development was regarded as synonymous with the evolution of a country from a poor, traditionally rural-based economy to a prosperous industrial nation. Both the route and objective of development were considered as self-evident and involved the transposition of Western

economic, social, cultural and political ways of living upon non-European societies. The only uncertainty in the minds of development planners of the time was the pace of development, which depended on the resources available in each country. Back then, development cooperation was likened to the Marshall Plan. The prevailing opinion was that post-colonial countries needed financial stimulus to set catch-up processes in motion, just as Germany had required such aid in the aftermath of World War II. People widely believed that in a few decades, with enough capital and forced industrialisation, developing countries would be able to achieve the same level of prosperity as in Western Europe. In practice, however, the predicted level of progress failed to materialise. As a result, the capital-injection model that had been intended to allow developing countries to catch up was called into question. Capital alone was not sufficient. During the political turmoil of the late 1960s and the 1970s, greater emphasis was placed on the role of people in the development process. International development aid began to flow heavily to human resources and social infrastructure. As a result, roads and water pipelines were built and healthcare and education systems were established and expanded.

The previous view that issues were primarily limited to southern hemisphere countries gradually gave way to a more global perspective. Unfair trading practices and international dependency were portrayed as the structural causes of slow or stagnant development and became the subject of political debate. Civil society organisations called for reform of international trade relations and for developing countries to be granted genuine rights of codetermination within international bodies. The export of Western-style development models to southern hemisphere countries whose socio-cultural conditions were very different from those in Europe or North America also drew criticism. Discussions began to focus on a new development policy that would consider the specific needs and different starting points of individual southern hemisphere countries. In the 1980s and 1990s, the model intended to help developing countries catch up with their Western counterparts was supplanted by the sustainable development model. In 1987, a report by the World Commission on Environment and Development (known as the Brundtland Report) introduced the concept of sustainable development. The report stated that development had to satisfy the needs of the present without undermining the development prospects of future generations. The report formed the starting point for the United Nations Conference on Environment and Development in Rio in 1992. This summit meeting called for the careful use of natural resources in northern and southern hemi sphere countries. The development concept once again evolved, away from a purely economic and social focus to a more comprehensive one that included environmental issues. Accelerated by the fall of the Berlin Wall in 1989 and rapid technological advances (e.g. the Internet), globalisation expanded the development concept by bringing human rights and universal standards to the

forefront. In the year 2000, 189 Heads of State and Government laid down a number of requirements in the Millennium Declaration. Principles such as respect for human rights, equal opportunities for men and women, the fair distribution of wealth and good governance were added to the development concept. Since then, development has no longer been a national or bilateral affair, but rather a global challenge with binding objectives and a binding timeframe. As part of the Millennium Development Goals (MDGs), industrialised and developing countries undertook to work together to halve global poverty by 2015. The MDGs marked a paradigm shift: until then, development aid had connotations of charity as well as a clear division of roles between donor countries (which provided available funding and development models) and recipient countries (which implemented proscribed measures). With the MDGs, development aid gave way to a new concept of development cooperation, which set out to develop and implement programmes in consultation with the authorities and civil society in partner countries. Partnership-based approaches combined with mutual and differentiated responsibilities took centre stage. As a concept, development is closely associated with individual and collective values, which vary with distance and time. The shift in development policy attitudes and activities is a reflection of the upheavals taking place in world politics. In past decades, developing countries could be categorised as a fairly homogenous group of countries with similar underlying structural problems. It was during this time that the term “Third World” was coined. However, the term no longer applies since the map of the world has become much more nuanced. There is still a group of extremely poor countries that rely on external aid. At the same time, there are many large and medium-sized developing countries that have progressed considerably and have managed to significantly reduce poverty. Moreover, emerging countries such as China, India and Brazil now play an important role in the global economy and are helping to shape international policies. Other countries, such as South Africa, Mexico, Chile, Indonesia, Thailand, Vietnam and many others are making rapid economic and social advances. The power to influence world economic and policy matters is rapidly shifting and new realities are now upsetting conventional worldviews. Emerging countries, the cross-border movement of goods and people combined with new communication technologies have blurred the divisions between northern and southern hemisphere countries. The world has become one global village. The increasing interdependence of industrialised, emerging and developing countries has also made Earth more vulnerable to climate change, the increasing scarcity of water and other vital resources and major migration flows. Globalisation coupled with the strong economic growth of the past 20 years has exacerbated latent problems while simultaneously creating new ones. The fragility of our ecosystems and the loss of biodiversity have now become development cooperation issues. This vulnerability means that international

cooperation has become more important than ever. Global problems cannot be resolved by the richer countries acting in isolation, but rather through close cooperation with developing and emerging countries. Development is therefore a common worldwide endeavour to secure the foundations for the longterm social and economic development of humankind[1b]. This must be taken into account, especially in light of the recent cuts to international cooperation and humanitarian aid for developing countries and Africa, including those made by one of the most significant global economic players: the United States of America.

1.3 The international cooperation system: from Italy to a worldwide perspective

International cooperation is crucial for social justice. As reported by the website of the Italian Ministry of Foreign Affairs and International Cooperation: its action, in accordance with the principle of Article 11 of the Constitution, contributes to the promotion of peace and justice and aims to promote solidarity and equal relations among peoples based on the principles of interdependence and partnership. The term "Cooperation" generally means any economic initiative that connects rich countries and countries with lower rates of development. But to understand what it is, we must first distinguish what the different forms of international cooperation are: international cooperation, development cooperation, and official development assistance[2s]. International cooperation indicates any collaborative activity between countries and/or private organizations. Development cooperation, on the other hand, expressly identifies activities and initiatives aimed at pursuing the improvement of socio-economic conditions in areas still with low rates of development. These objectives can also be achieved with private resources (aid credits, institutional support, concessions of advantageous trade conditions, etc.). Finally, official development assistance is part of development cooperation, pursued, however, with public resources alone, within the framework of international agreements. Talking about the Italian context, an important legislative milestone to manage international cooperation activities was the 1033 law of 1966, made by an Italian Deputy born in Montichiari (Brescia), Mario Pedini. That law started organizing the vast world of the civil service in development countries, which was at that time strongly characterized by the catholic volunteering and missionary associations (and during the Pontificate of another illustrious Brescian person, Pope Paul VI, who was the Bishop of Rome from 1963 to 1978). Italian development cooperation policy became more structured from 1979 onward. This led to the adoption of Law 49/1987, which made development cooperation an important part of Italian foreign policy. In addition, with the reform of the sector that took place in 2014 with Law 125/14 there were further changes:

1. Establishment of the Italian Agency for Development Cooperation (AICS) under the supervision of the Ministry of Foreign Affairs and International Cooperation.
2. Stronger role of civil society in the implementation of development projects.
3. Policy coherence for development to ensure that all Italian public policies, including trade and security policies, are aligned with sustainable development goals.
4. New financing modalities such as the involvement of the private sector and the use of more flexible financial instruments, including public-private partnerships.
5. Focus on the Sustainable Development Goals (SDGs) that aligned Italian cooperation with the UN Sustainable Development Goals.
6. Improved transparency and reporting to ensure greater accountability and control over achievements.
7. Increased focus on human rights as essential components of development cooperation.

There are several entities that carry out intervention actions in the field of international development cooperation. The Organization for Economic Cooperation and Development (OECD), that contains the Development Assistance Committee (DAC), which has 32 members, including Italy and the European Union, which has policy-making functions. The main objective of the DAC is to promote development cooperation and other policies that contribute to the sustainable development of developing countries, poverty eradication and improved living standards, with the ultimate goal of creating a future in which no country is dependent on aid. Then there are the state funds to International Cooperation, which are managed internally by each individual government. In Italy, "Cooperation is an integral and qualifying part of foreign policy and the Italian Agency for Development Cooperation, under the supervision of the Ministry of Foreign Affairs and International Cooperation, has in this field a large capacity for action thanks to an autonomous legal personality, its own budget and its own organization". Regions and local authorities can also carry out interventions with so-called "decentralized cooperation," whose initiatives are coordinated at the central level by the Italian Agency for Development Cooperation at the Directorate General of Development Cooperation of the Ministry of Foreign Affairs. Then there are the Non-Governmental Organizations and other civil society entities that help make Cooperation a daily practice at different levels. Listed below are some international cooperation activities and their multistakeholders effect on the society.

- *Cooperation for gender justice*

  Investing in programs that address the structural causes of gender inequality and integrating gender justice into all development cooperation policies can have a strong impact on reducing economic and gender inequality. It is essential to adopt concrete policies that

uphold gender justice and women's rights, such as combating gender-based violence and supporting women's leadership. For example, allocating specific funds for gender issues can increase women's participation in decision-making processes and improve their access to educational and health services, enhancing their life chances and ability to assert their rights. A concrete example is Rwanda, where UN Women has supported the analysis of gender effects in agricultural funding, leading to a 26 percent increase in the agricultural budget between 2009 and 2011.

- *Cooperation for Education*
  There are several historical examples of cooperative education interventions:
  - the Civil Society Education Fund (CSEF), which has supported civil society in more than 60 countries to hold governments accountable for education and promote better policies and resource allocations. This support has enabled national groups to organize citizens to influence educational decisions.
  - the Global Partnership for Education (GPE) is a global partnership and multilateral fund dedicated to improving education in low-income countries. Since 2002, the GPE has supported more than 76 countries, enabling more than 160 million children to access primary and secondary education. In 2021, GPE launched a $5 billion fundraising campaign to support education systems in developing countries during and after the COVID-19 pandemic. Various governments and global organizations participated in the campaign.
- Education Cannot Wait (ECW) is a global fund for education in crisis contexts, launched in 2016 to address educational emergencies in countries affected by conflict, natural disasters and other crises. In 2022, ECW funded programs in Yemen, Syria and other countries in crisis, reaching millions of children who otherwise would not have access to education.
- *Cooperation against inequality*
  Doing cooperation means fighting poverty. And the fight against poverty cannot be separated from the fight against inequality, which translates into creating equitable conditions for access to essential services in education and health. To be effective, such actions need multi-year funding that is accessible even to small local organizations[2s].

Along this line of reasoning, I'd like to mention an aspect, which is related to one of the latest global challenges the world faced, the COVID-19 disease as reported from a World Bank article titled “why we need international cooperation now more than ever”[3s]. Before the tumultuous arrival of COVID-19, many parts of the world were suffering from dangerous polarization and

division. Bitter disagreements over what is true or not pose a real threat to stability everywhere. And yet surprisingly, around the world, it turns out that most people - regardless of their origin, gender or age - share common hopes and fears about the future. We are all, it seems, more aligned than we are led to believe. And most of us believe strongly in the power of working together to face the challenges of today and tomorrow". That's just one of the takeaways from a striking new initiative led by the United Nations.

Amid all the global tumult and turmoil, the United Nations just hosted a massive conversation about the state of the world, launched as part of the organization's 75th anniversary. Between January and August 2020, the United Nations solicited inputs from people across virtually every sector in at least 193 countries. The survey asked people from all walks of life about their priorities and possible solutions to the planet's most intractable challenges. One of the single biggest concerns was climate change and the importance of mustering global consensus and cooperation to tackle it. Notwithstanding the recent surge in nationalism and declining support for multilateralism, most people want more global cooperation, not less. Almost 9 in 10 respondents to the United Nations survey believe that international collaboration is vital to tackle contemporary challenges. Roughly three quarters of them also believe that the United Nations should lead the charge. That said, there is hope for a more diverse form of multilateralism - one that accounts for female, youth and indigenous voices, alongside the private sector and city leaders. And youth voices around the world are particularly optimistic about the promise of international cooperation. While overall public support for the United Nations remains strong - six in 10 people say that the organization has made the world a better place - the organization has work to do to connect its efforts more directly to the individual experience. Over half of all respondents feel that the United Nations is remote from their lives. Many are not entirely sure what the organization does. While the United Nations Charter begins with the words "we the peoples", a considerable part of the public feels alienated from institutions in general, which makes it easier for populists to cynically disregard them. There is, in all of this, a risk that global mistrust jeopardizes our shared future. Yet there are signs that popular support for global cooperation and the United Nations has increased since the onset of the COVID-19 pandemic. The viral outbreak has not only exposed the fragilities and failures of the international system - it has also clarified the essential importance of greater cooperation. With political and economic systems facing deep uncertainties and global supply chains increasingly fragmented, there is an opportunity to re-imagine and reset global partnerships. This is all the more important because COVID-19 is just the warmup to the big challenge: climate change.

Virtually all respondents to the UN survey agreed that tackling the vulnerabilities exacerbated by COVID-19 are the most urgent priority. Tackling inequalities will be especially vital, including improving access to basic services, especially water, sanitation, health and education. They also feel that greater solidarity and shared support should be directed toward those places hardest hit by the pandemic. Over 72% of all respondents believe access to healthcare will be the same or better in the next 25 years.

As for the most urgent future challenges, climate change is the overwhelming priority. It is also what most people feel should be the United Nations' principal concern moving forward. There is widespread anxiety about the impacts of climate change, and deep worries that environmental conditions are set to worsen in the coming years. These findings are echoed in countless scientific studies, as well as the surge of warming temperatures, forest fires, melting glaciers and breathtaking decline in biodiversity.

Another profound area of consensus is that the United Nations must be more inclusive in how it fosters global cooperation. The latest round of consultations is a positive expression of this, consisting of over 1,000 dialogues across 82 countries. Respondents urged member states to proactively engage women, youth and vulnerable groups in decision-making. Suggestions ranged from the reform of the Security Council to the appointment of a high-level civil society focal point at the United Nations. As ever, the problem is not a lack of ideas, but rather the middling levels of political will to make the United Nations more accessible, inclusive, and transparent, something the UN Secretary-General himself has advocated for when calling for a more inclusive multilateralism[3s.]

1.4 The Organisation of the United Nations (UN)

The United Nations (UN) is an intergovernmental organization that aims to maintain international peace and security, develop friendly relations among nations and countries, achieve international cooperation, and serve as a centre for coordinating the actions of member states. It is widely recognized as the world's largest international organization. The UN is headquartered in New York City, in international territory with certain privileges extraterritorial to the United States, and the UN has other offices in Geneva, Nairobi, Vienna, and The Hague, where the International Court of Justice is headquartered at the Peace Palace. The UN was established after World War II with the aim of preventing future world wars, and succeeded the League of Nations, which was characterized as being ineffective. On 25 April 1945, 50 nations assembled in San Francisco, California, for a conference and initialized the drafting of the UN Charter, which was adopted on 25 June 1945. The charter took effect on 24 October 1945, when the UN began operations. The

UN's objectives, as outlined by its charter, include maintaining international peace and security, protecting human rights, delivering humanitarian aid, promoting sustainable development, and upholding international law. At its founding, the UN had 51 member states; as of 2024, it has 193 sovereign states, nearly all of the world's recognized sovereign states.The UN's mission to preserve world peace was complicated in its initial decades due in part to Cold War tensions that existed between the United States and Soviet Union and their respective allies. Its mission has included the provision of primarily unarmed military observers and lightly armed troops charged with primarily monitoring, reporting and confidence-building roles. The UN System includes a multitude of specialized agencies, funds, and programmes, including the World Bank Group, the World Health Organization, the World Food Programme, UNESCO, and UNICEF. Additionally, non-governmental organizations may be granted consultative status with the Economic and Social Council and other agencies. The UN's chief administrative officer is the secretary-general, currently António Guterres, who is a Portuguese politician and diplomat. He began his first five-year term on 1 January 2017 and was re-elected on 8 June 2021. The organization is financed by assessed and voluntary contributions from its member states. The UN, its officers, and its agencies have won multiple Nobel Peace Prizes, although other evaluations of its effectiveness have been contentious. Some commentators believe the organization to be a leader in peace and human development, while others have criticized it for ineffectiveness, bias, and corruption[4s].

To summarise, the UN has 4 main purposes

- To keep peace throughout the world
- To develop friendly relations among nations
- To help nations work together to improve the lives of poor people, to conquer hunger, disease and illiteracy, and to encourage respect for each other's rights and freedoms
- To be a centre for harmonizing the actions of nations to achieve these goals.

The Charter established six principal organs of the United Nations: the General Assembly, the Security Council, the Economic and Social Council, the Trusteeship Council, the International Court of Justice, and the Secretariat. The United Nations family, however, is much larger, encompassing 15 agencies and several programmes and bodies. The General Assembly is the main deliberative organ of the UN and is composed of representatives of all Member States. The work of the United Nations year-round derives largely from the mandates given by the General Assembly. Comprising all Member States of the United Nations, it provides a unique forum for multilateral discussion of the full spectrum of international issues covered by the Charter. The Assembly meets in regular session intensively from September to December each year, and thereafter as required. Decisions on important questions, such as those on peace and security,

admission of new members and budgetary matters, require a two-thirds majority. Decisions on other questions are by simple majority. Each country has one vote. The Security Council has primary responsibility, under the UN Charter, for the maintenance of international peace and security. The Council is composed of five permanent members - China, France, Russian Federation, the United Kingdom and the United States - and ten non-permanent members. The non-permanent members are elected by the General Assembly for two-year terms. Each Council member has one vote. Decisions on procedural matters are made by an affirmative vote of at least nine of the 15 members. Decisions on substantive matters require nine votes, including the concurring votes of all five permanent members. This rule is often referred to as the "veto" power. A reform of the Security Council, including its membership, is under consideration.

The Economic and Social Council (ECOSOC) is the principal organ to coordinate the economic, social and related work of the United Nations and the specialized agencies and institutions. Voting in the Council is by simple majority; each member has one vote. The International Court of Justice, located at the Hague in the Netherlands, is the principal judicial organ of the United Nations. It settles legal disputes between States and gives advisory opinions to the UN and its specialized agencies. Its Statute is an integral part of the United Nations Charter. The Trusteeship Council was established in 1945 by the UN Charter to provide international supervision for 11 Trust Territories placed under the administration of 7 Member States and ensure that adequate steps were taken to prepare the Territories for self-government and independence. By 1994, all Trust Territories had attained self-government or independence. Its work completed, the Council has amended its rules of procedure to meet as and where occasion may require. The Secretariat - an international staff working in duty stations around the world - carries out the diverse day-to-day work of the Organization. It services the other principal organs of the United Nations and administers the programmes and policies laid down by them. At its head is the Secretary-General, who is appointed by the General Assembly on the recommendation of the Security Council for a five-year, renewable term. The Secretary-General is a symbol of United Nations ideals and a spokesman for the interests of the world's peoples, in particular the poor and vulnerable among them. The current Secretary-General, and the ninth occupant of the post, is Mr. António Guterres of Portugal, who took office on 1 January 2017. The duties carried out by the Secretariat are as varied as the problems dealt with by the United Nations. These range from administering peacekeeping operations to mediating international disputes, from surveying economic and social trends and problems to preparing studies on human rights and sustainable development. Secretariat staff also inform the world's communications media about the work of the United Nations; organize international conferences on issues of worldwide concern; and interpret speeches and translate

documents into the Organization's official languages. As international civil servants, staff members and the Secretary-General answer to the United Nations alone for their activities, and take an oath not to seek or receive instructions from any Government or outside authority. Under the Charter, each Member State undertakes to respect the exclusively international character of the responsibilities of the Secretary-General and the staff and to refrain from seeking to influence them improperly in the discharge of their duties.

The United Nations, while headquartered in New York, maintains a significant presence in Addis Ababa, Bangkok, Beirut, Geneva, Nairobi, Santiago and Vienna, and has offices all over the world. The work of the United Nations reaches every corner of the globe. Although best known for peacekeeping, peacebuilding, conflict prevention and humanitarian assistance, there are many other ways the United Nations and its System (specialized agencies, funds and programmes) affect our lives and make the world a better place. The Organization works on a broad range of fundamental issues, from sustainable development, environment and refugees protection, disaster relief, counter terrorism, disarmament and non-proliferation, to promoting democracy, human rights, gender equality and the advancement of women, governance, economic and social development and international health, clearing landmines, expanding food production, and more, in order to achieve its goals and coordinate efforts for a safer world for this and future generations[5s].

The UN system focuses its work on promoting social progress and improving the well-being of people around the world. The main components of development are:

- Living a long and healthy life
- Being educated
- Having a decent standard of living
- Having the freedom to participate in the life of one's community

All development is ultimately about expanding human potential and human freedoms. At the UN Millennium Summit in 2000, world leaders met to develop a plan to improve the quality of life in developing countries. All countries signed the Millennium Declaration, the first internationally agreed upon framework for fighting global poverty, hunger, disease, and inequality. To realize the aspirations of the Millennium Declaration, eight specific development goals were created. The eight MDGs were:

1. Eradicate extreme poverty and hunger
2. Achieve universal primary education
3. Promote gender equality and empower women
4. Reduce child mortality

5. Improve maternal health
6. Combat HIV/AIDS, malaria, and other diseases
7. Ensure environmental sustainability
8. Develop a global partnership for development[5s]

1.5 Sustainable development

Sustainable development has been defined in many ways, but the most frequently quoted definition is from *Our Common Future*, also known as the Brundtland Report, released by the United Nations World Commission on Environment and Development in 1987: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."
It contains two key concepts within it:

- The concept of 'needs', in particular, the essential needs of the world's poor, to which overriding priority should be given; and
- The idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs[6s].

1.5.1 The Agenda 2030 and the positive externalities

The UN Agenda 2030 for Sustainable Development is an action programme for people, the planet and prosperity.
The SDGs build on decades of work by countries and the UN, including the UN Department of Economic and Social Affairs[7s.]

- In June 1992, at the Earth Summit in Rio de Janeiro, Brazil, more than 178 countries adopted Agenda 21, a comprehensive plan of action to build a global partnership for sustainable development to improve human lives and protect the environment.
- Member States unanimously adopted the Millennium Declaration at the Millennium Summit in September 2000 at UN Headquarters in New York. The Summit led to the elaboration of eight Millennium Development Goals (MDGs) to reduce extreme poverty by 2015.
- The Johannesburg Declaration on Sustainable Development and the Plan of Implementation, adopted at the World Summit on Sustainable Development in South Africa in 2002, reaffirmed the global community's commitments to poverty eradication and

the environment, and built on Agenda 21 and the Millennium Declaration by including more emphasis on multilateral partnerships.

- At the United Nations Conference on Sustainable Development (Rio+20) in Rio de Janeiro, Brazil, in June 2012, Member States adopted the outcome document "The Future We Want" in which they decided, inter alia, to launch a process to develop a set of SDGs to build upon the MDGs and to establish the UN High-level Political Forum on Sustainable Development. The Rio +20 outcome also contained other measures for implementing sustainable development, including mandates for future programmes of work in development financing, small island developing states and more.
- In 2013, the General Assembly set up a 30-member Open Working Group to develop a proposal on the SDGs.
- In January 2015, the General Assembly began the negotiation process on the post-2015 development agenda. The process culminated in the subsequent adoption of the 2030 Agenda for Sustainable Development, with 17 SDGs at its core, at the UN Sustainable Development Summit in September 2015.
- 2015 was a landmark year for multilateralism and international policy shaping, with the adoption of several major agreements:
    - Sendai Framework for Disaster Risk Reduction (March 2015)
    - Addis Ababa Action Agenda on Financing for Development (July 2015)
    - Transforming our world: the 2030 Agenda for Sustainable Development with its 17 SDGs was adopted at the UN Sustainable Development Summit in New York in September 2015.
    - Paris Agreement on Climate Change (December 2015)
- Now, the annual High-level Political Forum on Sustainable Development serves as the central UN platform for the follow-up and review of the SDGs[7s].

Signed on 25 September 2015 by the governments of the 193 Member Countries of the United Nations, and approved by the UN General Assembly, the Agenda sets out **17 Sustainable Development Goals, SDGs,** which are part of a broader programme of action consisting of 169 associated targets to be achieved in the environmental, economic, social and institutional domains **by 2030**.

This programme does not solve all the problems but represents a good common basis to build a different world and offer everyone the chance to live in an environmentally, economically and socially sustainable world[8s].

The objectives set for sustainable development have a **global validity**, concern and involve all countries and components of society, from private companies to the public sector, from civil society to information and culture operators.

The 17 SDGs refer to a set of important development issues that take account of the **three dimensions of sustainable development** – economic, social and ecological – in a balanced way and aim to end poverty, fight against **inequality**, tackle **climate change**, and build peaceful societies that respect **human rights**.

Sustainability is not a purely environmental issue. Four years after the signing of the UN Agenda 2030, awareness has increased in civil society, in the business world, in national government and public opinion as to the need to adopt an **integrated approach and concrete measures** to address a major socio-economic paradigm shift, and cope with the several complex environmental and institutional challenges.

Implementing the Agenda 2030 requires strong involvement from all components of society, ranging from private enterprises to the public sector, from civil society to information and culture operators.

All Countries are called upon to define their own sustainable development strategies to achieve the objectives pursued, and report the results achieved within a process coordinated by the UN.

Each Country is evaluated annually at the UN through the work of the High-level Political Forum (HLPF), responsible for assessing progress, results and challenges for all Countries, and by national and international public opinion. Every four years there is also a debate on the implementation of the 2030 Agenda at the UN General Assembly before Heads of State and/or Government: the first such review was carried out in September 2019.

Additionally, a positive externality in sustainable development refers to a benefit that arises from sustainable actions or policies, affecting third parties who are not directly involved in the decision-making process. These benefits are often unintentional and go beyond the immediate stakeholders. For example, investing in solar or wind energy reduces carbon emissions, leading to cleaner air and improved public health, while education on sustainability concepts fosters a culture of responsible consumption and environmental stewardship. Green Infrastructure such as urban parks, green roofs, and tree planting improve air quality, reduce urban heat, and promote mental well-being, and public transportation & cycling lanes can reduce car dependency, air pollution, and health risks associated with sedentary lifestyles.

- The Agenda 2030 in Italy

In Italy, the "**Benessere Italia**" ("**Well-being Italy**") steering committee was set up at Prime Minister's Office launched in 2020, to "coordinate, monitor, measure and improve the policies

implemented by all Ministries in favour of citizens' well-being". A step ahead to empower Italy's governance of the 2030 Agenda, a tool that will enable the Italian Government to promote fair and sustainable well-being through new policies and new approaches.

The **five macro-areas developing its policy lines are**: sustainable equitable regeneration of territories, mobility, territorial cohesion, energy transition, quality of life, and circular economy. These macro-areas place the individual at the centre of their action focus and aim at: promoting healthy lifestyles; defining work-private life balance patterns; designing fair living conditions; promoting human development actions; and lifelong learning.

- The National Sustainable Development Strategy (NSDS) and the 5 intervention areas

At a national level, the instrument for coordinating the implementation of the Agenda 2030 is the National Sustainable Development Strategy (NSDS), approved via CIPE (Comitato Interministeriale per la Programmazione Economica) Resolution No. 108/2017. This measure provides for a three-yearly update and "*defines the national reference framework for planning, programming and evaluation processes at environmental and territorial level to implement the sustainable development goals set by the United Nations Agenda 2030*".

The implementation of the National Sustainable Development Strategy must be linked to current policy documents, primarily the National Reform Programme (NRP) and, more generally, the Economic and Financial Document (Italy's *DEF*). The proposed actions and operational instruments must also be reconciled with present binding objectives at EU level.

The National Sustainable Development Strategy 2017-2030 is the main instrument for **creating a new circular economic model** with low CO2 emissions, resilient to climate change and other global changes triggered by local crises (e.g., biodiversity loss, transformation of fundamental biogeochemical cycles (carbon, nitrogen, phosphorus), and land use changes.

An innovative aspect of the UN Agenda 2030 lies in its **focus on inequalities**. In the absence of an adequate intervention strategy, several factors can contribute to polarising different situations. It is therefore necessary to identify and share policies to boost growth and make it sustainable in the long term.

The National Sustainable Development Strategy is based on a multidimensional method to overcome **economic, environmental and social inequalities** and thus pursue sustainable, balanced and inclusive development. This approach implies a wide range of instruments, including **budgetary policies and structural reforms**.

The plan updates the previous "Environmental Action Strategy for Sustainable Development in Italy 2002-2010″, yet extends its scope, thus integrating the goals laid down in the UN Agenda 2030.

The plan is broken down in five intervention areas, corresponding to the **"5Ps" of sustainable development** proposed by the UN Agenda 2030, each one laying down Italy's Strategic Choices and Strategic Objectives related to the Agenda 2030 SDGs and recalling the deep **interconnection between economic dynamics, social growth and environmental quality** – namely, the three pillars of sustainable development

– **People**: Fighting poverty and social exclusion and promoting health and well-being to ensure human capital development.

– **Planet**: Ensuring sustainable management of natural resources, countering biodiversity loss, and protecting environmental and cultural assets.

– **Prosperity**: Affirming sustainable models of production and consumption, guaranteeing decent employment and training.

– **Peace**: Promoting a non-violent and inclusive society without discrimination. Fighting illegality.

– **Partnership**: Taking integrated actions in the several areas involved.

The 2017 Budget Law is an important step ahead in the implementation of the UN 2030 Agenda in Italy.

The 17 Goals of the UN Agenda 2030 are also mentioned in the recently devised **2030 Plan for Southern Italy (*Piano Sud 2030*)** – Development and Cohesion for Italy.

- Italian Alliance for Sustainable Development – ASviS

As to **civil society participation** and awareness-raising on the 2030 Sustainable Development Goals, it is worth mentioning the **Italian Alliance for Sustainable Development** (ASviS), an organisation established in 2016 upon initiative of the Unipolis Foundation and the "Tor Vergata" University of Rome to disseminate, at a social and institutional level, knowledge and mindfulness of the importance of the 2030 Agenda for sustainable development.

ASviS publishes an annual report to illustrate an **analysis of Italy's progress** as to the UN Agenda 2030 and its Sustainable Development Goals, and sets forth **proposals for developing ad-hoc strategies** to ensure the Country's economic and social development8[s].

The preamble of the Declaration "Transforming Our World: The 2030 Agenda for Sustainable Development" reads as follows: "*We are resolved to free the human race from the tyranny of poverty and we want to heal and secure our planet for present and future generations. We are determined to take the bold and transformative steps which are urgently needed to shift the world onto a sustainable and resilient path. As we embark on this great collective journey, we pledge that no one will be left behind*".

While emphasising the goal of poverty eradication by 2030, the new Agenda focuses on economic, social, environmental integration and on development governance, and urge all countries to engage

in a common development path without leaving anyone behind. The five "Ps" – People, Planet, Prosperity, Peace and Partnership – are the principles on which the Agenda is based[8s].

- The SDG no. 3: good health and well-being -ensure healthy lives and promote well-being for all at all ages.

Goal 3 aims to ensure healthy lives and promote well-being for all, at all ages. Health and well-being are important at every stage of one's life, starting from the beginning. This goal addresses all major health priorities: reproductive, maternal, newborn, child and adolescent health; communicable and non-communicable diseases; universal health coverage; and access for all to safe, effective, quality and affordable medicines and vaccines.

SDG 3 aims to prevent needless suffering from preventable diseases and premature death by focusing on key targets that boost the health of a country's overall population. Regions with the highest burden of disease and neglected population groups and regions are priority areas. Goal 3 also calls for deeper investments in research and development, health financing and health risk reduction and management[9s].

Listed herby the targets of Sustainable Development Goal 3 to ensure healthy lives and promote well-being for all at all ages:

3.1. Maternal mortality

By 2030, reduce the global maternal mortality ratio to less than 70 per 100 000 live births.

3.2. Neonatal and child mortality

By 2030, end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1000 live births and under-5 mortality to at least as low as 25 per 1000 live births.

3.3. Infectious diseases

By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases, and combat hepatitis, waterborne diseases and other communicable diseases.

3.4. Noncommunicable diseases

By 2030, reduce by one third premature mortality from noncommunicable diseases through prevention and treatment, and promote mental health and well-being.

3.5. Substance abuse

Strengthen the prevention and treatment of substance abuse, including narcotic drug abuse and harmful use of alcohol.

3.6. Road traffic

By 2030, halve the number of global deaths and injuries from road traffic accidents.

3.7. Sexual and reproductive health

By 2030, ensure universal access to sexual and reproductive health-care services, including for family planning, information and education, and the integration of reproductive health into national strategies and programmes.

3.8. Universal health coverage

Achieve universal health coverage, including financial risk protection, access to quality essential health-care services, and access to safe, effective, quality and affordable essential medicines and vaccines for all.

3.9. Environmental health

By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination.

- Goal 3 – Means of implementation for the targets

3.a. Tobacco control

Strengthen the implementation of the WHO Framework Convention on Tobacco Control in all countries, as appropriate.

3.b. Medicines and vaccines

Support the research and development of vaccines and medicines for the communicable and noncommunicable diseases that primarily affect developing countries. Provide access to affordable essential medicines and vaccines in accordance with the Doha Declaration on TRIPS and Public Health, which affirms the right of developing countries to the fullest use of the provisions in the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS agreement) regarding flexibilities to protect public health and, in particular, provide access to medicines for all.

3.c. Health financing and workforce

Substantially increase health financing and the recruitment, development, training and retention of the health workforce in developing countries, especially in least developed countries and small island developing States.

3.d. Emergency preparedness

Strengthen the capacity of all countries, in particular developing countries, for early warning, risk reduction and management of national and global health risks.

Target 3.8. Universal health coverage

This target can be seen as an overarching one that supports the achievement of the other targets. It is derived from the Millennium Development Goals, the new targets and the means of implementation[10s].

Targets from Goal 3 focus on health and well-being, but the implementation of other Goals also benefits from or contributes to progress on Goal 3.

- Goal 1. No poverty
  - **1.5**. By 2030, build the resilience of poor people and those in vulnerable situations, and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters.
- Goal 2. Zero hunger
  - **2.2**. By 2030, end all forms of malnutrition, including achieving, by 2025, the internationally agreed targets on stunting and wasting in children under 5 years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women and older people.
- Goal 4. Quality education
  - **4.2.** By 2030, ensure that all girls and boys have access to quality early childhood development, care and pre-primary education so that they are ready for primary education.
  - **4.a.** Build and upgrade education facilities that are child, disability and gender sensitive and provide safe, nonviolent, inclusive and effective learning environments.
- Goal 5. Gender equality
  - **5.1.** End all forms of discrimination against all women and girls everywhere.
  - **5.3.** Eliminate all harmful practices, such as child, early and forced marriage, and female genital mutilation.
- Goal 6. Clean water and sanitation
  - **6.1.** By 2030, achieve universal and equitable access to safe and affordable drinking-water for all.
  - **6.2**. By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations.
- Goal 7. Affordable and clean energy
  - **7.1.** By 2030, ensure universal access to affordable, reliable and modern energy services.
- Goal 8. Decent work and economic growth
  - **8.7**. Take immediate and effective measures to eradicate forced labour, end modern slavery and human trafficking, and secure the prohibition and elimination of the worst forms of child labour, including recruitment and use of child soldiers, and, by 2025, end child labour in all its forms.

- **8.8.** Protect labour rights and promote safe and secure working environments for all workers, including migrant workers, in particular women migrants, and those in precarious employment.

- Goal 9. Resilient infrastructure, inclusive and sustainable industrialization and innovation
  - **9.1.** Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all.
- Goal 10. Reduced inequalities
  - **10.7.** Facilitate orderly, safe, regular and responsible migration and mobility of people, including through the implementation of planned and well-managed migration policies.
- Goal 11. Sustainable cities and communities
  - **11.2**. By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, people with disabilities and older people.
  - **11.5**. By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting poor people and people in vulnerable situations.
  - **11.6.** By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management.
  - **11.7**. By 2030, provide universal access to safe, inclusive and accessible green and public spaces, in particular for women and children, older people and people with disabilities.
- Goal 12. Responsible consumption and production
  - **12.4.** By 2030, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment.
- Goal 13. Climate action
  - **13.1.** Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries.
- Goal 14. Life below water

- **14.2.** By 2030, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans.

- Goal 15. Life on land
  - **15.8.** By 2030, introduce measures to prevent the introduction and significantly reduce the impact of invasive species.
- Goal 16. Peace, justice and strong institutions
  - **16.1.** Significantly reduce all forms of violence and related death rates everywhere.
  - **16.2.** End abuse, exploitation, trafficking and all forms of violence against and torture of children.
- Goal 17. Partnerships for the Goals
  - **17.1**. Strengthen domestic resource mobilization, including through international support to developing countries, to improve domestic capacity for tax and other revenue collection.
  - **17.2.** Developed countries to implement fully their official development assistance commitments, including the commitment by many developed countries to achieve the target of 0.7 per cent of ODA/GNI to developing countries and 0.15 to 0.20 per cent of ODA/GNI to least developed countries; ODA providers are encouraged to consider setting a target to provide at least 0.20 per cent of ODA/GNI to least developed countries.
  - **17.9.** Enhance international support for implementing effective and targeted capacity-building in developing countries to support national plans to implement all the sustainable development goals, including through North-South, South-South and triangular cooperation.
  - **17.14.** Enhance policy coherence for sustainable development.
  - **17.19**. By 2030, build on existing initiatives to develop measurements of progress on sustainable development that complement gross domestic product, and support statistical capacity-building in developing countries[11s].
- SDG no. 4: quality education - ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

  Education liberates the intellect, unlocks the imagination and is fundamental for self-respect. It is the key to prosperity and opens a world of opportunities, making it possible for each of us to contribute to a progressive, healthy society. Learning benefits every human being and should be available to all[12s].

  Goal 4 aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. This goal supports the reduction of disparities and inequities in education,

both in terms of access and quality. It recognizes the need to provide quality education for all, and most especially vulnerable populations, including poor children, children living in rural areas, persons with disabilities, indigenous people and refugee children.

This goal is of critical importance because of its transformative effects on the other SDGs. Sustainable development hinges on every child receiving a quality education. When children are offered the tools to develop to their full potential, they become productive adults ready to give back to their communities and break the cycle of poverty. Education enables upward socioeconomic mobility.

Significant progress was achieved during the last decade in increasing access to education and school enrolment rates at all levels, particularly for girls. Despite these gains, about 260 million children were out of school in 2018, nearly one fifth of the global population in that age group. Furthermore, more than half of all children and adolescents worldwide are failing to meet minimum proficiency standards in reading and mathematics[13s].

Listed below are the targets for the SDG 4

- **4.1** By 2030, ensure that all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and Goal-4 effective learning outcomes
- **4.2** By 2030, ensure that all girls and boys have access to quality early childhood development, care and preprimary education so that they are ready for primary education
- **4.3** By 2030, ensure equal access for all women and men to affordable and quality technical, vocational and tertiary education, including university
- **4.4** By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship
- **4.5** By 2030, eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples and children in vulnerable situations
- **4.6** By 2030, ensure that all youth and a substantial proportion of adults, both men and women, achieve literacy and numeracy
- **4.7** By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development

- **4.A** Build and upgrade education facilities that are child, disability and gender sensitive and provide safe, nonviolent, inclusive and effective learning environments for all
- **4.B** By 2030, substantially expand globally the number of scholarships available to developing countries, in particular least developed countries, small island developing States and African countries, for enrolment in higher education, including vocational training and information and communications technology, technical, engineering and scientific programmes, in developed countries and other developing countries
- **4.C** By 2030, substantially increase the supply of qualified teachers, including through international cooperation for teacher training in developing countries, especially least developed countries and small island developing states[13s].

1.5.2 The African Union Agenda 2063

Named "The Africa We Want", AGENDA 2063 is Africa's blueprint and master plan for transforming Africa into the global powerhouse of the future. It is the continent's strategic framework that aims to deliver on its goal for inclusive and sustainable development and is a concrete manifestation of the pan-African drive for unity, self-determination, freedom, progress and collective prosperity pursued under Pan-Africanism and African Renaissance The genesis of Agenda 2063 was the realisation by African leaders that there was a need to refocus and reprioritise Africa's agenda from the struggle against apartheid and the attainment of political independence for the continent which had been the focus of The Organisation of African Unity (OAU), the precursor of the African Union; and instead to prioritise inclusive social and economic development, continental and regional integration, democratic governance and peace and security amongst other issues aimed at repositioning Africa to becoming a dominant player in the global arena.

As an affirmation of their commitment to support Africa's new path for attaining inclusive and sustainable economic growth and development African heads of state and government signed the 50th Anniversary Solemn Declaration during the Golden Jubilee celebrations of the formation of the OAU /AU in May 2013. The declaration marked the re-dedication of Africa towards the attainment of the Pan African Vision of ***An integrated, prosperous and peaceful Africa, driven by its own citizens, representing a dynamic force in the international*** **arena** and Agenda 2063 is the concrete manifestation of how the continent intends to achieve this vision within a 50 year period from 2013 to 2063. The Africa of the future was captured in a letter presented by the former Chairperson of the African Union Commission, Dr. Nkosazana Dlaminin Zuma.

The need to envision a long-term 50 year development trajectory for Africa is important as Africa needs to revise and adapt its development agenda due to ongoing structural transformations; increased peace and reduction in the number of conflicts; renewed economic growth and social progress; the need for people centered development, gender equality and youth empowerment; changing global contexts such as increased globalization and the ICT revolution; the increased unity of Africa which makes it a global power to be reckoned with and capable of rallying support around its own common agenda; and emerging development and investment opportunities in areas such as agri-business, infrastructure development, health and education as well as the value addition in African commodities

Agenda 2063 encapsulates not only Africa's Aspirations for the Future but also identifies key Flagship Programmes which can boost Africa's economic growth and development and lead to the rapid transformation of the continent.

Agenda 2063 also identifies key activities to be undertaken in its 10 year Implementation Plans which will ensure that Agenda 2063 delivers both quantitative and qualitative Transformational Outcomes for Africa's people[14s].

The seven Aspiration of the Agenda 2063

Agenda 2063 seeks to deliver on a set of **Seven Aspirations** each with its own set of goals which if achieved will move Africa closer to achieving its vision for the year 2063. These 7 Aspirations reflect our desire for shared prosperity and well-being, for unity and integration, for a continent of free citizens and expanded horizons, where the full potential of women and youth are realised, and with freedom from fear, disease and want.

Aspiration 1: ***A prosperous Africa based on inclusive growth and sustainable development***

We are determined to eradicate poverty in one generation and build shared prosperity through social and economic transformation of the continent.

Goals:

1. A high standard of living, quality of life and well-being for all
    - ending poverty, inequalities of income and opportunity; job creation, especially addressing youth unemployment; facing up to the challenges of rapid population growth and urbanization, improvement of habitats and access to basic necessities of life – water, sanitation, electricity; providing social security and protection;
2. Well educated citizens and skills revolutions underpinned by science, technology and innovation
    - developing Africa's human and social capital (through an education and skills revolution emphasizing science and technology)

3. Healthy and well-nourished citizens
    - expanding access to quality health care services, particularly for women and girls;
4. Transformed economies and jobs
    - transforming Africa's economies through beneficiation from Africa's natural resources, manufacturing, industrialization and value addition, as well as raising productivity and competitiveness
5. Modern agriculture for increased proactivity and production
    - radically transforming African agriculture to enable the continent to feed itself and be a major player as a net food exporter;
6. Blue/Ocean Economy for accelerated economic growth
    - exploiting the vast potential of Africa's blue/ocean economy;
7. Environmentally sustainable climate and resilient economies and communities
    - putting in place measures to sustainably manage the continent's rich biodiversity, forests, land and waters and using mainly adaptive measures to address climate change risks

Aspiration 2: ***An integrated continent, politically united and based on the ideals of Pan-Africanism and the vision of Africa's Renaissance***

Since 1963, the quest for African Unity has been inspired by the spirit of Pan Africanism, focusing on liberation, and political and economic independence. It is motivated by development based on self-reliance and self-determination of African people, with democratic and people-centred governance.

Goals:

1. United Africa (Federal/Confederate)
    - accelerating progress towards continental unity and integration for sustained growth, trade, exchanges of goods, services, free movement of people and capital through establishing a United Africa and fast tracking economic integration through the of the CFTA
2. World class infrastructure criss-crosses Africa
    - improving connectivity through newer and bolder initiatives to link the continent by rail, road, sea and air; and developing regional and continental power pools, as well as ICT
3. Decolonisation
    - All remnants of colonialism will have ended and all African territories under occupation fully liberated. We shall take measures to expeditiously end the

unlawful occupation of the Chagos Archipelago, the Comorian Island of Mayotte and affirming the right to self-determination of the people of Western Sahara.

Aspiration 3: ***An Africa of good governance, democracy, respect for human rights, justice and the rule of law***

An Africa of good governance, democracy, respect for human rights, justice and the rule of law. Africa shall have a universal culture of good governance, democratic values, gender equality, and respect for human rights, justice and the rule of law.

Goals:

1. Democratic values, practices, universal principles for human rights, justice and rule of law entrenched
    - consolidating democratic gains and improving the quality of governance, respect for human rights and the rule of law;
2. Capable institutions and transformed leadership in place at all levels
    - building strong institutions for a development state; and facilitating the emergence of development-oriented and visionary leadership in all spheres and at all levels.

Aspiration 4: ***A peaceful and secure Africa***

Mechanisms for peaceful prevention and resolution of conflicts will be functional at all levels. As a first step, dialogue-centred conflict prevention and resolution will be actively promoted in such a way that by 2020 all guns will be silent. A culture of peace and tolerance shall be nurtured in Africa's children and youth through peace education.

Goals:

1. Peace security and stability is preserved
    - strengthening governance, accountability and transparency as a foundation for a peaceful Africa;
2. A stable and peaceful Africa
    - strengthening mechanisms for securing peace and reconciliation at all levels, as well as addressing emerging threats to Africa's peace and security
3. A fully functional and operational APSA
    - putting in place strategies for the continent to finance her security needs.

Aspiration 5: ***An Africa with a strong cultural identity, common heritage, shared values and ethics***

Pan-Africanism and the common history, destiny, identity, heritage, respect for religious diversity and consciousness of African people's and her diaspora's will be entrenched.

Goal:

1. Africa cultural renaissance is pre-eminent
    - inculcating the spirit of Pan Africanism; tapping Africa's rich heritage and culture to ensure that the creative arts are major contributors to Africa's growth and transformation; and restoring and preserving Africa's cultural heritage, including its languages.

Aspiration 6: ***An Africa, whose development is people-driven, relying on the potential of African people, especially its women and youth, and caring for children.***

All the citizens of Africa will be actively involved in decision making in all aspects. Africa shall be an inclusive continent where no child, woman or man will be left behind or excluded, on the basis of gender, political affiliation, religion, ethnic affiliation, locality, age or other factors.

Goals:

1. Full gender equality in all spheres of life
    - strengthening the role of Africa's women through ensuring gender equality and parity in all spheres of life (political, economic and social); eliminating all forms of discrimination and violence against women and girls;
2. Engaged and empowered youth and children
    - creating opportunities for Africa's youth for self-realisation, access to health, education and jobs; ensuring safety and security for Africa's children, and providing for early childhood development.

Aspiration 7*: Africa as a strong, united, resilient and influential global player and partner.*

Africa shall be a strong, united, resilient, peaceful and influential global player and partner with a significant role in world affairs. We affirm the importance of African unity and solidarity in the face of continued external interference including, attempts to divide the continent and undue pressures and sanctions on some countries.

Goals:

1. Africa as a major partner in global affairs and peaceful co-existence
    - improving Africa's place in the global governance system (UN Security Council, financial institutions, global commons such as outer space);
2. Africa takes full responsibility for financing her development
    - improving Africa's partnerships and refocusing them more strategically to respond to African priorities for growth and transformation; and ensuring that the continent has the right strategies to finance its own development and reducing aid dependency[15s].

Flagship Projects of Agenda 2063

The flagship projects of Agenda 2063 refers to key programmes and initiatives which have been identified as key to accelerating Africa's economic growth and development as well as promoting common identity of all Africans by celebrating their history and their vibrant culture:

1. **Integrated High Speed Train Network**

The project aims to connect all African capitals and commercial centres through an African High Speed Train Network thereby facilitating the movement of goods, factor services and people. The increased connectivity by rail also aims to reduce transport costs and relieve congestion of current and future systems.

2. **Formulation of an African Commodities Strategy**

The development of a continental commodities strategy is seen as key to enabling African countries to add value, extract higher rents from their commodities, integrate into the Global Value chains, and promote vertical and horizontal diversification anchored in value addition and local content development. The strategy aims to transform Africa from simply being a raw materials supplier for the rest of the world to a continent that actively uses its own resources to ensure the economic development of Africans

3. **Establishment of The African Continental Free Trade Area (Afcfta)**

Accelerate intra-African trade and boost Africa's trading position in the global market place. The AfCFTA aims to significantly accelerate growth of Intra-Africa trade and use trade more effectively as an engine of growth and sustainable development by doubling intra-Africa trade, strengthening Africa's common voice and policy space in global trade negotiations.

4. **The African Passport And Free Movement of People**

Remove restrictions on Africans ability to travel, work and live within their own continent. The initiative aims at transforming Africa's laws, which remain generally restrictive on movement of people despite political commitments to bring down borders with the view to promoting the issuance of visas by Member States to enhance free movement of all African citizens in all African countries.

5. **Silencing The Guns By 2020**

To achieve the goals of Agenda 2063, Africa needs to work towards ending all wars, civil conflicts, gender-based violence, violent conflicts and preventing genocide. In addition progress in the areas are to be monitored through the establishment and operationalisation of an African Human Security Index (AHSI)

6. **Implementation of The Grand Inga Dam Project**

The development of the Inga Dam is expected to generate 43,200 MW of power, to support current regional power pools and their combined service to transform Africa from traditional to modern sources of energy and ensure access of all Africans to clean and affordable electricity.

7. Establishment of A Single African Air-Transport Market (Saatm)

The SAATM aims to ensure intra-regional connectivity between the capital cities of Africa and create a single unified air transport market in Africa, as an impetus to the continent's economic integration and growth agenda. SAATM provides for the full liberalisation of intra-African air transport services in terms of market access, traffic rights for scheduled and freight air services by eligible airlines thereby improving air services connectivity and air carrier efficiencies. It removes restrictions on ownership and provides for the full liberalisation of frequencies, tariffs and capacity. It also provides eligibility criteria for African community carriers, safety and security standards, mechanisms for fair competition and dispute settlement as well as consumer protection.

8. Establishment of An Annual African Economic Forum

The annual African Economic Forum, is a multi-stakeholder meeting that brings together the African political leadership, the private sector, academia and civil society to reflect on how to accelerate Africa's economic transformation harnessing its vast resources to enhance the development of the African people. The forum discusses key opportunities as well as the constraints that hamper economic development and proposes measures to be taken to realise the Aspirations and goals of Agenda 2063.

9. Establishment of The African Financial Institutions

The creation of African Continental Financial Institutions aims at accelerating integration and socio-economic development of the continent through the establishment of organisations which will play a pivotal role in the mobilization of resources and management of the African financial sector. The financial institutions envisaged to promote economic integration are the African Investment Bank and Pan African Stock Exchange; the African Monetary Fund and the African Central Bank.

10. The Pan-African E-Network

This aims to put in place policies and strategies that will lead to transformative e-applications and services in Africa; especially the intra-African broad band terrestrial infrastructure; and cyber security, making the information revolution the basis for service delivery in the bio and nanotechnology industries and ultimately transform Africa into an e-Society.

11. **Africa Outer Space Strategy**

The Africa outer space strategy aims to strengthen Africa's use of outer space to bolster its development. Outer space is of critical importance to the development of Africa in all fields:

agriculture, disaster management, remote sensing, climate forecast, banking and finance, as well as defence and security. Africa's access to space technology products is no longer a matter of luxury and there is a need to speed up access to these technologies and products. New developments in satellite technologies make these accessible to African countries and appropriate policies and strategies are required to develop a regional market for space products in Africa.

12. An African Virtual And E-University

This project aims to use ICT based programmes to increase access to tertiary and continuing education in Africa by reaching large numbers of students and professionals in multiple sites simultaneously. It aims to develop relevant and high quality Open, Distance and eLearning (ODeL) resources to offer students guaranteed access to the University from anywhere in the world and anytime (24 hours a day, 7 days a week.

13. Cyber Security

The decision to adopt Cyber Security as a flagship programme of Agenda 2063 is a clear indication that Africa needs to not only incorporate in its development plans the rapid changes brought about by emerging technologies, but also to ensure that these technologies are used for the benefit of African individuals, institutions or nation states by ensuring data protection and safety online. The Cyber Security project is guided by the African Union Convention on Cyber Security and Personal Data Protection.

14. Great African Museum

The African Charter for African Cultural Renaissance recognises the important role that culture pays in mobilising and unifying people around common ideals and promoting African culture to build the ideals of Pan-Africanism. The Great African Museum project aims to create awareness about Africa's vast, dynamic and diverse cultural artefacts and the influence Africa has had and continues to have on the various cultures of the world in areas such as art, music, language, science, and so on. The Great African Museum will be a focal centre for preserving and promoting the African cultural heritage.

15. Encyclopaedia Africana

- The Encyclopaedia Africana aims to provide an authoritative resource on the authentic history of Africa and African life. The Encyclopaedia provides Africans a body of truth to guide and unite them in their development with foundations in all aspect of the African life including history, legal, economic, religion, architecture and education as well as the systems and practices of African societies.

- The Encyclopaedia Africana provides an African worldview of the people, culture, literature and history of Africa and is a key tool to be used to educate, inform and set the records straight regarding the history, culture and contributions of African people throughout the world[16s].

1.5.3 Linking Agenda 2063 and the SDGs[18s]

Agenda 2063 Goals	Agenda 2063 Priority Areas	UN Sustainable Development Goals
1. A high standard of living, quality of life and well-being for all citizens.	Incomes, jobs and decent work Poverty, inequality and hunger Social security and protection, including persons with disabilities Modern, affordable and liveable habitats and quality basic services	1. End poverty in all its forms everywhere in the world 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture. 8. Promote sustained, inclusive and sustainable Economic growth, full and productive employment and decent work for all. 11.Make cities and human settlements inclusive, safe, resilient and sustainable.
2. Well educated citizens and skills revolution underpinned by science, technology and innovation.	• Education and science, technology and innovation (STI) driven skills revolution	4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
3. Healthy and well-nourished citizens.	• Health and nutrition	3. Ensure healthy lives and promote well-being for all at all ages.

4.	Transformed economies.	• Sustainable and inclusive economic growth • STI driven manufacturing, industrialization and value addition • Economic diversification and resilience	8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all. 9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.
5.	Modern agriculture for increased productivity and production.	• Agricultural productivity and production	2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture.
6.	Blue/ocean economy for accelerated economic growth.	• Marine resources and energy • Port operations and marine transport	14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
7.	Environmentally sustainable and climate resilient economies and communities.	• Bio-diversity, conservation and Sustainable natural resource management. • Water security • Climate resilience and natural disasters preparedness	6. Ensure availability and sustainable management of water and sanitation for all. 7. Ensure access to affordable, reliable, sustainable and modern energy for all. 13. Take urgent action to combat climate change and its impacts. 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

8.	A United Africa (Federal or Confederate).	• Frameworks and institutions for a United Africa	
9.	Continental financial and monetary institutions established and functional.	• Financial and monetary institutions	
10.	World class infrastructure criss - crosses Africa.	• Communications and infrastructure connectivity.	9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.
11.	Democratic values, practices, universal principles of human rights, justice and the rule of law entrenched.	• Democracy and good governance • Human rights, justice and the rule of law	16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.
12.	Capable institutions and transformative leadership in place.	• Institutions and leadership • Participatory development and local governance.	16.Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.
13.	Peace, security and stability is preserved.	• Maintenance and preservation of peace and security	16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.

14.	A stable and peaceful Africa.	• Institutional structure for AU instruments on peace and security • Defence, security and peace	
15.	A fully functional and operational APSA	• Fully operational and functional APSA all pillars	
16.	African cultural renaissance is pre-eminent.	• Values and ideals of Pan Africanism • Cultural values and African Renaissance • Cultural heritage, creative arts and businesses	
17.	Full gender equality in all spheres of life.	• Women and girls empowerment • Violence and discrimination against women and girls	5.Achieve gender equality and empower all women and girls.
18.	Engaged and empowered youth and children.	• Youth empowerment and children's rights	4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. 5. Achieve gender equality and empower all women and girls.

19.	Africa as a major partner in global affairs and peaceful co-existence.	• Africa's place in global affairs • Partnerships	17. Strengthen the means of implementation and revitalize the global partnership for sustainable development.
20.	Africa takes full responsibility for financing her development Goals.	• African capital markets • Fiscal systems and public sector revenue • Development assistance	10. Reduce inequality within and among countries. 17.Strengthen the means of implementation and revitalize the global partnership for sustainable development.

Image 1. Linking Agenda 2063 and the SDGs

1.5.4 The Italian Mattei Plan and the EU strategy

The Italian Mattei Plan is a strategic initiative launched by the Italian government in late 2023 and officially presented in January 2024 by the Prime Minister. It aims to redesign Italy's relations with African countries based on a model of "equal-to-equal" cooperation, moving away from traditional aid towards economic partnerships, energy security, and sustainable development.

The EU Global Gateway is the European Union's flagship strategy launched in 2021 to foster sustainable, high-quality investments and partnerships with developing countries, with a strong focus on Africa. It aims to support a green, digital, and inclusive recovery and transformation by mobilizing up to €300 billion in investments from 2021 to 2027

The Italian Mattei Plan and the EU's Global Gateway have been formally aligned with Africa's development priorities for a renewed, equitable partnership anchored in Agenda 2063 and that can advance strategic investments in infrastructure and sustainable growth.

1.6 The WHO

Created in 1948 as part of the United Nations, WHO is the directing and coordinating authority for health within the United Nations system. It is responsible for providing leadership on global health matters, shaping the health research agenda, setting norms and standards, articulating evidence-based policy options, providing technical support to countries and monitoring and assessing health trends.

The WHO is headquartered in Geneva and has six regional and 150 country offices. It is controlled by delegates from its 194 member states, who vote on policy and elect the director general. Tedros Adhanom Ghebreyesus, previously Ethiopia's foreign minister, was elected to a five-year term in

2017 and re-elected in 2022. He is the WHO's first leader from Africa, and his election was the first time all WHO countries had an equal vote.

WHO delegates set the agency's agenda and approve an aspirational budget each year at the World Health Assembly. The director general is responsible for raising the lion's share of funds from donors.

In the 21st century, health is a shared responsibility, involving equitable access to essential care and collective defence against transnational threats.

WHO operates in an increasingly complex and rapidly changing landscape. The boundaries of public health action have become blurred, extending into other sectors that influence health opportunities and outcomes. WHO responds to these challenges using a six-point agenda. The six points address two health objectives, two strategic needs, and two operational approaches. The overall performance of WHO will be measured by the impact of its work on women's health and health in Africa.

During the past decade, health has achieved unprecedented prominence as a key driver of socioeconomic progress, and more resources than ever are being invested in health. Yet poverty continues to contribute to poor health, and poor health anchors large populations in poverty. Health development is directed by the ethical principle of equity: Access to life-saving or health-promoting interventions should not be denied for unfair reasons, including those with economic or social roots. Commitment to this principle ensures that WHO activities aimed at health development give priority to health outcomes in poor, disadvantaged or vulnerable groups. Attainment of the health-related Millennium Development Goals, preventing and treating chronic diseases and addressing the neglected tropical diseases are the cornerstones of the health and development agenda.

- **Fostering health security**

Shared vulnerability to health security threats demands collective action. One of the greatest threats to international health security arises from outbreaks of emerging and epidemic-prone diseases. Such outbreaks are occurring in increasing numbers, fuelled by such factors as rapid urbanization, environmental mismanagement, the way food is produced and traded, and the way antibiotics are used and misused. The world's ability to defend itself collectively against outbreaks has been strengthened since June 2007, when the revised International Health Regulations came into force.

- **Strengthening health systems**

For health improvement to operate as a poverty-reduction strategy, health services must reach poor and underserved populations. Health systems in many parts of the world are unable to do so,

making the strengthening of health systems a high priority for WHO. Areas being addressed include the provision of adequate numbers of appropriately trained staff, sufficient financing, suitable systems for collecting vital statistics, and access to appropriate technology including essential drugs.

- **Harnessing research, information and evidence**

Evidence provides the foundation for setting priorities, defining strategies, and measuring results. WHO generates authoritative health information, in consultation with leading experts, to set norms and standards, articulate evidence-based policy options and monitor the evolving global heath situation.

- **Enhancing partnerships**

WHO carries out its work with the support and collaboration of many partners, including UN agencies and other international organizations, donors, civil society and the private sector. WHO uses the strategic power of evidence to encourage partners implementing programmes within countries to align their activities with best technical guidelines and practices, as well as with the priorities established by countries.

- **Improving performance**

WHO participates in ongoing reforms aimed at improving its efficiency and effectiveness, both at the international level and within countries. WHO aims to ensure that its strongest asset – its staff – works in an environment that is motivating and rewarding. WHO plans its budget and activities through results-based management, with clear expected results to measure performance at country, regional and international levels.

Regarding the role of WHO in public health, core function are

- providing leadership on matters critical to health and engaging in partnerships where joint action is needed;
- shaping the research agenda and stimulating the generation, translation and dissemination of valuable knowledge;
- setting norms and standards and promoting and monitoring their implementation;
- articulating ethical and evidence-based policy options;
- providing technical support, catalysing change, and building sustainable institutional capacity; and
- monitoring the health situation and assessing health trends[19s].

The WHO's strategic priorities are rooted in the United Nations' Sustainable Development Goals, a set of seventeen objectives for ending poverty by 2030[20s].

1.6.1 The Primary health care

Primary health care (**PHC**) is a whole-of-society approach to effectively organise and strengthen national health systems to bring services for health and wellbeing closer to communities.
Primary health care enables health systems to support a person's health needs – from health promotion to disease prevention, treatment, rehabilitation, palliative care and more. It is essential health care that is based on scientifically sound and socially acceptable methods and technology. This makes universal health care accessible to all individuals and families in a community. PHC initiatives allow for the full participation of community members in implementation and decision making.[2] Services are provided at a cost that the community and the country can afford at every stage of their development in the spirit of self-reliance and self-determination.[3] In other words, PHC is an approach to health beyond the traditional health care system that focuses on health equity-producing social policy.[4][5] PHC includes all areas that play a role in health, such as access to health services, environment and lifestyle.[6] Thus, primary healthcare and public health measures, taken together, may be considered as the cornerstones of universal health systems.[7]
The World Health Organization, or WHO, elaborates on the goals of PHC as defined by three major categories, "empowering people and communities, multisectoral policy and action; and primary care and essential public health functions as the core of integrated health services[1]." Based on these definitions, PHC cannot only help an individual after being diagnosed with a disease or disorder, but can actively contribute to preventing such issues by understanding the individual as a whole.
This ideal model of healthcare was adopted in the declaration of the International Conference on Primary Health Care held in Alma Ata, Kazakhstan in 1978 (known as the "Alma Ata Declaration"), and became a core concept of the World Health Organization's goal of *Health for all*. The Alma-Ata Conference mobilized a "Primary Health Care movement" of professionals and institutions, governments and civil society organizations, researchers and grassroots organizations that undertook to tackle the "politically, socially and economically unacceptable" health inequalities in all countries. There were many factors that inspired PHC; a prominent example is the Barefoot Doctors of China[21s].
The ultimate goal of primary healthcare is the attainment of better health services for all. It is for this reason that the World Health Organization (WHO), has identified five key elements to achieving this goal:[11]

1. reducing exclusion and social disparities in health (universal coverage reforms);

2. organizing health services around people's needs and expectations (service delivery reforms);
3. integrating health into all sectors (public policy reforms);
4. pursuing collaborative models of policy dialogue (leadership reforms); and
5. increasing stakeholder participation.

Moreover, there are eight essential components of PHC, including health education, on prevailing health problems and the methods of preventing and controlling them, nutritional promotion including food supply, supply of adequate safe water and sanitization, maternal and child health care, immunization against major infectious diseases, prevention and control of locally endemic diseases, appropriate treatment of common diseases and injuries and provisions for essential drugs, all these basic requirements are incorporated in the SDGs for 2030 from goal 2 to goal 4 .

Since the last four decades, PHC Provision has moved from simple planning to action. Alma-Ata Declaration is still crucial in current global health like COVID-19 pandemic, especially for developing countries.

In sum, PHC recognizes that healthcare is not a short-lived intervention, but an ongoing process of improving people's lives and alleviating the underlying socioeconomic conditions that contribute to poor health. The principles link health, development, and advocating political interventions rather than passive acceptance of economic conditions[22s].

1.7 Global Health

From the article **Towards a common definition of global health,** published on Lancet in 2009 by J.P. Koplan et al. "global health is an area for study, research, and practice that places a priority on improving health and achieving equity in health for all people worldwide. Global health emphasizes transnational health issues, determinants, and solutions; involves many disciplines within and beyond the health sciences and promotes interdisciplinary collaboration; and is a synthesis of population-based prevention with individual-level clinical care."

Thanks to this definition, key components can be listed as:

- **Improving Health**

While health is often thought of in a physical or health care context, its meaning is much broader. Health refers not only to the absence of illness, but also, as defined in the 1946 Constitution of the World Health Organization, "a state of complete physical, mental, and social well-being." Improving health requires attention to all three of these parts, as well as equal emphasis on prevention and care.

- **Achieving Equity**

Everyone should have the opportunity to live a life that supports good health. However, vast differences in people's environments, resources, and social statuses affect the choices available to them. Achieving equity in health means addressing social and environmental determinants and eliminating disparities in health systems and health care access. These efforts should be focused not only in far-away places, but also among vulnerable populations in Rutgers' surrounding communities.

- **Reaching Beyond Borders**

Global health deals with health issues and determinants that are transnational, meaning they affect multiple countries. Examples of health issues that transcend borders include infectious diseases that travel between countries, as well as noncommunicable diseases and conditions that affect many populations around the world. Climate change and pollution are health determinants that affect everyone, especially the poor and vulnerable.

- **Uniting Disciplines**

Global health issues involve a complex interplay of factors, many of which exist beyond the confines of a clinic. They must be approached from multiple angles: cultural, economic, environmental, infrastructural, political, social, and technological. The involvement of many disciplines, both within and beyond the health sciences, brings the perspectives needed to achieve comprehensive solutions.

- **Building Partnerships**

No one sector or organization can achieve global health solutions on its own. The complexity of the problems involved requires alliances that bring together different perspectives, organizations, and skills. By building partnerships that exchange knowledge and capabilities among countries and stakeholders, including those most affected by these problems, we are more likely to reach practical and long-term solutions[23s].

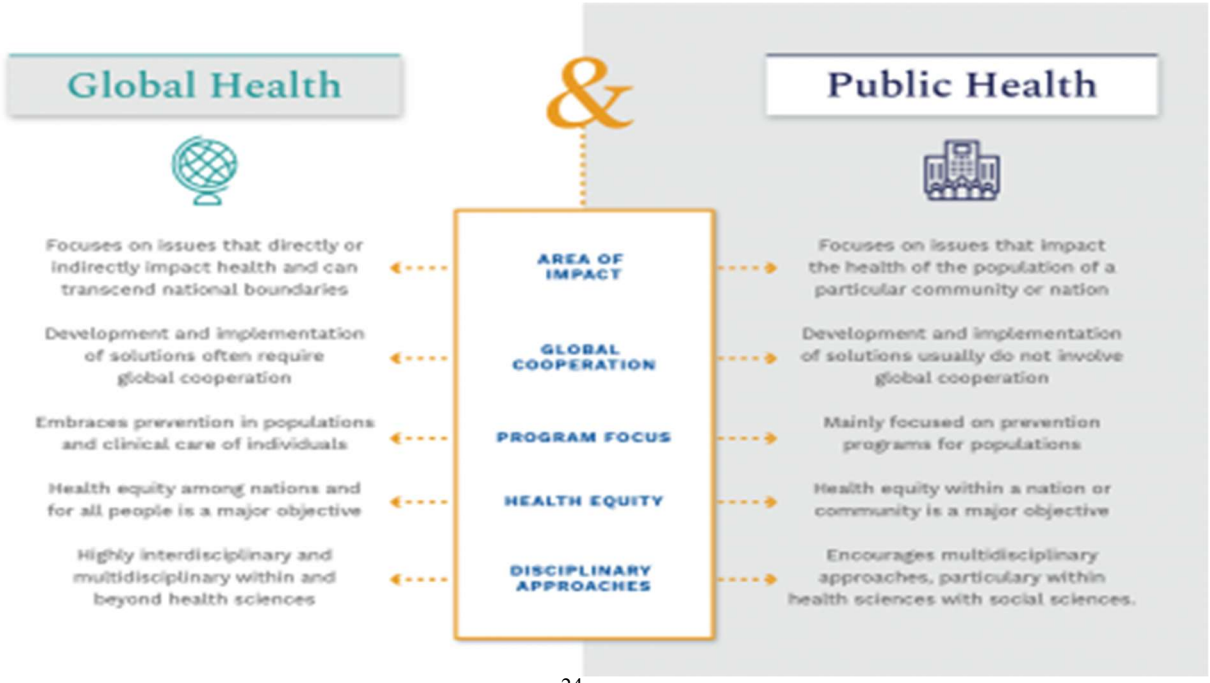

Image 2. Global and public health connection ([24s])

This area of knowledge can therefore have a widespread role and impact in the international cooperation scenario, by transcending borders across disciplines.

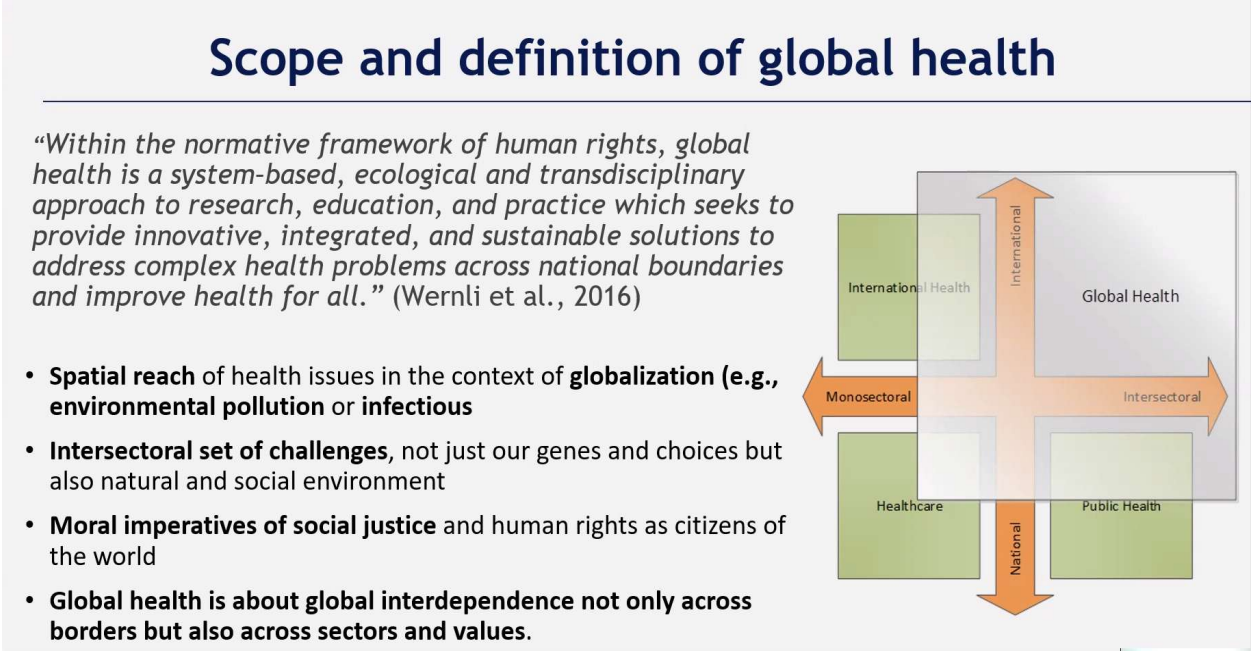

Image 3. Global health – Mario Raviglione, Global health essentials, Springer, 2023

Global health topics can range from bioethics to infectious diseases, to chronic-non communicable diseases as well as mobile health, environmental and climate change issues and ultimately, one-health.

1.8 One Health

By the WHO definition, One Health is an integrated, unifying approach to balance and optimize the health of people, animals and the environment. It is particularly important to prevent, predict, detect, and respond to global health threats such as the COVID-19 pandemic.

The approach mobilizes multiple sectors, disciplines and communities at varying levels of society to work together. This way, new and better ideas are developed that address root causes and create long-term, sustainable solutions.

One Health involves the public health, veterinary, public health and environmental sectors. The One Health approach is particularly relevant for food and water safety, nutrition, the control of zoonoses (diseases that can spread between animals and humans, such as flu, rabies and Rift Valley fever), pollution management, and combating antimicrobial resistance (the emergence of microbes that are resistant to antibiotic therapy).

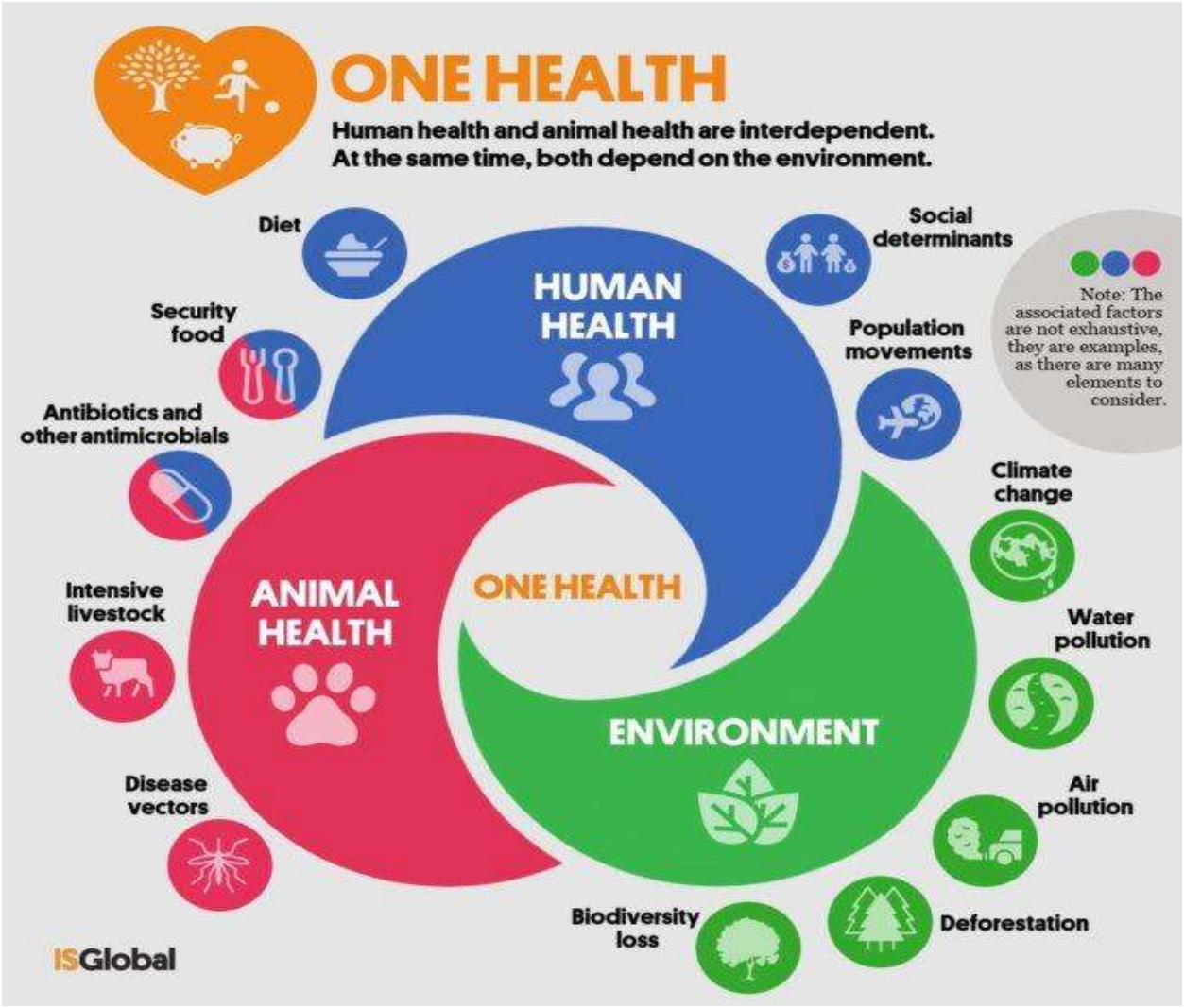

Image 4. One Health (ISGlobal-2018)

One Health is an approach that recognizes that the health of people is closely connected to the health of animals and our shared environment. One Health is not new, but it has become more important in recent years. This is because many factors have changed interactions between people, animals, plants, and our environment[25s].

- Human populations are growing and expanding into new geographic areas. As a result, more people live in close contact with wild and domestic animals, both livestock and pets. Animals play an important role in our lives, whether for food, fiber, livelihoods, travel, sport, education, or companionship. Close contact with animals and their environments provides more opportunities for diseases to pass between animals and people.
- The earth has experienced changes in climate and land use, such as deforestation and intensive farming practices. Disruptions in environmental conditions and habitats can provide new opportunities for diseases to pass to animals.
- The movement of people, animals, and animal products has increased from international travel and trade. As a result, diseases can spread quickly across borders and around the globe.

These changes have led to the spread of existing or known (endemic) and new or emerging zoonotic diseases, which are diseases that can spread between animals and people. Every year, millions of people and animals around the world are affected by zoonotic diseases. Examples of zoonotic diseases include: Rabies, *Salmonella* infection, West Nile virus infection, Q Fever (Coxiella burnetii), Anthrax, Brucellosis, Lyme disease, Ringworm, Ebola.

Similar to humans, animals are also at risk of getting sick from some diseases and environmental hazards. Because of this, they can sometimes serve as early warning signs of potential human illness. For example, birds often die of West Nile virus before people in the same area get sick with West Nile virus infection.

One Health issues include emerging, re-emerging, and endemic zoonotic diseases, neglected tropical diseases, vector-borne diseases, antimicrobial resistance, food safety and food security, environmental contamination, climate change and other health threats shared by people, animals, and the environment. For example:

- **Antimicrobial-resistant germs** can quickly spread through communities, the food supply, healthcare facilities, and the environment (soil, water), making it harder to treat certain infections in animals and people.
- **Vector-borne diseases** are on the rise with warmer temperatures and expanded mosquito and tick habitats.

- **Diseases in food animals** can threaten supplies, livelihoods, and economies.
- The **human-animal bond** can help improve mental well-being.
- **Contamination of water** used for drinking, recreation, and more can make people and animals sick.

Even the fields of chronic disease, mental health, injury, occupational health, and noncommunicable diseases can benefit from the One Health approach involving collaboration across disciplines and sectors.

In addition, the One Health approach can:

- Prevent outbreaks of zoonotic disease in animals and people.
- Improve food safety and security.
- Reduce antimicrobial-resistant infections and improve human and animal health.
- Protect global health security.
- Protect biodiversity and conservation[25s].

According to the World Bank, the expected benefit of One Health to the global community was estimated in 2022 to be at least US$ 37 billion per year. The estimated annual need for expenditure on prevention is less than 10% of these benefits.

Since 2003, the world has seen over 15 million human deaths and US$ 4 trillion in economic losses due to disease and pandemics, as well as immense losses from food and water safety hazards, which are One Health related health threats[26s].

1.9 Human rights and human development index

Human rights are rights inherent to all human beings, regardless of race, sex, nationality, ethnicity, language, religion, or any other status. Human rights include the right to life and liberty, freedom from slavery and torture, freedom of opinion and expression, the right to work and education, and many more. Everyone is entitled to these rights, without discrimination.

- **International Human Rights Law**

International human rights law lays down the obligations of Governments to act in certain ways or to refrain from certain acts, in order to promote and protect human rights and fundamental freedoms of individuals or groups.

One of the great achievements of the United Nations is the creation of a comprehensive body of human rights law—a universal and internationally protected code to which all nations can subscribe and all people aspire. The United Nations has defined a broad range of internationally accepted rights, including civil, cultural, economic, political and social rights. It has also

established mechanisms to promote and protect these rights and to assist states in carrying out their responsibilities.

The foundations of this body of law are the Charter of the United Nations and the Universal Declaration of Human Rights, adopted by the General Assembly in 1945 and 1948, respectively. Since then, the United Nations has gradually expanded human rights law to encompass specific standards for women, children, persons with disabilities, minorities and other vulnerable groups, who now possess rights that protect them from discrimination that had long been common in many societies.

The Universal Declaration of Human Rights (UDHR) is a milestone document in the history of human rights. Drafted by representatives with different legal and cultural backgrounds from all regions of the world, the Declaration was proclaimed by the United Nations General Assembly in Paris on 10 December 1948 by General Assembly resolution 217 A (III) as a common standard of achievements for all peoples and all nations. It sets out, for the first time, fundamental human rights to be universally protected. Since its adoption in 1948, the UDHR has been translated into more than 500 languages - the most translated document in the world - and has inspired the constitutions of many newly independent States and many new democracies. The UDHR, together with the International Covenant on Civil and Political Rights and its two Optional Protocols (on the complaints procedure and on the death penalty) and the International Covenant on Economic, Social and Cultural Rights and its Optional Protocol, form the so-called International Bill of Human Rights.

- **Economic, social and cultural rights**

The International Covenant on Economic, Social and Cultural Rights entered into force in 1976. The Committee on Economic, Social and Cultural Rights is the body of 18 independent experts that monitors implementation of the Covenant by its States parties. Its Optional Protocol entered into force in 2013. The human rights that the Covenant seeks to promote and protect include

- the right to work in just and favourable conditions;
- the right to social protection, to an adequate standard of living and to the highest attainable standards of physical and mental well-being;
- the right to education and the enjoyment of benefits of cultural freedom and scientific progress.

Civil and political rights

The International Covenant on Civil and Political Rights and its First Optional Protocol entered into force in 1976 and the Second Optional Protocol came into force in 1991. The Human Rights Committee monitors the implementation of this multilateral treaty and its Optional Protocols.

The Covenant deals with such rights as freedom of movement; equality before the law; the right to a fair trial and presumption of innocence; freedom of thought, conscience and religion; freedom of opinion and expression; peaceful assembly; freedom of association; participation in public affairs and elections; and protection of minority rights. It prohibits arbitrary deprivation of life; torture, cruel or degrading treatment or punishment; slavery and forced labour; arbitrary arrest or detention; arbitrary interference with privacy; war propaganda; discrimination; and advocacy of racial or religious hatred[27s].

The Human Development Index (HDI) is a summary measure of average achievement in key dimensions of human development: a long and healthy life, being knowledgeable and having a decent standard of living. The HDI is the geometric mean of normalized indices for each of the three dimensions.

The health dimension is assessed by life expectancy at birth, the education dimension is measured by mean of years of schooling for adults aged 25 years and more and expected years of schooling for children of school entering age. The standard of living dimension is measured by gross national income per capita. The HDI uses the logarithm of income, to reflect the diminishing importance of income with increasing GNI (gross national income). The scores for the three HDI dimension indices are then aggregated into a composite index using geometric mean. Refer to Technical notes for more details.

The HDI can be used to question national policy choices, asking how two countries with the same level of GNI per capita can end up with different human development outcomes. These contrasts can stimulate debate about government policy priorities.

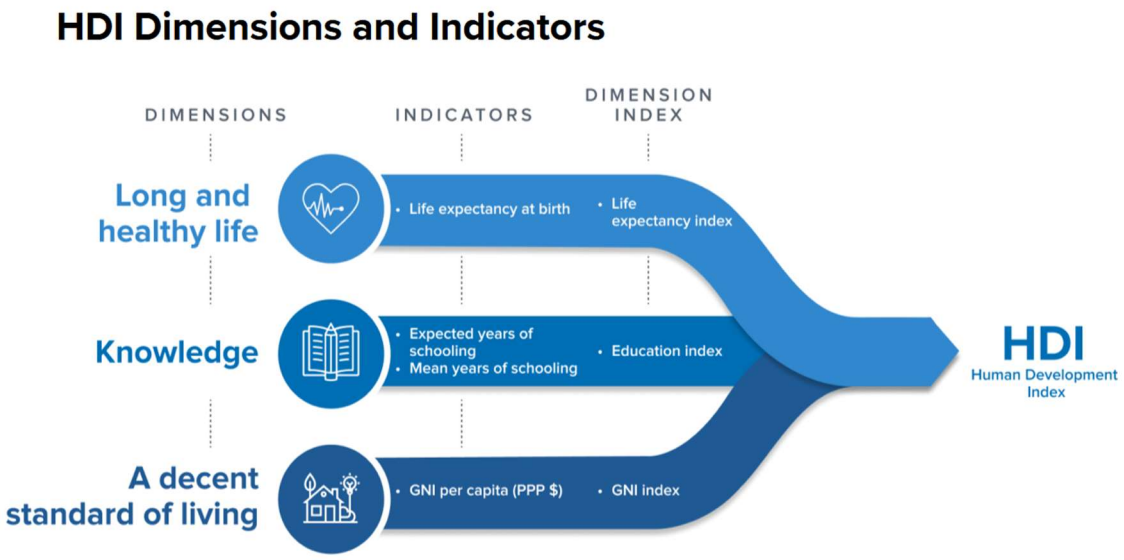

Image 5. The Human Development Index, by UNDP

2. A PERSONAL PATH TOWARD INTERNATIONAL COOPERATION

2.1 The bachelor's and master's degrees

Far from being planned or anticipated, my path into the field of international cooperation began in an unconventional way. From an educational perspective, my bachelor's degree in Sport Sciences played a role in shaping my future direction. It sparked a sense of restlessness and dissatisfaction as I reflected on the broader potential of sport beyond its traditional scope. However, this perspective was not immediately clear to me; it took time to expand my thinking and deepen my understanding of how sport can be integrated into a more universal and accessible framework. Over time, I came to see its connection with other disciplines, particularly through the concept of lifestyles and their impact on society.

I'll start by talking a little about my educational path, which, after completing scientific high school, led me to pursue a bachelor's degree in Sport Sciences. The bachelor'degree in Sport Sciences is an interdisciplinary program that focuses on the study of human movement, physical activity, exercise, and sports performance. It blends knowledge from fields such as **physiology, biomechanics, psychology, and nutrition** to understand how physical activity impacts health, well-being, and athletic performance.

Key Areas of Study

1. **Exercise Physiology** – How the body responds and adapts to physical activity.

2. **Biomechanics** – The study of movement mechanics and how to optimize performance while preventing injuries.
3. **Sports Psychology** – Understanding mental aspects of sports, motivation, and performance enhancement.
4. **Kinesiology** – The study of human movement and motor skills.
5. **Sports Nutrition** – The role of diet in athletic performance and recovery.
6. **Coaching & Training Methods** – Techniques to improve athletic skills and conditioning.
7. **Rehabilitation & Injury Prevention** – Understanding how to prevent and recover from sports injuries.
8. **Sport Management** – Learning about the business side of sports, including marketing, event management, and administration.

After obtaining my bachelor's degree, with an experimental thesis on the effects of sport and physical activity on Type 1 diabetes, I had the opportunity to choose between two master's programs: the natural continuation of my studies with a degree in *Preventive and Adaptive Physical Activities* or a completely new path with a master's in *Science and Technology of Population Health and Wealth*. Once again, the sense of curiosity and restlessness that had shaped my academic journey led me toward the latter. I was particularly drawn to the vision and philosophy of this program, which embraced interdisciplinarity and welcomed students from diverse educational backgrounds.

The program has been designed to provide students with the opportunity to gain a comprehensive understanding of the challenges in the field of global health (by taking into account issues such as poverty, inequality, and access to healthcare), and to develop the skills to develop innovative solutions for the wellbeing of the population. The courses cover topics such as data science, health informatics, public health, nanotechnology, environmental issues, food and agriculture, and others.

As per the “Strategic document” of the course, ideated by Professor Sergio Pecorelli, former Rector of the University of Brescia, the Master’s Degree course has 4 thematic features, which are described below:

Longevity

The characterizing theme concerns the processes that promote increased healthy life expectancy and functional and cognitive well-being so that citizens can remain happy, active, strong, independent and socially useful until late old age (healthy and active longevity). The study of longevity is also concerned with understanding of the biological mechanisms that promote aging of the body and potential interventions that prevent or slow down simultaneously the onset of

major chronic diseases associated aging, contributing to the sustainability and efficiency of the system health, social and welfare systems.

These are primary, though not exclusive, of action of the longevity theme all research, decision-making political and economic, industrial, and health care that enable the maintenance of the active and healthy life of the elderly. That includes the extension of work activity, physical activity, intellectual activity, and social activity in a context of controlling chronic diseases in out-of-hospital situations and containment of their effects on quality of life.

Since the female population is longer-lived but has a greater burden of disease, special attention in this course has been paid to the issues of medicine of gender. Finally, research and technology transfer initiatives that contribute to the design of products and services related to well-being, longevity and aging active health.

Population aging is progressing very rapidly in many industrialized countries. In Italy the percentage of citizens over 65 years old has increased from 8 percent in 1861 to 20 percent in 2009, and it is projected that in 2025 more than 30 percent of Italians will be over 65 years old. Unfortunately, this extraordinary increase in life expectancy has not been accompanied by a similar increase in the quantity and quality of years lived in health. In fact, about 90% of adults over 65 have at least one chronic disease, and 70% have two or more chronic diseases. About 65% of the causes of death are due to cardio- and cerebro-vascular, cancer, respiratory and metabolic diseases, diseases that in most cases are caused by improper lifestyles and chronic exposure to pollutants.

The financial burden caused by these chronic diseases is already alarming, but if current trends continue it risks becoming unsustainable in the near future both for public budgets and for individual families. The consumption of obesogenic and atherogenic diets along with the adoption of a lifestyle that is increasingly sedentary lifestyle represents one of the trends that has led to the current 'epidemic' of overweight, obesity and metabolic syndrome in Italy. To date, in Italy 11.1% of men and 9.7% of women are obese, 50% of men and 34% of women are overweight; these numbers are steadily increasing especially in children. Overweight and obesity are important risk factors for the development of chronic diseases associated with aging, such as type 2 diabetes mellitus, nephropathy diabetic and hypertensive nephropathy, chronic non-alcoholic hepatopathy, cardio- and cerebrovascular diseases and some of the most common forms of cancer, which explains the exponential increase in health care costs in Italy linked to increasing body weight.

Finally, although advances in diagnostics and improved medical and surgical treatment of cardiovascular and cancer disorders have led to some reduction in mortality in recent decades, these same interventions focused on treatment rather than prevention of disease, have made

increasing costs of the National Health System and financial burdens associated with lost labor productivity due to illness and disability. The onset of multiple chronic diseases in the same person and syndromes in the old age related to functional and cognitive decline, has become a major cause of rising health care costs. Shortly this burden will become unsustainable for our society unless we implement social health and environmental policies that promote the health of citizens in all age groups, reducing the current gap between life expectancy and healthy life expectancy, so that our citizens can remain physically and mentally healthy, happy, active, strong, independent and socially useful for as long as possible as possible (healthy and active longevity).

In recent years, scientific knowledge about the biological mechanisms that regulate aging has extraordinarily increased. There are cellular signaling pathways that are very important for slowing down the aging processes in the body and to prevent or postpone the onset of multiple diseases associated with aging. Studies in animal models and humans have confirmed that many of these metabolic and molecular pathways can be manipulated by targeted nutritional interventions, by specific exercise protocols and probably by the administration of certain molecular nutraceuticals and pharmacological drugs. Many studies suggest that specific cognitive training exercises can slow down the aging processes in certain areas of the brain and prevent or slow down the decline cognitive decline associated with aging.

Environment

The characterizing theme includes everything pertaining to the management, enjoyment and preservation of the environment as a valuable resource, both for its direct effect on the health of people and ecosystems, as well as for the wealth and well-being that its enhancement can produce. The environment is understood as a whole and therefore includes both the natural and the man-made, characterized by the presence of agricultural and industrial activities, infrastructure, urban areas and all whatever has been created and modified by man to improve his daily life in all its aspects, from working to recreational, social and cultural. The study of the environment, its development, its degradation, and the resulting impact on the population and ecosystems, the economic opportunities associated with its enhancement, are all characteristic, though not exclusive, themes that contribute to the prediction of evolutionary scenarios, the assessment of economic and social effects, and policy choices related to issues such as energy, transportation, urbanization and industrialization, the use of land and natural resources in general, and the enjoyment of environmental, historical and artistic heritage (Article 9 of the Constitution).

The environment in which we live is a valuable resource both because its quality has a direct effect on the health of the population and ecosystems, and because its enhancement produces wealth and

social welfare. A healthy, attractive, safe and functional environment provides the opportunity to meet individual and social needs,
promotes the physical and psychological health of citizens, and triggers processes of cultural and economic growth. Advances in scientific and technological knowledge, if properly implemented with a overview, would enable us to improve the quality of both the natural and anthropic where human activities take place: daily living, use of services, work, recreation recreation, hobbies, as well as rest and private, social and cultural life.

The extreme complexity of environmental systems is being addressed by numerous and heterogeneous sectors of the science. Only in recent times, prompted by political-decisional needs and aided by tools for analysis and calculation, the scientific community is moving toward integrated approaches to assess all aspects (physical, technological, social, health, economic, regulatory, cultural, ...) of the actions (positive and negative) human actions on the environment and the sustainability of those actions.

The Environment theme also proposes the adoption of a methodological scheme for defining, communicating and then plan research activities aimed at monitoring, managing, planning and enhancement of the environment. The DPSIR - driving forces, Pressures, State, Impact and. Responses scheme - (proposed by EEA - European Environment Agency and also adopted by UNEP and EPA) defines and organizes data, models, methodologies, and knowledge to support decision makers in formalizing and implement policies for environmental restoration and enhancement. The elements of the DPSIR are in cause-and-effect relationships: individual and societal needs and the activities and infrastructure required to meet them satisfaction are the Determinants that exert Pressures that produce alterations on the quality of the environment and natural resources defined State. The alteration of environmental conditions results in Impacts on the health of the population, ecosystems, the economy, cultural heritage, etc. that require Responses to mitigate the effects or enhance the area. Actions on Determinants, Pressures, Status and Impacts are how the decision maker must ensure the safeguarding of health, the sustainable development, social welfare and protection of ecosystems, and enhancement of land and cultural heritage. The proposed scheme offers an approach to classify each type of action, distinguish the areas of intervention, identify its nature (model, process, technology, ...), quantify its impact, enhance its economic potential.

Determinants (or socioeconomic factors) include factors that meet individual and society (food, raw materials, health, culture, security, energy, social relations, equity, cultural identity, ...), infrastructure and activities that support these sectors (industry, agriculture, energy production, transportation, research, health, culture, governance). Pressures are all human activities that create

stress on the environment. They include modifications of the natural landscape resulting from alterations to the environment, the release of pollutants (into air, water, soil), waste disposal, the presence of noise and electromagnetic pollution, direct actions on the ecosystem, the natural and man-made environment (cultural heritage), individual behaviors that contribute to personal vulnerability, exposure risk or produce environmental pressures . The state of the system can be monitored or reconstructed by models that can assess the effect of different levels of Pressure on the integrity of the natural and man-made environment.

Impacts are the positive and negative effects, caused by state changes, on ecosystems, economy, health, welfare, cultural heritage, security, equity. Responses are actions taken by groups or individuals in society and government to prevent, compensate, and ameliorate impacts on the natural and man-made environment, people, and their well-being.

Thus, responses are policies, strategies and interventions on Determinants, Pressures, Status or Impacts whose objectives are specified below:

Responses for Determinants:

- Orienting needs (food, energy needs, water, resources ...) and then acting with prescriptions and technologies aimed at making more efficient and healthy/safe actions and infrastructure useful for meeting needs (transportation, production and trade, building codes and regulations and urban planning, economic policies);
- Modify individual behaviors to increase physical and psychological health status, and reduce environmental impact;
- Influence the distribution and operation of cultural sectors (including tourism, recreation recreation and culture, education, and social organization); limit or increase tourism, educate the public to improve environmental awareness, increase funding for scientific research and popularization.

Answers for Pressures:

- Regulate and control with technological solutions (green economy) the discharge of waste into the environment, pollutants and the use of chemicals.

Responses for the State:

- Directly change the state of the natural and man-made environment through activities of remediation and enhancement, redevelopment of land use, restoration and enjoyment of property cultural.

Responses for Impacts:

- Economically compensate for damage to health, ecosystems, physical and psychological well-being, physical and psychological well-being, cultural heritage, security, social equity.

Lifestyles

The characterizing theme concerns all behaviours of individuals, protective and/or risk behaviours, which are the result of the reciprocal action of an individual's own characteristics individual, of social interactions with living conditions of a socioeconomic and environmental. They are primary, though not exclusive, of the lifestyles theme all initiatives capable of influencing concretely human health risk factors, such as for example smoking, sedentary living, unbalanced nutrition, excessive consumption of alcohol, drug use, unprotected sexual intercourse, excessive exposure to UV rays or other harmful substances (biological or chemical), excessive use of noisy equipment and source of electromagnetic fields, improper use of private transportation, heating/air conditioning, electricity and water, and the improper disposal of household waste.

Characteristic areas of the "lifestyles" theme are the initiatives of research, education, social, health, political and economic planning, which involve the implementation of integrated, interdisciplinary and intersectoral preventive actions, with an approach that looks at the person, communities and the environment as complex phenomena and that, as such, require articulated, coordinated and non-sectoral responses. The theme is also concerned with how to disseminate and adoption of correct lifestyles through support for personal development, promotion of active participation, preventive training, medical screening of diseases, school-age and post-school education, and the design and improvement of work organization and the work.

Moreover, it is well known that cigarette smoking, lack of physical activity, poor diet, and excessive alcohol consumption are powerful risk factors for some of the most common chronic diseases. However, there are many other misbehaviors that negatively affect health, such as for example, (1) excessive UV exposure that increases the risk of skin malignancies, (2) the poor dental hygiene that causes periodontitis, systemic inflammation, and tooth loss, (3) the participation in unprotected sexual activities with people potentially suffering from infectious diseases (e.g., HIV, herpes virus, papilloma virus, syphilis, hepatitis B and C), (4) the consumption of drugs or harmful substances (bacterial toxins, chemicals) that increase cancer risk, and (5) the excessive use of noisy equipment and source of electromagnetic fields.

Incorrect lifestyles, not only affect the health of individuals, but in many cases exert deleterious effects on the environment in which we live. For example, excessive and unnecessary use of private means of transportation, instead of those public or non-polluting ones, increases air pollution levels and global warming; the same applies to the improper use of heating and air

conditioning systems, and of energy electricity in homes and workplaces. Excessive use of polluting chemicals for cleaning the home and improper waste disposal have harmful consequences on the health of both citizens and the environment (air, water, and soil pollution).

It is well known, that healthy or harmful lifestyles are transmitted from generation to generation. According to a study by Case et al, when a child aged 0-3 years has a mother who practices a healthy lifestyle, this child will be 27% more likely to adopt the same lifestyle and be healthy. For example, parents who have a high level of education tend to exercise more, to eat healthier foods, do not smoke, respect the environment, and provide the best living conditions for their children. In contrast, poorly educated parents smoke more frequently, eat more and worse, and are often sedentary.

For this and other reasons, it is essential to put in place initiatives that are "structured" education, dissemination, and adoption of healthy lifestyles through support for personal development personal development, promotion of active participation, preventive training, medical screening of diseases, school-age and post-school education, design and improvement of the organization of work and the work environment. These initiatives must be supported by research programs scientific, and by social, health, and economic planning policies, which provide for the implementation of integrated, interdisciplinary and intersectoral preventive actions, with an approach that looks at the individual communities, and the environment as complex phenomena and, as such, requiring articulated responses, coordinated and non-sectoral.

As part of the socio-cultural and political process destined to radically change the organization of the national health systems there is a need to reorient research, teaching, technological development and social services toward the pursuit of these goals:

- improving knowledge of the pathophysiological, clinical and environmental consequences of correct and incorrect lifestyles;
- develop and promote new educational and preventive approaches, with emphasis on correct lifestyles and exercise;
- test and validate new technology for clinical monitoring of individuals at risk for diseases chronic diseases associated with poor lifestyles.

Technologies for health and well-being

The characterizing theme concerns the design, implementation, evaluation, the impact of new products, services, and technologies for the prevention, diagnosis, treatment therapy, and rehabilitation of diseases and for improving the well-being of people. Included are biomedical technologies, medical devices, drugs, pharmaceuticals, biotechnology products, and aids, as well as innovative solutions for well being, which includes economic well-being, culture, inclusion,

safety and comfort of the person. The theme places humans at the center of development processes technology, and in this sense the latter will be designed and implemented in a context complex that in addition to the purely technological aspects equally takes into consideration the medical-biological ones, the economic ones, and the ethical and legal ones.

Health technologies find their place in the areas of prevention, diagnosis, therapy and rehabilitation. Much more articulated is the area of wellness technologies, wellness being a more nuanced concept. The availability of new materials and biomaterials, nanotechnology, biotech, optical technologies, mechatronics, biorobotics and image processing, genetics, the pharmaceuticals, nutraceuticals, and ICT are the enabling technologies for medical devices and to supporting wellness and for the identification of new diagnostic and therapeutic methods.

The challenges of the near future involve diagnostic technologies and non-invasive and non-injurious therapeutic approaches of quality of life, proven and safe medical devices that can be brought to market in a expeditiously, wellness devices that are also accessible to the less affluent that educate to a better and healthier lifestyle, new technologies for food safety, biological, safety in the workplace and environmental safety, technologies for the social inclusion of the fragile, and supports pervasive information technology and infrastructure to benefit the needs of the individual while respecting his or her privacy. Assisted living, both indoor and outdoor, plays a special role, thanks to which the frail individual also finds assisted environments and activities that enable them to improve their quality of life.

The previous was an extract of the strategic document of the H&W project of the University of Brescia, which can be consulted for further studies and developments, upon request to its founder, Prof Sergio Pecorelli.

The main vision of the course is to find an effective integration between different thematic areas merging into a better understanding of how health and wellbeing can be preserved to improve quality of life and longevity in the modern environment we live in.

During this course I also had the opportunity to spend a period of 8 months abroad, where i conducted an internship at the Icahn School of Medicine at Mount Sinai, in New York City, United States of America.

During my stay at Mount Sinai Hospital, I had the opportunity to learn about the most recent state of art of scientific knowledge in the field of rehabilitation for spinal cord injury. I've participated in several interesting activities in which I had the possibility to work with a team of excellent people, interacting with colleagues from various backgrounds such as medical doctors, physical and occupational therapist, engineers and statisticians, developing my scientific skills and expanding my capability to deal with disabled patients characterised by different

physical and psychological conditions and needs.
In particular I have participated in the conduction of three Institutional Review Board approved protocols where I assisted the Principal Investigators and other study team members with recruitment, screening, and data collection, which are:

- Influence of spinal mobility exercise program on balance as measured by posturography
- in persons with spinal cord injury
- Safety of exoskeleton assisted walking in SCI inpatient rehabilitation
- A mobile application for home evaluation and DME appropriateness for space:

During my internship at Mount Sinai Hospital, I have also been involved in several curricular and extracurricular activities related to the theme of rehabilitation for spinal cord injury, such as Seminars, conference and workshops.

2.2 Network, associationism and volunteering

Thanks to the start of this new educational path, I began expanding my perspective toward a vision that integrates professional training with societal relationships, networking, and volunteering.
This process truly began to take shape when I joined the NOHA Foundation (*Network Organization Health Association*) as a council member. Based in Brescia, the foundation operates in the fields of social and healthcare services, education, human rights protection, and environmental sustainability. Its activities include:

- Medical-surgical-sanitary activities and construction of facilities
- Social projects for the enhancement and development of territorial and cultural resources
- Environmental protection activities aimed at safeguarding collective health
- Education for the disadvantaged
- Social and health care with special reference to maternal and child problems
- Training local personnel to cope with social, health, medical and surgical needs in emergency situations
- Implementation, in Italy or in industrialized and considered Developed countries, of interventions of a humanitarian nature, due to situations of particular emergency or natural disasters

Another way to strengthen networking was through joining the Rotary International in 2019, with the club named Rotary Club Brescia Museo Mille Miglia.
Rotary International is a global humanitarian organization made up of **business and professional leaders** who work together to create positive change in communities worldwide.

Founded in **1905** in Chicago, Rotary now has over **1.4 million members** in **more than 46,000 clubs** across the world. Key aspects of Rotary comprehends:

1. **Service Above Self** – Rotary's motto emphasizes its commitment to community service.
2. **Humanitarian Projects** – Rotary supports initiatives in areas like:
    - **Disease prevention and treatment** (e.g., polio eradication)
    - **Clean water and sanitation**
    - **Education and literacy**
    - **Economic development**
    - **Peacebuilding and conflict resolution**
3. **The Rotary Foundation** – A charitable arm that funds projects globally, including scholarships, disaster relief, and sustainable development.
4. **Networking & Leadership Development** – Rotary brings together professionals and community leaders to build relationships and work on meaningful causes.
5. **Rotary Youth Programs** – Includes **Rotaract (for young adults)** and **Interact (for high school students)** to develop leadership and service skills.

Famous Rotary Initiatives

- **Polio Eradication:** Rotary has played a major role in reducing polio cases worldwide through its **End Polio Now** campaign.
- **Scholarships & Youth Exchange:** Rotary provides **global grants** for education and international exchange programs.
- **Community Projects:** Clubs run local initiatives like medical camps, school funding, and environmental protection programs.

Related to my field of knowledge, i'd like to mention that Rotary International is deeply involved in **global and local humanitarian efforts** aimed at improving lives, promoting peace, and supporting sustainable development. Below are some of the **key humanitarian initiatives** that Rotary undertakes worldwide.

1. Disease Prevention & Treatment

Rotary plays a significant role in combating diseases by funding medical initiatives and supporting healthcare access.

End Polio Now: A global campaign to eradicate polio, in partnership with the **WHO, UNICEF, and the Bill & Melinda Gates Foundation**. Rotary has contributed over **$2.1 billion** to polio eradication.

Malaria & Tuberculosis Prevention: Supports vaccination and medical aid projects in high-risk regions.

HIV/AIDS Awareness & Treatment: Funds educational programs and medical assistance. **Medical Missions:** Organizes free medical check-ups, surgeries, and distribution of medicines in underserved areas.

2. Clean Water, Sanitation & Hygiene (WASH)

Rotary helps provide access to **clean drinking water and proper sanitation** in developing communities.

Building Wells & Water Systems: In rural and disaster-hit areas. **Sanitation Projects:** Constructs toilets and hygiene facilities to prevent waterborne diseases. **Hygiene Education:** Promotes handwashing and hygiene awareness in schools and communities.

3. Education & Literacy

Rotary works to ensure **quality education and literacy** for children and adults worldwide. **Building & Equipping Schools:** Provides books, computers, and educational materials. **Scholarships & Grants:** Funds higher education, vocational training, and international exchange programs.

Adult Literacy Programs: Helps adults learn to read and write to improve job opportunities. **Special Needs Education:** Supports inclusive education for children with disabilities.

4. Economic Development & Community Empowerment

Rotary fosters **economic growth** by helping people develop skills and find jobs. **Microfinance & Small Business Support:** Provides funding for startups and local businesses. **Vocational Training:** Offers workshops in areas like farming, technology, and entrepreneurship. **Empowering Women & Youth:** Supports financial independence programs for marginalized groups.

Farming & Agricultural Development: Helps communities improve food security through sustainable farming techniques.

5. Disaster Relief & Humanitarian Aid

Rotary provides **immediate and long-term aid** to disaster-affected communities. **Emergency Shelter & Supplies:** Works with **ShelterBox** to provide tents, food, and emergency supplies after disasters. **Medical & Psychological Support:** Sends medical teams and counselors to disaster zones. **Rebuilding Homes & Infrastructure:** Assists communities in recovering after earthquakes, floods, and hurricanes.

6. Promoting Peace & Conflict Resolution

Rotary is committed to **peacebuilding and conflict prevention** worldwide. **Rotary Peace Centers:** Funds master's degree programs in peace and conflict resolution at top

universities.

Dialogue & Mediation Programs: Organizes interfaith and intercultural discussions to promote understanding.

Support for Refugees & Displaced People: Provides education and job opportunities for those affected by conflict.

7. Environmental Sustainability

Rotary is actively working on projects that protect the environment and combat climate change. **Tree Planting Campaigns:** Aims to restore forests and improve air quality. **Renewable Energy Projects:** Supports solar energy, clean cooking stoves, and wind power. **Waste Management & Recycling Programs:** Educates communities about reducing plastic pollution and proper waste disposal. **Conservation Initiatives:** Protects endangered species and promotes sustainable agriculture.

Lastly, i'd like to mention about my involvement from 2020 as a volunteer with an international organization named the Sovereign Military Order of Malta. The Sovereign Order of Malta is one of the oldest institutions of Western and Christian civilisation. A **lay religious order of the Catholic Church** since 1113 and a subject of international law, the Sovereign Order of Malta has diplomatic relations with over 100 states and the European Union, and permanent observer status at the United Nations. It is **neutral**, **impartial** and **apolitical**.

Today, the Order of Malta is active in **120 countries** caring for people in need through its medical, social and humanitarian works. Day-to-day, its broad spectrum of social projects provides a constant support for forgotten or excluded members of society. It is especially involved in helping people living in the midst of armed conflicts and natural disasters by providing medical assistance, caring for refugees, and distributing medicines and basic equipment for survival. Across the world, the Order of Malta is dedicated to the **preservation of human dignity** and the care of all those in need, regardless of their origin or religion.

Founded in **Jerusalem** in the 11th century, the Order of Malta has a long history of **service to the vulnerable and the sick**. This 900-year history is reflected in its full name: Sovereign Military Hospitaller Order of St John of Jerusalem of Rhodes and of Malta. Since 1834 the Order of Malta's government seat has been in Rome, where it is guaranteed extraterritorial rights.

The Order of Malta operates through **11 Priories**, **48 national Associations**, **133 diplomatic missions**, **1 worldwide relief agency** and **33 national volunteer corps**, as well as numerous hospitals, medical centres and specialist foundations. It does not pursue any economic or political goal and does not depend on any other state or government[29s].

2.3 Landing on the University of Brescia PhD – the curriculum

The PhD programme in Appropriate methodologies and techniques for international cooperation for development has represented a turning point in my professional career. During it I had the opportunity to learn about a broad range of topics such as international cooperation methodologies, international law economy, cultural anthropology, political geography and geopolitics, pedagogy, project cycle methods. Moreover, by participating in several summer school related to appropriate technologies in the environmental field in the countries of the southern hemisphere, management/treatment of water for human use, water and sanitation, solid waste management, energy and power, I could expand my knowledge in the field of international cooperation. I also wanna thank the infectious diseases department at the ASST Spedali Civili di Brescia to give me the opportunity to pursue the PhD.

As per the ASST- Spedali Civili website, The Complex Operative Unit of Infectious Diseases was set up in 1987 as a hospital O.U. affiliated with the University of Brescia under the name of Infectious and Tropical Diseases Clinic. It is home to the UNESCO Chair 'Training and empowering human resources for health development in resource-limited countries' and the World Health Organisation 'WHO collaborating centre for TB/HIV collaborative activities and for the TB elimination strategy'.The Unit works in close collaboration with the Departmental Simple Structure of Infectious Diseases with Tropical Address and deals with the diagnosis and treatment of chronic and acute diseases caused by microorganisms. Care activities are carried out in ordinary inpatient care, in Day Hospital, and in simple outpatient care and complex outpatient macro-activity (MAC).

Main topics of my PhD track (health track) covered:

- medical methodologies for countries with limited resources;
- medical statistics;
- infectious and tropical diseases;
- diagnostic methodologies;
- monitoring protocols;
- therapeutic tools.
- determinants of health and disease in resource-limited contexts
- primary health care strategy
- health systems in resource-limited countries
- integrated healthcare projects
- the major infectious endemics (HIV, malaria, tuberculosis, parasitic endemics)
- maternal and child health

- malnutrition

In addition to the previously mentioned research activities, this curriculum is distinguished by the direct involvement of doctoral students in cooperation projects in the Global South. These projects aim to implement, validate, and disseminate appropriate solutions and technologies to improve both environmental and human health[30s].

This framework allowed me to initiate the implementation of a research project in Kenya, which will be discussed in detail in Chapter 3 of this thesis.

Ultimately, i'd like to report of my activity as an Erasmus student's Tutor at the University of Brescia, where I served as a facilitator for internationalization services for incoming and outgoing students with the following activities:

- Providing information on international mobility programs offered by the University (Erasmus+ study, Erasmus+ traineeship, thesis abroad, double degrees, joint degrees, etc.);
- Helping students with non-EU citizenship with the procedures for requesting the issuance or renewal of the residence permit;
- Assisting all international students for green pass requests (vaccinated abroad) and vaccination reservations;
- Participating in the University's orientation initiatives and events defined in the University's orientation project, even outside the province.
- Helping in carrying out paper based or online procedures (application for study visa in Universitaly portal; registration in UniBs portal; issuance of Italian tax code; request for bank account; request for health care insurance; application for residence permit; enrollment in study programs; subscription for public transport; tickets / appointments with university offices)
- Information about admission process and documents required for enrollment
- Specific information for holders of international protection status
- Information about university career steps, grants opportunities, Italian language courses held by the University Linguistic center.

2.4 INSPIRING PRINCIPLES AND STRATEGIES UNDERLYING THE RESEARCH PROJECT

2.4.1 Scientific and cultural diplomacy

Science diplomacy eludes an agreed definition but is generally understood to include three strands[31s]:

- **Diplomacy for science** – the use of diplomatic action to facilitate international scientific collaboration, e.g. by negotiating R&D agreements and exchange programmes or enabling the establishment of international research infrastructures;
- **Science for diplomacy** – the use of science as a soft power to advance diplomatic objectives, e.g. for building bridges between nations and creating good will on which diplomatic relations can be built;
- **Science in diplomacy** – the direct support of diplomatic processes through science, e.g. by providing scientific advice and evidence to inform and support decision-making in foreign and security policies.

Global challenges are becoming increasingly complex, interconnected and interdependent, requiring expert knowledge to understand the potential consequences of political action. At the same time, science, technology and innovation have been both a driver and enabler of global change, with the digital transformation advancing at unprecedented speed. While science is regarded as a public good, independent, transparent, politically neutral and life-saving, recent years also saw the rise of a populist narrative questioning scientific facts, discrediting institutions, and projecting 'alternative truths', thus undermining public trust in democracy and multilateralism.

Science and technology play an increasingly important role in the geopolitical arena. Issues span from the race for technological supremacy between global powers to the increasing politicization, militarization and commercialization of the global commons such as the polar zones, the high seas and outer space. New technologies have opened questions for diplomacy, from artificial intelligence to cybersecurity to automated drones. For this reason diplomats need to have a thorough understanding of what is "cooking in the labs" and how this may impact foreign and security policies. Not least the COVID-19 pandemic has shown how important it is for diplomats to reach out beyond traditional circles of foreign and security policy think tanks, and talk to natural sciences, social sciences, medicine, and engineering. Science, technology and innovation can support diplomatic efforts in many ways. The Paris Climate Accord is among the most prominent recent examples of science enabling an international agreement. Science has always been a backbone of multilateralism through the worldwide cooperation of researchers. Science can help

getting traction with non-likeminded countries and lead to tangible results, e.g. making multilateral institutions fit for the challenges of the 21st century[32s].

With a view of integration with science, it is important in this context to talk about the effect of the cultural approach in the cooperation between different countries.

Cultural Diplomacy (or "Diplomacy between Cultures") has existed as a practice for centuries. Whilst the term "cultural diplomacy" has only recently been established, evidence of its practice can be seen throughout history and has existed for centuries. Explorers, travelers, traders, teachers and artists can be all considered living examples of “informal ambassadors” or early “cultural diplomats”. Indeed, any person who interacts with different cultures, (currently or in the past), facilitates a form of cultural exchange, which can take place in many fields such as art, sports, literature, music, science, business & economy and beyond.

Throughout history the interaction of peoples, the exchange of language, religion, ideas, arts and societal structures have consistently improved relations between divergent groups. For example, the establishment of regular trade routes enables a frequent exchange of information and cultural gifts and expressions between traders and government representatives. Such deliberate efforts of cultural and communication exchange can be identified as early examples of cultural diplomacy.

Cultural Diplomacy may best be described as a course of actions, which are based on and utilize the exchange of ideas, values, traditions and other aspects of culture or identity, whether to strengthen relationships, enhance socio-cultural cooperation, promote national interests and beyond; Cultural diplomacy can be practiced by either the public sector, private sector or civil society.

In an increasingly globalized, interdependent world, in which the proliferation of mass communication technology ensures we all have greater access to each other than ever before, cultural diplomacy is critical to fostering peace & stability throughout the world. Cultural diplomacy, when learned and applied at all levels, possesses the unique ability to influence the “Global Public Opinion” and ideology of individuals, communities, nations.

This can accelerate the realization of the 5 important principles below. By accomplishing the first principle, one enables the second, which in turn enables the third until the fifth ultimate principle of global peace and stability is achieved[33s].

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This can accelerate the realization of the 5 important principles below. By accomplishing the first principle, one enables the second, which in turn enables the third until the fifth ultimate principle of global peace and stability is achieved.

The principles are

1) Respect & Recognition of Cultural Diversity & Heritage
2) Constant Global Intercultural Dialogue
3) Justice, Equality & Interdependence to All
4) The Protection of Global Human Rights
5) Global Peace & Stability

Moreover, two broad approaches to conducting regional and international relations can be distinguished; that of 'hard power' and 'soft power'. The political scientist **Prof. Joseph S. Nye** has made the renowned distinction between the two, describing 'soft power' as:

"*The ability to persuade through culture, values and ideas, as opposed to 'hard power', which conquers or coerces through military might*".

Whilst the 'hard power' approach has historically been a favored policy of governments in conducting international and regional relations, the increasingly interconnected world stage highlights the need for co-operation on a new level. This is where the role of Soft Power as a **form of cultural diplomacy** becomes significant. On this basis, cultural diplomacy is not secondary to political or economic diplomacy, but rather functions as an intrinsic and necessary component of it.

Even the UNESCO (United Nations Educational, Scientific and Cultural Organization) talks about the importance of cultural diplomacy.

Culture increasingly permeates international relations and foreign policies. Cultural diplomacy is harnessed by countries to promote their cultural distinctiveness, thus enhancing the world's cultural diversity while paving the way to cooperation and dialogue. In a globalized, interconnected world where countries are increasingly interdependent, cultural diplomacy can be critical to fostering peace and stability. By supporting mutual understanding, trust and exposure to cultural diversity, it enhances international relations in many areas of cooperation. This unique form of intercultural dialogue has the power to bolster and renew multilateral cooperation, beyond competing interests, to put forth global public goods, while also tackling some of the pressing issues of our time, such as disinformation, social inequalities, conflict and climate change.

New models of cultural diplomacy are emerging that are mutually beneficial for the countries involved and build on culture as a resource for social cohesion and dialogue. Traditionally about winning “hearts and minds” for strategic purposes – or even, sometimes,

instrumentalised for divisive purposes - contemporary cultural diplomacy can be seen as more about long term cooperation and sharing values. Whether it be enabling the mobility of artists to promote cultural diversity, lending museums pieces to build a shared understanding of the past, pooling expertise to boost the capacity of the creative industries or launching languages programmes, cultural diplomacy initiatives have multiple benefits for fostering global citizenship. Furthermore, facing the homogenisation of a globalised culture, cultural diplomacy can also serve as a way of enhancing a country's national and local cultural assets and so promote cultural diversity.Valuing cultural diversity, in turn, enhances social inclusion and well-being through the arts and creativity, as well as cultural heritage, leading to enhanced participation and the feeling of being part of a society. As the economic weight of the cultural sector is now firmly established, cultural diplomacy efforts can also be leveraged to boost the cultural assets and creative industries of a country to support decent jobs and to highlight their economic leadership.

UNESCO has been a unique global platform for cultural diplomacy since its inception in 1945, rooted in its conviction in the "free exchange of ideas and knowledge… for the purposes of mutual understanding and a truer and more perfect knowledge of each other's lives," as articulated in its Constitution. Particularly through its normative instruments and programmes, UNESCO facilitates cultural diplomacy, opening new arenas for cooperation and dialogue on complex and sometimes sensitive issues related to culture, creativity, and heritage, building international consensus and frameworks for action.

Forms of culture diplomacy have existed for centuries, with explorers, travellers, traders, teachers and artists being early "cultural diplomats". Documents on the UNESCO Memory of the World list - such as those related to peace building and cultural exchanges between Korea and Japan from the 17th to the 19th century - bear witness to formal government exchanges since the birth of the modern state. It was used by many European countries as a token of pride and courtesy and/or to build political alliances. In the late 19th century countries such as France (1883) and Italy (1889) began setting up networks of institutions to promote their cultures and languages abroad. Some countries, such as Brazil, began mapping cultural relations as early as 1920's to promote its image abroad – particularly in North America, Europe and Latin America – but also to connect with historical roots in sub-Saharan Africa in subsequent decades, marking a trend of strategies that have an external (foreign policy) and internal (nation building) purpose.The 1920's also shifted the contours of cultural diplomacy as radio broadcasts in foreign languages could be used as a way to share cultural messages to populations abroad. Across history, culture was sometimes instrumentalised as part of geopolitics and competition between different countries..

Following independence, several countries centred their foreign policy around culture, or development policies around inter-state cooperation in culture. Cultural diplomacy was a way of recovering from the dark pages of their past marked by discrimination and persecution. For instance, Senegal's foreign policy strategy focused on the idea of "culture-peace", including intercultural dialogue as one of its main pillars, thus prioritizing soft power over hard power. Whereas in the Caribbean, culture was a cornerstone of national development policies and a strong regional multilateral dimension emerged through cultural diplomacy efforts, including through festivals such as the Caribbean Festival of Arts - CARIFESTA (1972) forging inter-state relations through the arts, which predates the creation of The Caribbean Community (CARICOM) which collaborates in other policy areas.

Despite being a long-term practice of cultural relations at State level in different forms, the term "cultural diplomacy" has only recently been established. Building on the notion of "soft power", coined in the 1980's by Joseph Nye, Milton Cummings proposed a definition of cultural diplomacy being the "exchange of ideas, information, art, language and other aspects of culture among nations and peoples in order to foster mutual understanding". Cultural diplomacy encompasses a wide range of practices with different objectives, be it forging alliances, stimulating economic development or supporting peace and security. John Lenczowski categorizes several instruments of cultural diplomacy, including the arts, exhibitions, exchanges, educational programmes, literature, language teaching, broadcasting, gifts, promotion of ideas (like rule of law), promotion of social policy (like campaigns against HIV), history and religious diplomacy (like interfaith dialogue).

Beyond State driven policy processes, cultural diplomacy engages a wide range of non-governmental actors such as artists, curators, journalists, teachers, lecturers and students which support or amplify these processes, differentiating it from other areas of diplomacy. International art biennials, for example, rely on artists and curators. The Fulbright Foreign Student Programme of the United States of America or the European Union's ERASMUS student exchange programme are also a tool for fostering cultural exchange and building mutual values, whilst multilingual public media also influence cultural cooperation. The development in recent years of non-state actors is transforming international relations, accelerating the circulation of ideas. Civil society organizations often have more flexibility to pursue exchanges and programmes. Such cultural relations often grow more organically, rather than having strategic foreign policy purposes. The Institute for Cultural Diplomacy (Germany) even identifies private sector cultural diplomacy. Given the move towards more socially responsible business practices,

the ability to understand and embrace the different values and needs of diverse cultures and societies becomes ever more important.

Museums are a particularly effective vehicle for cultural diplomacy. As platforms for civic discourse among a broad group of users, they bring together globally shared experiences for mutual understanding among cultures, such as the Canadian Museum for Human Rights on the issue of genocide and The Casa de la Memoria in Colombia that explores armed conflict. Opened in 2017, the Louvre Abu Dhabi Museum was the first museum in the world that was the result of a diplomatic agreement, between France and the United Arab Emirates, and aims to foster a dialogue between civilizations. Networks of museums, such as the Ibermuseos of the Ibero-American General Secretariat (SEGIB), also collaborate to share expertise to strengthen museological heritage and the social functions of museums.

Although cultural diplomacy is traditionally State-driven and anchored in bilateral processes, it is also gaining traction at the local level, fostering new forms of culture-based networking and cooperation worldwide. Global exchanges through cities can foster cooperation and leadership as well as pooling expertise, reshaping governance models of the cultural sector particularly for post-pandemic recovery. Cities are laboratories for new models of external cultural relations and their proximity to citizens allows more responsive and innovative policies and initiatives. UNESCO's Creative Cities Network (UCCN), for example, joins together 246 cities across the globe to embed cultural and creative industries in their local development, allowing these cities to promote their culture. Similarly, UNESCO's World Heritage Cities Programme brings together urban World Heritage around the world, for the sharing of experiences and providing assistance for addressing the particular conservation challenges that these sites face. Morocco has effectively harnessed the city space through cultural festivals, such as Marrakech International Film Festival and the Mawazine music festival in Rabat, bringing together international performers and visitors, as well as enhancing the status of these cities internationally.

Furthermore, digital technologies are transforming methods of cultural diplomacy, as digital platforms are no longer simply a platform for visibility and dissemination of messages and information but also the method for engaging audiences. "Network cultural diplomacy" is a term evolving around digital technologies. For example, Oman and China's cultural ministries recently held a digital cultural exchange week for youth, artists and entrepreneurs to share experiences and increase cultural cooperation between the two countries. The pandemic particularly increased digital demands and offer and opened new avenues to continue cultural diplomacy. An example is a livestreaming tour in Chinese facilitated by the Victoria and Albert (V&A) Museum in London, in August 2020 through the platform Kuaishou, which was highly successful[34s].

2.4.2 The Laudato Si Encyclical and the Global Education Pact

"Praise be to you, my Lord, through our Sister, Mother Earth, who sustains and governs us, and who produces various fruit with coloured flowers and herbs".

In the words of this beautiful canticle, *Saint Francis of Assisi reminds us that our common home is like a sister* with whom we share our life[35s].

The Laudato Si Encyclical has been particularly relevant and inspiring during my PhD route.

Laudato Si' is an encyclical of Pope Francis published in May 2015. It focuses on care for the natural environment and all people, as well as broader questions of the relationship between God, humans, and the Earth. The encyclical's subtitle, "Care for Our Common Home," reinforces these key themes.

An encyclical is a public letter from the Pope developing Catholic teaching on a topic often in light of current events. Laudato Si' is addressed to "every living person on this planet" (LS 3). Hence, it is offered as part of an ongoing dialogue within the Catholic Church and between Catholics and the wider world.

The title of an encyclical is typically drawn from the first words of the document. That is, encyclicals do not receive a topical title, but are instead named by their opening phrase, often one suggestive of a major theme of the work.

The first words of Laudato Si' are Italian and translate as "praise be to you." They are part of a quotation from St. Francis of Assisi's "Canticle of the Creatures" that opens the encyclical in which the saint praises God by meditating on the goodness of sun, wind, Earth, water, and other natural forces.

The choice of this passage to begin Laudato Si' is a reminder of how people of faith should not only respect the Earth but also praise and honor God through their engagement with creation.

Laudato Si' is divided into six chapters, each of which can be read in a sitting of 20 to 30 minutes.

"Chapter One: What is Happening to Our Common Home" summarizes the scope of current problems related to the environment. Issues discussed include pollution, climate change, water scarcity, loss of biodiversity, and global inequality.

"Chapter Two: The Gospel of Creation" draws on the Bible as a source of insight. The Genesis creation stories are interpreted as enjoining responsible cultivation and protection of nature. Past attempts to justify the absolute human domination of other species are "not a correct interpretation of the Bible". The natural world is further portrayed as a gift, a message, and a common inheritance of all people.

"Chapter Three: The Human Roots of the Ecological Crisis" explores social trends and ideologies that have caused environmental problems. These include the unreflective use of

technology, an impulse to manipulate and control nature, a view of humans as separate from the environment, narrowly-focused economic theories, and moral relativism.

"Chapter Four: Integral Ecology" presents the encyclical's main solution to ongoing social and environmental problems. Integral ecology affirms that humans are part of a broader world and calls for "comprehensive solutions which consider the interactions within natural systems themselves and with social systems". While the study of ecosystems has become well-known in the science of ecology, integral ecology expands this paradigm to consider the ethical and spiritual dimensions of how humans are meant to relate to each other and the natural world – drawing on culture, family, community, virtue, religion, and respect for the common good.

"Chapter Five: Lines of Approach and Action" applies the concept of integral ecology to political life. It calls for international agreements to protect the environment and assist low-income countries, new national and local policies, inclusive and transparent decision-making, and an economy ordered to the good of all.

Lastly, **"Chapter Six: Ecological Education and Spirituality"** concludes the encyclical with applications to personal life. It recommends a lifestyle focused less on consumerism and more on timeless, enduring values. It calls for environmental education, joy in one's surroundings, civic love, reception of the sacraments, and an "ecological conversion" in which an encounter with Jesus leads to deeper communion with God, other people, and the world of nature.

Climate change is one of the most prominent topics associated with Laudato Si', both because the encyclical speaks in detail about the moral imperative to address it and because the threat of the climate crisis has grown only more severe since the encyclical's publication.

Laudato Si' affirms the "very solid scientific consensus" that climate change is occurring as well as the evidence that human activity is the primary driver of this warming. Climate change is "one of the principal challenges facing humanity in our day".

Further, the encyclical stresses that existing efforts to reduce climate change have been deeply inadequate. This is because "many of those who possess more resources and economic or political power seem mostly to be concerned with masking the problems or concealing their symptoms".

In turn, several ways to address the climate emergency and biodiversity crisis are outlined. These include a drastic reduction in carbon emissions and those of other greenhouse gases, the development of renewable energy sources and related storage capacity, and a transition to energy efficient methods of production and transportation . For example, a switch from coal and oil to solar and wind power would embody these recommendations. The increased protection of tropical forests is also discussed.

One key theme of Laudato Si' is that efforts to reduce climate change and help people in poverty should not be pitted against each other, but instead pursued as a unified project.

It would be wrong to cut emissions in a way that harms the marginalized in society or places an unmanageable burden on very poor countries. As the encyclical states, "We are faced not with two separate crises, one environmental and the other social, but rather with one complex crisis which is both social and environmental. Strategies for a solution demand an integrated approach to combating poverty, restoring dignity to the excluded, and at the same time protecting nature".

Low-income countries are expected to suffer the worst effects of climate change and need financial assistance in making the transition to sustainable practices. Accordingly, there is a duty for rich countries to take the lead in reducing their own emissions and in providing funds to developing countries seeking to do the same. Laudato Si' also notes how climate change will cause a rise in the number of migrants leaving homes destroyed by environmental degradation and calls on people to welcome and support these environmental refugees.

Chapter six of Laudato Si' outlines steps a person can take in the process of ecological conversion. These include prayer and contemplation, learning more about nature, observance of the Sabbath day of rest, and reduced participation in materialistic forms of consumer culture. A step as simple as giving thanks at mealtime can be a reminder of integral ecology and an individual's relation to God, nature, and other people.

Most Catholics have positive memories and experiences of nature but may not have connected these with their faith, so the advice in this section can be helpful in linking spirituality with environmental awareness.

In addition, Laudato Si' is clear that many environmental problems extend beyond individuals to broader economic and political systems. This is a fact that can be challenging to think about.

Even if every reader of the encyclical became environmentally engaged in their personal mindset and lifestyle, this would not be enough to stop problems like the climate crisis and pollution. That is because the main decisions impacting the availability of renewable energy and sustainable practices are not made by individuals, but by governments and large corporations.

Accordingly, it is important for people of faith to get involved in politics and work strategically for positive change. Some of this can happen at the local level through the formation of renewable energy cooperatives and similar initiatives. Other work can be done through non-governmental advocacy groups, such as the Laudato Si' Movement. In addition, the encyclical calls on Catholics to enter the arena of national and international politics, pushing back against the incentive for leaders to prioritize short-term gains and instead advocating for policies that support the disadvantaged and advance the long-term common good.

Laudato Si' describes a wide spectrum of possibilities for the coming century. It is bracing in its discussion of the threats facing humans and the environment.

Many of the problems surveyed would have been much easier to address 30 or 40 years ago and are now already causing widespread harm. However, the encyclical also offers hope – both in specific policies it recommends and in its promise of integral ecology a new, more fulfilling outlook on politics, the economy, and everyday life.

As the encyclical states, "All is not lost. Human beings, while capable of the worst, are also capable of rising above themselves, choosing again what is good, and making a new start, despite their mental and social conditioning".

For this reason, "although the post-industrial period [of the last few decades] may well be remembered as one of the most irresponsible in history, nonetheless there is reason to hope that humanity at the dawn of the twenty-first century will be remembered for having generously shouldered its grave responsibilities". We can also consider that ecological conversion is not a purely human process, but an encounter with God leading to a grace-filled change of heart and mind. It is this kind of experience which Laudato Si' recommends as a way for people of faith to begin moving toward a better and more caring world[36s].

2.4.3 The WHO vision for health and well-being

As introduced in the chapter 1 of this thesis, WHO works worldwide to promote health, keep the world safe, and serve the vulnerable.

Its goal is to ensure that a billion more people have universal health coverage, to protect a billion more people from health emergencies, and provide a further billion people with better health and well-being.

Regarding universal health coverage, the WHO[37s]:

- focus on primary health care to improve access to quality essential services
- work towards sustainable financing and financial protection
- improve access to essential medicines and health products
- train the health workforce and advise on labour policies
- support people's participation in national health policies
- improve monitoring, data and information.

Regarding health emergencies:

- prepare for emergencies by identifying, mitigating and managing risks
- prevent emergencies and support development of tools necessary during outbreaks
- detect and respond to acute health emergencies

- support delivery of essential health services in fragile settings.

For health and well-being:

- address social determinants
- promote intersectoral approaches for health
- prioritize health in all policies and healthy settings.

Related to the topic of health and well-being, the WHO has crafted some relevant document to address the increase of chronic diseases in a fast changing world.

One of them is the "Global Strategy on Diet, Physical Activity and Health" document, which WHO endorsed during the the 57th World Health Assembly (WHA) in May 2004.

The overall goal of the Global Strategy on Diet, Physical Activity and Health is to promote and protect health by guiding the development of an enabling environment for sustainable actions at individual, community, national and global levels that, when taken together, will lead to reduced disease and death rates related to unhealthy diet and physical inactivity. These actions support the United Nations Millennium Development Goals and have immense potential for public health gains worldwide.

The global strategy main objectives:

- Reduce risk factors for chronic diseases that stem from unhealthy diets and physical inactivity through public health actions.
- Increase awareness and understanding of the influences of diet and physical activity on health and the positive impact of preventive interventions.
- Develop, strengthen and implement global, regional, national policies and action plans to improve diets and increase physical activity that are sustainable, comprehensive and actively engage all sectors.
- Monitor science and promote research on diet and physical activity.

Physical inactivity is recognized as a major risk factor for non-communicable diseases (NCDs), and ranks between the second and sixth most important risk factor in contributing to the population burden of disease in westernized countries. The increasing global problem of NCDs means that obesity, poor diet and inactivity are increasing problems for countries in the epidemiological transition.

From a physical activity standpoint, it is interesting to reflect on the temporal relationship between the accrual of evidence and the time delays to the development of policy frameworks for action. Initial epidemiological studies in the 1950s and 1960s identified, for the first time, population level evidence that inactivity was a risk factor for cardiovascular disease or for all cause mortality . This evidence continued to accumulate, such that by 1987 a systematic review reported a consistent

relationship between inactivity and cardiovascular disease. Three years later, this was confirmed by a formal meta-analysis. This period and the following half dozen years was characterized by increased interest and advocacy by physical activity researchers and organizations, resulting in consensus statements and a US Surgeon General's Report . Gradually, some countries engaged with the physical activity agenda, developed guidelines and started to identify physical activity related health targets. However, most countries paid little attention to addressing levels of inactivity in a systematic manner.

Over the past few years the World Health Organization (WHO) has become interested in NCD prevention as a global health concern, fueled by WHO discussion and a resolution to focus on NCD prevention and control in mid 2000 . This document urged countries to "to develop national policy frameworks... to create conducive environment for healthy lifestyles... (largely due to) unhealthy diet, physical inactivity and tobacco use" .

Interest in NCD prevention led to reflections on the contributory risk factors, and in a global context, diet and inactivity became issues of concern. Increasing rates of obesity among youth have been recognized since the 1960s , and since around 1980 among adults, but quite suddenly since the late 1990s, obesity has received increasing political and media interest. This further contributed to increased international interest in inactivity and poor diet by around 2000 or 2001. Furthermore, following the advocacy and efforts stimulated by the Agita programs in South America created interest in developing countries. As a consequence of these efforts, and of the WHA53.17 resolution, the Director General of WHO in 2001 recommended that world Health Day in 2002 should be physical activity focused, and the 'Move for Health' initiative was launched in early 2002.

Specifically speaking about physical activity, the WHO itemizes some key facts:

- Regular physical activity provides significant physical and mental health benefits.
- In adults, physical activity contributes to prevention and management of noncommunicable diseases such as cardiovascular diseases, cancer and diabetes and reduces symptoms of depression and anxiety, enhances brain health, and can improve overall well-being.
- In children and adolescents, physical activity promotes bone health, encourages healthy growth and development of muscle, and improves motor and cognitive development.
- 31% of adults and 80% of adolescents do not meet the recommended levels of physical activity.
- The global target set to reduce levels of physical inactivity in adults and adolescents is a 10% relative reduction by 2025 and 15% by 2030, from the 2010 baseline.

- The global estimate of the cost of physical inactivity to public health care systems between 2020 and 2030 is about US$ 300 billion (approximately US$ 27 billion per year) if levels of physical inactivity are not reduced.

WHO defines physical activity as any bodily movement produced by skeletal muscles that requires energy expenditure. Physical activity refers to all movement including during leisure time, for transport to get to and from places, or as part of a person's work or domestic activities. Both moderate- and vigorous-intensity physical activity improve health. Popular ways to be active include walking, cycling, wheeling, sports, active recreation and play, and can be done at any level of skill and for enjoyment by everybody.

Physical activity is beneficial to health and well-being and conversely, physical inactivity increases risk for noncommunicable diseases (NCDs) and other poor health outcomes. Together, physical inactivity and sedentary behaviours are contributing to the rise in NCDs and placing a burden on healthcare systems.

Improving levels of physical activity will benefit health and well-being and contribute to attainment of global NCD targets and a number of the Sustainable Development Goals. However, this will require increased commitments and investments by Member States; innovation and contributions from non-state actors; cross sector coordination and collaboration; and ongoing guidance and monitoring from WHO.

Benefits of physical activity and risks of sedentary behaviour and inactivity

Physical inactivity is one of the leading risk factors for noncommunicable diseases mortality. People who are insufficiently active have a 20% to 30% increased risk of death compared to people who are sufficiently active. Regular physical activity is associated with:

- **in children and adolescents**, improved physical fitness, cardiometabolic health, bone health, cognitive outcomes, mental health and reduced body fat;
- **in adults and older adults**, reduced risk of all-cause mortality, risk of cardiovascular disease mortality, incident hypertension, incident site-specific cancers, incident type-2 diabetes, and falls and improved mental health, cognitive health, sleep and measures of body fat; and
- **for pregnant and post-partum women**, decreased risk of pre-eclampsia, gestational hypertension, gestational diabetes, excessive gestational weight gain, delivery complications, postpartum depression and newborn complications. Physical activity has no adverse effects on birthweight or increased risk of stillbirth.

Sedentary behaviour is any period of low-energy expenditure while awake such as sitting, reclining or lying. Lives are becoming increasingly sedentary through the use of motorized transport and

the increased use of screens for work, education and recreation. Evidence shows higher amounts of sedentary behaviour are associated with the following poor health outcomes:

- **in children and adolescents,** increased adiposity, poorer cardiometabolic health, fitness, and behavioural conduct/pro-social behaviour, and reduced sleep duration; and
- **in adults,** increased all-cause mortality, cardiovascular disease mortality and cancer mortality and incidence of cardiovascular disease, cancer and type-2 diabetes.

A recent study[3] found that nearly one third (31%) of the world's adult population, 1.8 billion adults, are physically inactive. That is, they do not meet the global recommendations of at least 150 minutes of moderate-intensity physical activity per week. This is an increase of 5 percentage points between 2010 and 2022. If this trend continues, the proportion of adults not meeting recommended levels of physical activity is projected to rise to 35% by 2030.

Globally, there are notable age and gender differences in levels of physical inactivity.

- Women are less active than men by an average of 5 percentage points. This has not changed since 2000.
- After 60 years of age physical inactivity levels increase in both men and women.
- 81% of adolescents (aged 11–17 years) were physically inactive *(2)*.
- Adolescent girls were less active than adolescent boys, with 85% vs. 78%, not meeting WHO guidelines.

Many different factors can determine how active people are and the overall levels of physical activity in different population groups. These factors can be related to the individual or wider social, cultural, environmental and economic determinants that influence access and opportunities to be active in safe and enjoyable ways[38s].

Physical inactivity is one of the leading risk factors for noncommunicable diseases (NCDs) and death worldwide. Alternately, regular physical activity reduces risk of many types of cancer by 8–28%; heart disease and stroke by 19%; diabetes by 17%, depression and dementia by 28–32%. It is estimated that 4–5 million deaths per year could be averted if the global population was more active.

One in 4 adults and 4 in 5 adolescents don't do enough physical activity. Women and girls generally are less active than men and boys, widening health inequalities. Older adults and people living with disabilities are also less likely to be active and miss out on the physical, mental and social health benefits. Physical inactivity burdens society through the hidden and growing cost of medical care and loss of productivity.

Failing to increase levels of physical activity will negatively impact attainment of global targets as well as multiple SDGs[39s].

Regular physical activity is proven to help prevent and manage noncommunicable diseases (NCDs) such as heart disease, hypertension, stroke, diabetes and several cancers. It also helps to maintain a healthy body weight and can improve mental health, quality of life and well-being. Physical activity refers to all movement. Popular ways to be active include walking, cycling, wheeling, sports, active recreation and play, and can be done at any level of skill and for enjoyment by everybody. Work such as household chores or jobs requiring physical labour is another way to be physically active.

Yet, current global estimates show 1 in 3 adults and 81% of adolescents do not do enough physical activity. Furthermore, as countries develop economically, levels of inactivity increase and can be as high as 70% due to changing transport patterns, increased use of technology for work and recreation, cultural values and increasing sedentary behaviour.

Sedentary behaviour is periods of low energy expenditure such as sitting and watching TV. Both sedentary behaviour and inadequate levels of physical activity have negative impacts on health systems, the environment, economic development, community and individual well-being and quality of life[40s].

In the Global Recommendations on Physical Activity for Health by the WHO[4], Physical inactivity has been identified as the fourth leading risk factor for global mortality (6% of deaths globally). This follows high blood pressure (13%), tobacco use (9%) and high blood glucose (6%). Overweight and obesity are responsible for 5% of global mortality (1). Levels of physical inactivity are rising in many countries with major implications for the general health of people worldwide and for the prevalence of NCDs such as cardiovascular disease, diabetes and cancer and their risk factors such as raised blood pressure, raised blood sugar and overweight. Physical inactivity is estimated as being the principal cause for approximately 21–25% of breast and colon cancer burden, 27% of diabetes and approximately 30% of ischaemic heart disease burden. In addition, NCDs now account for nearly half of the overall global burden of disease. It is estimated currently that of every 10 deaths, 6 are attributable to noncommunicable conditions. Global health is being influenced by three trends: population-ageing, rapid unplanned urbanization, and globalization, all of which result in unhealthy environments and behaviours. As a result, the growing prevalence of NCDs and their risk factors has become a global issue affecting both low- and middle-income countries. Nearly 45% of the adult disease burden in these countries is now attributable to NCDs. Many low- and middle-income countries are beginning to suffer the double burden of communicable and noncommunicable diseases, and health systems in these countries are now having to cope with the additional costs of treating both. It has been shown that participation in regular physical activity reduces the risk of coronary heart disease and stroke, diabetes,

hypertension, colon cancer, breast cancer and depression. Additionally, physical activity is a key determinant of energy expenditure, and thus is fundamental to energy balance and weight control[5–10].

The Global Recommendations should be understood as an evidence-based starting point for policy-makers looking to promote physical activity at national level. Policy-makers at national level are encouraged to adopt the recommended levels of physical activity for health proposed in this document. Policy-makers are encouraged to incorporate the global recommended levels of physical activity for health to national policies, taking into consideration the most adequate and feasible options according to their needs, characteristics, physical activity domain and national resources while aiming to be participatory and socially inclusive, particularly of the most vulnerable groups. In addition, the adaptation and translation of the recommended levels of physical activity at national level must take into consideration the cultural background, gender issues, ethnic minorities and burden of disease relevant to the country. Listed below are additional issues to be considered by policymakers when using the global recommended levels of physical activity for health in national or local interventions:

• Social norms, Religious values, Security situation at national and/or local levels., Availability of safe spaces for the practice of physical activity, Geographical settings, seasons and climate, Gender issues, Involvement of all concerned sectors and actors.Role of municipalities and local leadership, Access and attendance to schools and worksite, especially with regard to girls and women, Existing transport infrastructures, sports and recreational facilities and urban design, Patterns of participation in all domains of physical activity (leisure, transportation and occupational).

In many low- and middle-income countries, the levels of participation in leisure time physical activity may be limited, and moderate to vigorous physical activity may be performed in the context of transport and/or occupational and/or domestic activities. These characteristics and patterns of physical activity must be taken into consideration for a more tailored and targeted implementation of interventions aiming at promoting the global recommended levels of physical activity for health. In countries with high levels of occupational and transportation physical activity, policy-makers need to acknowledge that, although these high levels of activity may not be the result of efforts to improve health, such levels of activity provide major health benefits for the population. Caution is therefore needed when implementing policies and infrastructure changes which may lead to a reduction in the levels of physical activity in any domain. For those communities who currently do not achieve the global recommendations of physical activity for health, science supports health benefits for both moderate- and vigorous-intensity activity. However the net health benefit (benefits versus risks) in community-based programmes is likely

to be higher if the main focus is on moderate-intensity activity. Moderate-intensity activity is more relevant to the public health goals of policy implementation than vigorous-intensity activity because of the lower risk of orthopaedic injuries and other medical complications potentially acquired during moderate-intensity activity. If the focus of policy implementation is in promoting vigorous-intensity activity, issues related to potential risks, especially for older adults and populations with various morbidities, need to be taken into consideration. For both levels of intensity, the use of appropriate protective equipment should always be encouraged[4].

In closing this overview about the WHO vision about health and lifestyles, which can support the general framework of this PhD thesis, i'd like to mention about the "Global action plan on physical activity 2018–2030: more active people for a healthier world".

As reported in the dossier, investing in policies to promote walking, cycling, sport, active recreation and play can contribute directly to achieving many of the 2030 Sustainable Development Goals (SDGs). Policy actions on physical activity have multiplicative health, social and economic benefits, and will directly contribute to achieving SDG3 (good health and well-being), as well as other Goals including SDG2 (ending all forms of malnutrition); SDG4 (quality education); SDG5 (gender equality); SDG8 (decent work and economic growth), SDG9 (industry, innovation and infrastructure); SDG10 (reduced inequalities); SDG11 (sustainable cities and communities); SDG12 (responsible production and consumption); SDG13 (climate action); SDG15 (life on land); SDG16 (peace, justice and strong institutions) and SDG17 (partnerships)[11].

Fig. 1: Physical activity can contribute directly to eight Sustainable Development Goals (SDG 3 Health and wellbeing,
SDG 4 Quality education, SDG 5 Gender equity, SDG 10 Reduced inequalities, SDG 11 Sustainable cities and communities, SDG 13 Climate action, SDG 15 Life on land, SDG 16 Peace and justice) according to the Bangkok Declaration on Physical Activity for Global Health and Sustainable Development [16].

Image 6. SDGs by WHO

Fig. 2: The WHO Global Action Plan systems-based roadmap depicts the 4 objectives and 20 policy actions that are universally applicable and address the multiple determinants of physical inactivity.

Image 7. The WHO strategy for health

2.4.4 The UNESCO and education

As per the UNESCO statement[41s], Education transforms lives and is at the heart of UNESCO's mission to build peace, eradicate poverty and drive sustainable development. It is a human right for all throughout life. The Organization is the only United Nations agency with a mandate to cover all aspects of education. It has been entrusted to lead the Global Education 2030 Agenda through Sustainable Development Goal 4.

UNESCO provides global and regional leadership in education, strengthens education systems worldwide and responds to contemporary global challenges through education with gender equality as an underlying principle. Its work encompasses quality educational development from pre-school to higher education and beyond.

Moreover, UNESCO is leading efforts to advance education across Africa, driven by its strong commitment to ensure inclusive, equitable quality education for all.

Various initiatives aimed at improving access to education, enhancing the quality of teaching, and promoting lifelong learning opportunities are making positive impact throughout the continent.

It's useful in this dissertation to speak briefly about an innovative UNESCO section dedicated to "the care of the common home and protection of creation[12]."

On 7 October 2021, the Pontifical Lateran University (PUL), in collaboration with the UNESCO, established a UNESCO Chair on Futures of Education for Sustainability, with the aim of promoting an integrated system of research, training, information and documentation on futures of education for sustainability. The PUL UNESCO Chair is expected to foster an interdisciplinary and trans-disciplinary high level-quality education to work for the care for our common home and to broaden the debate on how knowledge and education can change the future of humanity and the planet. It is inspired by the growing concern that pushes the international community to address the meaning of "human action" towards the integrity of the environment, and to seriously take into consideration education for a radical change of civilization, which also calls for an adequate implementation and enhancement of the concept of sustainability. The 2021 UNESCO Report on "Reimagining Our Future Together. A New Social Contract for Edu- cation" states that «our world is at a turning point [… and] that knowledge and learning are the basis for renewal and transformation» (p. 1). We have to «reinvent education to help us address common challenge» (pag. 2) and to build a new social contract for education, strengthening this latter as a public endeavor and a common good. We are experiencing a number of socio environmental challenges that question our business as usual societies. Climate change and the pervasive multidimensional inequality within and between nations are ones of the main common challenges. They highlight the need fora radical shift and a "change of route" by our international and national communities in the current development paradigms and for our common future. The new education perspective should have as core axes two concepts: sustainability and interdependence, based on the concept of integral ecology 18.

The Chair is, therefore, aimed at contributing and addressing both local and global challenges linked to the issue of integral ecology, and to enhance thereto the awareness and the education of the young generation and all communities to a greater responsibility with regards to the care for our common home. It is clear that this "change of route" must be set through a process aimed at fostering a clear understanding and implementation of the interconnected concepts of sustainability and interdependence. We are invited to make a change of course in favour of a culture of care that places human dignity and the common good at the centre, and can help us to overcome the sustainability crisis, which is well highlighted by the social and environmental degradation caused by human actions.

Unfortunately, we have to recognize that Africa is one of the victims of this sustainability crisis. On the other hand, we have also to realise that the African continent could also be a major player

in our socio-ecological thinking to address this crisis. Africa can and must contribute with all the richness of its culture and rationality not only to repair the harm done to the natural and social environment, but also to enrich a body of thought capable of sustaining the culture of care and the flourishing of our common home. A survey of most African society reveals that socio-political philosophy of traditional African society hinges on the concept of "social solidarity and belongingness". Pope Francis has often quoted a well-known African proverb that says "it takes a whole village to raise a child". Another African proverb states that "a pot standing on three stones cannot tip over". It is important to lay good foundations, define good principles, provide clear guidelines and demonstrate them by sharing best practices. Among the first project that the PUL UNESCO Chair has embarked on is to deepen the theme of sustainability through the implementation of a multi-cultural and trans-disciplinary university network. This means strengthening exchange of experience and knowledge between universities and other institutions of higher learning, and promoting inter alia an "inter-university" cooperation. A deep analysis of sustainability from an ethical, philosophical, juridical, economic, social, environmental and scientific point of view is, indeed, required. An analysis that also focuses on deepening the teaching methods for raising awareness of sustainability and implementing it, by identifying barriers and opportunities. To go deeper in this understanding, we need to integrate diverse cultures and knowledge systems. In this process we started by highlighting the contribution that African culture can offer to sustainability, recovering the more relevant African values and traditions. The UNESCO Chair on Futures of Education for Sustainability of the Pontifical Lateran University kicked off a project focusing on a better understanding of "sustainability" under the African perspective, taking into consideration different issues: Health, Urban Housing, Inclusion, New technologies and Education. It involved different African Universities sharing their views on these issues. The PUL UNESCO Chair is very glad that this Report of the Network of UNESCO Italian Chairs on Africa moves in the same spirit of recovering and revaluating the way African cultures and values can contribute to strengthen the means to reshape our approach to sustainability and caring for our common home.

I'm glad to conclude this section about the inspiring principles and strategies underlying my PhD route, by talking about the UNESCO Education for sustainable development (ESD).

Education for Sustainable Development (ESD) sees education as the key to unlocking progress in all the global development goals. It teaches individuals to make informed decisions and take action, both individually and collectively, to change society and protect the planet. It equips people of all ages with the knowledge, skills, values, and ability to tackle issues such as climate change,

biodiversity loss, overuse of resources, and inequality that impact the well-being of people and the planet.

ESD advocates for learning that is:

1. **Cognitive**: Improving how we think and understand information.
2. **Socio-emotional**: Building social skills, empathy and emotional intelligence.
3. **Behavioral**: Encouraging positive actions and behaviors.

ESD is a powerful strategy to transform education, covering what we learn, how we learn it, and the environment in which we learn. It is a lifelong learning process that is an integral part of a quality education.

UNESCO is the lead United Nations agency for ESD and is responsible for the implementation of ESD for 2030 framework to which countries committed in Berlin in 2021 (see the Roadmap and key documents below).

Government agencies, educators and civil society actors are invited to take action in the 5 key areas:

- Advancing policy
- Transforming learning environments
- Building capacities of educators
- Empowering and mobilizing youth
- Accelerating local level action

UNESCO supports countries to develop and expand educational activities that focus on sustainability issues such as climate change, biodiversity, disaster risk reduction, water, the oceans, sustainable urbanization, and sustainable lifestyles. Most importantly, ESD helps learners understand complex interconnectedness between those issues, and empower them to contribute to environmentally sound, economically viable and socially inclusive futures.

UNESCO provides guidance and standards in ESD. It also tracks data on ESD and monitors progress on SDG Indicator 4.7.1, which measures how well global citizenship education and ESD are integrated into national education policies, curricula, teacher education, and student assessments.

The climate change crisis represents one of the most serious threats to sustainable development and requires urgent action at the global, national and local levels. Climate change is linked with other issues related to biodiversity loss, health, food and sustainable production and consumption. Climate change education is a key component of ESD, as it helps people understand key issues, change attitudes and behaviors, and take action to limit climate change.

UNESCO works to make education a more central part of the international response to climate change, in particular by gathering key players from governments, learning communities, civil society and the private sector around the Greening Education Partnership.

UNESCO is also involved in the annual Conference of Parties (COP) where it advocates for the essential role of learning and greening education in tackling climate change.

The Greening Education Partnership is a global community of practice which aims to get every learner climate-ready. It aims to coordinate actions in climate change education and addresses four key areas: greening schools, curricula, teachers training and education system's capacities, and communities. The Partnership's wholistic approach to climate change education is grounded in the ESD framework, which embraces cognitive, social and emotional and behavioral change, and addresses climate change from socio-economic and environment perspectives

The Greening Education Partnership was launched during the UN Secretary General's Summit on Transforming Education in 2022, and the Secretariat is hosted by UNESCO. It brings together Member States, IGOs and other education stakeholders including civil society, youth, academia and the private sector.

ESD, climate change education and greening education are interrelated and distinct.

Education for sustainable development is an integral element of SDG target 4.7. It is a holistic approach to education that empowers learners of all ages with the knowledge, skills, values and agency to make informed decisions and act responsibly to protect the environment, promote just and equal economic development and societies.

Climate change education is an important part of education for sustainable development and relates to how climate change and its implications is taught in different learning environments.

The concept of **greening education** proposes a broader approach to climate change education, going beyond simply teaching about climate change to include also the learning environment, teacher preparation, communities and so on. Greening education is a comprehensive approach that equips learners with the knowledge, skills, and attitudes needed to take meaningful action on climate change mitigation, adaptation, and resilience.

Given the growing recognition of the complexity of and urgency of the climate crisis on all aspects of society, young people are calling for this more holistic approach to education related to climate change. The Greening Education Partnership uses a whole institution approach to respond to this.

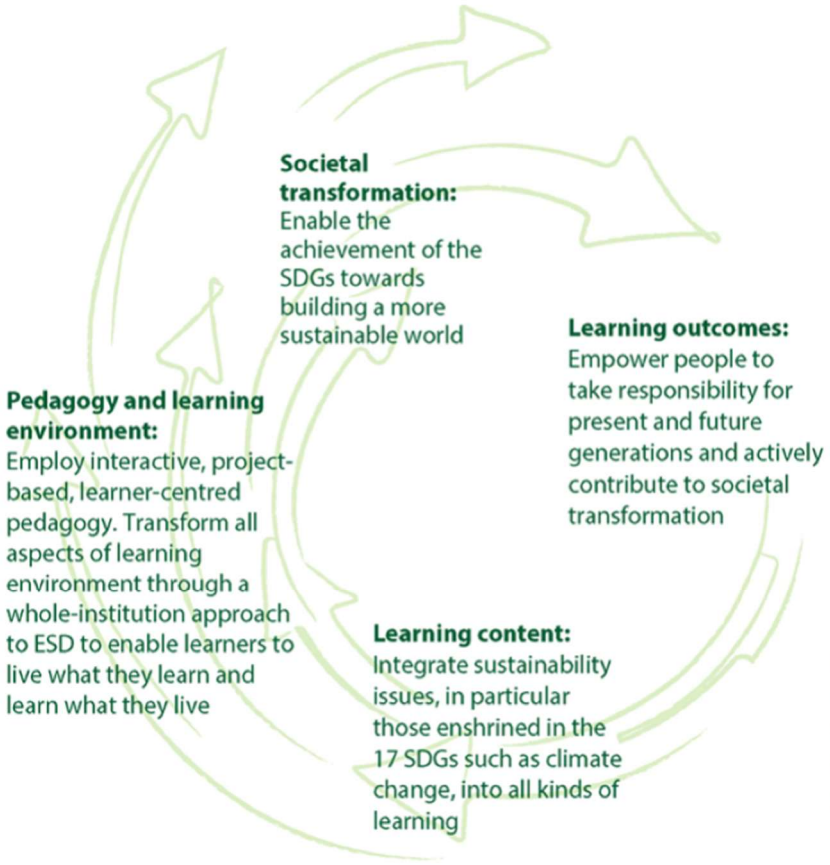


Figure 1: Holistic transformational approach to societal transformation of the ESD for the 2030 roadmap (UNESCO, 2020)

Image 8. UNESCO education

Figure 2: Model showing central role of ESD in advancing the SDGs (UNESCO, 2020)

Image 9. UNESCO SDGs

2.5 Lifestyles for health: between physiology and anthropology

"Health is an essential asset for social, economic and personal development, and it is a fundamental aspect of the quality of life" (Ottawa Charter, 1986).

Health depends on numerous factors: promoting it according to a lifelong perspective helps people to exercise greater control over choices that favor their own well-being.

For this reason, in recent years, attention has increased towards strategies focused on promoting healthy choices[42s].

Lifestyle choices are the main opportunity for protection or, modifying risk with respect to one's own well-being and the onset of chronic pathologies and are most important for diseases that impact mortality and health expenditure.

Lifestyles, where the term "style of life" (German: Lebensstil) was introduced by Austrian psychologist Alfred Adler in his 1929 book, The Case of Miss R., with the meaning of "a person's basic character as established early in childhood[43s]", are indeed a complex system of behaviours that define the way we live.

From a physiological perspective, they are strictly related to behavioral risk factors for health (physical inactivity, obesity, alcohol, smoke, bad nutrition, lack of sleep)

Disease prevention and health promotion therefore are achieved not only through intersectoral policies and strategies but also through actions aimed directly at the population (in different age groups) in order to promote healthy habits, most importantly: healthy nutrition, physical activity, reducing smoking and alcohol consumption.

Eating in a correct and balanced way helps to prevent and treat some pathological conditions such as obesity, hypertension, diseases of the cardiovascular system, type 2 diabetes and certain types of cancer.

For example, a healthy diet is very important for a healthy physical development starting from the prenatal period and then during the subsequent stages of life. Nevertheless, regular physical activity is an essential component of a healthy lifestyle and is a valid ally of psychophysical well-being: at any age, regular exercise, even moderate, has many beneficial effects on the body, proving to be important for prevention and therapy for many pathologies.

However, a sedentary lifestyle, is a public health problem, with a high burden of disease and related social costs. Promoting physical activity is a priority public health action[42s].

The United Nations take a step forward by talking about sustainable lifestyles which are considered as ways of living, social behaviors and choices, that minimize environmental degradation (use of natural resources, CO2 emissions, waste and pollution) while supporting equitable socio-economic development and better quality of life for all. Sustainable living and lifestyles for the first time appear in the Sustainable Development Goals (4 Education and 12.8 Responsible Consumption).

By 2050, the world's population may reach a whopping 10 billion and with more people comes more demand for – food, fashion, travel, housing and related aspirations. An increasing number of people are unable to meet basic needs while two to three billion new urban consumers and youth will receive the majority of their information from social media. In a world stretched thin for resources and under the threat of global biodiversity loss and climate change, our lifestyles decisions are putting the planet at risk[44s].

And it is interesting to discuss of how lifestyles are perceived and conceptualized by the anthropological perspective.

Anthropology is the study of humans, their past and present, including their cultures, societies, languages, and biological development. It seeks to understand what makes us human by examining our behaviors, traditions, and how we have evolved over time.

Medical anthropology is a subfield of anthropology that studies how health, illness, and healthcare are influenced by culture, society, biology, and history. It combines insights from cultural, biological, and social anthropology to understand how people experience and respond to disease, healing, and medical systems worldwide.

Therefore, to understand the full sweep and complexity of cultures across all of human history, anthropology, that often combines these fields to gain a full picture of humanity, draws and builds upon knowledge from the social and biological sciences as well as the humanities and physical sciences[45s].

From an anthropological perspective, a healthy lifestyle is not just about individual choices but is deeply influenced by culture, environment, social structures, and evolutionary history. Anthropologists study health holistically, looking at how different societies define and achieve well-being. Listed below some of the factors through how anthropology healthy lifestyles:

1. Cultural Variations in Health Practices

Different cultures have unique health-related practices based on traditions, environment, and beliefs:

- **Blue Zones:** originally coined by Poulain et al. in their demographic research in Sardinia, Italy, where they discovered an unusually high number of centenarians; anthropologists study regions where people live exceptionally long lives (e.g., Okinawa, Japan; Sardinia,

Italy). Their **healthy lifestyles** include plant-based diets, strong social connections, and daily movement.

- **Traditional Medicine:** Indigenous and non-Western societies use herbal medicine, spiritual healing, and community-based healthcare. For example, Ayurveda in India and Traditional Chinese Medicine focus on body-mind balance and holistic wellness.

2. Evolutionary Health & Lifestyle Adaptations

- **Hunter-Gatherer Lifestyles:** Early humans lived highly active lives, eating natural, unprocessed foods. Many anthropologists suggest that modern sedentary lifestyles and processed diets contribute to chronic diseases.
- **Gut Microbiome & Diet:** Traditional diets (rich in fiber and fermented foods) help maintain gut health, while industrialized diets may lead to obesity and metabolic issues.
- **Circadian Rhythms & Natural Living:** Many traditional societies align their sleep and activity patterns with natural light, improving overall health.

3. Social & Community-Based Health

- **Collectivist vs. Individualist Societies:** Studies show that strong **community bonds** (common in collectivist cultures) reduce stress, depression, and loneliness, leading to better overall health.
- **Rituals & Healing Practices:** Many cultures use **rituals, dance, and storytelling** as mental health therapy, strengthening identity and resilience.
- **Elders' Role in Health:** In some societies, elders guide younger generations on health, food, and medicine, passing down traditional wisdom.

4. Industrialization & Modern Health Challenges

- **Urbanization & Lifestyle Diseases:** As societies shift from rural to urban life, physical activity decreases while processed food consumption increases, leading to obesity, diabetes, and heart disease.
- **Work-Life Balance:** Traditional societies often have a more relaxed approach to work, emphasizing rest, festivals, and communal living, while modern societies struggle with stress and burnout.

Finally, anthropology teaches us that **health is not just biological but cultural and social**. A **healthy lifestyle** is influenced by how we eat, move, socialize, and even how we perceive health itself. Looking at **traditional societies**, whereas scientific literature is now studying and demonstrating the solidity of these behaviours, we can adopt practices like:

-Eating whole, natural foods

-Staying physically active in daily life

- Maintaining strong social connections
- Managing stress through nature, rituals, and relaxation
- Aligning sleep and work habits with natural rhythms

2.5.1 The determinants of health

The previous 2.5 chapter section can be propaedeutic to the understanding of the concept of determinants of health.

Many factors combine together to affect the health of individuals and communities. Whether people are healthy or not, is determined by their circumstances and environment. To a large extent, factors such as where we live, the state of our environment, genetics, our income and education level, and our relationships with friends and family all have considerable impacts on health, whereas the more commonly considered factors such as access and use of health care services often have less of an impact[46s].

The determinants of health include:

- the social and economic environment,
- the physical environment, and
- the person's individual characteristics and behaviours.

The context of people's lives determine their health, and the determinants of health include the above factors, and many others, such as:

- Income and social status - higher income and social status are linked to better health. The greater the gap between the richest and poorest people, the greater the differences in health.
- Education – low education levels are linked with poor health, more stress and lower self-confidence.
- Physical environment – safe water and clean air, healthy workplaces, safe houses, communities and roads all contribute to good health. Employment and working conditions – people in employment are healthier, particularly those who have more control over their working conditions
- Social support networks – greater support from families, friends and communities is linked to better health. Culture - customs and traditions, and the beliefs of the family and community all affect health.
- Genetics - inheritance plays a part in determining lifespan, healthiness and the likelihood of developing certain illnesses. Personal behaviour and coping skills – balanced eating, keeping active, smoking, drinking, and how we deal with life's stresses and challenges all affect health.

- Health services - access and use of services that prevent and treat disease influences health
- Gender - Men and women suffer from different types of diseases at different ages.

Figure 1. The determinants of health and well-being in the urban context *(6)*

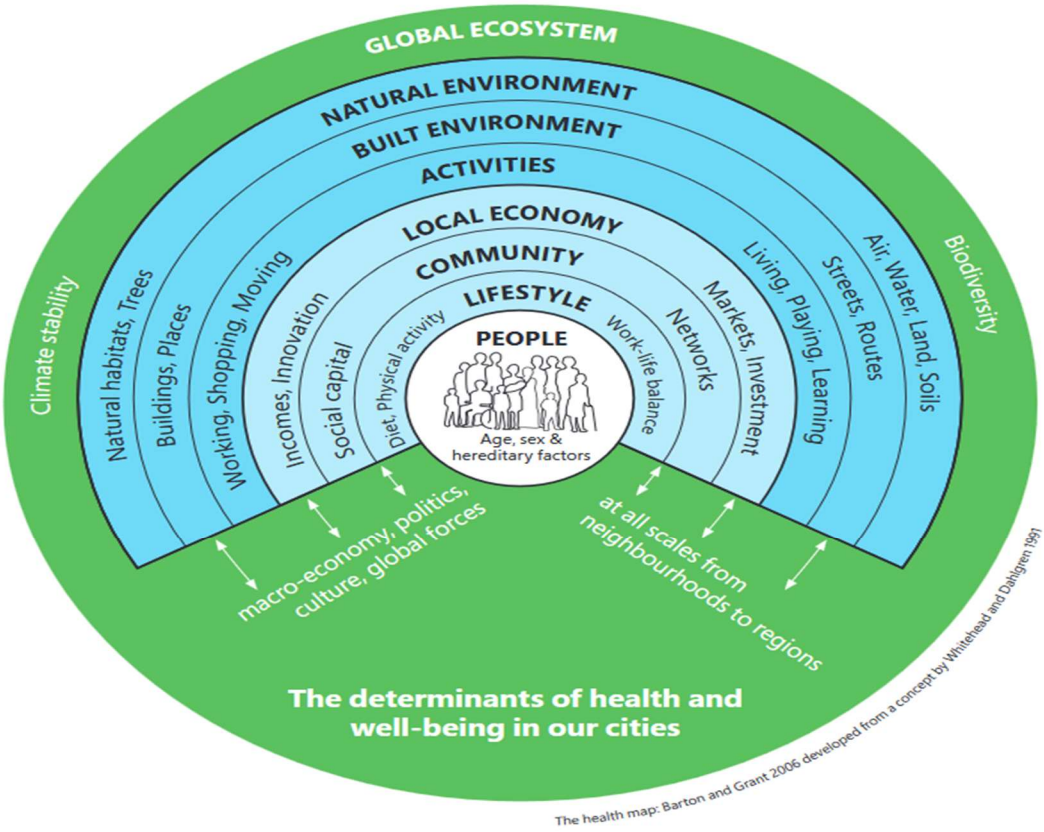


Image 10. Determinants of health

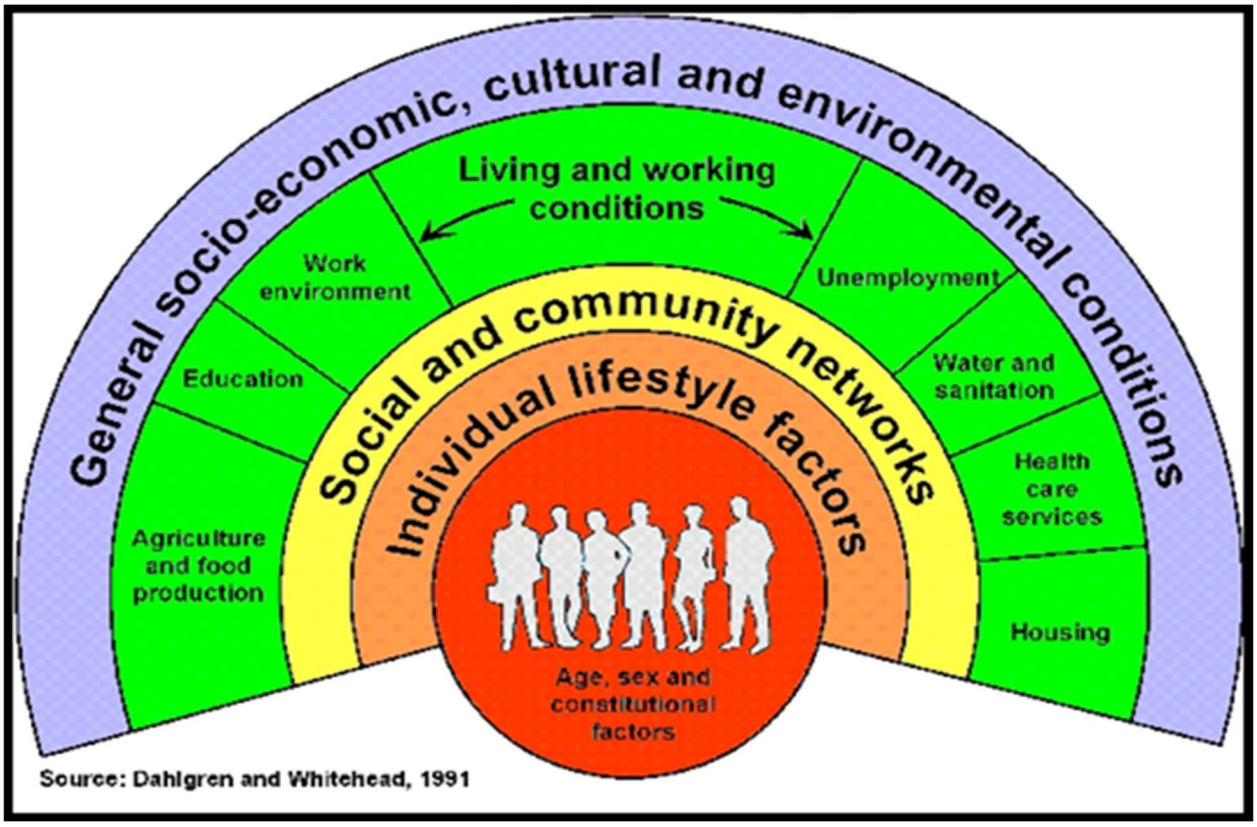


Image 11. Determinants of health

2.5.2 Exposome and epigenetics

The exposome can be defined as the measure of all the exposures of an individual in a lifetime and how those exposures relate to health. An individual's exposure begins before birth and includes insults from environmental and occupational sources. Understanding how exposures from our environment, diet, lifestyle, etc. interact with our own unique characteristics such as genetics, physiology, and epigenetics impact our health and well-being[47s].

Exposomics is holistic, encompassing the chemical, physical, nutritional, and social environments and the interrelationships among them.

Therefore, the exposome is all the environmental factors that affect a person's health across the lifespan. It includes things that are outside our bodies, like the air we breathe, the food we eat, our social support systems, and neighbourhood characteristics. The exposome also includes factors inside our bodies like our metabolism and biological response to stress. Exposomics is the study of the totality of our environmental exposures and how they affect health and disease[48s].

This topic well connects with the theme of epigenetics.

Epigenetics represents a very actual and broad frontier of science that I'm not able to describe in depth in this thesis, but of which i'd like to briefly highlight its link with the thesis main theme.

To make a simple representation of it by using a metaphor: let's image that the DNA is like a big recipe book that tells the body how to grow and work. Every cell in the body has the same book,

but different cells use different recipes to do their jobs—like how a heart cell follows a different recipe than a skin cell.

Epigenetics is like little sticky notes placed on the recipe book. These sticky notes can turn a recipe on or off without changing the actual words in the book.

Things like what we eat, how much we exercise, and even stress can add or remove these sticky notes, changing how your body uses its recipes.

So, even though your DNA stays the same, epigenetics helps decide which parts of the DNA are "read" or "ignored"- kind of like a librarian choosing which books to display.

Various lifestyle choices—such as diet, physical activity, stress, smoking, and exposure to pollutants—can induce epigenetic modifications, including DNA methylation (gene "on" or "off" switch), histone modification (DNA packaging and accessibility), and non-coding RNA activity (gene expression control). These changes can impact health, aging, and disease susceptibility.

So, by using the previous example of the book:

DNA Methylation means putting sticky notes over words so they can't be read.

Histone Modification in equivalent to the act of tightening or loosening the book's binding to make pages harder or easier to open.

Non-Coding RNA is like a commentary guide that helps decide which parts of the book should be read.

Lastly on epigenetics, it is important to mention about the DNA sequences the composes chromosomes, called telomeres.

Telomeres - from the Greek telos, meaning "end," and meros, meaning "part" - are repetitive DNA sequences at the ends of chromosomes that protect them from deterioration (usually associated to the plastic capst at the end of shoelaces). As cells divide, telomeres shorten, eventually leading to cellular aging and dysfunction. Various lifestyle factors can influence telomere length and, by extension, aging and disease risk. Shortly, this effect can be described as follows:

a) Diet

- A diet rich in antioxidants, fiber, and healthy fats has been linked to longer telomeres.
- Mediterranean diet (high in fruits, vegetables, whole grains, fish, and olive oil) is associated with reduced telomere shortening.
- High sugar, processed food, and red meat consumption correlate with shorter telomeres[14-15].

b) Physical Activity

- Regular moderate exercise (e.g., walking, jogging, yoga) is linked to longer telomeres[16], while sedentary behavior can accelerate telomere shortening.

c) Stress and Mental Health

- Chronic stress increases **cortisol levels**, leading to oxidative damage and inflammation, which accelerate telomere shortening[17].
- Mindfulness, meditation, and positive social interactions may help maintain telomere length[18].

d) Sleep

- **Short sleep duration (<6 hours per night)** is associated with increased oxidative stress and telomere shortening (Prather et al., 2015)[19].

5. Smoking and Alcohol Consumption

Both smoking and excessive alcohol intake contribute to telomere damage.

- Negative Effects
    - Smoking increases oxidative stress and inflammation, leading to faster telomere shortening (Needham et al., 2013).
    - Excessive alcohol consumption causes DNA damage and inflammation, accelerating cellular aging.[20]

6. Environmental and Toxin Exposure

Pollution and toxins in the environment negatively affect telomeres.

- **Negative Effects**
    - **Air pollution and heavy metal exposure** increase oxidative stress, damaging telomeres[21].
    - **Pesticides and industrial chemicals** contribute to telomere attrition and increased disease risk[22].

2.5.3 The first 1000 days

This is another important topic that helps illustrate the weight and magnitude of behaviors on health outcomes. In this case, it focuses on lifestyles within a specific life stage: that of the mother and the developing baby.
The first 1,000 days refers to a child's life from conception until they reach 2 years of age (24 months). This is a time when their brain, body and immune system grow and develop significantly. During pregnancy, mother's health, nutrition and stress levels can have an effect on the baby's future. After the baby is born, their physical environment, nutrition and relationships can have a lifelong impact on their health and well-being[49s].
Science is already demonstrating that lifestyle behaviors—including **diet, physical activity, stress management, and environmental exposure**—directly influence fetal and early childhood development.
The mother's health and habits during pregnancy set the stage for fetal growth.
Key factors include:

- Nutrition: a well-balanced diet rich in proteins, healthy fats, and micronutrients (e.g., folic acid, iron, omega-3s) supports proper fetal brain and body development.
- Exercise: moderate physical activity reduces the risk of gestational diabetes, preeclampsia, and low birth weight.
- Stress & Mental Health: high stress levels increase cortisol, which can negatively impact fetal brain development.
- Substance Use: smoking, alcohol, and drugs increase the risk of preterm birth, low birth weight, and developmental disorders[23].

After birth, parenting choices and the home environment shape the child's **immune system, metabolism, and cognitive abilities**.

- **Breastfeeding & Nutrition** : Exclusive breastfeeding for 6 months boosts immunity, while **early exposure to ultra-processed foods** increases the risk of obesity.
- **Sleep Patterns** : Poor sleep in early life is linked to **metabolic disorders and poor cognitive outcomes**.
- **Physical Activity**: Active babies and toddlers develop **stronger motor skills and healthier metabolic profiles**.
- **Screen Time & Social Interaction**: Early overexposure to screens can affect **language development and emotional regulation**, while face-to-face interactions strengthen brain development[23].

To conclude this section, the first 1,000 days influence **lifelong lifestyle habits**:

- Children with **healthy eating habits** early on are more likely to maintain good nutrition.
- Early exposure to stress and poor mental health increases the risk of **depression and anxiety** in adulthood.
- Childhood obesity, largely determined in this period, is a strong predictor of **adult obesity and chronic diseases**.

2.6 Vision of the research project in Kenya: culture of health through inter-academic cooperation

To truly understand the core of this research project, it is essential to first explore the vision that underpins it: the promotion of a holistic concept of health.

Holistic health is an approach to well-being that considers the whole person—mind, body, and spirit. It emphasizes balance and prevention, integrating physical, emotional, mental, social, and spiritual well-being to achieve optimal health.

From a scientific perspective, holistic health and healthcare encompass various fields, including:

- **Life sciences** – the study of living organisms and biological processes.
- **Public health** – improving health outcomes by addressing social, environmental, and behavioral factors.
- **Translational medicine** – bridging research, clinical practice, and community health to enhance medical applications.
- **Urban health** – a growing area of focus, particularly in city environments, where health is shaped by urban living conditions, infrastructure, and policies.

Urbanization is one of the leading global trends of the 21st century that has a significant impact on health. Over 55% of the world's population live in urban areas – a proportion that is expected to increase to 68% by 2050. As most future urban growth will take place in developing countries, the world today has a unique opportunity to guide urbanization and other major urban development trends in a way that protects and promotes health. This is important, not least because the health and well-being of citizens is perhaps a city's most important asset.

However, most of the 4.2 billion people living in cities suffer inadequate housing and transport, poor sanitation and waste management, and air quality that fails WHO guidelines. Other forms of pollution, such as noise, water and soil contamination, so-called urban heat islands, and a lack of space for walking, cycling and active living further combine to make cities epicentres of a noncommunicable disease epidemic and drivers of climate change.

Around 40% of urban growth is in slums that lack safe water and sanitation, and 91% of people in urban areas breathe polluted air. When it comes to healthy diets, urbanization increases the distance from farm to fork, driving demand for unhealthy, processed foods. Urban dwellers are also highly vulnerable to the effects of climate change because of their dependence on fossil fuels for transport, cooking and heating. Cities account for over two thirds of the world's energy and emit 60% of greenhouse gases, and those inland may experience temperatures 3–5º C higher than surrounding rural areas because of their large expanses of concrete and limited open green spaces. All of this puts urban dwellers' health at risk. Most the top 10 causes of death are closely related to rapid and unplanned urbanization, and poor urban design and planning. Cities face the triple health burden of infectious diseases like HIV/AIDS, tuberculosis, pneumonia, dengue and diarrhoea; noncommunicable diseases like heart disease, stroke, asthma, cancer, diabetes and depression; and violence and injuries, including road traffic injuries[50s].

For instance, A study published in The Lancet found that physical inactivity is responsible for around 5.3 million deaths worldwide each year. Designing cities with walkable infrastructure, cycling paths, and access to recreational spaces can promote physical activity and reduce sedentary behaviour. Research suggests that individuals living in more walkable neighbourhoods are more likely to achieve recommended levels of physical activity.

Studies have shown that access to green spaces and nature in urban environments positively impacts mental health and well-being. Spending time in parks or green areas has been linked to reduced stress, improved mood, and enhanced cognitive function. A study published in Environmental Science & Technology found that individuals who lived closer to green spaces had lower rates of mental health disorders, such as depression and anxiety.

Social connections and interactions are crucial for mental health and overall well-being. Strong social support networks and community engagement have been linked to reduced rates of mental health disorders and increased life satisfaction. Studies have shown that individuals who feel a sense of belonging and connection to their communities have better physical and mental health outcomes.

Investing in healthy cities yields economic benefits. The WHO estimates that for every dollar invested in physical activity, there is a return of $3.20 in health and productivity gains. According to research by the World Bank, healthier cities can contribute to economic growth through increased productivity, reduced healthcare costs, and enhanced livability that attracts investments and talent[51s].

Moreover, holistic health must also encompass aspects related to the cultural environment in which we live, recognizing that cultural beliefs, traditions, and societal norms play a crucial role in shaping healthcare practices and individual health outcomes.

Our project is built on the effort to integrate scientific and cultural knowledge by creating an interdisciplinary task force of lecturers and researchers.

From three different department at the University of Brescia in Italy (DSCS - clinical and experimental sciences, DII - informatics engineering, DICATAM civil engineering, architecture, territory, environment and mathematics): Prof. Alberto Matteelli (MD infectious diseases specialist) and Prof. Massimiliano Gobbo (MD, physiology), Prof. Nicola Lopomo (PhD bioengineering), myself (MS sport sciences); from the Rehabilitation and Human Performance dept. of the Icahn School of Medicine at Mount Sinai in New York City, NY (USA): Dr. David Putrino (Phd, Neuroscience), Dr Jamie Wood (PhD respiratory health); from the medical dept. State University of New York (SUNY): Mathew Komen (from military corps and medical student). From other two different institutions in Africa: Dr. Kibor Lelei (MD orthopedic) and Dr Gerald Lwande (Health researcher), from Moi University in Eldoret, and Dr. Alfred Saigero from Nanyuki Teaching and Referral Hospital.

This international synergy has focused not only on scientific research itself but also on efforts to promote complementary initiatives rooted in citizen science and a shared sense of global citizenship.

First of all, citizen science is the practice of public participation and collaboration in scientific research to increase scientific knowledge. Through citizen science, people share and contribute to data monitoring and collection programs.

Collaboration in citizen science involves scientists and researchers working with the public. Community-based groups may generate ideas and engage with scientists for advice, leadership,

and program coordination. Interested volunteers, amateur scientists, students, and educators may network and promote new ideas to advance our understanding of the world[52s].

The main benefit of involving citizens in science activities is the fact that people by being directly involved become more aware and proactive in finding solutions in the common interest.

This citizen science action was made possible thanks to the help of Community Health Workers volunteering for people gathering and data collection during the research activity in Kenya. A detailed explanation of the research activity will be object of discussion in the sext sections.

Global citizenship awareness—understood as a sense of belonging to a larger societal and global framework beyond local boundaries—represents a fundamental concept that has been strengthened through collaboration and the exchange of ideas with various institutions and companies. These partnerships have played a key role in shaping the overall research initiative.

This included meetings with the Italian Embassy, the Institute of Culture, and the AICS (Italian Agency for Development Cooperation) in Nairobi, Kenya. These organizations serve as key representatives of the Italian system in Kenya and are among the first to observe and respond to the needs of a rapidly evolving African society. Their guidance and presence have been instrumental in the implementation and success of the project.

I see this community engagement initiative as a contribution to building a health infrastructure—one that brings different segments of society closer together to promote the sharing of best practices. In the long term, this approach fosters peacekeeping efforts and supports local development.

This dialogue, initiated within the academic sphere, has fostered a diverse synergy of groups that contributed to the overall success of the initiative:

- **Private sector**: Involvement of **Fitbit Google**, which provided wearable technologies for health data monitoring, and **GDSM Global**, in collaboration with the Kenya Airways Italian branch.
- **Third sector**: Participation of **Noha Onlus**, the **Comboni group**, the **Shrine of the Sacred Heart of Nairobi**, and the **Rotary Club Brescia Museo Mille Miglia**, all of which played a crucial role in supporting the project.

This multidisciplinary collaboration has been essential in advancing the initiative's objectives and ensuring its impact.

2.7. Brescia, New York City and Kenya: a context overview on health and international cooperation

From official data of the local ATS in Brescia[53s] (Agenzia di Tutela della Salute - Agency for the protection of health) - characterised by a progressive rise in the average age and the presence of a particularly dynamic foreign population - , in 2003, the number of chronically ill persons in care was 263,936 out of a total of 1,048,006 persons in care (251.2/1,000 of the population in care): by 2022 the prevalence of chronically ill persons had increased by 53% (386.3/1,000) and the absolute number of chronic patients had increased by as much as 77%.

The increase is partly due to the change in methodology, but even using data from the old BDA (Banca Dati Assistito-patient database) up to 2016, the linear and continuous increase can be seen. The increase in the number of chronically ill persons has been determined, to a large extent, by the ageing of the population with consequent increase in the prevalence of diseases, but, in particular for some diseases, the increased care has been determined by a more extensive and accurate diagnostic process. Hypertension (+37,4%), cardiovascular diseases (+66%), hypercholesterolaemia (tripled prevalence), diabetes (+62%), oncological (+62%) and chronic respiratory diseases, with autoimmune an rare diseases have risen in the selected period of time (2003-2022).

In the Brescia ATS, malignant tumours are the leading cause of mortality both in terms of the number of deaths and in terms of potential years of life lost, and this is despite improvements in survival.

The most frequent cancers are largely associated with lifestyles and environments (the exposome) and, therefore, potentially preventable, as first recognised by the World Health Organisation in 1964[54s].

Even resources consumption (hospital admissions, drugs and outpatient services) have increased: in absolute terms there was a 56% increase in total resources during the period considered, with an uneven trend among the various components: admissions increased until 2010 and then decreased and stabilised; expenditure on drugs almost doubled (+98%) while outpatient services increased 121%.

From the last available data of 2022, there are 467,797 chronically ill people in Brescia absorbing the 85% of healthcare expenditure.

On the other hand, the health panorama in the State of New York is not reassuring: the local department of health[55s] describes chronic diseases - such as heart disease, cancer, diabetes, stroke, and arthritis - as the leading causes of disability and death in New York State and throughout the United States. More than 40% of New York adults suffer from a chronic disease (2015) and chronic

diseases are responsible for 23% of all hospitalizations in New York State. Six out of every 10 deaths in New York State are caused by chronic diseases. Heart disease and cancer account for over half of all deaths in New York State.

Projected total cost of chronic disease from 2016-2030 in New York is $2.2 trillion. Chronic disease could cost New York $107 billion in medical costs and an extra $41.1 billion annually in lost employee productivity (average per year 2016-2030).

Even though this trend in NCDs may be partly attributable to overdiagnosis and advanced diagnostic tools, scientific research is inquiring whether this may also reflect real changes in environmental and behavioural risk factors (Moslem Taheri Soodejani, Non-communicable diseases in the world over the past century: a secondary data analysis, 2024).

This brief demographic and health overview of Western regions such as Brescia and New York highlights how two distinct ecosystems are profoundly affected by the social and economic impact of chronic diseases (NCDs). Given the critical role of daily habits, lifestyles, and health determinants in shaping overall well-being and the sustainability of healthcare systems, the research team was driven by a strong curiosity to explore these parameters in a completely different context—Kenya.

As part of the world's youngest continent, Africa, Kenya presents a unique and rapidly evolving social, cultural, economic, and environmental landscape. This groundbreaking opportunity to study and promote research, awareness, and education on how healthy lifestyles contribute to disease prevention and improved quality of life can be framed within a new perspective: the mutual exchange of how different societies interpret and value lifestyles. This cross-cultural dialogue has the potential to foster advancements and strengthen international cooperation on a global scale.

Brescia has a renowned history in the international cooperation field.

At the University of Brescia, development cooperation has always been at the heart of the teaching and research sensitivities and interests of a substantial number of lecturers, researchers and students. Its cooperation strategy pays attention to avoiding brain drain, favouring collaboration agreements with universities and research centres in the countries of origin with which to jointly develop research projects of mutual interest. The strategic importance of development cooperation has been confirmed by the institution of a specifically dedicated Rectoral Delegation, with a strategy in tune with the strong humanitarian thrust of the social fabric of its territory, which is rich in NGOs.

Interest in development cooperation has grown over the years and has been characterised by numerous initiatives that have helped to recognise the university with a solid identity on the national and international scene. These include:

i. the activation in the 1980s of one of the first courses in Tropical Medicine in Italy, which is currently recognised as a Core Course of the European Masters in International Health

ii. the establishment in 2000 of the Research Centre on Appropriate Technologies for Environmental Management in Resource-limited Countries

iii. the realisation in 2008 of an interdisciplinary third-level doctoral course in 'Appropriate Methodologies and Techniques for International Development Cooperation' (technology and health focus).

iv. the establishment in 2014 of the UNESCO Chair 'Training and empowering human resources for health development in resource-limited countries.

v. The establishment of the World Health Organisation Collaborating Centre on 'Tuberculosis prevention', established in 2010 (WHOCC - WHO Collaborating Centres)

Moreover, besides being among the main manufacturing provinces in Europe with commercial relations with all over the world, the city of Brescia pursues international cooperation through many ways, for example:

- the establishment of 5 Twin Cities (Bethlehem, Darmstadt, Kaunas, Logroño, Troyes and soon with a new city in Ukraine);
- the institution of Consulta della Pace (Council for Peace and Cooperation, International Solidarity and the Promotion of Human Rights), including more than 40 NGOs and third sector associations;
- the adherence to the Eurocities International Network for city innovation and internationalization in the European dimension and beyond. Eurocities is the network of major European cities and an ambitious changemaker, working to make cities places where everyone can enjoy a good quality of life;
- the creation of a city branding "Brescia la tua città Europea" (Brescia your European City), which represents an Identity Manifesto with the traditional and multicultural essence of the city
- International musical and artistic events, etc.

Another interesting feature regarding the city of Brescia and its vocation in International cooperation is given by the the figure of Lodovico Montini, the brother of our Pope Paul VI

A story that starts in 1946 with the foundation of the worldwide Unicef, to which Montini contributed, to take care of European children, therefore also Italian, victims of the Second World War[56s].

A native of Brescia, brother of Pope Paul VI and son of Giorgio Montini, leader of the Brescian Catholic social movement and member of parliament, Montini was a key figure in Italy's

membership of Unicef and its assistance to children around the world, the founding of the Italian Committee in 1974, of which he was the first president, and the very extension of Unicef, whose experience was to end with the recovery from poverty of the European countries involved in World War II. Ludovico Montini was the person who contributed for Italy in talks with the Americans for the organisation to become stable. An avant-garde and visionary figure, Montini rewrote the rules of the very concept of assistance, turning from charitable activity alone to a more complex action that led, among the many innovations for the time, to the spread of canteens in schools, the application of a dietary table in school canteens (especially for the 6-12 year age group), but also the aid from Unicef to set up Milk Centres throughout Italy, in the wake of the Brescia and Milan Milk Centres and the Florence Milk Plan.

Not only that: Montini is responsible for the total paradigm shift whereby assistance is provided without humiliating the assisted, because it is not 'someone who receives, it is someone who is entitled to receive'.

Conversely, at the Municipality level, New York can claim the presence of a Mayor's office for international affairs. The New York City Mayor's Office for International Affairs fosters positive relations and encourages collaborations between the international community and New York City's agencies and local neighbourhoods. The Office is focused on sharing New York City's policies and best practices globally, as well as responding to requests from foreign governments, the United Nations, and the U.S. Department of State. International Affairs also advises City agencies on diplomatic and consular matters and provides guidance to the diplomatic and consular community on City-related issues. The office also administers the City of New York/U.S. Department of State Diplomatic and Consular Parking Program. One interesting program of this office is represented by the Global Vision Urban Action program, a platform through which local governments engage to share information and forge innovative solutions to challenges using the lens of the Sustainable Development Goals (SDGs). The Office also works to highlight the synergies between the Sustainable Development Goals and New York City's local sustainability and development initiatives contained within *OneNYC*. The Office also provides opportunities for engagements between experts from NYC and the international community[57s].

Hence, the questions that have driven this research project forward are:

- Can the combination of the Brescia and New York ecosystems—with their contrasts and cultural diversity—serve as an innovative laboratory for developing a global platform for health and well-being?

- What if this laboratory were set in a developing country like Kenya, where social and economic conditions differ, the natural environment remains dominant, and a different flexibility shapes daily life?
- Could this vision of **consilience**—the integration of knowledge and expertise—serve as a precursor to a European-centric global initiative addressing lifestyle-related challenges and their impact on sustainability in Africa?
- Could this approach help spark new opportunities for human and social development while bridging diverse value systems?

These questions form the foundation of an inquiry aimed at fostering international cooperation and shaping sustainable health solutions.

2.7.1 Kenya and the Maasai tribe: demographics and anthropological features

With nearly 53.8 million inhabitants, Kenya ranks among the 10 most populated nations in Africa. By 2050, this number is forecast to almost double, and the country will be home to some 92.6 million people. Kenya has a diverse population, formed by over 40 different native ethnic groups. Furthermore, some 1.1 million international migrants live on Kenyan territory, while nearly 490 thousand people are refugees or asylum seekers[58s].

This extraordinary human biodiversity, with the presence of more than 40 ethnic groups, each with distinct languages, customs, and social structures attracted the interest of anthropologists who have long studied Kenyan tribes to understand aspects of culture, kinship, migration, political organization, economic systems, and ritual practices.

Here follow two original extracts from a small book that i'm writing in collaboration with the Maasai community in Laikipia County (Kenya), with the title: "The path leading to Kimanjo", and "The Maasai People" by Dr Alfred Saigero.

"The path leading to Kimanjo"

The path leading to Kimanjo, a small village inland from the town of Nanyuki, Laikipia district (Kenya), seems to belong to distant eras: ancestral places where unspoiled nature and slow rhythms create an atmosphere of enchanted peace and beauty, ruggedness and nostalgia. It is early in the morning, and on the dirt roads the inhabitants walk the paths traced in the endless grasslands, dotted with lush greenery and red earth, acacia trees and fascinating cliffs carved by torrential rains. There where the sign of time immemorial dwells, where the Ewaso Nyiro River, among the longest in Kenya, passes, elephants, giraffes and primates protected by rangers populate a landscape shrouded in silence, sometimes interrupted by the rustling of the wind.

We thus arrive at the foot of the village of Kimanjo, greeted by Dr Alfred Saigero, Maasai doctor, by barefoot children who curiously peek from the streets, by women who turn around and interrupt for a moment their work with the livestock and the land. Animals and land, elements on which the livelihood and prosperity of the Maasai community, "the lion hunters," have always been based, are the protagonists of this initiative. Elements of immense cultural and economic value, firmly rooted in the cultural and spiritual identity of the indigenous Maasai people. Indeed, the native peoples remain repositories of traditions and practices thousands of years old aimed at protecting the natural ecosystem and its life forms, through practices based on sustainable and respectful management of resources, of a generative economy, in harmony with nature. People where humanity and relationships still represent the center of an existence that has never taken anything for granted. Peaceful populations, which lifestyle is in symbiosis with the natural element, yet increasingly threatened by climate change, depletion of available resources, and the social unrest that results from them, including cattle theft due to increased demand for meat from urban areas, a phenomenon that is on the rise in Africa. Lifestyles, the awareness and care of which are fundamental for the maintenance of health and the prevention of risk factors of diseases, to reduce the cost on the health system and nonetheless our environmental impact, thus in a perspective of individual and collective sustainability. This project was created to observe and understand how that set of daily behaviors related to movement, eating and social habits are functional to mental and physical well-being and quality of life, starting with the continent with the youngest and growing population, which can chart the future paths of humanity. This scientific study involves the measurement of key anthropometric values (weight, height, mass index and body composition) and the level of fitness and well-being through the use of Smartwatches, wearable technologies capable of measuring key health indicators including heart rate, skin temperature, calories consumed, distance traveled, stress level, respiratory rate, arterial saturation, blood pressure, sleep patterns, etc. Additional wearable technologies used include measurement of metabolism and maximal oxygen consumption. A quality of life questionnaire, from the World Health Organization, will also be administered. A project that crosses countries involving Universities, Institutions, associations and religious centers, such as the Apostles of Christ Shrine of the sacred heart of Jesus. A scientific and anthropological operation, focused on observing the lifestyles of an ancestral and vulnerable population, living in defense of our planet and biodiversity, through an in-depth assessment that was created to transcend the boundaries of academia. The aim is to contribute to a path that can draw new maps to connections between different countries, facilitating initiatives for inclusion, solidarity and expression of talents-from sports to education-and to build

bridges between nations. In conclusion, A project that is inspired by a concept well encapsulated in a word used by African people: “Ubuntu” - I am because we are.

The Maasai People

Maasai people are found in Kenya and Tanzania, where they finally settled following their migration downwards along river Nile, all the way from the current Egypt. Some continued further southwards and settled in Malawi. It is one of the famous tribe of Africa whose lifestyle is nomadic and pastoralism! The Maasai are in part the better known ethnic people in east Africa due to their traditional origins from areas surrounding Maasai Mara game reserve and Amboseli Park. The Maasai speak a language known as Maa and their shared Nilotic origins link them in various ways to the Kalenjin tribe of Kenya which is famous for producing some of the best long distance runners in the world.

Below are some of the unique characteristics about the Maasai population:

CULTURE: Maasai community is firmly patriarchal in nature, with elder Maasai men sometimes joined by retired elders, determining most major matters for the Maasai tribes. For Maasai people living a traditional way of life, the end of life is virtually without a formal funeral ceremony, and the dead are left out in the fields for scavengers. Burial has in the past been reserved for great chiefs only since it is believed by the Maasai that burial is harmful to the soil. Traditional Maasai people’s lifestyle concentrates on their cattle which make up the primary source of food. Among the Maasai, the measure of a man’s wealth is in terms of children and cattle. So the more the better. They believe that a man who has plenty of cattle but not many children is considered to be poor and vice versa. A maasai myth says that God afforded them all the cattle on earth , resulting in the belief that cattle rustling from other tribes is a matter of claiming what is rightfully theirs.

DIET: the traditional Maasai diet consist of six basic foods: meat, blood, milk, fat, honey and tree bark. They drink both fresh and curdled milk. The fresh milk is drunk from calabash and sometimes is mixed with fresh cattle blood. The blood is obtained from nicking the jugular veins. Mixed blood and milk is mostly used as a ritual drink and as nourishment for the sick and youth recovering from circumcision. Bulls, oxen, and lambs are slaughtered for meat on special occasions and for ceremonies. The byproducts of the animals – skin and hides are used as bedding while cow dung is used for building (it is smeared on the walls). The Maasai entire way of life truly revolves around their cattle. More recently, the Maasai people have supplemented their diet with farm crops such as maize meal, rice, cabbage among other food crops.

SOCIAL LIFE & MUSIC: the Maasai people don’t use instruments when they are singing or dancing. All of their music is vocal, except for the large horns used for certain songs. Their music comprises of rhythms rendered by a chorus of vocalists singing harmonies, all the while the

olaranyani (song leader) sings the melody. The song leader (**olaranyani**) is usually the person who can best sing that song. When **olaranyani** starts singing a line or title (namba) of a song, the group responds with one unanimous call in acknowledgement. The beads that both the men and women wear also create a jingling sound themselves while Maasai jump and dance. Women recite lullabies, Hum songs and sing music that praises their sons. The peak season for singing and dancing is during the rains, which is off course a favorable time to celebrate important passages of life such as circumcision and marriage. This mostly occurs around the manyattas and involves romantic practices.

CLOTHING: clothing varies by sex, age and place. Young men wear black for several months after circumcision. Although red is a favored color among the Maasai. Black, blue checked and striped clothes are also worn, together with multi-colored African garments. In the 1960s, the Maasai began to replace sheepskin, calf hides and animals' skin for more commercial materials. The cloth used to wrap around the body is called Shuka in the Maasai language. Maasai women regularly weave and bead jewelry, which plays an essential part in the ornamentation of their body. Ear piercing and the stretching of their earlobes are also part of Maasai beauty, and both men and women wear metals hoops on their stretched earlobes.

SHELTER: the Maasai tribe are historically a nomadic people; they have traditionally relied on readily available materials and indigenous technology to construct their unusual and interesting housing. The traditional Maasai house was designed for people on the move and thus their houses were very impermanent in nature. The houses are either circular or loaf shaped, and are made by women. Their villages are enveloped in a circular fence **(enkang**) built by the men and this protect their cattle at night from wild animals.

RELIGION: the Maasai people are monotheistic, and their god is named **Engai** or **Enkai**, a God who is mostly benevolent and who manifests himself in the form of different colors, according to the feelings he is experiencing. Said colors have precise meanings: black and dark blue mean that God is well disposed towards men: red on the other hand is identified with God irritation. **Enkai** has two manifestations: Enkai Narok: the black God, good and beloved – brings grass and prosperity. He is found in thunder and rains. Enkai Nanyokie : the red God , vengeful , brings famine and hunger . He is found in lightning and is identified with the dry season. The importance of cattle to the Maasai can be traced back to their religion and **Enkai**. Today most of the Maasai people are Christians and very few are Muslims.

HAIR: the Maasai people, both men and women mostly shave their heads to celebrate rites of passage such as circumcision and marriage. This represents the fresh start that will be made as one passes from one to another of life's chapters. It's only the Maasai warriors who are allowed to

wear long hairs, which they weave in thinly braided strands. The Maasai children are named upon reaching the age of 3 “moon”; and their heads are shaved clean apart from a tuft of hair, which resembles a cockade, from the nape of the neck to the forehead. The young boys are also shaved two days before they are circumcised. The young warriors then allow their hair to grow, and spend a great deal of time styling the hair.

As a summary[59s], the Maasai are a Nilotic ethnic community primarily residing in Kenya and Tanzania (1 million people circa), renowned for their distinctive culture, customs, and traditions. The Maasai are a Nilotic ethnic community primarily residing in Kenya and Tanzania, renowned for their distinctive culture, customs, and traditions.

The Maasai are internationally recognized for their unique customs, including the 'high jumping dance' known as Adumu, traditional attire, and their reputation as courageous warriors. In Maasai society, men are traditionally raised to become Morans (warriors), responsible for protecting the community and livestock. They play significant roles in decision-making and conflict resolution across various age groups and clans.

Women, on the other hand, are integral to building and maintaining homes, showcasing a clear division of labor based on gender. The Maasai's enduring traditions and adaptability continue to captivate and inspire, offering valuable insights into a culture that harmoniously balances preservation and evolution.

They’re part of indigenous peoples, defined as “intangible living heritage” by the UNESCO.

Indigenous Peoples have long been successful stewards of the world’s biodiversity, and their knowledge, innovations and practices ensure the sustainable use of biological resources, carbon sequestration, food security and crop diversity[60s].

They speak more than 4,000 of the world´s 7,000 languages though some estimates indicate that more than half of the world's languages are at risk of becoming extinct by 2100. Indigenous Peoples manage or hold tenure rights to approximately a quarter of the world’s surface area, overlaying a significant portion of the world’s biodiversity, almost half of the of the earth’s protected areas and a significant proportion of the planet’s most ecologically intact landscapes. Studies also reveal that forestlands under collective IPs and local community stewardship hold at least 1/4 quarter of all tropical and subtropical forest above-ground carbon. They hold vital ancestral knowledge and expertise on how to adapt, mitigate, and reduce climate and disaster risks. Over the last 30 years, Indigenous Peoples’ rights have been increasingly recognized through the adoption of international instruments such as the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) in 2007, the American Declaration on the Rights of Indigenous Peoples in 2016, the Regional Agreement on Access to Information, Public Participation and

Justice in Environmental matters in Latin America and the Caribbean (Escazú Agreement) in 2021 and the Indigenous and Tribal Peoples Convention from 1991. At the same time, global institutional mechanisms have been created to promote Indigenous peoples' rights such as the United Nations Permanent Forum on Indigenous Issues (UNPFII), the Expert Mechanism on the Rights of Indigenous Peoples (EMRIP), and the UN Special Rapporteur on the Rights of Indigenous Peoples (UNSR)[61s].

3. AN EMBLEMATIC CASE STUDY IN KENYA: LONGITUDINAL, OBSERVATIONAL AND COMPARATIVE STUDY ON HOW RURAL AND URBAN LIFESTYLES AFFECT HEALTH INDICATORS AMONG MEMBERS OF A SELECTED PASTORAL COMMUNITY IN KENYA.

3.1 Background

Non-communicable diseases (NCDs) are major causes of morbidity and mortality globally (NCD Alliance, 2018). These NCDs which are chronic in nature and occur as a combination of genetic, physiological, environmental and behavioural factors (Fujiwara et al., 2020). Cancers, metabolic disorders (such as diabetes) and cardiovascular diseases (such as hypertension, stroke and congestive heart failure) are among the most common NCDs globally (Kendagor et al., 2018; Lee et al., 2015; Melo et al., 2021; Waweru & Gatimu, 2021). Previously, epidemiological data showed a greater burden of NCDs in countries with developed economies, however, over time the disease trends have been rising among countries with developing economies in Sub-Saharan Africa such as Kenya (Ataklte et al., 2015; Dalal et al., 2011; Dosoo et al., 2019; Mendis et al., 2015; 2017; Wamai et al., 2018).

Because of the rising burden of NCDs in Kenya alongside other countries within Sub-Saharan Africa, there is need to determine their social predictors, and how these predictors could also influence other health indicators and quality of life of the affected individuals. Furthermore, most of the studies conducted around NCDs have been in urban and peri-urban areas with limited local studies being conducted in very rural areas. This necessitates a local study to not only objectively determine the influence of lifestyle on health indicators but the physiological indicators as well.

3.2 Problem statement

Cardiovascular diseases account for a great burden of NCD-related mortality which is estimated at about 17.9 million people annually (Anand et al., 2019; Yusuf et al., 2014). The cardiovascular disease morbidity and mortality burden is also rising in Kenya (MOH, 2018; Park et al., 2015; Ruchman et al., 2021; Tran et al., 2020; Vedanthan et al., 2017). Despite this knowledge, very little information is available among rural dwelling pastoral communities such as the Maasai. This limited information is negatively influencing community intervention strategies. Furthermore, because most pastoralists are associated with a lot of physical activity, assumptions are often made to imply that they have a lower risk of these NCDs. There is need to objectively determine these social, lifestyle and physiological determinants of NCDs. This is because of the rapid urbanization, migration and the subsequent sedentary life that has been witnessed in many arid and semi-arid areas of Kenya. The effect of unhealthy diets and reduced physical activity may manifest late when their effects are already irreversible. These effects are not limited to physiological functions and health status but also quality of life, as most individuals may present with secondary conditions such as musculoskeletal degeneration.

3.3 Justification

The United Nations 2030 Agenda for Sustainable Development recognizes NCDs as a major challenge for sustainable development (UNASD, 2016). This is because NCDs threaten progress towards sustainable development targets of reducing the likelihood of death from any of the four main NCDs between ages 30 and 70 years by 2030 (Cluver et al., 2019; UNASD, 2016). Poverty as a socioeconomic aspect is closely linked with NCDs. The rapid rise in NCDs is predicted to impede poverty reduction initiatives in low-income countries, particularly by increasing household costs associated with health care. Vulnerable and socially disadvantaged people are more likely to get sick and probably succumb to the disease compared to their counterparts with a higher socioeconomic status. Additionally, in low-resource settings, health-care costs for NCDs quickly drain household resources. The exorbitant costs associated with NCD treatment, loss of income and prolonged hospitalization may both force millions of people into poverty and stifle development.

This creates the need to understand modifiable behaviours (such as lifestyle) as probable intervention approach. However, previously done studies have subjectively assessed lifestyle using participant recall and reported outcome. There is need to objectively measure and quantify this lifestyle activity to determine whether or not they are protective against NCDs. Furthermore, assessing their overall effect on the quality of life may create an opportunity for both social and clinical interventions.

In Kenya, some of the pastoralist communities include the Turkana, Pokot, Samburu and Maasai among others. The Maasai, for instance, have maintained an active semi-nomadic and pastoralist lifestyle for centuries. Although the changing social-economic landscape may have affected the Maasai to some extent, the extent of this effect has not been objectively quantified. This creates a unique opportunity to compare the effect of lifestyle on anthropometric, physiological and quality of life among rural and urban dwelling members of pastoral communities. The majority of Maasai still live traditional lifestyles that may not have been largely affected by urbanization experienced by members of other ethnic communities in Kenya. This study assesses how this variance in lifestyle affects their health assessment parameters such as anthropometrics, risk of injury and other sedentary lifestyle associated non-communicable diseases (NCDs). Therefore, the findings of this study are aimed at providing baseline data on these anthropometric, lifestyle and physiological indicators among rural and urban dwelling members of the pastoralist community such as the Maasai. The collected data will concur to the construction and development of an extensive body of evidence, furthering meaningful health and wellness research for a model of

assessment and promotion of healthy lifestyles in the environment. This will be implementable through the connection with future larger research studies and randomized clinical trials.

This model will be useful to the scientific and citizen communities, given the growing influence of lifestyles - and their associated risk factors such as obesity, alcohol, smoke, sedentarily, bad nutrition, lack of sleep - have on health outcomes. This operation is in order to orient policymakers and healthcare practitioners with internationally recognized best practices for disease prevention and well-being, as well as with good decision-making.

The design of the study provides two cohorts of subjects, which will undertake the same lifestyle and health assessment.

3.4 Research hypothesis

H1: Individuals from pastoral communities who reside in urban areas tend to have significantly higher mean values for anthropometric measures (such as BMI, waist circumference, and body fat percentage) and physiological parameters (such as blood pressure and resting heart rate), compared to those living in rural settings. This may reflect differences in lifestyle, diet, physical activity levels, and environmental exposures associated with urbanization. If the alternative hypothesis is correct, it will confirm a positive association between lifestyle and positive health outcomes. Additionally, if the alternative hypothesis is proven correct, it will show a positive association between other positive daily practices that promote a healthy lifestyle.

The scientific literature on this subject has repeatedly shown a positive association between an active lifestyle and positive health outcomes and if the alternative hypothesis is correct from this study, it will provide more support for this.

3.5 Research objectives

3.5.1 Broad Objectives

To determine the effect of urbanization on anthropometric, physiological, and quality of life indicators

3.5.2 Specific Objectives

1. To compare the anthropometric parameters of rural and urban dwelling Maasai community members.

2. To compare the physiological and health status indicators among rural and urban dwelling Maasai community members.

3. To assess the quality-of-life status among rural and urban dwelling Maasai community members.

3.6 Methodology

3.6.1 Study Design

This has been a pilot longitudinal observational study comparing the anthropometric, lifestyle and physiological (such as the level of fitness) and quality of life parameters among rural and urban dwelling members of Maasai community. Since this is a pilot study, the design is appropriate as it follows two-groups of participants over six time-points that are one-week apart. During this period, baseline and endline anthropometric, physiological and quality of life parameters have been collected. Additionally, continuous exercise and lifestyle related information have been obtained. These data points have been reviewed on a weekly basis till the close of the study. The authors hope that by the end of the pilot phase, a more robust study scale-up phase will be initiated (following regulatory approval) to include additional members of the pastoralist communities irrespective of their ethnicity and spatial location, to ensure generalizability of study findings.

3.6.2 Study Setting

The study has been conducted at Nanyuki Teaching and Referral Hospital (for urban dwellers) and Kimanjo Sub-County Hospital (for rural dwellers) all located in Laikipia County in the Rift Valley region of Kenya between July to September 2024. These two facilities are approximately 60 kilometers apart. Kimanjo sub-county hospital is a level 4 facility sitting at the heart of Laikipia North sub-county. This hospital serves an estimated population of 100,000 people who are mainly community members of Ewaso, Ilmotiok, Tura, Nkiloriti, Ilpolei and Seek group ranches. Laikipia County is among the 47 counties in Kenya. The name Laikipia is derived from a Maasai word, which means treeless plain, where different kinds of wildlife live. The county is cosmopolitan in nature with about 23 communities namely Maasai, Samburu, Rendile, Somali, Pokots, Kalenjins, Meru, Kikuyu and Turkana among others residing there. It is largely rural in settlement with the main economic activities being crop farming, livestock rearing, tourism, retail and wholesale trade. The eastern and northern parts of the county are suitable for grazing while the plateau lying in the central and the northern parts of the county is suitable for ranching.

3.7 Study Population

Majority of Maa-speaking pastoralists live in the Northern part of Laikipia county, with members of the Maasai and Samburu communities being the two large maa speaking tribes in the county. Although there is limited ethnographic differences in these two tribes, there are subtle linguistic deviations (in their dialect - which include pronunciation of words and naming of certain objects) which distinguish them. Furthermore, they have significant sociocultural differences in their rituals (such as rites of passage and names given to the age groups, families or clans) that could objectively distinguish members from these two communities. It is with the foregoing that equal numbers of young adult members of the Maasai community dwelling in rural (Kimanjo – Laikipia North) and urban areas (Nanyuki – Laikipia Central) of Laikipia county have been approached to participate in this pilot study. According to the national census of 2019, the population of Laikipia county was estimated at 518,560 of which Laikipia North was 36,184 and Laikipia Central at 95,594 (KNBS, 2019).

3.7.1 Sample Size

Since this is a pilot study, equal numbers (n=20) of both rural and urban dwellers have been included.

3.7.2 Sampling Technique

Potential study participants have been selected through a simple random sampling technique and stratified as either rural or urban dwellers.

3.8 Eligibility criteria

3.8.1 Inclusion criteria:

1. Young adults aged between 18 to 35 years.
2. Be a rural Maasai resident of Kimanjo in Laikipia North sub-county.

And:

1. Young adults aged between 18 to 35 years.

2. Be a member of Maasai Community residing in Nanyuki town within Laikipia county. Rural Dwellers:

3.8.2 Exclusion criteria

1. Those already clinically diagnosed to have a pre-existing cardiovascular condition or any other non-communicable disease.

3.9 Study endpoints/outcomes

3.9.1 Primary Outcome

The primary outcomes of interest are clinical in nature. They have been obtained from health indicators using anthropometrics and physiological technologies. The indicators of interest include nutritional (body mass index - BMI, body composition, Waist/Hip ratio) and physiological status (heart rate, heart rate variability, oxygen saturation, blood pressure, resting metabolic rate and VO2max - the maximum amount of oxygen that an individual can utilize during intense or maximal exercise).

3.9.2 Secondary Outcomes

The secondary outcomes are social in nature as they objectively describe the participants lifestyle. This have been collected using wearable technologies and WHO Quality of Life assessment tool. They have included physical activity, caloric expenditure, sleep patterns and participant reported quality of life.

3.10 Study procedures

3.10.1 Screening and Sampling Procedure

Healthy individuals have been mobilized by trained research assistants from their residences and encouraged to visit the county or sub-county hospitals. For those who have come to the hospital (study setting), they have been stratified as either rural or urban dwellers. The study clinician has assessed them to ensure that they did not have a pre-existing cardiovascular disease. Those who met the eligibility criteria have then been directed back to the trained research assistants for consenting.

3.10.2 Recruitment and Consenting

A written informed consenting process has been conducted in a private room within the county hospital. The trained research assistant has provided the informed consent form (ICF) in a language that the potential study participant can understand (either in English, Kiswahili or Maa languages). In case all the potential participants couldn't read, the research assistant could loudly read the ICF to them. All the concerns and questions raised by the potential participant have been addressed. The research assistant have then assess comprehension of the ICF by asking a few topical questions. Once comprehension has been confirmed, the potential participants have then been

asked to either sign or use a thumb print to confirm consent. Confidentiality has been maintained by deidentifying participants data. No coercion or enticement has been used during the consenting process.

3.10.3 Data Collection

Data collection has been done in three stages at the county and sub-county hospitals, at home and in the field. Anthropometric measurements have been collected at the study hospital while physiological parameters will be collected either remotely or on the field. Quality of Life (QoL) assessment has been conducted using World Health Organization's QoL tool (WHOQoL questionnaire) at the county and sub-county hospitals.

I. Anthropometry assessment:

- Height measurement using a tape measure.
- Weight and body composition using automatic weighing scale (MyTanita® weighing balance).

  MyTanita® weighing balance is able to measure a series of body composition parameters, namely: Weight (Up to 200kg), Body Fat % (Total & Segmental), Total Body Water, Muscle Mass (Total & Segmental), Muscle Quality (Segmental - High, Standard or Low), BMR (Basal metabolic rate), Metabolic Age, Visceral Fat Rating, Physique Rating, Bone Mass, BMI (Body mass index) by using a low-intensity electric signal called Bioelectrical Impedance Analysis (BIA). BIA is considered one of the most reliable and accessible methods of screening body fat. Electrodes in the foot sensor pads (and hand sensor pads in a segmental monitor) send a low, safe electrical signal through the body and weight is calculated automatically along with up to 25 other readings in seconds. The addition of the above listed parameters (fat, lean muscle mass, bone mass, water, etc) to the sole bodyweight measurement is relevant to complete and add accuracy to the assessment of health or fitness level (alongside with the use of the measuring tape). The scientific community well-recognizes the effect of body fat (subcutaneous and visceral fat) on the health of the participant. One of the most important developments is the realization that the fat cell is an endocrine organ, secreting hormones and other molecules that have far reaching effects on other tissues. Visceral fat makes more of the proteins called cytokines, which can trigger low-level inflammation, a risk factor for heart disease and other chronic conditions. It also produces a precursor to angiotensin, a protein that causes blood vessels to constrict and blood pressure to rise. Monitoring body composition allows to gain a

deeper insight into the overall body health, adding the knowledge to make future educated changes to daily behaviours such as diet and fitness routines.

- BMI (derivation of kg/m2). WHO defines BMI as a person's weight in kilograms divided by the square of their height in meters, providing a general indication of whether a person is underweight, normal weight, overweight, or obese.
- Waist and Hips Circumference (using a tape measure), waist/hip ratio WHR (derivation). Waist circumference is a widely used anthropometric measure to assess abdominal fat and associated health risks. As per WHO, waist circumference is a valuable tool in assessing health risks because it provides a direct measure of central obesity, which is strongly associated with visceral fat. Visceral fat is linked to increased risks of chronic diseases like heart disease and diabetes. In clinical practice, waist circumference is often used alongside BMI to provide a more comprehensive assessment of obesity-related health risks. Hip circumference is a measurement used to assess body fat distribution, particularly in conjunction with waist circumference to calculate the waist-to-hip ratio (WHR). The waist-to-hip ratio (WHR) is a simple and effective measure used to assess body fat distribution and its implications for health. As per WHO, waist circumference, waist–hip ratio and waist–height ratio, have been suggested as being integrative to BMI in predicting CVD risk. This is based largely on the rationale that increased visceral adipose tissue is associated with a range of metabolic abnormalities, including decreased glucose tolerance, reduced insulin sensitivity and adverse lipid profiles, which are risk factors for type 2 diabetes and CVD.

II. Physiological parameters collection with wearable devices:

Wearable technologies has been used for continuous monitoring. The selected wearable technology Fitbit Inspire 3 is a smartwatch device. It is increasingly utilized for fitness and activity tracking and to achieve continuous physiological monitoring, in a behavioral health promotion and well-being perspective. These devices are also employed for the potentiation of digital health and tele-medicine practices. The Fitbit Inspire 3 has been found to be suitable for the selected research area, due to the remoteness and scarcity of internet connectivity and electric power. The Fitbit Inspire 3 is a device able to record and store granular data for the duration of 7 days, without the use of a smartphone and without dependence on Wi-Fi or other internet sources. There's an extensive body of research regarding this brand, which has been recognized as the consumer wearable of choice in health research most widely used brand in clinical research with over 1400 studies. Moreover, the safety of the Fitbit wearable devices has been certified by the EU

Declaration of Conformity, which document has been attached with the IREC application. Fitbit products and services are not a medical device, and are not intended to diagnose, treat, cure, or prevent any disease. With regard to accuracy, Fitbit has developed products and services to track certain wellness information as accurately as reasonably possible. The accuracy of Fibit's products and services is not intended to be equivalent to medical devices or scientific measurement devices. The technology used by Fitbit devices does not expose the subjects to any risks concerning their health.

The device includes the registration of the following parameters:

- Breathing rate: This metric is the number of breaths per minute. The body usually adjusts breathing rate to help getting enough oxygen. Typically, breathing rate is 12-20 breaths per minute. Tracking average breathing rate during sleep to help assess overall well-being. Typically, the average breathing rate during sleep won't vary significantly from night to night. Factors that can affect breathing rate include age, sex, weight, lung and heart conditions, anxiety, and fever.
- Heart rate variability (HRV): This metric is the variation in time between heartbeats. If heart rate is 60 beats per minute (bpm), it doesn't mean that the heart beats once a second. The autonomic nervous system (ANS) determines the timing of each heartbeat. Fitbit uses the common formula called the RMSSD (Root Mean Square of Successive Difference) to determine heart-rate variability (HRV) from heart-rate data. HRV varies from person to person. Age, sex, sleep, hormones, circadian rhythm, and other factors (for example, caffeine or alcohol intake, exercise, and stress) can affect HRV. Studies show that a higher HRV is linked with better health. A significant drop in HRV may indicate that the body is experiencing stress, strain, or showing potential signs of illness (Montes et al., 2019).
- Number of steps: The daily number of steps taken by the participants (Montes et al., 2019).
- Heart rate: The beat-by-beat value of heart rate, which is the number of contractions of the heart muscle (a biometric data). This value is useful to understand the level of intensity of daily activities. The resting heart rate value is the number of times the heart beats per minute when well-rested. Resting heart rate typically ranges from 60-100 bpm, but this range can vary based on age and fitness level. Resting heart rate can be an important indicator of the fitness level and overall cardiovascular health. In general, active people often have a lower resting heart rate.
- Calories expenditure: The derivation of the biometric (physical) data of the subject (height, weight, age, sex). Fitbit devices combine the basal metabolic rate (BMR) - the rate at which

calories are burnt at rest to maintain vital body functions (including breathing, blood circulation, and heartbeat) - and the activity data to estimate calories burnt.

- Sleep patterns

Other parameters have been collected through the use of electronic devices, such as_

- Blood pressure (BP): Blood pressure (BP), measured via electronic sphygmomanometer is the force exerted by circulating blood against the walls of the arteries. It is a key physiological parameter that reflects cardiovascular health. Systolic blood pressure is the top number in a blood pressure reading (e.g., 120/80 mmHg), and it represents the maximum pressure in the arteries when the heart contracts and pumps blood out into the body. Diastolic blood pressure (DBP), the bottom number in a blood pressure reading, reflects the pressure in arteries between heartbeats and plays a critical role in cardiovascular health. Normal values fall in the range between 120 (systolic BP) and 80 (diastolic BP)
- Arterial oxygen saturation (SpO2): SpO_2 stands for Peripheral Capillary Oxygen Saturation — it is a measure of how much oxygen is carried by hemoglobin in the blood relative to its maximum capacity. It's a key non-invasive indicator of blood oxygenation. SpO_2 reflects the percentage of oxygenated hemoglobin in the arterial blood. It tells how well oxygen is being delivered to the parts of your body furthest from your heart - like arms and legs. Normal values range from 95 to 100%.
- Metabolism and VO2max Testing using Cortex MetaMax 3B portable CPET unit.

This tool is used to check a metabolic parameter known as maximal oxygen consumption (VO2max). It is among the health indicators and indexes of cardiorespiratory efficiency. Cardiorespiratory fitness, as measured by maximal oxygen uptake (VO2max), is related to functional capacity and human performance and has been shown to be a strong and independent predictor of all-cause and disease-specific mortality (Strasser & Burtscher, 2018). A document containing the declaration of conformity has been added to the research application. This measurement has followed after a medical evaluation of general health and cardiovascular status, which has determined the absolute safety of the above-mentioned procedures.

III. Quality of Life Assessment using WHOQOL survey by World Health Organization

The WHOQOL survey was created by the World Health Organization as a scientific way to approach cross cultural differences in the assessment of quality-of-life self-reported questionnaires. This can be understood as the individual perception of one's position in life in the context of the culture and value systems in which one lives, through the administration of an ad hoc questionnaire created by the World Health Organization. Every data acquired has been used

for a comprehensive evaluation of the research subject, by anonymously profiling the individual physiological parameters, health indicators, human performance, overall lifestyle, and well-being during daily activities. At the end of the study, and after the data analysis, an individual report for each of the participants have been object of delivery and communication, with explanation of the results.

3.10.4 Study Timelines

There has been a total of seven study visits over a six-week period. This are the enrolment (T0) followed by six (T1, T2, T3, T4, T5, T6) additional visits that have been seven days apart for the lifestyle assessment and monitoring: During these visits, data from the smartwatches have been downloaded and the device batteries recharged. Additionally, the SpO2 and blood pressure have been measured on each visit. Additionally, metabolic (VO2max) assessment has been made on the fifth week (T5) visit. On T6 (final assessment) visit, the WHOQOL (WHO survey on quality of life) - patient reported outcome - has been assessed as well as a final (follow-up) anthropometric assessment.

3.10.5 Data management

An electronic database in Access/Excel format has been set up for anonymous data storage and data analysis. Data analysis has been done using coded, de-identified datasets, with all fields that directly identify an individual removed. When data is no longer needed in an identifiable form, they will be permanently de-identified.

The database includes the following data:

- Anthropometric and body composition data – 2 (two) times assessment
- Heart rate (HR) and heart rate variability (HRV) - intraday data
- Number of steps, distance and calories expenditure - intraday data
- Sleep stages and skin temperature - intraday data
- Resting metabolic rate, VO2max (maximal oxygen consumption) - 1 (one) time assessment
- Quality of life score - via survey – 1 (one) time assessment

3.11 Data analysis technique

A descriptive statistical analysis has been performed, in order to evaluate data acquired through the longitudinal-prospective observational study. Data have been analyzed using widely used statistical analysis programs (i.e. student t test, willcoxon rank sum test). Descriptive statistics have been used to determine features, possible differences and trends between the two populations (also considering correlation coefficients). Relating to quantitative and qualitative features of the

sample size, it is expected that the alternative hypothesis is correct. A p-value less than or equal to 0.05 has been considered statistically significant.

3.12 Ethical considerations

Prior to commencing the study, ethical approval has been sought from the Institutional Research and Ethics Committee (IREC) of Moi Teaching and Referral Hospital (MTRH) and Moi University School of Medicine. A research license has been obtained from the National Commission for Science, Technology, and Innovation (NACOSTI). A written informed consent has been obtained in a privately room by trained research assistants. Confidentiality has been maintained using a password protected database and limiting the access only to the principal investigator and the research assistants. The study results will be disseminated through conferences and published in a reputable peer-reviewed scientific journal. To compensate for transportation costs and other inconveniences, participants received KSh. 500.0 per visit.

3.12.1 Data ownership and disclosure

The Principal Investigators are ultimately responsible for the integrity of the stored data, that can be shared only with the legally recognized institution and research collaborators.

Every phase of the research activity has been conducted with full transparency and complete public disclosure with the collaborators and the communities involved in the protocol. The Moi University and University of Brescia jointly own the research data.

3.12.2 Study Documents' Chain of Custody

All information relating to the study participants, as well as all the documentation relating to the submission and approval by the ethics committee, are kept by the research manager in a safe and accessible place for possible inspections.

Archiving is carried out in compliance with current regulations and institutional directives for archiving scientific data.

3.13 Study results and discussion

Specific Objective	Main Methodology/Procedure	Primary Indicators (Outcomes)
1. To compare anthropometric parameters between rural and urban Maasai communities	Anthropometric data collection at baseline and endline through measurements	BMI, body composition, waist-to-hip ratio
2. To compare physiological and health status indicators between rural and urban Maasai	Weekly and continuous (wearables) + end-of-study physiological measurements	Oxygen saturation, blood pressure, heart rate, resting heart rate, VO2max, heart rate variability, physical activity, caloric expenditure,
3. To assess quality of life among rural and urban Maasai	Administration of WHOQOL-BREF questionnaire	Quality of life score

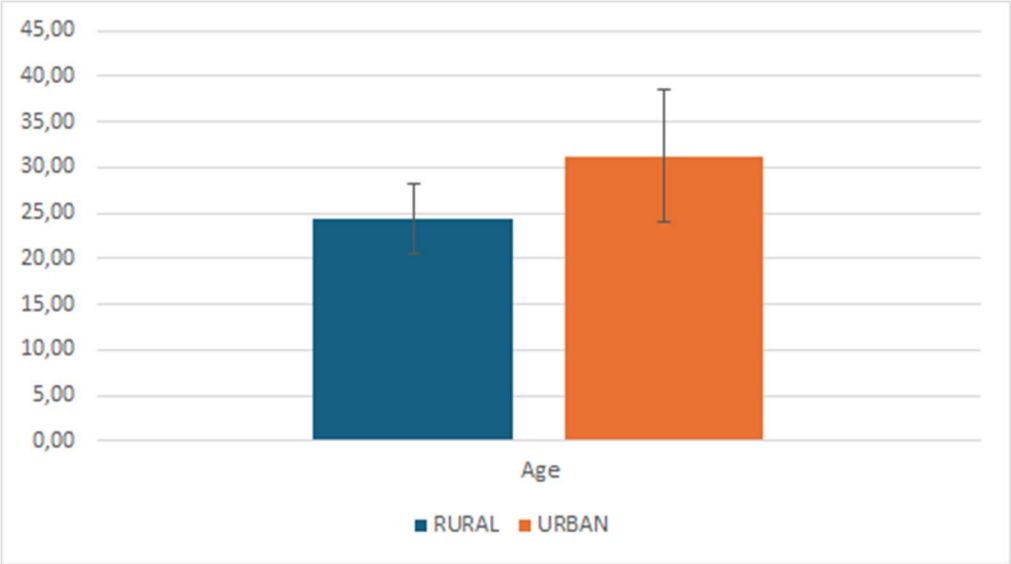
Image 12. Objectives and methods table

- **Study population**

	Total enrolled	Males	Females	Average age (y/o)	Drop out
Rural population	21	18	3	24.38	1
Urban population	20	8	12	31.21	2

- **Age of subjects**

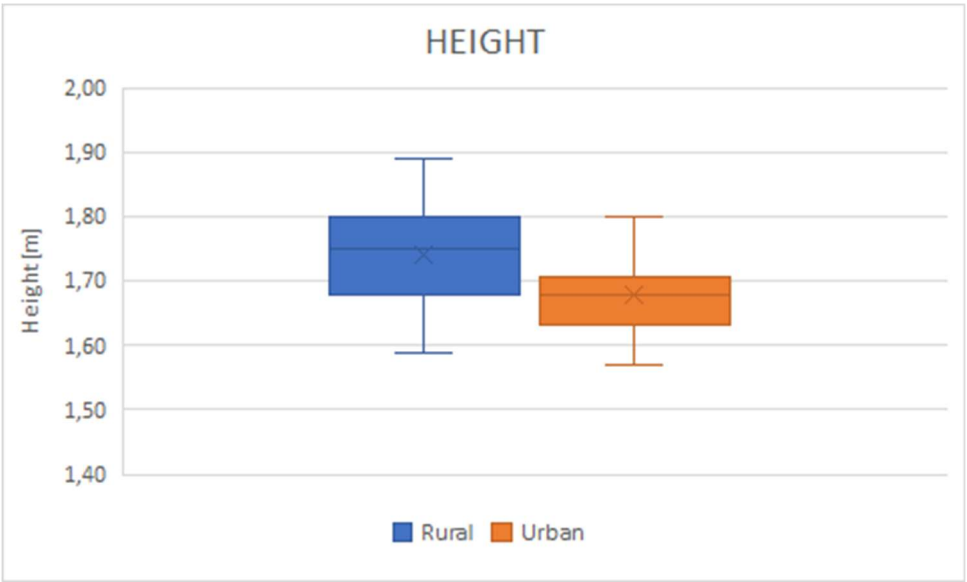
	RURAL		URBAN	
	Average	STD	Average	STD
Age	24,38	3,76	31,21	7,27



1) **OBJECTIVE ONE: Anthropometrics**

- **Rural vs Urban - height**

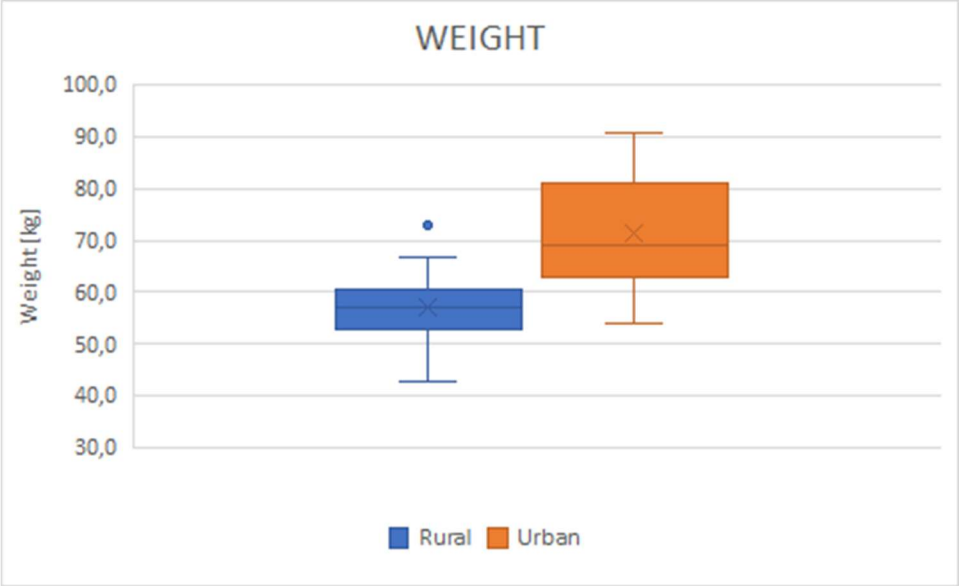
	RURAL	URBAN	Student's t-test
AVG	1.74	1.68	
STD	0.08	0.06	p-value <0.05



There is a statistically significant difference in height between the rural and urban Maasai that may be due to differences in lifestyles, nutrition and/or socio-economical, epigenetic and environmental factors.

- **Rural vs Urban - weight**

	RURAL	URBAN	Student's t-test
AVG	57.49	71.73	
STD	6.18	11.31	p-value <0.05

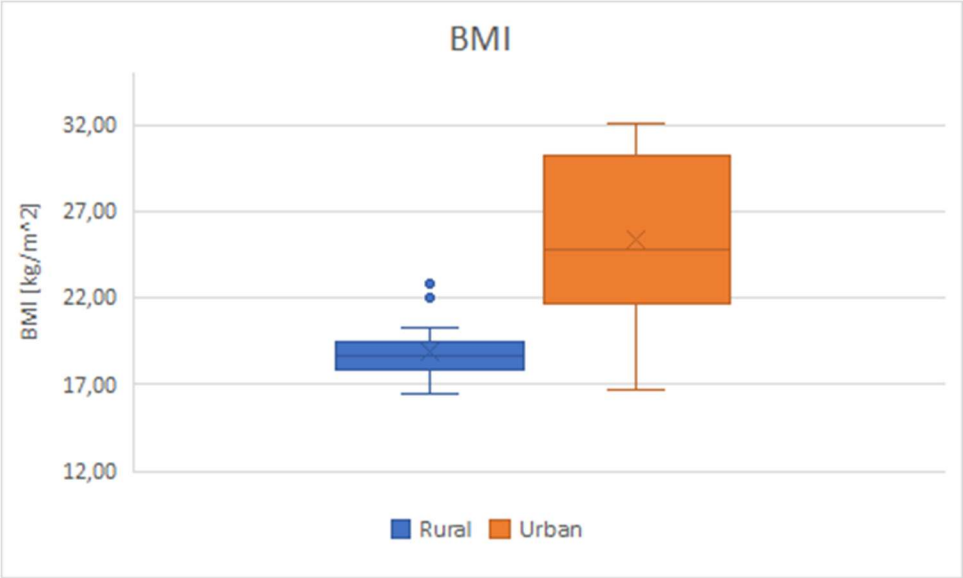


There is a statistically significant difference in weight between the rural and urban Maasai, where environmental, lifestyles and socio-economic factors may play a role.

There's also a higher values dispersion - as per standard deviation - for the urbans than the rurals, suggesting a major variability in weight within this group. This can be seen in populations with a mix of underweight, normal weight, overweight, and obese individuals.

- **Rural vs Urban - BMI**

	RURAL	URBAN	Student's t-test
AVG	18.99	25.4	
STD	1.56	4.12	p-value <0.05



BMI categories can be divided into underweight: BMI < 18.5, normal weight: BMI = 18.5 to 24.9, overweight: BMI = 25 to 29.9 and obese: BMI ≥ 30

We can observe for the rural maasai group an average BMI in the normal weight category, while average of the urban group falls slightly above the normal category.

Important to notice in this case is the great dispersion of values as per standard deviation in the urbans.

A high standard deviation (SD) in BMI indicates a large variability in body mass index within a population. This means that there is a significant spread of BMI values from the mean, reflecting diverse body compositions and health statuses among individuals.

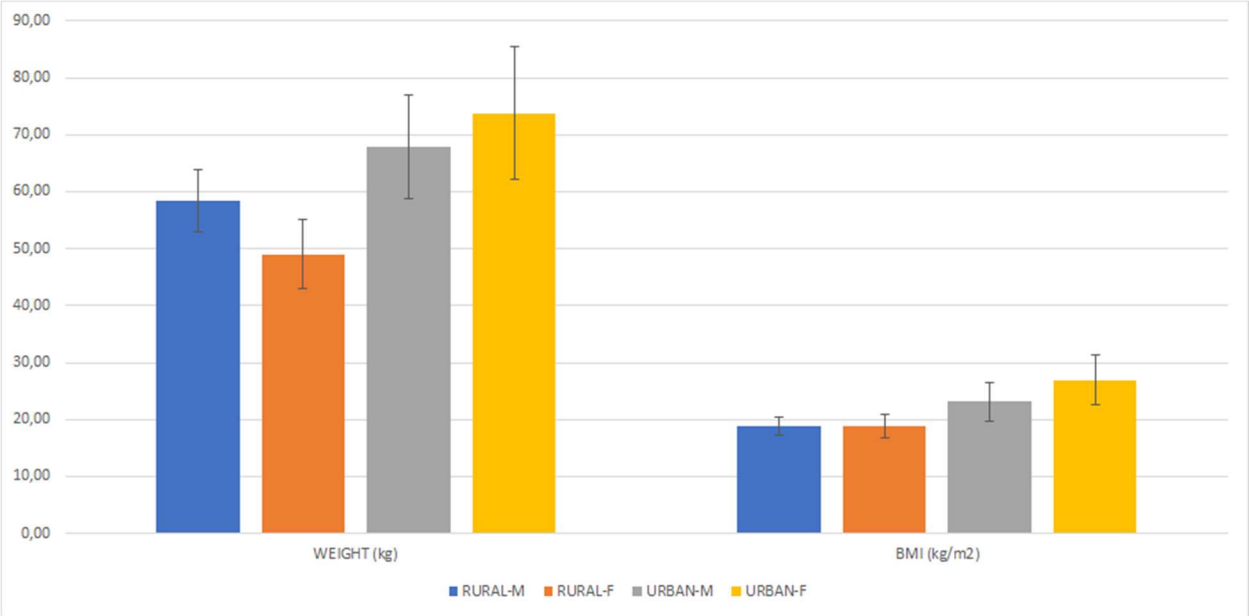
A high SD in BMI suggests that there is considerable heterogeneity in weight relative to height among the population. This could be due to various factors such as differences in lifestyle, epigenetics, or socioeconomic status.

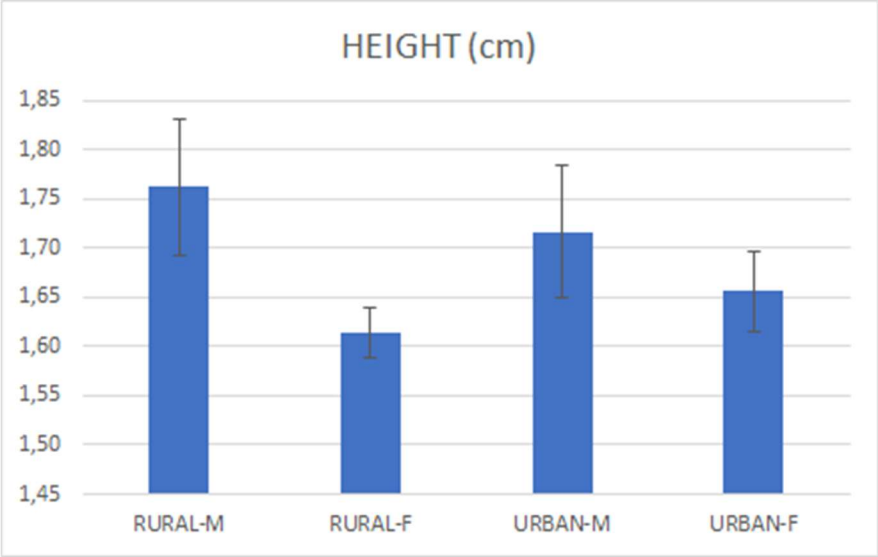
In addition, BMI does not directly measure fat; it only accounts for weight relative to height. This can lead to inaccuracies, especially for individuals with high muscle mass or those with a small frame. It also does not consider age, sex, or body composition variations. BMI difference can be due to genetic predispositions, differences in dietary habits and physical activity levels, and certain medical conditions or medications which can influence metabolism and body composition.
Understanding the causes and implications of BMI differences is crucial for public health initiatives and individual health assessments. However, due to its limitations, BMI should be used in conjunction with other health indicators for a comprehensive evaluation, that follows in the next data sections.

- **Heigh, weight and BMI stratified for sex**

	RURAL				URBAN				Unpaired Student's t-test/Mann Whitney	
	MALE		FEMALE		MALE		FEMALE		p-value considering only MALES	p-vaule considering only FEMALES
	Avg.	STD	Avg.	STD	Avg.	STD	Avg.	STD		
HEIGHT (cm)	1.76	0.07	1.61	0.03	1.72	0.07	1.66	0.04	0.136	0.071
WEIGHT (kg)	58.46	5.48	49.03	6.00	67.79	9.12	73.74	11.68	0.024*	0.002*
BMI (kg/m2)	18.84	1.48	18.82	2.05	23.11	3.43	26.88	4.35	0.009*	0.002*

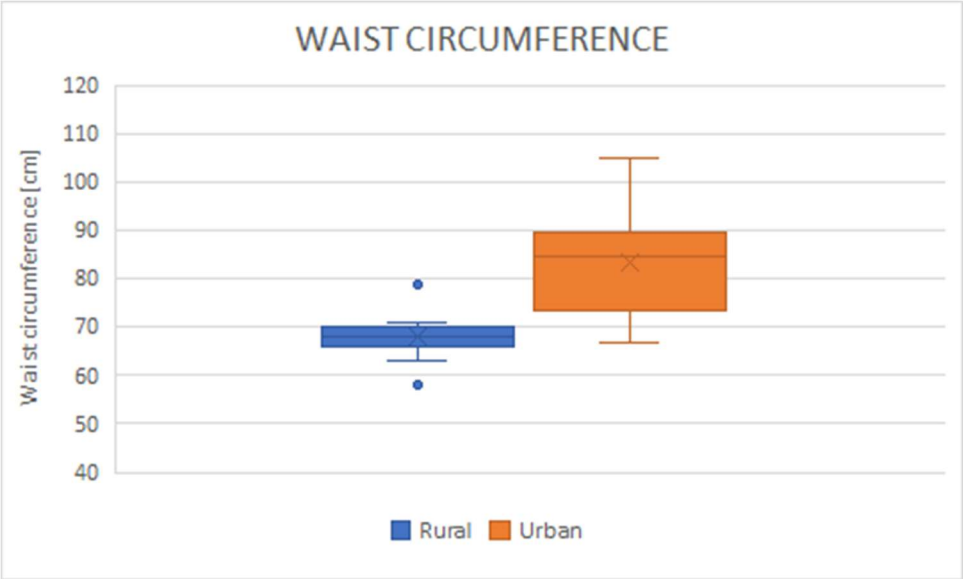
Statistically significant difference is confirmed in weight and BMI for both males and females.





- **Rural vs Urban - waist circumference**

	RURAL	URBAN	T-student test
AVG	68.19	83.4	
STD	4.59	10.19	p-value <0.05



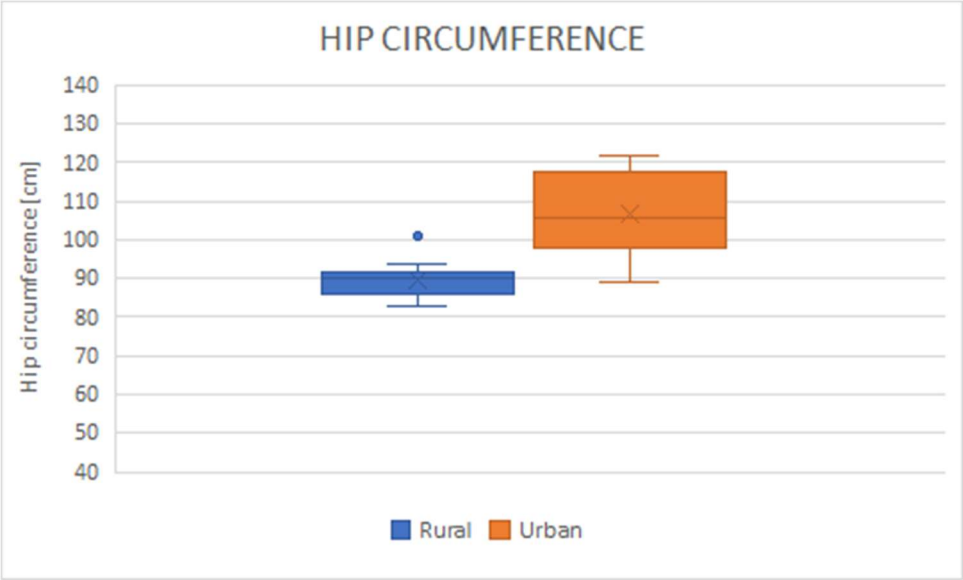
Recommended levels of waist circumference are <88 cm for women and <102 cm for men.

In the comparison between the rural and urban groups, we can observe a statistically significant difference, where the rural population has a 22,31% lower mean for waist circumference than urban Maasai.

We can also observe an higher values dispersion in the urban group.

- **Rural vs Urban - hip circumference**

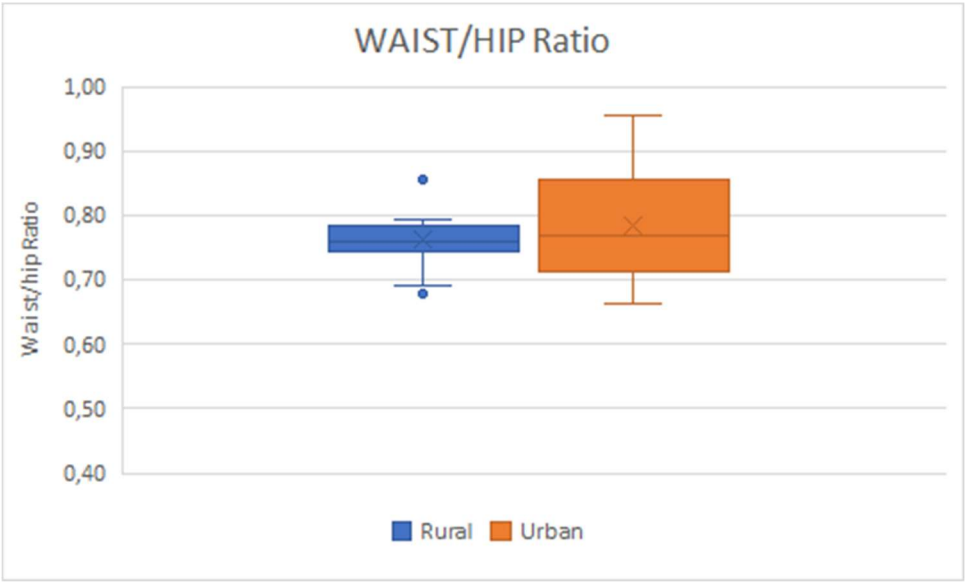
	RURAL	URBAN	Student's t-test
AVG	89.52	106.5	
STD	3.89	9.72	p-value <0.05



We can observe a statistically significant difference, where the rural population has a 18,97% lower hip circumference mean than the urban group.

Rural vs Urban - Waist/hip Ratio

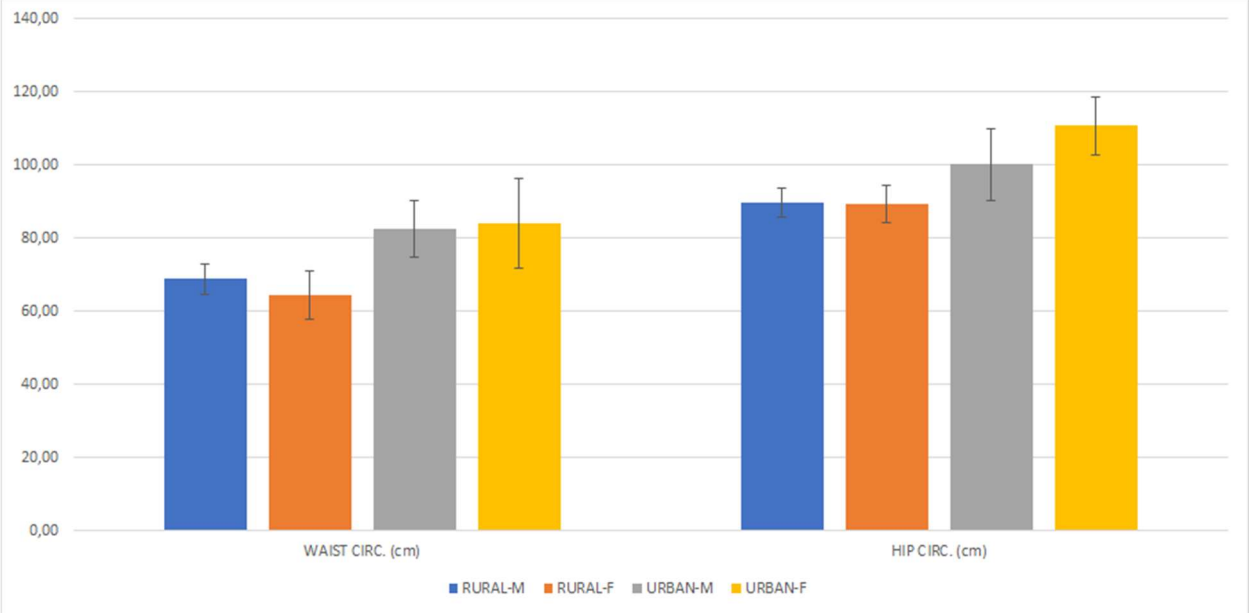
	RURAL	URBAN	Student's t-test
AVG	0.76	0.78	p-value
STD	0.04	0.08	p>0,05

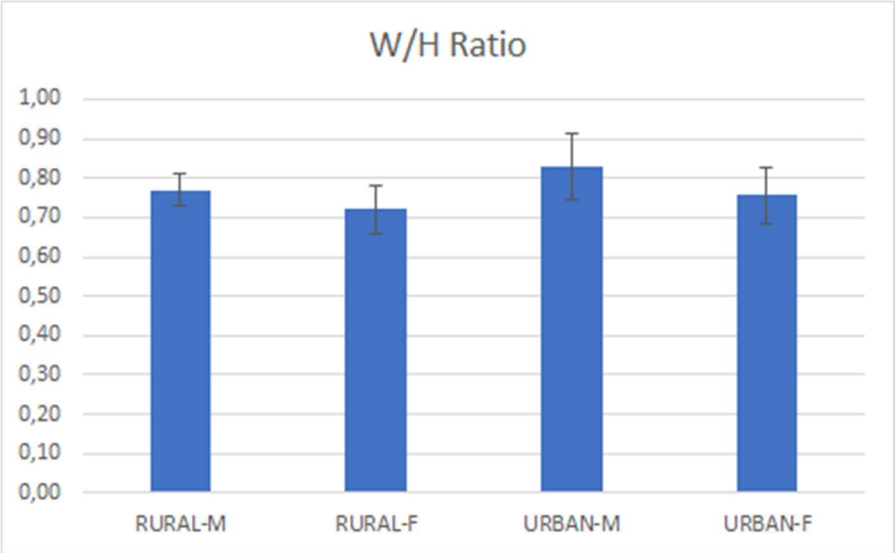


There's not a statistically significant difference between rurals and urbans for W/H ratio. Sex comparison for W/H ratio will be described in the table below.

	RURAL		URBAN		Unpaired Student's t-test/Mann Whitney	
	MALE	FEMALE	MALE	FEMALE	p-value considering only MALES	p-vaule considering only FEMALES

	Avg.	STD	Avg.	STD	Avg.	STD	Avg.	STD		
WAIST CIRC. (cm)	68..83	4.25	64.33	6.51	82.63	7.76	83.92	12.24	0.001*	0.008*
HIP CIRC. (cm)	89.56	3.96	89.33	5.03	100.13	979	110.75	7.85	0.018*	0.002*
W/H Ratio	0.77	0.04	0.72	0.06	0.83	0.08	0.76	0.07	0.086	0.429





There's a statistically significant difference for waist and hip circumference between males and females of the two groups, apart from the W/H ratio.

For men, A WHR of 0.95 or less is considered low risk, 0.96-1.0 moderate risk, and 1.0 or higher high risk. For women, A WHR of 0.80 or less is considered low risk, 0.81-0.85 moderate risk, and 0.86 or higher high risk. Both groups fall within the low risk ranges.

	ANCOVA
	p-value adjusted for AGE
HEIGHT (cm)	0.0314*
WEIGHT (kg)	0.0004*
BMI (kg/m2)	0.0000*
WAIST CIRC. (cm)	0.0000*

HIP CIRC. (cm)	0.0000*
W/H Ratio	0.3522

A statistically significant age-adjusted difference is present among subjects for height, weight, BMI, waist and hip circumference, while the W/H ratio difference is not statistically significant.

- **Rural vs Urban - Body composition**

	RURAL		**URBAN**		**Unpaired Student's t-test/Mann Whitney**
	Average	**STD**	**Average**	**STD**	**p-value**
Body Fat (%)	18.14	6.00	34.04	10.35	0.000*
Visc Fat (%)	2.31	1.46	5.88	2.50	0.000*
Muscle Mass (kg)	44.71	5.80	44.07	4.45	0.319
Muscle Quality	52.07	6.86	59.27	10.07	0.395
Bone Mass (kg)	2.40	0.30	2.35	0.23	0.251

BMR (kcal)	1408.05	148.88	1432.48	119.85	0.776
Metab Age	20.12	9.08	40.88	10.31	0.000*
Body Water (%)	61.02	4.12	47.21	6.68	0.000*
Physique Rating	3.74 (4)	0.91	2.39 (2)	1.30	0.008*
Muscle mass - right arm	2.10	0.33	2.13	0.25	0.624
Muscle mass - left arm	2.08	0.33	2.16	0.26	0.905
Muscle mass - right leg	7.77	0.99	7.18	0.72	0.014*
Muscle mass - left leg	7.57	0.92	7.18	0.74	0.098
Muscle mass - trunk	25.19	3.35	25.41	2.84	0.544

Muscle quality - right arm	62.90	7.88	60.76	13.17	0.261
Muscle quality - left arm	61.86	8.98	58.24	14.48	0.267
Muscle quality - right leg	49.48	7.50	59.48	10.60	0.155
Muscle quality - left leg	49.05	8.06	59.00	10.39	0.173
Body fat (%) - right arm	22.38	4.33	36.07	9.30	0.001*
Body fat (%) - left arm	24.85	5.10	37.76	9.82	0.005*
Body fat (%) - right leg	16.00	8.73	38.04	8.26	0.000*
Body fat (%) - left leg	16.55	8.25	37.38	8.83	0.000*

Body fat (%) - trunk	18.18	5.49	31.15	12.23	0.005*

There's a statistically significant difference in body fat percentage, visceral fat, metabolic age, body water, physique rating, muscle mass right leg, body fat (%) - right arm, body fat (%) - left arm, body fat (%) - right leg, body fat (%) - left leg, body fat (%) - trunk, where the rural Maasai show a better body composition profile than the urban Maasai.

As a premise, for clinical and public health purposes, BMI remains the WHO's primary metric for assessing weight status. While body fat percentage is occasionally referenced in research, no universally validated thresholds exist, and reliance on BMI persists due to its simplicity and global applicability

Our tool for bioelectrical impedance analysis (BIA) - MyTanita R-545HR - has been demonstrated with good reliability and validity (Validity of Various Bioelectrical Impedance Analysis Devices vs the Bod Pod for Body Composition the Bod Pod for Body Composition, Alivia Blakley, 2019), (Evaluation of the novel Tanita body-fat analyser to measure body composition by comparison with a four-compartment model, S A Jebb et al., 2000).

Regarding body fat, it fulfils important functions, regulating metabolism, hormones, nutritional absorption, cell structure and immune function, or protecting organs. It is scientifically recognized that excessive fat accumulation (e.g., visceral fat) correlates with chronic inflammation, insulin resistance, and metabolic disorders like type 2 diabetes. Conversely, critically low body fat impairs hormone regulation and energy availability.

Visceral fat, also known is a type of body fat stored deep within the abdominal cavity, surrounding vital organs such as the liver, intestines, and pancreas. While some visceral fat is necessary for protecting internal organs, excess amounts are strongly linked to serious health risks. Health risks associated with excess visceral fat includes cardiovascular disease, type 2 diabetes, cancer, neurological diseases, etc.

Image 13. Body fat ranges

It has to be underlined that the rural Maasai group presents a percentage of body fat and visceral fat which is almost the half lower than those of urbans. By our tool - MyTanita - reference values, both groups' visceral fat percentage fall within the healthy range. Sex stratified results and reference values will be discussed in the next table.

The metabolic age is the result of the comparison between basal metabolic rate and the chronological age group. Basal Metabolic Rate (BMR) is the amount of energy, measured in calories, that the body requires to maintain basic life functions while at rest. These functions include breathing, blood circulation, nutrient processing, cell production, etc. BMR accounts for approximately 60–70% of daily calorie expenditure and is influenced by factors such as age, gender, weight, muscle mass, and genetics

If metabolic age is higher than the actual age, this may indicate that metabolism is not as efficient as it could be.

From available data we can observe that the rural Maasai group is the half of the metabolic age than the rural Maasai group, respectively lower (for rural) and higher (for urbans) than their actual age.

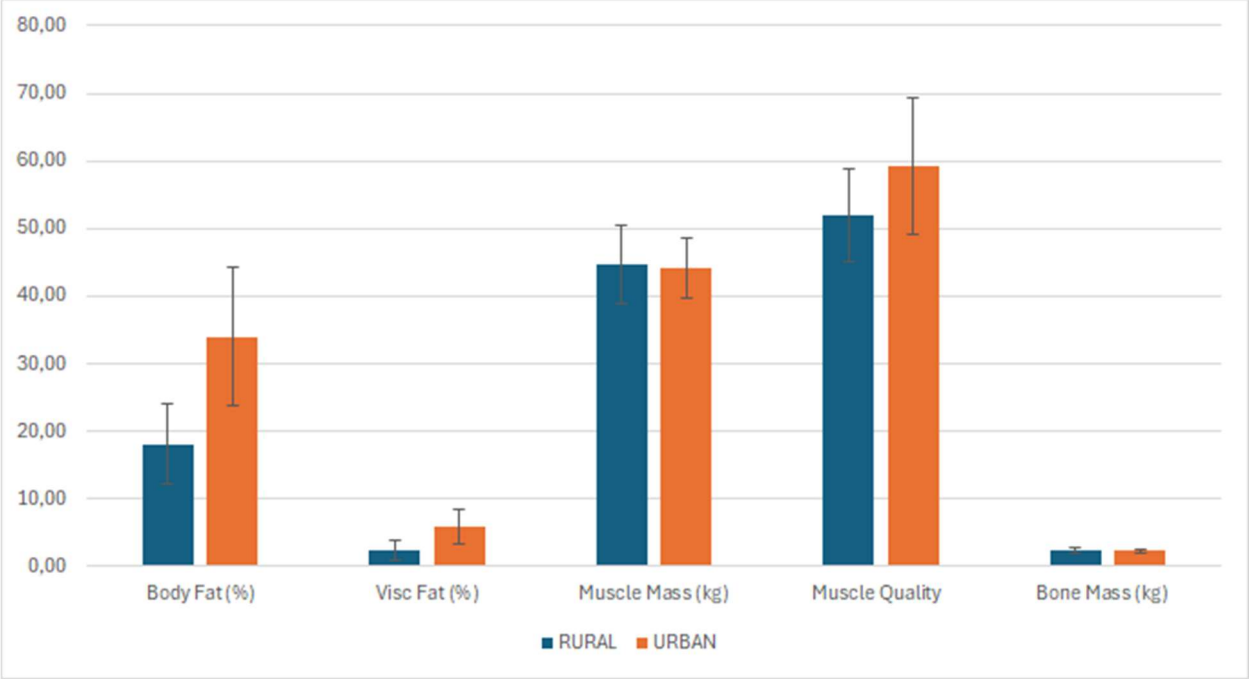
The body water percentage is the amount of fluid in the body, expressed as a percentage of the total body weight.

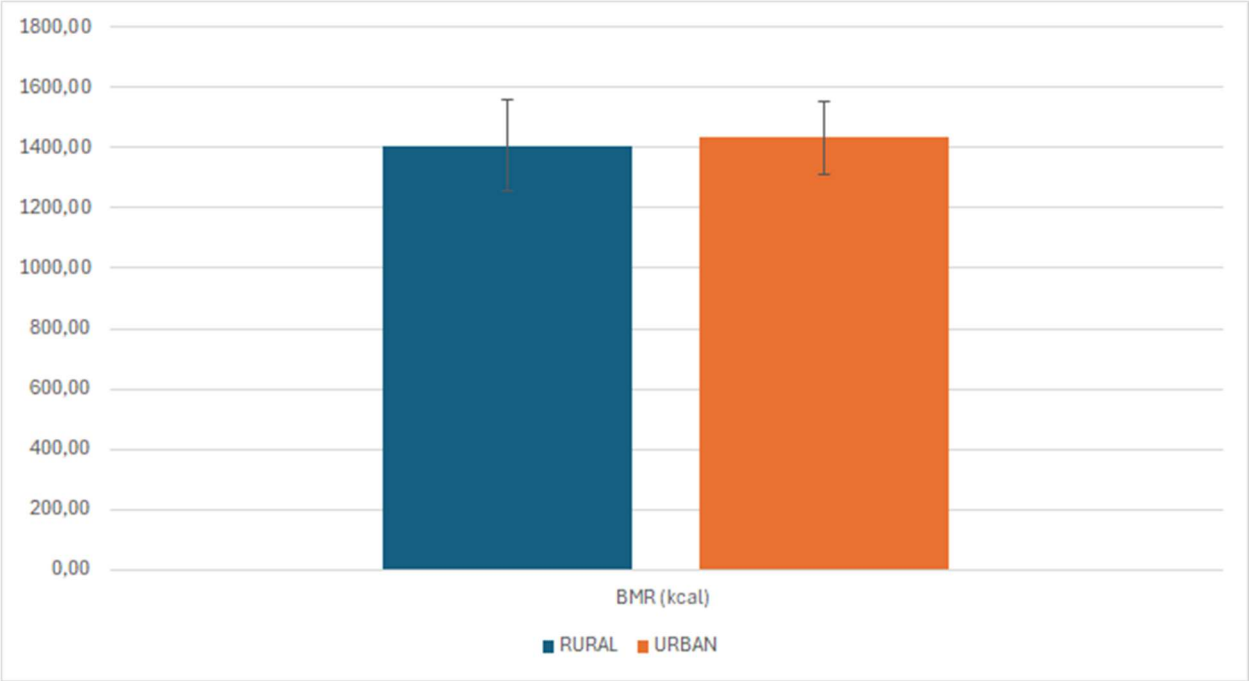
Water plays an important role in various body processes and is found in every cell, tissue and organ. By the European Food Safety Authority (EFSA), a healthy body water percentage for women is between 45% and 60%. For men, it is between 50% and 65%. A healthy body fluid percentage reduces the risk of health problems and ensures that the body functions properly.

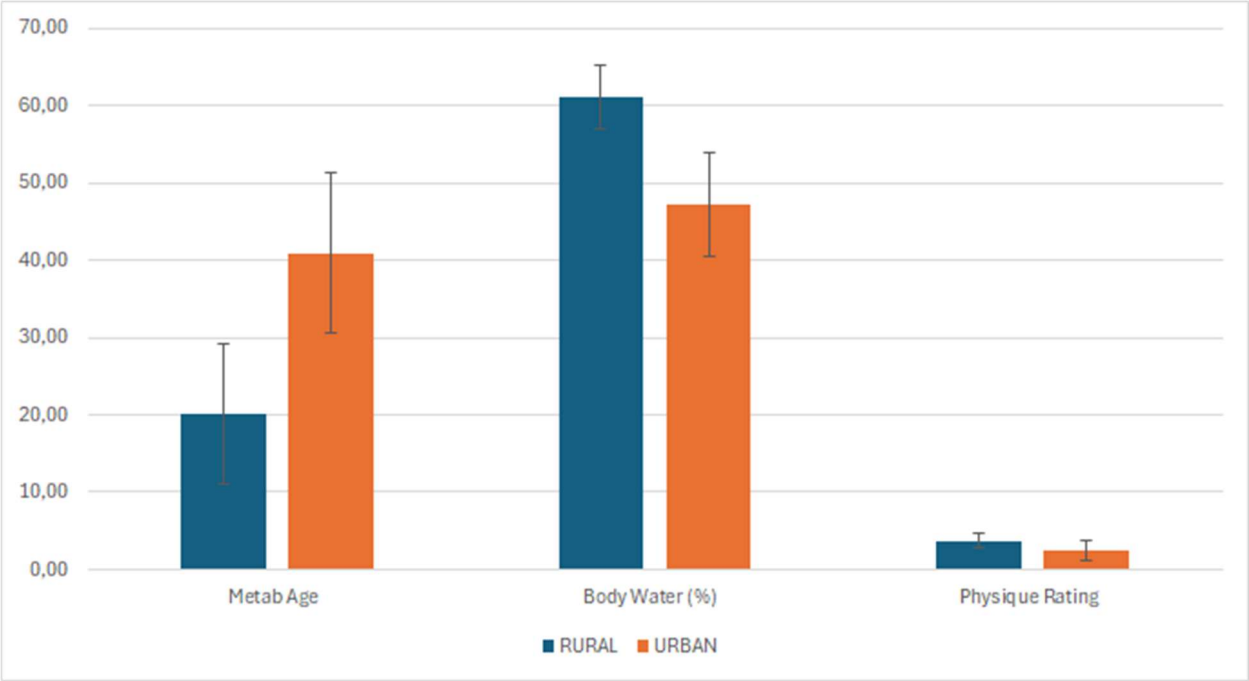
Considering the normal range of total body water (55 and 60% for females and men) Body water in the rural maasai group fall within the average healthy ranges, while the urban maasai present an amount of water below the normality.

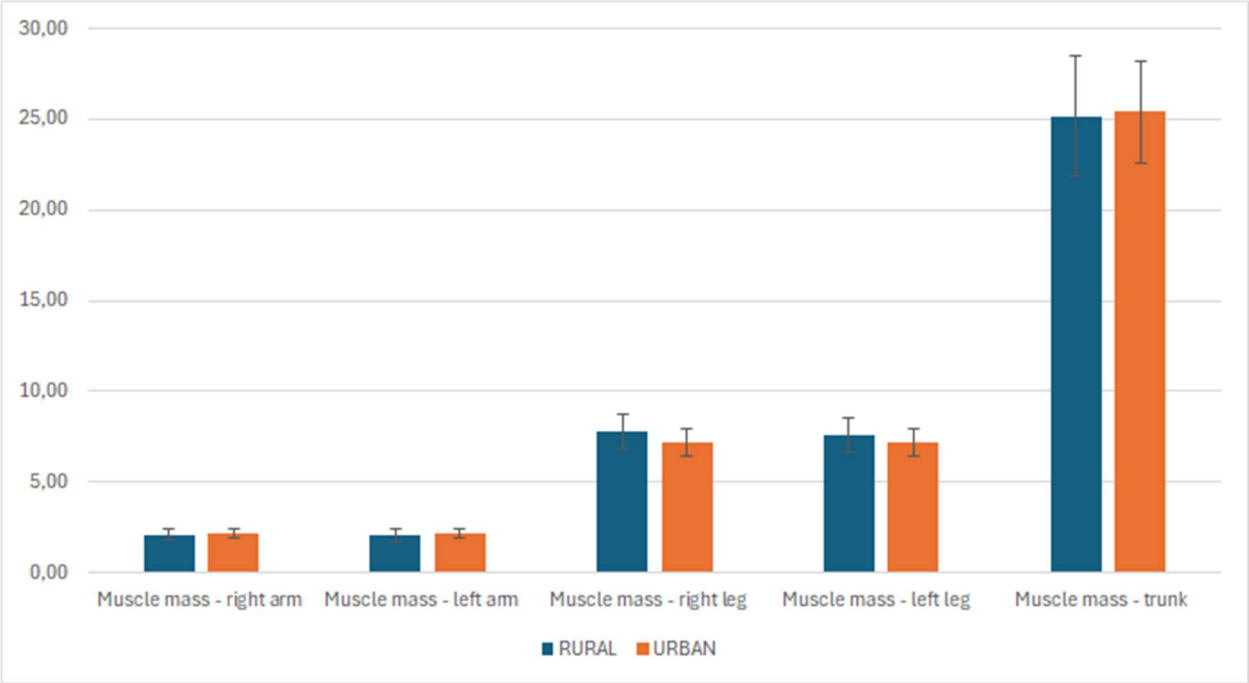
All other statistically significant difference [muscle mass right leg, body fat (%) - right arm, body fat (%) - left arm, body fat (%) - right leg, body fat (%) - left leg, body fat (%) - trunk] refer to segmental body fat measurements, where the way fat is distributed differs between different people and body types. This is especially useful for anyone who is monitoring the balance of the left and right side of the body or trying to build a particular part of one's body. It can also help sports people to assess the impact of their training programs on different parts of their bodies.

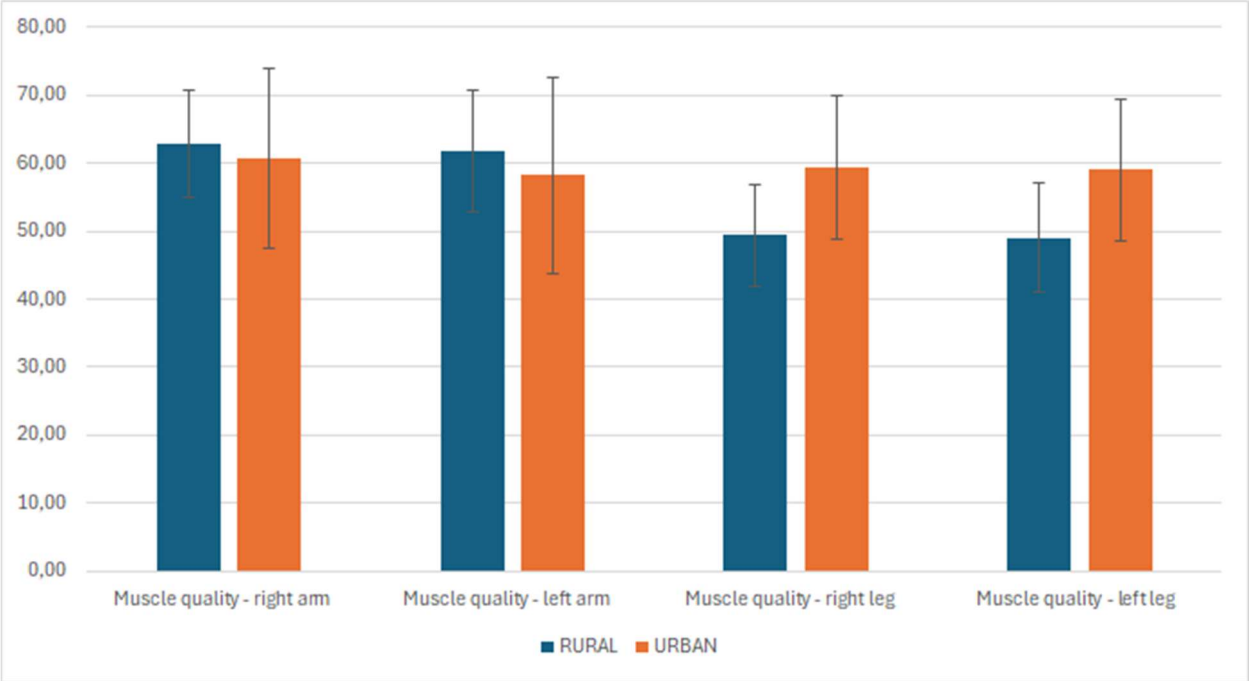
Physique rating refers to a specific categorization of MyTanita which classifies the body type based on muscle mass and body fat percentage, providing nine classifications to help track health and fitness progress. The rural group with a 3,74 (approximated to 4) while the urban with 2,39 (approximated to 2) falls respectively under the “underexercised” and “obese” categories.

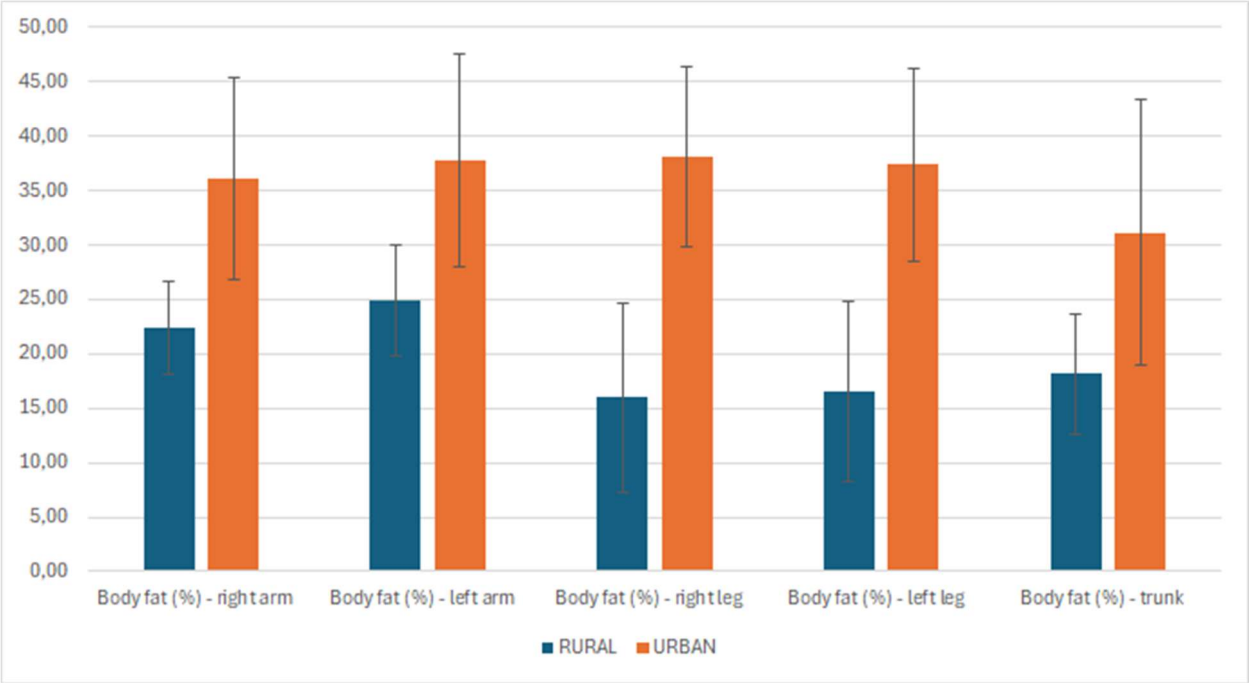



1800,00
1600,00
1400,00
1200,00
1000,00
800,00
600,00
400,00
200,00
0,00
BMR (kcal)
RURAL
URBAN


70,00
60,00
50,00
40,00
30,00
20,00
10,00
0,00
Metab Age
Body Water (%)
Physique Rating
RURAL
URBAN


30,00
25,00
20,00
15,00
10,00
5,00
0,00
Muscle mass - right arm
Muscle mass - left arm
Muscle mass - right leg
Muscle mass - left leg
Muscle mass - trunk
RURAL
URBAN


80,00
70,00
60,00
50,00
40,00
30,00
20,00
10,00
0,00
Muscle quality - right arm
Muscle quality - left arm
Muscle quality - right leg
Muscle quality - left leg
RURAL
URBAN



- **Rural vs Urban - Male vs Female body composition**

	RURAL				URBAN				Unpaired Student's t-test/Mann Whitney	
	MALE		FEMALE		MALE		FEMALE		p-value only MALE	p-vaule only FEMALE
	Avg.	STD	Avg	STD	Avg	STD	Avg	STD		
Weight (kg)	58.44	5.44	49.07	5.98	67.61	9.85	67.11	24,11	0,050*	0.037*
BMI	18.83	1.48	18.80	2.02	22.26	3.61	24.18	8,62	0,046*	0.072
Body Fat (%)	15.89	3.58	30.53	1.40	24.71	8.09	35.81	14.24	0.028*	0.232
Visc Fat (%)	2.03	1.61	1.50	0.50	5.21	2.50	5.71	3.24	0.009*	0.001*

Muscle Quality	54.00	6.32	43,33	2.31	62.29	6.70	52.33	19.46	0.017*	0.145
Bone Mass (kg)	2.49	0.18	1.73	0.21	2.56	0.10	2.03	0.66	0.278	0.026*
Metab Age	18.11	10.06	20,00	7.55	37.86	15.64	38.67	15.79	0.015*	0.020*
Body Water (%)	62.48	3.65	54.97	1.50	52.76	7.19	40.62	13.87	0.011*	0.004*
Physique Rating	3.67	0.97	4.00	0.00	2.71	1.60	2.25	1.42	0.156	0.001*
Muscle mass - right leg	8.09	0.70	5.80	0.44	7.51	0.50	6.34	2.09	0.036*	0.423
Muscle quality - right leg	51.17	7.16	42.00	5.29	62.71	6.99	52.08	19.69	0.003*	0.143
Muscle quality - left leg	50.83	8.05	42.67	1.53	62.14	9.28	51,67	18.91	0.018*	0.131
Body fat (%) - right arm	21.31	4.16	26.67	0.31	28.70	7.68	36.43	14.32	0.045*	0.038*
Body fat (%) - left arm	23.56	4.46	32.87	1.26	29.51	8.48	38.36	14.74	0.119	0.228

Body fat (%) - right leg	13.32	6.48	32.53	2.42	31.60	8.02	38.06	13.76	0.000*	0.212
Body fat (%) - left leg	13.52	5.68	32.97	1.95	30.33	8.48	37.88	13.88	0.001*	0.260

We have a statistically significant difference for both males and females in weight, visceral fat, metabolic age, body water and body fat (%) - right arm, where the rurals show a better body composition profile.

By using MyTanita reference values for body fat percentage, which are comparable to references of values the American Council on Exercise (ACE) for men and women, we can observe that rural Maasai with an average of 15,89% body fat fall within the healthy range (green for MyTanita and as Fitness level for the ACE), while urban Maasai with an average of 24.71% falls within a less healthy range (yellow and at the limit of acceptable level for ACE). Average body fat percentage difference among females of the two groups results not statistically significant, even if we can observe a slightly higher fat percentage in the urbans than the rurals (35.81vs30.53), respectively falling into the yellow-obese and green-acceptable levels.

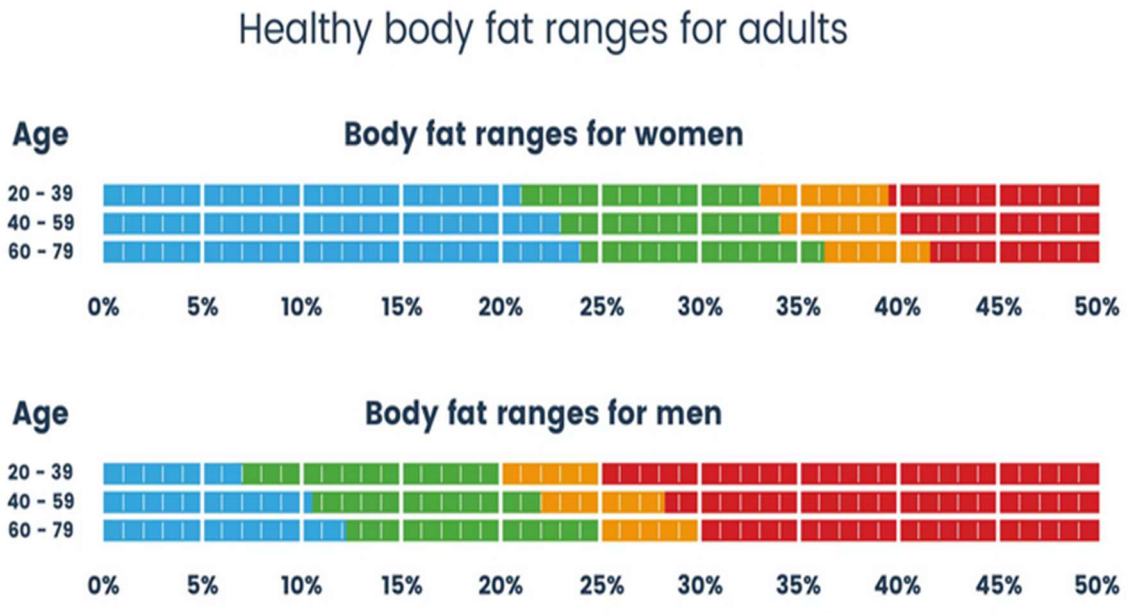


Image 14. BF ranges M/F

General Body Fat Categories (American Council on Exercise)

Category	Women (%)	Men (%)
Essential Fat	10–13	2–5
Athletes	14–20	6–13
Fitness	21–24	14–17
Acceptable	25–31	18–24
Obesity	>32	>25

Image 15. BF % for M/F

Regarding the total body water, rural Maasai males show an amount of 62.48% of water vs 52.75% for urban males, and rural Maasai females present an amount of 54.97% vs 40.62% of their urban counterparts.

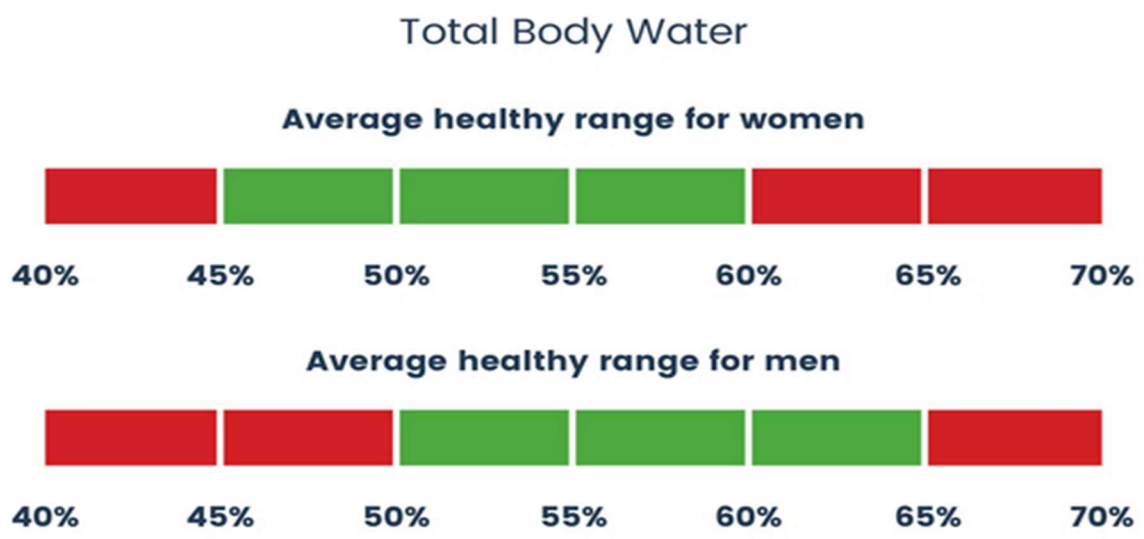


Image 16. Total body water % for M/F

Among the statistically significant difference between rural and urban males only, we can list BMI, body fat, muscle quality, muscle mass-right leg, muscle quality-right and left leg, body fat (%) right and left leg, where muscle quality, muscle quality-right and left leg are the only one parameters that have a better score for the urban group (that may be influenced by the amount of connective tissue, which wasn't part of this research). Among rural and urban females: bone mass is higher in the urbans, while physique rating has a better score for rurals.

Muscle quality by MyTanita refers to the amount of contractile vs non contractile tissue (connective tissue and fat), where more contractile tissue is referred to a better muscle quality, (e.g. influenced by lifestyle factors and ageing).

Below are the reference values for muscle quality by MyTanita:

Male	18-29	30s	40s	50s	60s	70s	80 & over
High	82 & higher	80 & higher	77 & higher	72 & higher	65 & higher	56 & higher	51 & higher
Average	55 - 81	53 - 79	49 - 76	45 - 71	38 - 64	30 - 55	26 - 50
Low	54 or less	52 or less	48 or less	44 or less	37 or less	29 or less	25 or less

Female	18-29	30s	40s	50s	60s	70s	80 & over
High	88 & higher	85 & higher	80 & higher	74 & higher	66 & higher	58 & higher	53 & higher
Average	60 - 87	59 - 84	56 - 79	50 - 73	43 - 65	33 - 57	27 - 52
Low	59 or less	58 or less	55 or less	49 or less	42 or less	32 or less	26 or less

Image 17. Muscle quality for M/F

- **Rural vs Urban - body composition stratified by age**

	ANCOVA
	p-value adjusted for AGE
Body Fat (%)	0.004*
Visc Fat (%)	0.004*
Metab Age	0.007*

Body Water (%)	0.000*
Physique Rating	0.028*
Muscle mass - right leg	0.013*
Muscle mass - left leg	0.032*
Body fat (%) - right arm	0.012*
Body fat (%) - left arm	0.048*
Body fat (%) - right leg	0.000*
Body fat (%) - left leg	0.000*
Body fat (%) - trunk	0.031*

Statistically significant age adjusted differences can be observed in the above listed parameters.

2) OBJECTIVE TWO – Physiologicals

- **Blood pressure measurement**

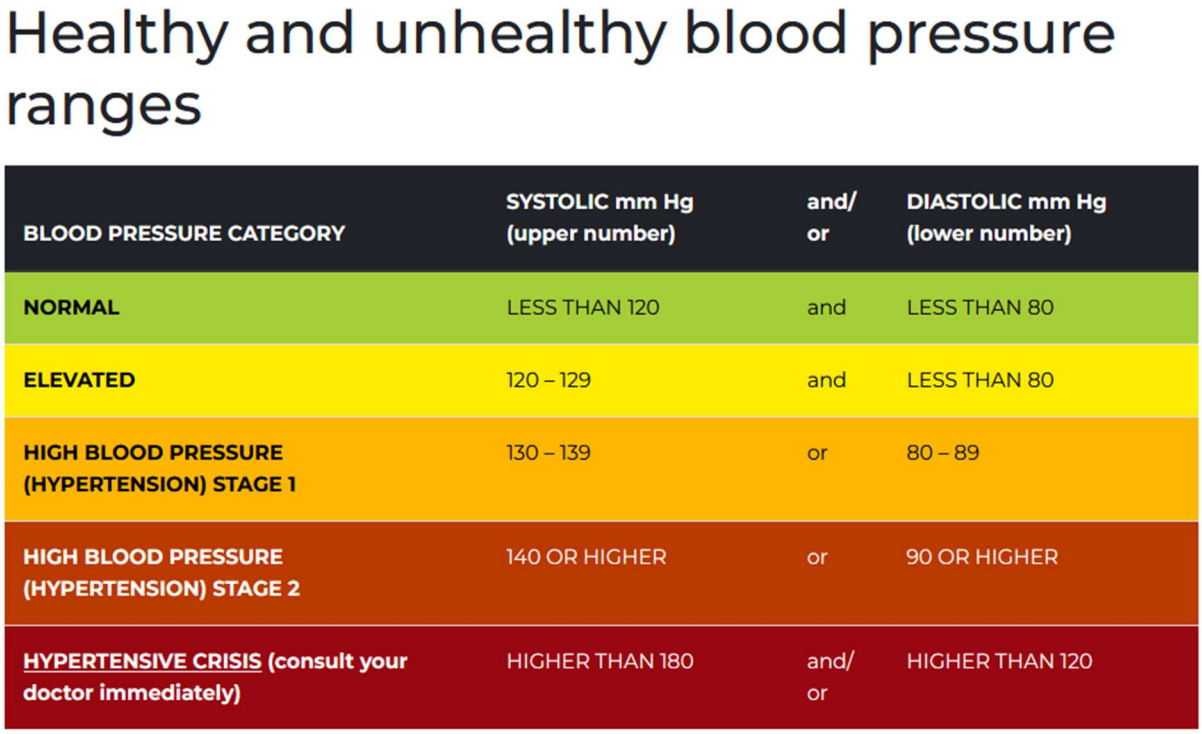
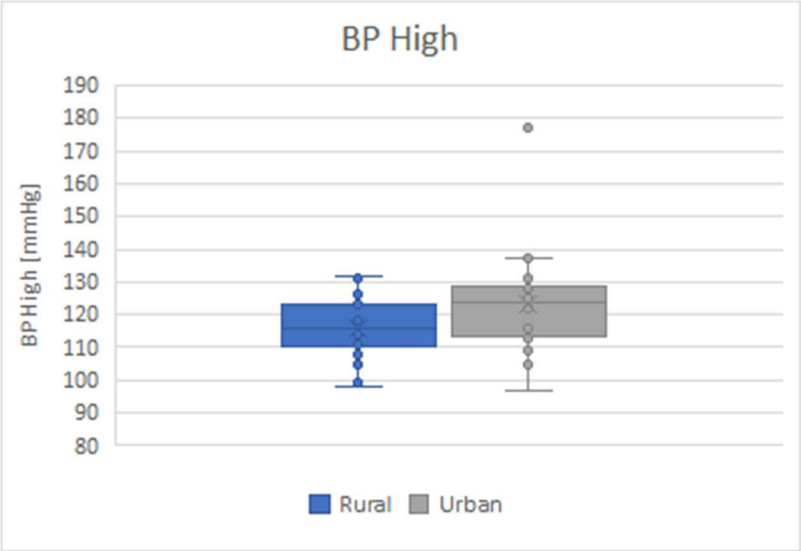


Image 18. Blood pressure reference values by the American heart association

- **Systolic blood pressure**

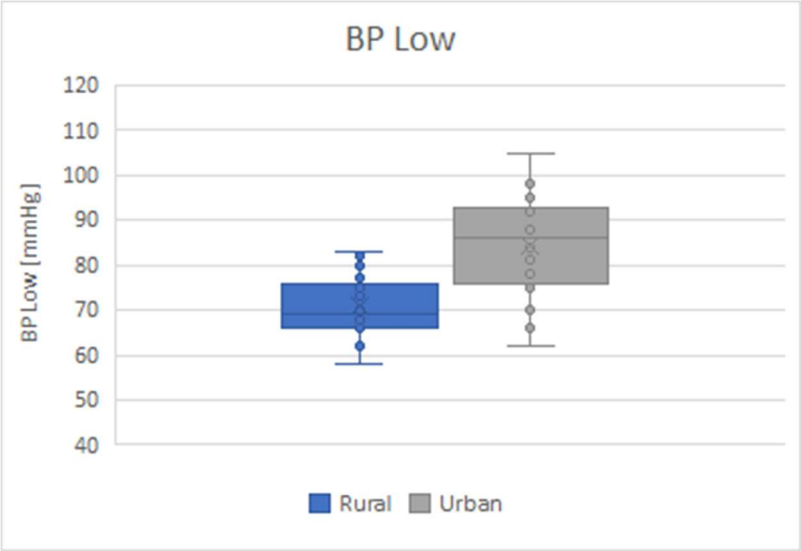
	RURAL	URBAN	Student's t-test
AVG	115.90	123.40	
STD	8.93	15.96	p.value=0.076

Systolic BP results in the normal range for both groups, without statistically significant differences.



- **Diastolic blood pressure**

	RURAL	URBAN	p-value
AVG	70.90	84.40	
STD	6.89	11.16	<0,05*



Systolic BP appears in the normal range for the rurals, with a statistically significant difference with the urbans, which group average DBP results in a hypertension grade I level.

- **Blood pressure and SpO2 adjusted by sex**

	RURAL				URBAN				Unpaired Student's t-test/Mann Whitney	
	MALE		FEMALE		MALE		FEMALE		p-value considering only MALES	p-vaule considering only FEMALES
	Average	STD	Average	STD	Average	STD	Average	STD		
BP Systolic (mmHg)	116.33	9.52	113.33	7.37	128.50	24.12	120.00	7.85	0.205	0.254
BP Diastolic (mmHg)	70.67	6.28	72.33	1.,66	86.13	15.63	83.25	8.21	0.027*	0.270
SpO2 (/100)	96.17	2.26	97.33	0.58	93.88	1.73	95.67	2.61	0.011*	0.064

There's a statistically significant difference for DBP and SpO2 between males. SpO2 results will be described in the table below. Briefly here, we can say that there's a statistically significant difference for SpO2 among rural and urban males. Urban females fall within a normal range, and urban males slightly below the normal (95-100%).

- **SpO2 measurement**

	RURAL	URBAN	Student's t-test
AVG	96.33	94.95	
STD	2.08	2.36	p-value=0.059

Even if oxygen saturation difference between rurals and urbans doesn't result statistically significant, we can observe a certain trend among the two groups, where the males groups showed a difference (as described above)

- **Blood pressure and SpO2 stratified for age**

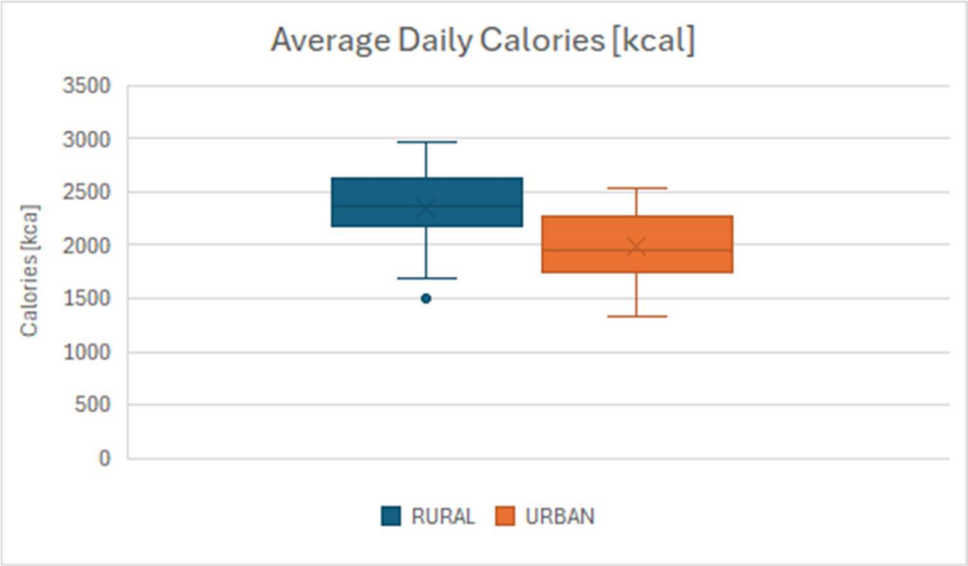
	ANCOVA
	p-value adjusted for AGE
BP Systolic (mmHg)	0.5894
BP Diastolic (mmHg)	0.0120*
SpO2 (/100)	0.2741

Statistically significant difference has been confirmed for age adjusted data only for DBP.

- **Wearables technology data**

- **Daily calories (Kcal)**

	Rural	Urban	Unpaired Student's t-test
AVERAGE	2348	1998	
STD	368	351	p-value<0.05*



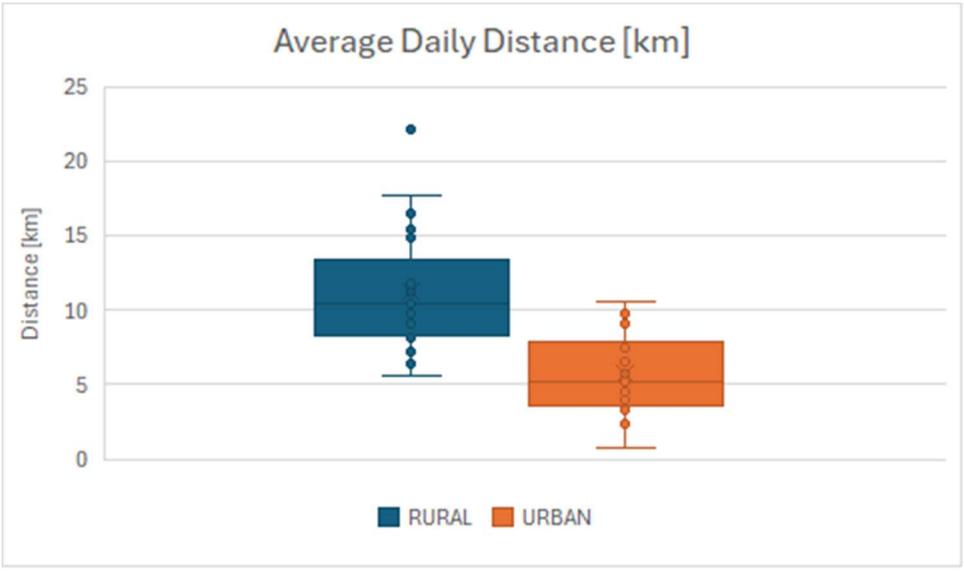
Daily calorie consumption reference values vary based on factors like age, sex, activity level, and health goals. The U.S. Food and Drug Administration (FDA) uses a standard reference of 2,000 calories per day for general nutrition guidance on food labels.

We can observe a statistically significant difference between rurals and urbans, where the first have a daily calories consumption 17.52% higher than the latter.

- **Daily distance (Km)**

	Rural	Urban	Unpaired Student's t-test
AVERAGE	11	6	

STD	4	3	p-value <0.05*



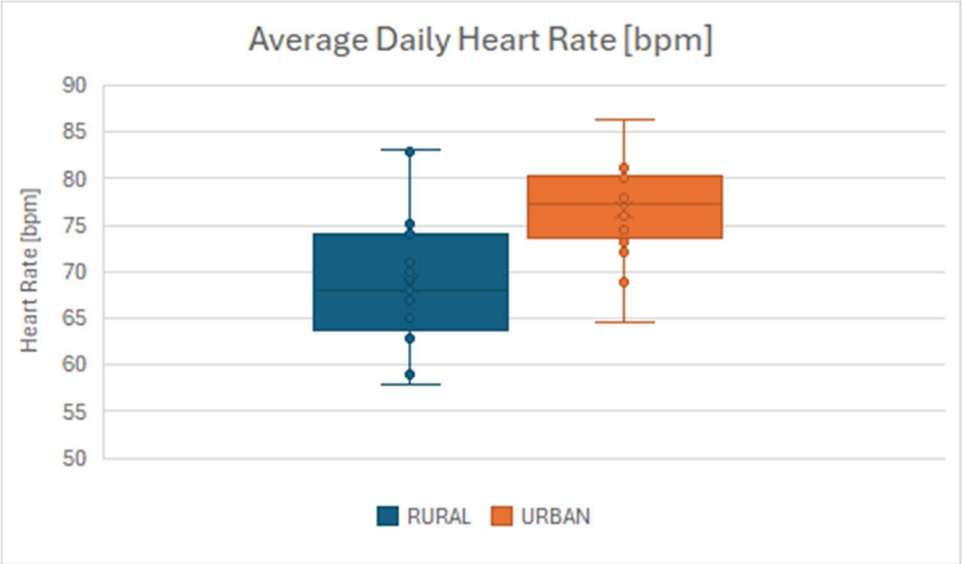
A general reference of 10.000 steps per day has been widely recognized, where the WHO defines that the goal of "10,000 steps" per day has been widely promoted and advocated as a strategy for increasing physical activity among able adults. The benefit of advocating a 10,000 steps goal per day message was highlighted in a study which showed that people walk more when recommended to take 10,000 steps a day compared with those advised to take a brisk 30-minute walk (Hultquist et al., 2005). This study indicates that promoting the 10 000 steps per day message may suit certain segments of the population. However, the 10,000 steps per day goal generally focuses on the number of steps taken, not activity intensity. Therefore, it is important to point out that the 10,000 steps recommendation is just one way of achieving the required physical activity level.

In our research data shows an average daily distance in Km covered by the rural Maasai (11km equivalent to 14.435steps circa) higher of +83.3% than the one of the urban group (6km equivalent to 7874 steps circa).

- **Daily heart rate (bpm)**

	Rural	Urban	Unpaired Student's t-test

AVERAGE	69	77	
STD	7	5	p-value <0.001*



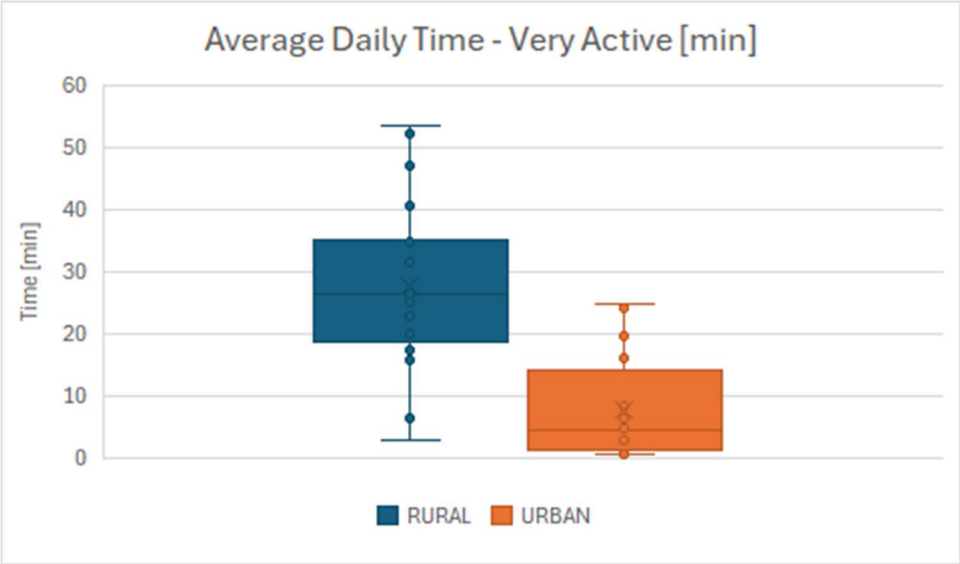
Reference values for daily heart rate are primarily defined by resting heart rate (RHR) benchmarks - furtherly analysed below - which vary by age, fitness level, and health status. While there are no universally mandated "daily" heart rate targets, guidelines focus on resting rates and target zones during exercise.

Average daily heart rate results are significantly higher in the urbans than rurals.

A higher average daily heart rate - distinct from resting heart rate (RHR) - reflects the heart's response to various activities, stressors, and physiological demands throughout the day. Lifestyles factors, poor cardiovascular fitness or even underlying health conditions can determine persistent elevation in daily heart rate. Not only an increased amount of physical activity can influence an increase in the average daily heart rate, but for example chronic stress, anxiety, or emotional distress can elevate the average daily heart rate due to activation of the sympathetic nervous system ("fight-or-flight" response). Furthermore individuals with lower fitness levels may have a higher average daily heart rate because their heart works harder to pump blood during routine activities.

- **Daily time - very active (min)**

	Rural	Urban	Unpaired Student's t-test
AVERAGE	28	8	
STD	13	8	p-value=<0.001*



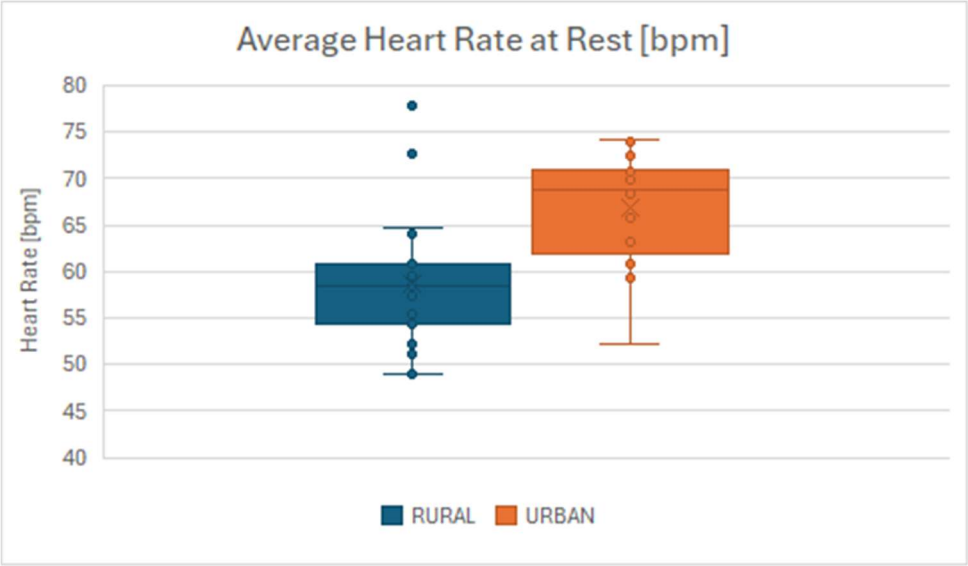
The Very Active Zone on the Fitbit Inspire 3 refers to the Peak Heart Rate Zone, which is the highest level of exertion during exercise. This zone is part of Fitbit's Active Zone Minutes (AZM) feature, which tracks time spent in different heart rate zones to measure workout intensity.

The Very Active Zone corresponds to the Peak Zone, where the heart rate exceeds 85% of the calculated maximum heart rate. This zone is typically achieved during high-intensity efforts or workouts.

Rural Maasai spend over three times more minutes in their very active zone than the urban counterparts, with a statistically significant difference, suggesting a higher intensity in their level of physical exertion during the day.

- **Heart rate at rest (bpm)**

	Rural	Urban	Unpaired Student's t-test
AVERAGE	59	67	
STD	7	6	p-value<0.001*



Resting Heart Rate (RHR) is a critical indicator of cardiovascular health and fitness level, reflecting how efficiently the heart pumps blood under resting conditions. In general, active people often have a lower resting heart rate because their heart muscle is in better condition and doesn't need to work as hard to maintain a steady beat.

There's a statistically significant difference between the two groups where the rural Maasai have a lower RHR than the urban Maasai. Both groups have a RHR in the normal range, even if the rurals with 59 bpm fall in the bradycardia range (<60bpm).

The American Heart Association defines for RHR a general adult range between 60 and 100 beats per minute, where Harvard health defines an optimal range between 50 and 85 bpm. An athlete RHR can be lower than 60bmp due to enhanced cardiovascular efficiency. Important to mention about the relevance of RHR.

For examples, two studies link RHR with cardiovascular health:

“Resting heart rate and all-cause and cardiovascular mortality in the general population: a meta-analysis” (Dongfeng Zhang et al., 2015) found that higher resting heart rate was independently associated with increased risks of all-cause and cardiovascular mortality. This indicates that resting heart rate is a predictor of all-cause and cardiovascular mortality in the general population.
Furthermore a 2013 study named “Elevated resting heart rate, physical fitness and all-cause mortality: a 16-year follow-up in the Copenhagen Male Study” (Magnus Thorsten Jensen et al.) in the journal *Heart* tracked the cardiovascular health of about 3,000 men for 16 years and found that a high resting heart rate was linked with lower physical fitness and higher blood pressure, body weight, and levels of circulating blood fats. The researchers also discovered that the higher a person's resting heart rate, the greater the risk of premature death. Specifically, an RHR between 81 and 90 doubled the chance of death, while an RHR higher than 90 tripled it.

- **Wearables data adjusted by age**

	ANCOVA
	p-value adjusted for AGE
Average Daily Calories [kcal]	0.0579
Average Daily Distance [km]	0.0002*
Average Daily HeartRate [bpm]	0.0012*
Average Daily Time as Very Active [min]	0.0000*
Average Heart Rate at Rest [bpm]	0.0057*

All data age-adjusted differences in the table above have been found statistically significant, a part from “average daily calories”.

- **Wearables data adjusted by sex** (p-values in the third table below)

- **Rural group**

	RURAL			
	MALE		FEMALE	
	Average	STD	Average	STD
Average Daily Calories [kcal]	2461.0	264.9	1670.3	157.3
Average Daily Distance [km]	11.9	4.0	7.0	1.4
Average Daily HeartRate [bpm]	67.1	5.3	79.0	6.9
Average Daily Time as Very Active [min]	30.5	11.6	9,7	9.1
Average Heart Rate at Rest [bpm]	56.9	4.7	69.7	9.9

- **Urban group**

	URBAN	
	MALE	FEMALE

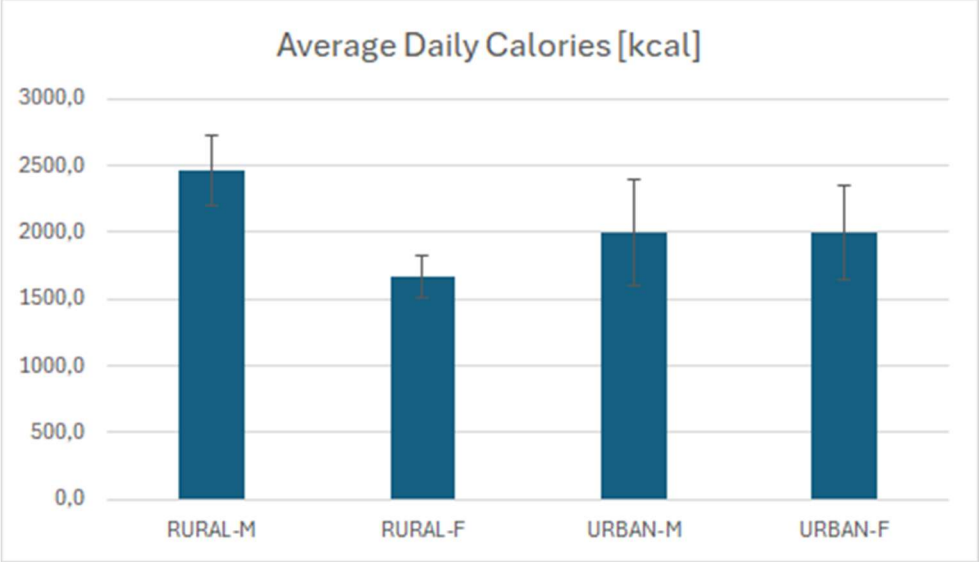
	Average	STD	Averag e	STD
Average Daily Calories [kcal]	2000.1	396.8	1996.0	352.4
Average Daily Distance [km]	5.4	3.3	5.9	2.4
Average Daily HeartRate [bpm]	74.9	5.1	77.9	4.5
Average Daily Time as Very Active [min]	9.0	9.4	6.8	7.7
Average Heart Rate at Rest [bpm]	64.9	6.5	68.0	5.0

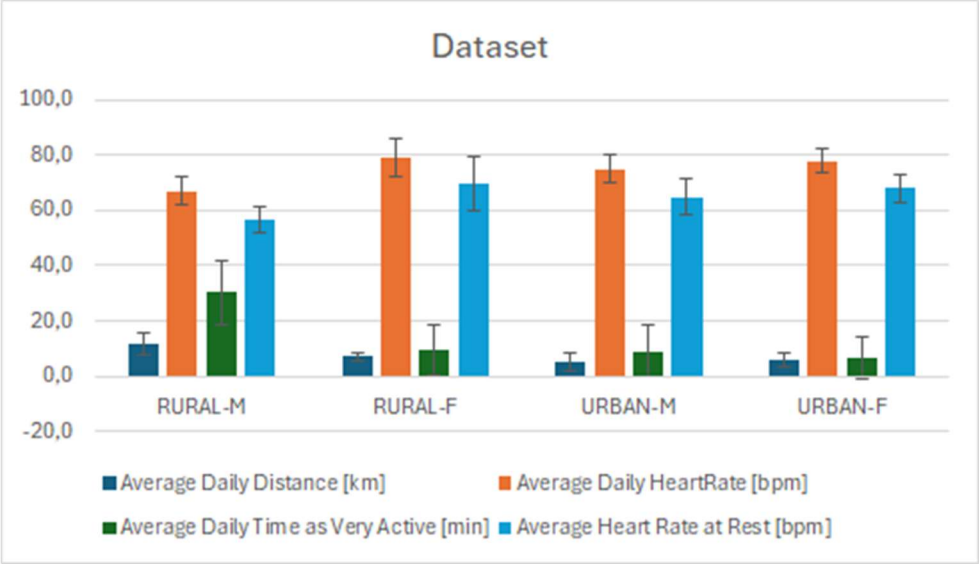
- **P-values for sex groups**

	Unpaired Student's t-test/Mann Whitney	
	p-value considering only MALES	p-vaule considering only FEMALES
Average Daily Calories [kcal]	0.0135*	0.0443*
Average Daily Distance [km]	0.0005*	0.3041

Average Daily HeartRate [bpm]	0.0029*	0.8169
Average Daily Time as Very Active [min]	0.0001*	0.6444
Average Heart Rate at Rest [bpm]	0.0099*	0.7912

Sex stratification data are shown in the table above, where statistically significant differences have been marked with an asterisk. See below graphics of values.

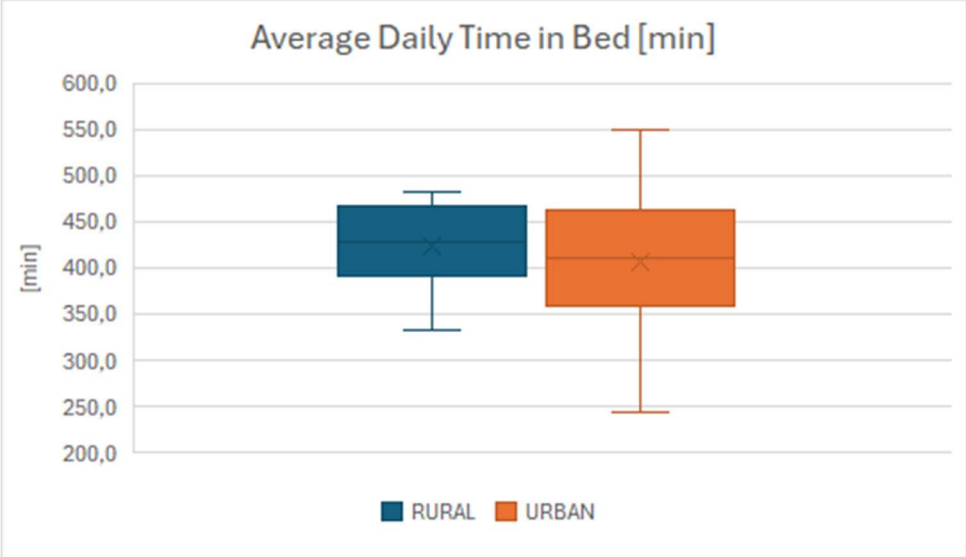




- **Sleep data**

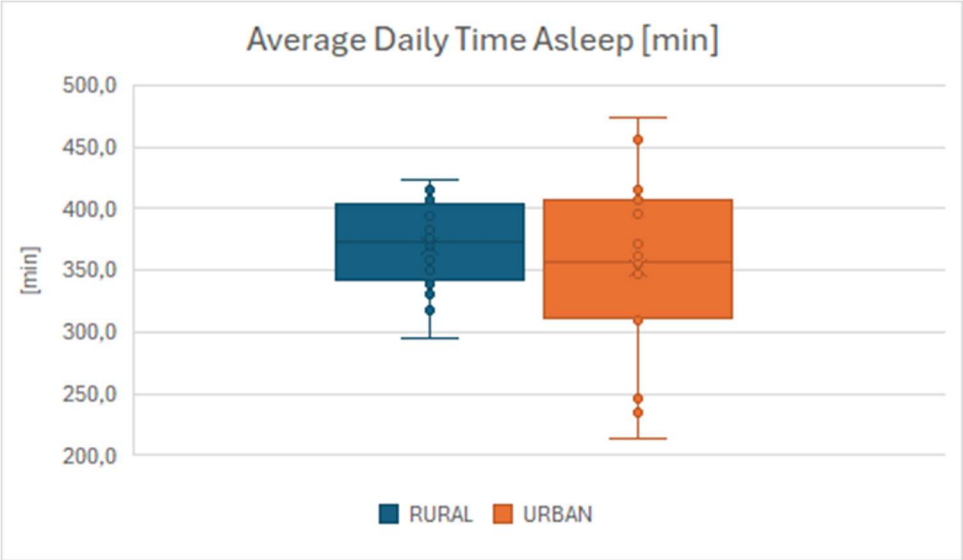
- **Average daily time in bed (min)**

	RURAL	URBAN	Unpaired Student's t-test
AVERAGE	424.5	406.4	
STD	42.2	79.0	p-value>0.05



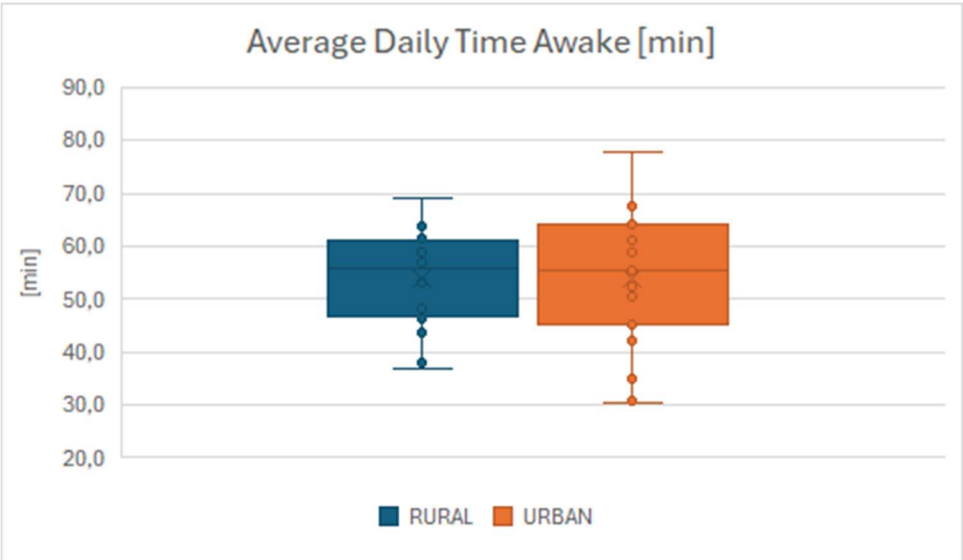
- **Average daily time asleep [min]**

RURAL	URBAN	Unpaired Student's t-test
370,5	352.4	
34,7	68.1	p-value>0.05



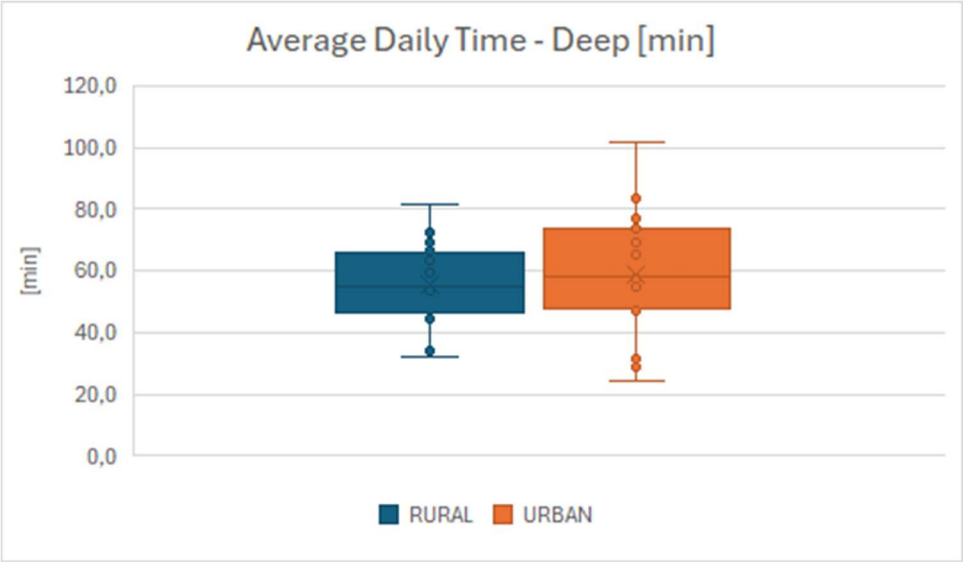
- **Average daily time awake [min]**

RURAL	URBAN	Unpaired Student's t-test
54.0	53.8	
8.6	12.7	p-value>0.05



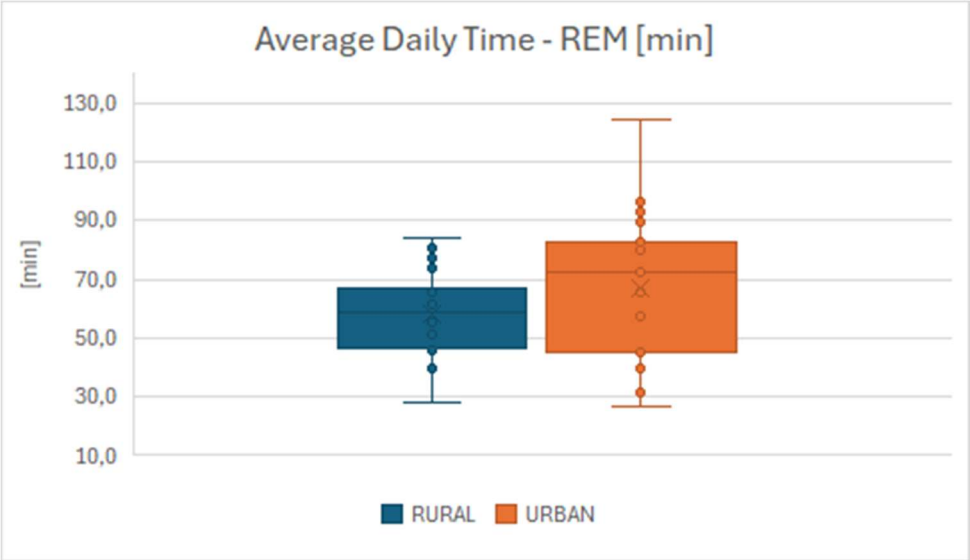
- **Average daily time - deep [min]**

RURAL	URBAN	Unpaired Student's t-test
55.7	59.0	
13.2	19.1	p-value>0.05



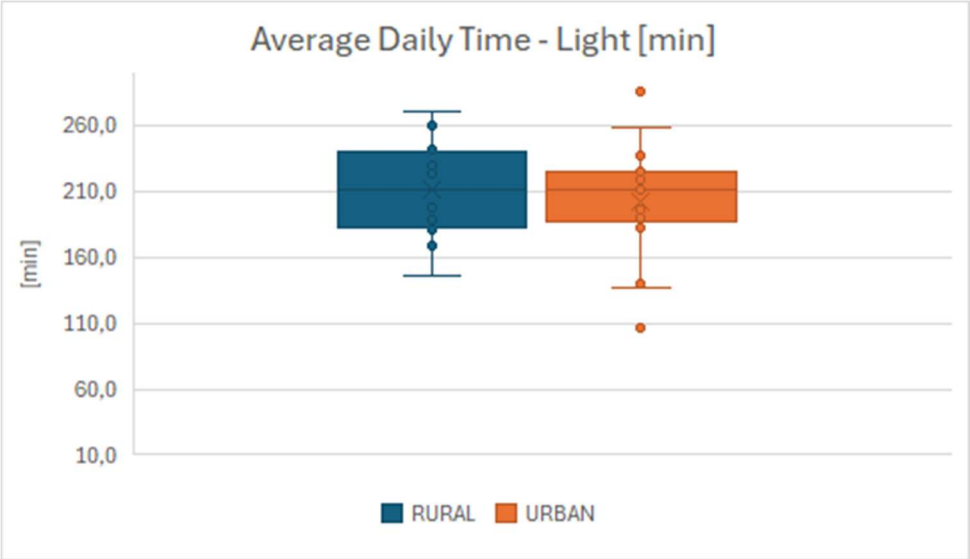
- **Average daily time in REM [min]**

	RURAL	URBAN	Unpaired Student's t-test
AVERAGE	58.3	67.2	
STD	14.6	24.6	p-value>0.05



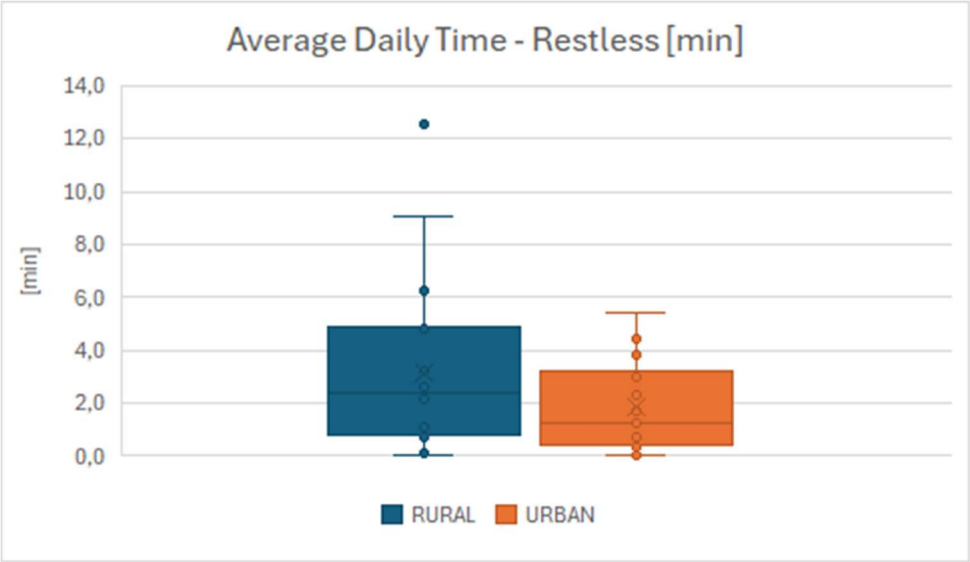
- **Average daily time light [min]**

	RURAL	URBAN	Unpaired Student's t-test
AVERAGE	211.6	203.0	
STD	34.1	41.2	p-value>0.05



- **Average daily time in restless [min]**

	RURAL	URBAN	Unpaired Student's t-test
AVERAGE	3.1	1.8	
STD	3.2	1.6	p-value>0.05



- **Average daily efficiency [min]**

RURAL	URBAN	Unpaired Student's t-test
91.9	91.2	
1.7	2.5	p-value>0.05

The Fitbit Inspire 3 offers sleep tracking features, providing insights into sleep quality and patterns. There are no statistically significant differences between rural and urban Maasai for all sleep parameters.

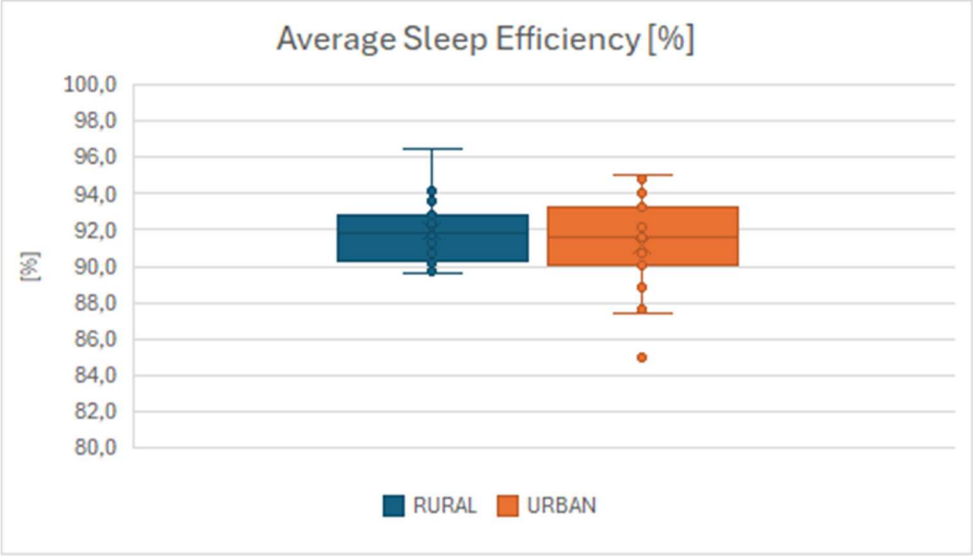
The rural group spend more average daily time in bed, asleep, awake (while in bed), in light sleep, in restless and have a better average sleep efficiency than the urbans (where both groups results in

high sleep efficiency (above 85-90% which indicates good sleep quality, meaning minimal wake periods by Fitbit).

The urban Maasai average daily time in deep and REM phases is higher than rurals.

Taking into consideration sleep patterns captured by Fitbit, I'd like to make a brief comparison with values averages according with the scientific community.

For example, according to the sleep foundation, if the usually recognized average night time is of 480 minutes duration (8 hours), rural and urban Maasai spend respectively 424.5 and 406.4 minutes in bed daily, with average daily time asleep of 370.5 min (6 hours 10.5 minutes) and 352.4 min (5 hours and 52.4 minutes) and an average daily time awake of 54 and 53.8 minutes (usual reference is 43-53 minutes). Regarding sleep stages, rural and urban Maasai presents the following percentages: light sleep covers 57.1% and 57.6% of total sleep time (where sleep foundation reference percentage is between 44-51% of total sleep time); deep sleep is 15.03% and 16.74% of total sleep time (references percentage is between 15-25% of total sleep) and REM is 15.7% and 19.1% of total sleep time (reference is among 20-25% of total sleep).



- **VO2max data**

	Rural Maasai males	Urban Maasai males	ACSM Average Male
Mean VO2 Max	60,46	43	29.9 - 55

SD VO2 Max	5,8	6,6	
	Rural Maasai females	Urban Maasai females	ACSM Average Female
Mean VO2 Max	45,33	34,5	27.9 - 49
SD VO2 Max	6,8	6,4	

Presented in this table a rundown of the average and SD of VO2 Max data for the two Maasai groups.

Given the smaller sample size for the urban group (only 5 people) and the fact that we have well accepted normative values from ACSM, the data shows that the rural Maasai males are almost exclusively in the "excellent" VO2 Max range and rural women are in the "Good"/Above Average" range.

These data show that a random sample of rural Maasai - receiving no special training but engaging in a non-sedentary lifestyle - had results above the 90th percentile of VO2 max.

The normative ranges alongside the values for rural Maasai vs. urban Maasai is taken from the book:

American College of Sports Medicine. (2022). ACSM's Guidelines for Exercise Testing and Prescription (11th ed.). Wolters Kluwer.

Additionally, the book breaks VO2 max into ranges

For WOMEN:

- *Excellent: ≥ 49.0*
- *Good: 44.0 - 48.9*
- *Above Average: 40.0 - 43.9*
- *Average: 36.0 - 39.9*
- *Below Average: 32.0 - 35.9*
- *Poor: 28.0 - 31.9*
- *Very Poor: ≤ 27.9*

And MEN:

- *Excellent: ≥ 55.0*

- *Good: 50.0 - 54.9*
- *Above Average: 45.0 - 49.9*
- *Average: 41.0 - 44.9*
- *Below Average: 37.0 - 40.9*
- *Poor: 30.0 - 36.9*
- *Very Poor: ≤ 29.9*

3) **OBJECTIVE THREE**: Quality-of-life status among rural and urban dwelling Maasai community members.

This study enrolled 38 participants with a mean age of 27.39 (±5.92) years, 24 (63.2%) were male, 14 (36.8%) females. 17 (44.7%) lived in urban areas and 21 (55.3%) in rural areas.

When quality of life was assessed, the mean for Domain 1 was 25.7 (± 3.048), Domain 2; 23.24 (± 2.353), Domain 3, 11.97 (± 1.98) and Domain 4, 24.76 (± 5.091).

Furthermore, we report a statistically significant difference in the responses of urban and rural dwelling participants on how they subjectively rate their quality of life (p=0.001), their feeling of life's meaningfulness (p=0.031), opportunities for leisure activities (p=0.024) and their satisfaction with personal relationships (p<0.001) as demonstrated on Table 1.

It has to be observed that this rating of quality of life was a subjective score as opposed to the domain rating which was objective in nature. Subjective responses are often biased by the study participants especially when they want to have a good standing in front of an interviewer.

Table 1: Summary of WHOQoL BREF Tool Responses based on participants area of residence.

			Residence		**p-value**
	WHOQoL Question		*Urban* n (%)	*Rural* n (%)	
	How would you rate your quality of life?[GL1]	Poor	0	1 (5.3)	**0.001**
		Neither poor nor good	3 (15.8)	5 (26.3)	
		Good	12 (63.2)	1 (5.3)	
		Very Good	4 (21.1)	12 (63.2)	

	How satisfied are you with your health?	Dissatisfied	1 (5.3)	1 (5.3)	0.367
		Neither Satisfied nor Dissatisfied	2 (10.5)	0	
		Satisfied	12 (63.2)	10 (52.6)	
		Very Satisfied	4 (21.1)	8 (42.1)	
	To what extent do you feel that physical pain prevents you from doing what you need to do?	An Extreme Amount	2 (10.5)	6 (31.6)	0.571
		Very much	4 (21.1)	2 (10.5)	
		A moderate amount	2 (10.5)	3 (15.8)	
		A little	6 (31.6)	5 (26.3)	
		Not at all	5 (26.3)	3 (15.8)	
	How much do you need any medical treatment to function in your daily life?	An Extreme Amount	1 (5.3)	4 (21.1)	0.478
		Very much	4 (21.1)	2 (10.5)	
		A moderate amount	1 (5.3)	3 (15.8)	
		A little	7 (36.8)	6 (31.6)	
		Not at all	6 (31.6)	4 (21.1)	
	How much do you enjoy life?	A little	1 (5.3)	1 (5.3)	0.134
		A moderate amount	7 (36.8)	5 (26.3)	
		Very much	9 (47.4)	5 (26.3)	
		Extremely	2 (10.5)	8 (42.1)	
	To what extent do you feel your life to be meaningful?	A little	0	1 (5.3)	**0.031**
		A moderate amount	1 (5.3)	0	
		Very much	6 (31.6)	13 (68.4)	
		Extremely	12 (63.2)	5 (26.3)	
			Residence		**p-value**
WHOQoL Question			*Urban* n (%)	*Rural* n (%)	
		Not at all	0	1 (5.3)	0.891

	How well are you able to concentrate?	A little	2 (10.5)	1 (5.3)	
		A moderate amount	3 (15.8)	4 (21.1)	
		Very much	10 (52.6)	8 (42.1)	
		Extremely	4 (21.1)	5 (26.3)	
	How safe do you feel in your daily life?	Not at all	1 (5.3)	0	0.189
		A little	5 (26.3)	3 (15.8)	
		A moderate amount	5 (26.3)	5 (26.3)	
		Very much	11 (57.9)	6 (31.6)	
		Extremely	1 (5.3)	5 (26.3)	
	To what extent do you have the opportunity for leisure activities?	Not at all	1 (5.3)	2 (10.5)	**0.024**
		A little	7 (36.8)	7 (36.8)	
		A moderate amount	8 (42.1)	1 (5.3)	
		Very much	3 (15.8)	5 (26.3)	
		Extremely	0	4 (21.1)	
	How well are you able to get around?	Very poor	1 (5.3)	0	0.350
		Poor	0	2 (10.5)	
		Neither poor nor good	3 (15.8)	5 (26.3)	
		Good	7 (36.8)	8 (42.1)	
		Very Good	8 (42.1)	4 (21.1)	
	How satisfied are you with your sleep?	Very dissatisfied	1 (5.3)	0	0.602
		Dissatisfied	1 (5.3)	0	
		Neither Satisfied nor Dissatisfied	1 (5.3)	2 (10.5)	
		Satisfied	11 (57.9)	9 (47.4)	
		Very Satisfied	5 (26.3)	8 (42.1)	
	How satisfied are you with your	Very dissatisfied	0	1 (5.3)	0.504
		Dissatisfied	1 (5.3)	1 (5.3)	

	ability to perform your daily living activities?	Neither Satisfied nor Dissatisfied	3 (15.8)	6 (31.6)	
		Satisfied	11 (57.9)	6 (31.6)	
		Very Satisfied	4 (21.1)	5 (26.3)	
	How satisfied are you with your capacity for work?	Dissatisfied	0	1 (5.3)	0.787
		Neither Satisfied nor Dissatisfied	3 (15.8)	3 (15.8)	
		Satisfied	9 (47.4)	8 (42.1)	
		Very Satisfied	7 (36.8)	7 (36.8)	
	How satisfied are you with yourself?	Dissatisfied	0	1 (5.3)	0.592
		Neither Satisfied nor Dissatisfied	2 (10.5)	3 (15.8)	
		Satisfied	10 (52.6)	6 (31.6)	
		Very Satisfied	7 (36.8)	9 (47.4)	
	How satisfied are you with your personal relationships?	Dissatisfied	0	2 (10.5	**<0.001**
		Neither Satisfied nor Dissatisfied	1 (5.3)	0	
		Satisfied	15 (78.9)	4 (21.1)	
		Very Satisfied	3 (15.8)	13 (68.4)	
					p-value
		WHOQoL Question	**Residence**		
			Urban n (%)	*Rural* n (%)	
		Very Dissatisfied	0	1 (5.3)	0.582
		Dissatisfied	1 (5.3)	2 (10.5)	

	How satisfied are you with your sex life?	Neither Satisfied nor Dissatisfied	2 (10.5)	4 (21.1)	
		Satisfied	10 (52.6)	6 (31.6)	
		Very Satisfied	6 (31.6)	6 (31.6)	
	How satisfied are you with the support you get from your friends?	Very Dissatisfied	1 (5.3)	1 (5.3)	0.523
		Dissatisfied	1 (5.3)	1 (5.3)	
		Neither Satisfied nor Dissatisfied	6 (31.6)	2 (10.5)	
		Satisfied	6 (31.6)	8 (42.1)	
		Very Satisfied	4 (21.1)	7 (36.8)	
	How satisfied are you with the conditions of your living place?	Very Dissatisfied	0	2 (10.5)	0.546
		Dissatisfied	2 (10.5)	4 (21.1)	
		Neither Satisfied nor Dissatisfied	3 (15.8)	3 (15.8)	
		Satisfied	11 (57.9)	7 (36.8)	
		Very Satisfied	3 (15.8)	3 (15.8)	
	How satisfied are you with your access to health services?	Very Dissatisfied	1 (5.3)	0	0.332
		Dissatisfied	3 (15.8)	8 (42.1)	
		Neither Satisfied nor Dissatisfied	3 (15.8)	3 (15.8)	
		Satisfied	11 (57.9)	7 (36.8)	
		Very Satisfied	1 (5.3)	1 (5.3)	
	How satisfied are you with your transport?	Very Dissatisfied	3 (15.8)	6 (31.6	0.080
		Dissatisfied	2 (10.5)	7 (36.8)	
		Neither Satisfied nor Dissatisfied	6 (31.6)	1 (5.3)	
		Satisfied	6 (31.6)	3 (15.8)	
		Very Satisfied	2 (10.5)	2 (10.5)	

	How often do you have negative feelings such as blue mood, despair, anxiety, depression?	Always	1 (5.3)	5 (26.3)	0.141
		Very Often	2 (10.5)	4 (21.1)	
		Quite Often	4 (21.1)	2 (10.5)	
		Seldom	10 (52.6)	4 (21.1)	
		Seldom	2 (10.5)	4 (21.1)	

There was a statistically significant mean untransformed and transformed Domain 3 scores for male and female participants. Male participants had a higher mean Domain 3 scores compared to females, with a raw and transformed mean difference of 1.429 (0.148, 2.709) and 8.976 (0.986, 16.966) respectively (Table 2).

The Maasai are a patriarchal society, and this could explain why male participants had a higher Domain 3 (social) score compared to their female counterparts. Culturally, Male Maasai's have a higher social standing than female Maasai (Towards a reconstruction of masculinity: A Kenyan Maasai perspective, Antony Mukasa, 2021).

Table 2: Comparison of Mean WHOQoL Domain Scores stratified by Sex (N=38)

WHOQoL	**Overall Mean**	**Male**	**Female**	**Mean Difference (95% CI)**	**p-value**
		Mean (SD)	Mean (SD)		
Domain 1 (Physical)	25.71 (3.048)	26.08 (3.08)	25.07 (2.99)	1.012 (-1.068, 3.092)	0.330
Domain 2 (Psychological)	23.24 (2.353)	23.5 (2.41)	22.78 (2.26)	0.714 (-0.895, 2.323)	0.374
Domain 3 (Social)	11.97 (1.979)	12.5 (1.98)	11.07 (1.69)	1.429 (0.148, 2.709)	**0.030**
Domain 4 (Environment)	24.76 (5.091)	24.83 (4.91)	24.64 (5.57)	1.735 (-3.3295, 3.710)	0.913

Domain 1 Transformed	135.82 (19.037)	138.21 (19.22)	131.71 (18.68)	6.400 (-6.485, 19.473)	0.317
Domain 2 Transformed	120.42 (14.718)	122.08 (15.15)	117.57 (14.02)	4.512 (-5.550, 14.574)	0.369
Domain 3 Transformed	50.03 (12.361)	53.33 (12.36)	44.36 (10.49)	8.976 (0.986, 16.966)	**0.029**
Domain 4 Transformed	129.95 (31.837)	130.38 (30.73)	129.21 (34.84)	1.16 (-20.850, 23.171)	0.915

There was no statistically significant mean untransformed and transformed WHOQoL Domain score differences between urban and rural dwelling pastoralists (Table 3).

Table 3: Comparison of Mean WHOQoL Domain Scores stratified by Residence

WHOQoL	Overall Mean	Urban	Rural	Mean Difference (95% CI)	p-value
		Mean (SD)	Mean (SD)		
Domain 1 (Physical)	25.71 (±3.048)	25.00 (±3.232)	26.42 (±26.42)	-1.421 (-1.421, 0.555)	0.153
Domain 2 (Psychological)	23.24 (±2.353)	22.89 (±2.158)	23.58 (±2.545)	-0.684 (-2.237, 0.868)	0.377
Domain 3 (Social)	11.97 (±1.979)	11.74 (±1.968)	12.21 (±2.016)	-0.474 (-1.784, 0.837)	0.468
Domain 4 (Environment)	24.76 (±5.091)	25.37 (±4.058)	24.16 (±6.002)	1.211 (-2.161, 4.582)	0.471
Domain 1 Transformed	135.82 (±19.037)	131.32 (±20.166)	140.32 (±17.192)	-9.000 (-21.330, 3.330)	0.147
Domain 2 Transformed	120.42 (±14.718)	118.32 (±13.408)	122.53 (±16.005)	-4.211 (-13.925, 5.504)	0.385

Domain 3 Transformed	50.03 (±12.361)	48.53 (±12.190)	51.53 (±12.677)	-3.000 (-11.183, 5.183)	0.462
Domain 4 Transformed	129.95 (±31.837)	133.74 (±25.326)	126.16 (±37.574)	7.579 (-13.504, 28.662)	0.471

The WHO Quality of Life (WHOQOL) tools have demonstrated good reliability and validity in African countries when culturally adapted and validated (Validation of Kiswahili version of WHOQOL-HIV BREF questionnaire among people living with HIV/AIDS in Tanzania- a cross sectional study, Nuru Abdallah Kondo et al., 2023).

While there are studies in Kenya using the WHO Quality of Life (WHOQoL) tools, most of these studies focus on specific populations such as patients with mental health issues or those seeking traditional and faith healing services. However, there is limited information available specifically on the use of WHOQoL tools in healthy individuals in Kenya.

The study "In the Company of Men: Quality of Life and Social Support Among the Ariaal of Northern Kenya, Benjamin C. Campbell & Peter B. Gray & Jason Radak, 2011" demonstrates its utility in distinguishing WHOQoL between nomadic and settled groups, making it a viable tool for similar populations. Results have shown that while reported quality of life declined significantly across age groups in both sub-populations, nomadic males reported significantly higher overall quality of life than did settled males. Support from other males, but not marital status, was a significant predictor of quality of life, controlled for age group and residence.

3.14 OVERALL DISCUSSION

This study initially enrolled 41 participants, with a total mean age of 27.8 (±5.52) years.

26 subjects (63.4%) were male, 15 (36.6%) were females. 21 people (51.1) lived in rural areas and 20 (48.9%) lived in urban areas, with 3 dropouts (1 from rurals, 2 from urbans).

From the body composition analysis, we can observe that the rural Maasai population is characterized by a statistically significant healthier profile (lower BMI, waist and hip circumference, body fat, visceral fat, metabolic age, segmental body fat percentage, and higher body water percentage and physique rating) than the urban Maasai.

Another study (**Obesity and regional fat distribution in Kenyan populations: impact of ethnicity and urbanization** Dirk L Christensen et al., 2008) found that abdominal visceral and subcutaneous fat thickness was higher with urban residency.

Moreover, rural Maasai showed healthier physiological indicators than their rural counterparts, with statistically significant lower DBP, a higher SpO2 (statistically significant sex adjusted for males). Regarding activity tracking, rural Maasai have shown a statistically significant higher daily calories expenditure, daily distance and daily time of very active intensity, lower daily heart rate and heart rate at rest.

Regarding the VO2 max data, rural Maasai shows better score than the urban Maasai (statistical significance couldn't be assessed because of the limited number of subjects tested) with a very high cardiorespiratory efficiency.

WHOQOL shows statistically significant difference in the subjective rate of quality of life (rurals higher score than urbans), feeling of life's meaningfulness (urban with a higher score than rurals), opportunities for leisure activities (higher score for rurals) and their satisfaction with personal relationships (higher score for rurals), where in domain 3 (social relationships) male participants had a higher mean Domain 3 scores compared to females.

Regarding the activity tracking of the two cohorts, Fitbit categorizes activity levels based on Active Zone Minutes (AZMs), which measure how much time a person spends in fat burn (50–69% of maximum heart rate), cardio (70–84% of maximum heart rate), or peak heart rate zones (>85% of maximum heart rate). According to Fitbit, a "very active" minute is defined as activity registering at greater than or equal to 6 METs (Metabolic Equivalent of Task) or greater than or equal to 145 steps per minute, sustained for at least 10 minutes (Comparison of Physical Activity Measures Derived From the Fitbit Flex and the ActiGraph GT3X+ in an Employee Population With Chronic Knee Symptoms Pamela Semanik et al., 2019). This level of activity corresponds to vigorous-intensity exercise (such as running, fast cycling, or high-intensity sports).

A **MET (Metabolic Equivalent of Task)** is a unit used to measure the intensity of physical activities by comparing the energy expenditure during an activity to the energy expended at rest. **1 MET** is the energy spent while sitting quietly at rest (equivalent to consuming **3.5 milliliters of oxygen per kilogram of body weight per minute** or burning about **1 kcal/kg/hour)**. Physical activity that burns 3 to 5.9 METs is moderate intensity. Physical activity that burns 6.0 METs or more is vigorous intensity.

As per our research data, the rural Maasai group can spend an average daily time as Very Active of 28 minutes (per day), while the urban Maasai of 8 minutes (per day).

As per WHO recommendations (based on extensive research showing that regular physical activity contributes to better health outcomes and reduces risks associated with sedentary behavior), regular physical activity can prevent and help manage heart disease, type-2 diabetes, and cancer

which cause nearly three quarters of deaths worldwide. Physical activity can also reduce symptoms of depression and anxiety, and enhance thinking, learning, and overall well-being.

The World Health Organization (WHO) provides evidence-based guidelines for physical activity across different age groups, emphasizing both aerobic exercise and muscle-strengthening activities. Below are the key recommendations from the 2020 WHO Guidelines on Physical Activity and Sedentary Behaviour. For health and wellbeing, WHO recommends at least 150 to 300 minutes of moderate aerobic activity or 75–150 minutes of vigorous-intensity aerobic physical activity per week, or an equivalent combination of both for all adults, and an average of 60 minutes of moderate aerobic physical activity per day for children and adolescents. With a specification: physical activity can be done as part of work, sport and leisure or transport (walking, wheeling and cycling), as well as every day and household tasks.

The rural Maasai group, with 28 minutes of very active zone tracked (vigorous-intensity physical activity), which corresponds to 196 minutes/week, exceeds the basic threshold of recommended physical activity by WHO of 75-150 min per week, while the urban Maasai group physical activity vigorous intensity level (8min/day and 56min per wk.) falls behind the recommended range.

WHO reports that 31% of world's adults population - 1.8 billion adults *(*National, regional, and global trends in insufficient physical activity among adults from 2000 to 2022: a pooled analysis of 507 population-based surveys with 5·7 million participants *Tessa Strain et al., 2024)* are physically inactive. That is, they do not meet the global recommendations of at least 150 minutes of moderate-intensity physical activity per week. With an increase of 5 percentage points between 2010 and 2022. If this trend continues, the proportion of adults not meeting recommended levels of physical activity is projected to rise to 35% by 2030.

Even 80% of adolescents (Global trends in insufficient physical activity among adolescents: a pooled analysis of 298 population-based surveys with 1·6 million participants Regina Guthold et al. 2020) globally do not meet the recommended levels of physical activity (at least 150 minutes of moderate-intensity physical activity per week).

Finally, as per WHO, the global estimate of the cost of physical inactivity to public health care systems between 2020 and 2030 is about US$ 300 billion (approximately US$ 27 billion per year)

if levels of physical inactivity are not reduced.

Image 20. WHO infographics for physical activity

The World Health Organization (WHO) guidelines address physical activity even for people with chronic conditions by emphasizing the importance of regular activity tailored to individual abilities and health status. Regular physical activity helps manage symptoms, improves functional capacity, and enhances overall health outcomes, independence and quality of life including reduced risks of cardiovascular diseases, diabetes, and mental health issues.

Habitual physical activity and cardio-respiratory fitness (CRF) are important regulators of metabolism and major determinants of modern lifestyle diseases such as Type 2 diabetes and cardiovascular disease (Gill et al.,2006; Helmrich et al.,1991). Several studies have reported a reduction in CRF among ethnic groups in different continents as a consequence of a shift from traditional to more modern lifestyle (Celis-Morales et al.,2011; Ekblom and Gjessing,1968; Rode and Shephard,1984).

The lifestyles shift happening in Kenya has been observed by other studies such as (Emerging Evidence of the Physical Activity Transition in Kenya, Vincent Ochieng Onywera, 2012) where RKEN (rural) children were more physically active than their Urban (UKEN) counterparts with a

mean average steps per day (± SE) of 14,700 ± 521 vs. 11,717 ± 561 (P < .0001) for RKEN vs. UKEN children respectively.

Another study (Segmented physical activity and sedentary behavior patterns among children in Maasai village and Nairobi city. Tetsuhiro Kidokoro et al., 2021) where a comparison between those who maintain traditional lifestyles such as pastoralist Maasai children, and those who live in cities such as Nairobi, found that Maasai children were more physically active than Nairobi children with MVPA - moderate to vigorous physical activity - (min/day) of 166.6 and 81.4 for Maasai and Nairobi boys and 116.4 and 77.4 for Maasai and Nairobi girls, respectively. Furthermore, Maasai children were more active both in and out of school than Nairobi children. There was no significant difference in sleep duration between Maasai and Nairobi children. As per the authors of the study, these findings suggest that urbanization is negatively associated with activity patterns both in and out of school in Kenyan children. This is concerning given that Kenya is currently undergoing rapid urbanization, which may lead to further reductions in PA among Kenyan children.

Shifting the territory, I'd like to mention about another study in the pastoralist community of Tuvan (south-central Siberia, Russia) found that the Tuvan pastoralists were more physically active compared to western populations (609 ± 90 min/day of light, moderate, and vigorous physical activity).

Moreover, the study (Cardiorespiratory fitness and physical activity in Luo, Kamba, and Maasai of rural Kenya, D.L. Christensen et al., 2012), found out that physical activity levels among rural Kenyan adults are high, with highest levels observed in the Maasai and Kamba than Luo tribe. In combination with other changes in lifestyle, age-related declines in physical activity and CRF, especially in the Maasai and in the men, this may increase the risk of noncommunicable diseases in rural populations of low income.

It is also interesting to citate about the study by Xiaojie Tian et al. (2021), *"Sociocultural Dimensions of Children's Physical Activity in Contemporary Pastoralist Maasai Society,"* explores how children's physical activity (CPA) among the Maasai pastoralist community is deeply embedded in sociocultural practices beyond just physical exertion. For example, activities such as herding, hunting, and household chores teach children about survival, responsibility, and Maasai traditions. Hence, Understanding CPA from a cultural perspective challenges Western-centric models of physical activity that focus purely on fitness. Moreover it suggests that policy and educational programs should consider the cultural contexts.

This study sustains the thesis for which the current WHO guidelines regarding suggestions for the improvement of children's inactivity, for instance, are usually based on the findings in Western

and industrialized nations. Under this situation, the diverse conditions of children in small-scale societies have largely been overlooked. This omission may induce inadequate physical educational program design at both the national and international levels. Adapting and implementing national or international education policies in these less investigated societies without knowing the CPA conditions outside of school may have an unexpected negative influence on these children—not only in terms of their health but also their ability to gain sociocultural competence in local skills and knowledge. In conclusion, it is recommended that more attention be paid to the sociocultural dimensions of CPA in less investigated societies, through detailed ethnographic observations of children's daily lives both in and outside of school.

In the end. just to citate a study far back in time (Maximal Muscular Power (Aerobic and Anaerobic) in African Natives, Di Prampero, Cerretelli, 1969) showed that the body fat percentage is significantly lower in African natives, particularly in children; the maximal aerobic power, when expressed per kg of fat-free body weight, is not significantly different among different ethnic groups; the maximal anaerobic power is lower in African natives, possibly because of a different anatomy and geometry of the lower limb muscles.

Considering the broad and specific objectives of the research project, possible associations between parameters will be discussed in the manuscript co-writing among the Icahn School of Medicine at Mount Sinai and Moi University, as one the future developments among partners. Moreover, our further studies regarding the pastoralist communities in Kenya could consider **seasonal patterns** (assess activity/diet across dry and wet seasons), longitudinal trends (monitor health outcomes as lifestyles modernize) and genetic-environment interactions (clarify how genetic traits interact with diet and activity). Since this was a pilot research initiative, it will be interesting to compare in the near future a larger number of Maasai living in rural and urban areas, in order to show with a stronger evidence the effect that lifestyle can have on different health indicators, and to compare those findings with health and lifestyle parameters of western societies groups (this is currently under examination to increase the magnitude of this scientific action).

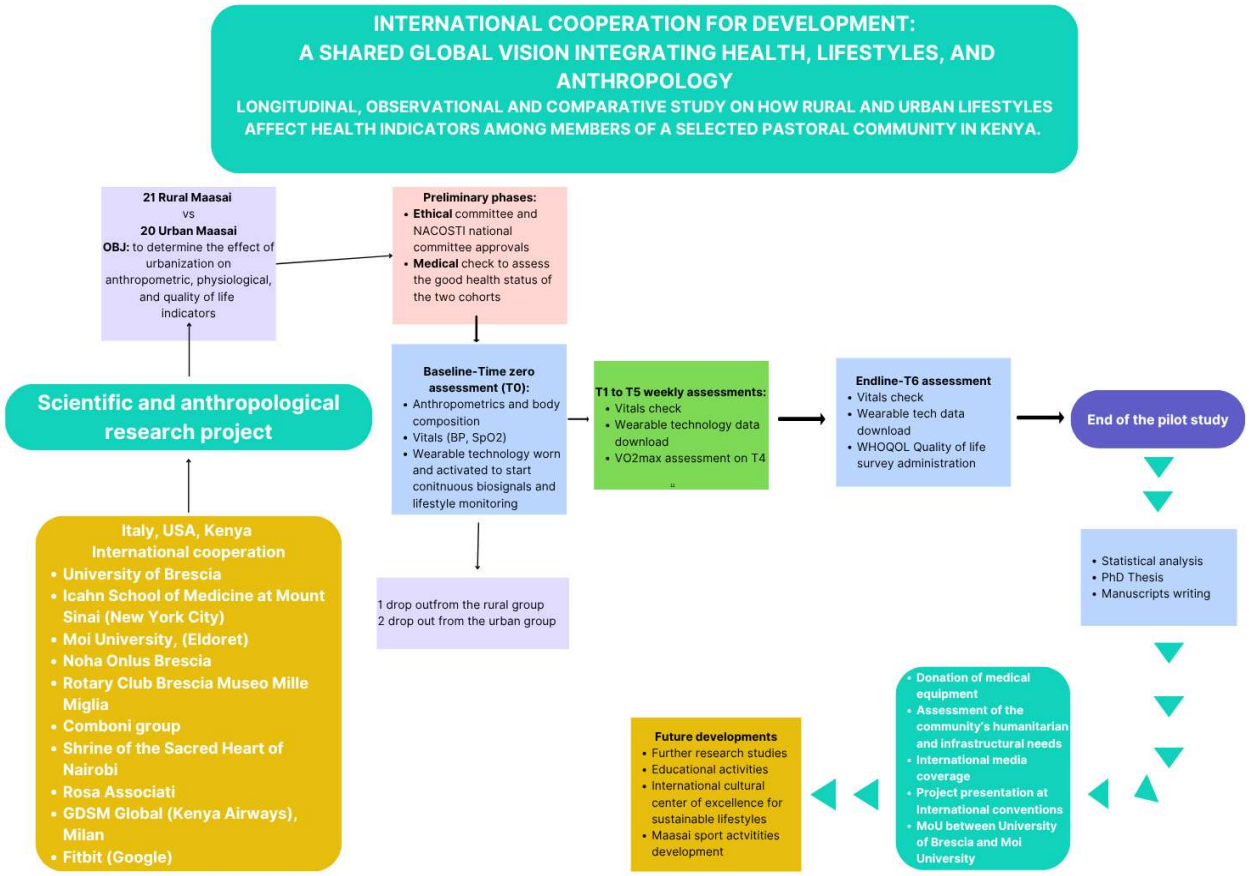


Image 21. Flowchart of activities for the research project

3.15 Conclusions and limits of the study

This study objectively explored a unique combination of health indicators, anthropometric data, physical activity, oxygen consumption, and quality of life among people living in an extremely remote area of Kenya.

The small number of subjects due to the non-optimal logistic conditions of the territory has certainly represented one of the limitations of this pilot-pragmatic study. Future studies including larger cohorts of subjects as well as with a more accurate assessment of control variables and confounders is recommended. Potential biases of the study related to data collection (due to the choice of the appropriate technological tools, lack of resources, sub-optimal standardized conditions) will be further investigated.

This research project is a scientific and anthropological initiative in the field of Global Health, resulting from an international collaboration of faculty and researchers from academic institutions, businesses, and third-sector entities.

Global Health aims to improve the bio-psycho-social well-being of populations by integrating scientific and cultural disciplines to promote quality of life, equity, and healthcare accessibility.

Given the extreme remoteness of the location and the uniqueness of the background, the project design followed a pragmatic, participatory approach.

Pragmatic because out of the lab, and as per definition of the “Enyclopedia of research design” because involved research designs that incorporate operational decisions based on 'what will work best' in finding answers for the questions under investigation and this enables pragmatic researchers to conduct research in innovative and dynamic ways to find solutions to research problems. This leads to research inquiry, which seeks to better understand and ultimately solve the problem. Finally, the research findings often result in policy suggestions, new environmental initiatives, or social change.

Participatory, because engaged community stakeholders (researchers, professionals, community members) in the research process, from problem identification and developing the research question, to dissemination of results (NIH). The use of a participatory research approach enables the integration of stakeholder perspectives and research on questions prioritized by communities that are often not considered by researchers.

The objective of monitoring a range of health indicators related to lifestyle—cornerstones of psychophysical well-being and the prevention of chronic disease risk factors—provided an opportunity to explore a new dimension of daily behaviors and their impact on both individual and collective health.

Beyond the research itself, the goal was to bridge Western knowledge on health, well-being, and longevity with the traditional wisdom of African native cultures. This approach aimed to uncover valuable insights and bring ancient knowledge to light, fostering cross-cultural understanding of natural lifestyles that could contribute to the pursuit of health.

This effort can serve as a contribution to a model for psychophysical well-being, inspiring global awareness of the importance of diverse lifestyles—such as those of indigenous communities—for holistic health and environmental sustainability. Moreover, it seeks to highlight the value and human potential of a marginalized population in Kenya.

The project took place in Nanyuki, a town at the foothills of Mount Kenya, a region of pristine beauty and extraordinary natural biodiversity. It was an immersive cultural and social experience, delving into the ancestral roots of the indigenous Maasai community. Beginning with the fundamental values of listening and caring for their community, trying to understand their social dynamics, opinions, and expectations was essential to gaining genuine insight into their world.

Indigenous peoples, as custodians of millennia-old knowledge rooted in sharing and harmony with nature, play a vital role in ecosystem preservation, climate change mitigation, and sustainability—factors essential to the survival and prosperity of our planet.

Their daily habits have been the subject of past and present studies from multiple perspectives, including their diet, movement, and social interactions—all of which offer valuable lessons for the modern world.

As per UNEP (United Nations Environment Programme), There's a growing realization among environmental advocates that the spread of indigenous practices is also crucial to the planet's future. An emerging body of research suggests that traditional techniques, some millennia old, for growing food, controlling wildfires and conserving endangered species could help arrest the dramatic decline of the natural world. In the Democratic Republic of the Congo, for example, the Bambuti-Babuluko community is helping to protect one of Central Africa's last remaining tracts of primary tropical forest. In Iran, the semi-nomadic Chahdegal Balouch oversee 580,000 hectares of fragile scrubland and desert. And in Canada's far north, Inuit leaders are working to restore caribou herds, whose numbers had been in steep decline. In areas like Australia and South America, indigenous land management, including slow-burning and purposefully set brush fires are considered key to preventing large-scale wildfires, which in many places could become more common as the climate becomes hotter and drier.

By learning from indigenous daily practices, societies can move toward a more sustainable, respectful, and health-conscious way of living. Their time-tested wisdom offers practical solutions for today's environmental and social challenges.

Indeed, healthy lifestyles and sustainability are closely linked, as many choices that benefit personal health also contribute to environmental and social well-being.

For example, physical activity and sustainable lifestyles are closely interconnected, as movement choices impact both personal well-being and environmental health.

It is well recognized that engaging in active transportation, such as walking, cycling, or using public transit, reduces reliance on fossil fuels, leading to lower carbon emissions and improved air quality. This shift not only benefits the planet but also enhances physical health by reducing the risk of obesity, heart disease, and other lifestyle-related conditions.

Regular physical activity in outdoor spaces, such as parks and green areas, promotes mental well-being while fostering a deeper connection with nature. All these physiological and mental effect are well proven by science.

This awareness often encourages environmentally responsible behaviors, such as conservation efforts and reduced waste.

Additionally, communities that invest in pedestrian-friendly infrastructure, bike lanes, and green spaces create healthier, more sustainable urban environments. These changes reduce traffic congestion, noise pollution, and the environmental impact of motorized transport.

Spending time in green spaces, gardening, and outdoor activities support mental health and encourage conservation efforts.

By incorporating movement into daily routines, individuals contribute to a more sustainable world while improving their overall health and quality of life.

This theme is related to the topic of fitness, which means “the quality of being suitable to fulfil a particular role or task”, and recently related to “a state of health and well-being and, more specifically, the ability to perform aspects of sports, occupations, and daily activities”.

There are indeed health-related components of fitness which are essential for general well-being and disease prevention:

1. Cardiorespiratory Endurance – The ability of the heart, lungs, and blood vessels to efficiently supply oxygen to muscles during prolonged physical activity (e.g., brisk walking, jogging, swimming).
2. Muscular Strength – The maximum force a muscle or group of muscles can exert (e.g., lifting heavy objects, push-ups, resistance training).
3. Muscular Endurance – The ability of muscles to perform repeated contractions over time without fatigue (e.g., cycling, bodyweight exercises).
4. Flexibility – The range of motion around a joint, which helps prevent injuries and improve movement efficiency (e.g., stretching, yoga).

5. Body Composition – The ratio of fat mass to lean body mass (muscle, bone, water), which influences overall health and fitness levels.

A healthier, fitness equipped population means lower healthcare demands, which translates into less resource use, medical waste, and energy consumption.

Another important aspect related in the health dimension is the one of chronic inflammation.

Although intermittent increases in inflammation (the natural defense of our immune system) are critical for survival during physical injury and infection, recent research has revealed that certain social, environmental and lifestyle factors (i.e. sedentarity, unhealthy diets, smoking, stress) can promote systemic chronic inflammation - which biomarkers represent a shared feature of metabolic, psychiatric, and neurodegenerative diseases - that can, in turn, lead to several diseases that collectively represent the leading causes of disability and mortality worldwide, such as cardiovascular disease, cancer, diabetes mellitus, chronic kidney disease, non-alcoholic fatty liver disease and autoimmune and neurodegenerative disorders (Chronic inflammation in the etiology of disease across the life span David Furman et al.,2019).

A linked aspect to chronic inflammation is stress: any intrinsic or extrinsic stimulus that evokes a biological response is known as stress. The compensatory responses to these stresses are known as stress responses. Based on the type, timing and severity of the applied stimulus, stress can exert various actions on the body ranging from alterations in homeostasis to life-threatening effects and death. In many cases, the pathophysiological complications of disease arise from stress and the subjects exposed to stress, e.g. those that work or live in stressful environments, have a higher likelihood of many disorders. Stress can be either a triggering or aggravating factor for many diseases and pathological conditions (The impact of stress on body function: A review, Habib Yaribeygi at al., 2017).

While there has been a growing number of evidence supporting that inflammatory response constitutes the “common soil” of the multifactorial diseases, including cardiovascular and metabolic diseases, psychotic neurodegenerative disorders and cancer (Scrivo et al., 2011), accumulating researches suggested that excessive inflammation plays critical roles in relationship between stress and stress-related diseases (CVD, metabolic diseases, depression, neurodegenerative diseases, cancer (Inflammation: The Common Pathway of Stress-Related Diseases,Yun-Zi Liu et al., 2017).

According to WHO, 60% of related factors to individual health and quality of life are correlated to lifestyle (The WHO cross-national study of health behavior in school-aged children from 35 countries: findings from 2001-2002) which have a relevant impact on health risk factors, levels of

inflammation and disease onset, working as enablers of prevention and promotion strategies for health (reducing hospitalizations and burden on health system).

As per WHO, Health prevention can be described as:

Primary prevention, that refers to actions aimed at avoiding the manifestation of a disease (this may include actions to improve health through changing the impact of social and economic determinants on health; the provision of information on behavioral and medical health risks, alongside consultation and measures to decrease them at the personal and community level; nutritional and food supplementation; oral and dental hygiene education; and clinical preventive services such as immunization and vaccination of children, adults and the elderly, as well as vaccination or post-exposure prophylaxis for people exposed to a communicable disease).

Secondary prevention deals with early detection when this improves the chances for positive health outcomes (this comprises activities such as evidence-based screening programs for early detection of diseases or for prevention of congenital malformations; and preventive drug therapies of proven effectiveness when administered at an early stage of the disease).

Health promotion is the process of empowering people to increase control over their health and its determinants through health literacy efforts and multisectoral action to increase healthy behaviors. This process includes activities for the community-at-large or for populations at increased risk of negative health outcomes. Health promotion usually addresses behavioral risk factors such as tobacco use, obesity, diet and physical inactivity, as well as the areas of mental health, injury prevention, drug abuse control, alcohol control, health behavior related to HIV, and sexual health.

Wearable technologies may play a significant role in supporting health by providing real-time data and insights that help individuals monitor and manage their well-being. By continuously collecting and analyzing health data, wearables empower individuals to be aware of useful indicators (heart rate, steps taken, distance travelled, calories burned, sleep, temperature, respiratory rate, blood pressure, oxygen saturation, etc), to boosts possible behavioural changes (i.e. through biofeedback) in their level of activity, dietary habits, stress management and rehabilitation with personalized insights and recommendations for the improvement of overall health and well-being.

The potential for wearable technology (fitness trackers, medical wearables, smart clothing devices, augmented reality devices, etc) to assist with health care, which has received recognition from health systems around the world (i.e. in the Long Term Plan shared by the National Health Service in England), can support health management in monitoring and diagnosis (ranging from Covid infection to cardiovascular health), treatment and therapy (via alerts for patients and continuous remote observation for clinicians), disease surveillance and clinical research.

Health prevention and promotion have a profound impact on some health parameters which are briefly described below.

In global health and epidemiology, Years of Life Lost (YLL), Years Lived with Disability (YLD), and Disability-Adjusted Life Years (DALY) are essential metrics for measuring the burden of diseases and injuries. These indicators help quantify the impact of premature mortality and non-fatal health conditions on populations. YLL represents the number of years lost due to premature death compared to a standard life expectancy (where YLL is particularly useful for assessing diseases with high mortality rates, such as cardiovascular diseases, cancers, and infectious diseases). YLD measures the years spent living with a disability or disease, adjusted for severity (mainly used to evaluate non-fatal conditions like mental disorders, musculoskeletal diseases, and chronic respiratory diseases. DALY is the sum of YLL and YLD, providing a comprehensive measure of disease burden. It quantifies the overall impact of diseases by combining premature death and years spent with illness or disability. DALYs are widely used in global health studies, particularly in the Global Burden of Disease (GBD) studies by the World Health Organization (WHO) and the Institute for Health Metrics and Evaluation (IHME), useful in setting public health priorities, allocating resources, and comparing the burden of different diseases across populations and time periods.

According to ISS (Istituto Superiore di Sanità) - a technical-scientific body of the National Health Service in Italy, performs research, experimentation, control, advisory, documentation and training functions in the field of public health - lifestyle choices are the main opportunity for protection or, modifying risk with respect to one's own well-being and the onset of chronic pathologies and are most important for diseases that impact mortality and health expenditure. And it is important to report that the importance of healthy lifestyle choices (proper diet, taking physical exercise, improving the quality of sleep, limiting smoking and alcohol consumption, nurturing positive relationships within the family) to improve physical and mental health have been also underlined by major health institutions during the COVID-19 pandemics, where co-morbidities have had an influence on the clinical outcome. Infact, co-existing diseases, such as cardiovascular disease, cancer, diabetes, and others, have been shown to make patients more vulnerable to severe outcomes from COVID-19 by modulating host–viral interactions and immune responses, causing severe infection and mortality. (COVID-19 and Preexisting Comorbidities: Risks, Synergies, and Clinical Outcomes, Banafsheh Bigdelou et al.)

In support of the importance of healthy lifestyles, the study named “Long-Term Leisure-Time Physical Activity Intensity and All-Cause and Cause-Specific Mortality: A Prospective Cohort of US Adults (Dong Hoon Lee et al., 2022)” analyzed 116,221 adults from two large US cohorts over

30 years (1988–2018) to assess the relationship between long-term leisure-time physical activity (both moderate and vigorous) and mortality. The findings suggested that individuals who met or exceeded the recommended physical activity guidelines (The 2018 physical activity guidelines for Americans recommend a minimum of 150 to 300 min/wk of moderate physical activity, 75 to 150 min/wk of vigorous physical activity, or an equivalent combination of both) had significantly lower risks of all-cause, cardiovascular, and non-cardiovascular mortality.

In conclusion, following the observation period, the research incorporated the beginning of several parallel activities to promote awareness of these themes, including:

- **Interactive training and literacy sessions** on health and well-being promotion, aimed at empowering individuals to take greater control over their health and its determinants through health literacy efforts and multisectoral initiatives to encourage healthy behaviors.
- **The donation of medical equipment**, including wearable technologies for measuring vital parameters.
- **An assessment of the community's humanitarian and infrastructural needs.**

It is also important to highlight that this lifestyle assessment has served as a foundation for future initiatives aimed at fostering widespread and sustainable impact, including but not limited to:

- **Promoting education and training for community empowerment**, covering topics such as health, sustainable lifestyles, human rights, global citizenship, and the United Nations Sustainable Development Goals (SDGs).
- **Organizing conferences and public outreach events** to raise awareness and encourage dialogue.
- **Establishing twinning and cooperation agreements between cities** to promote systemic actions aligned with integral human development and the concept of "care for our common home."
- **Enhancing local talents, particularly in sports**, which holds significant potential for social empowerment and transformation. The Maasai are renowned for their exceptional physical strength and endurance, a result of their active lifestyle and deep connection with natural rhythms. Exploring and developing these abilities—an area still largely uncharted—presents opportunities for innovation and long-term growth.

Additionally, an important milestone thanks to this research project was the establishment of a **Memorandum of Understanding between the University of Brescia and Moi University**, creating a bridge between institutions and countries to foster collaboration in knowledge exchange, teaching, research, and international mobility programs.

4. GENERAL CONCLUSIONS AND FUTURE PERSPECTIVES

When my American colleague and I first stepped through the low doorway of a Maasai house—built from wooden poles, leaves, mud, and cow dung—we immediately understood how different life can feel without modern comforts. No ready-made food, no internet, no running water or electricity.

We had ventured deep into the heart of the Kenyan savannah, where an incredible silence was only occasionally broken by the whistling wind, the laughter of children, or the sounds of animals.

The intensity of this experience, near the geographical frontiers of the world, made us feel as though we were traveling through both space and time. It sparked deep reflection within us, expanding our perspectives and making us question whether our Western way of living was truly right, sustainable, or authentic.

We asked ourselves: Do we, as Europeans and Americans, need to rethink and transform our lifestyles? Should we strive to live in a more creative and genuine way—more connected to others and more in harmony with the natural world?

On a broader scale, this feeling can be understood through the lens of the **Overview Effect**—a cognitive shift in awareness reported by astronauts when they view Earth from space. The term was coined by Frank White in his 1987 book *The Overview Effect: Space Exploration and Human Evolution*. Many astronauts, including Edgar Mitchell, Chris Hadfield, and Yuri Gagarin, have described this experience as life-changing.

From orbit or the Moon, astronauts witness Earth as a single, fragile entity without borders or divisions. They experience a profound sense of unity and interconnectedness, coupled with awe at the planet's beauty and vulnerability.

In a similar way, that is how we felt. Differences and distances faded away—we were simply human beings, sharing the same space.

It made us reflect on the choices we make every day: the resources we consume, the impact of our lifestyle on our health, on the communities around us, on other countries, and on the planet itself. How can we take care of personal and community well-being while aligning it with ecological responsibility, global justice, and the protection of our planet? How can we open new pathways that reconnect us to a state of purity—one that rekindles our sense of wonder and appreciation for beauty? How can we safeguard human, social, and natural capital for future generations?

Technology for health can play a key role in addressing these challenges. One idea that emerged during our initiative was the creation of a **Well-Being Innovation Platform**—an interactive tool designed to collect and share data and best practices on healthy lifestyles. This platform would

provide **open access** to valuable information for sustainable development, benefiting both the general population and decision-makers. This would represent in my opinion a powerful, cost-effective investment for a healthier, happier future for all.

Such an initiative could foster cross-cultural dialogue on how different societies perceive health and well-being, strengthening international awareness and social cohesion around fundamental topics like physical activity, nutrition, and stress reduction—always with sustainability in mind.

A shared space to preserve ancient wisdom, promote intergenerational learning on health, and amplify the voices of those on the margins—ensuring a common ground for communities. A space that prioritizes long-term thinking over short-term gains, fostering global solidarity and friendship through the lens of lifestyle choices.

"We did not listen to the cry of the poor, nor of our ailing planet. We carried on regardless, thinking we would stay healthy in a planet that was sick (Pope Francis, Urbi et orbi)". Pope Francis

I believe that, as a global community, we must exchange knowledge—for example with lifestyles—to cultivate a deeper awareness of our inner, unlimited potential in preserving our own health. In doing so, we also safeguard the health and beauty of the planet we call home.

The "human functioning" health approach, recent a concept highlighted by WHO can support this vision, also explained by the World economic forum in one of his publications called The human functioning revolution: implications for health systems and sciences by Jerome Bickenbach et.al

Human functioning refers to the economy of well-being. It is based on the idea that long-term, sustainable economic growth can be achieved by cultivating individual well-being. In other words, a society that prioritizes good education, healthcare, equality, and social support systems is more likely to prosper, also according to the world economic forum article named Why re-defining health will boost the economy.

Human functioning is a rethinking of health that goes beyond disability and disease. It encompasses people's biological health as well as their 'lived health' – their ability to perform daily activities from eating and personal care to working and socializing.

That's one strategy to support the thesis by which cultivating individual well-being on a large scale could enhance productivity and innovation, social cohesion and relationships, public health and well-being, economic growth and stability, environmental and technological advancements, cultural and artistic flourishing. That can truly transform our society, contributing to global development.

I believe that to restore harmony within our societies and between humanity and the environment, we must revolutionize the narrative around global health—bringing back to the center those who are at risk of being forgotten or excluded.

A new international approach that truly values the human factor—one that prioritizes meaningful, human-centered relationships as the foundation for values and motivation—can be a catalyst for real change, sparking a shift toward a more inclusive and sustainable future.

Ultimately, through this methodological approach, can we uncover universal principles for health and well-being, especially in a progressively ageing society, preserving the quality of life before quantity when talking about longevity?

Can we integrate science and technology with an anthropological approach—one that values the cultural identity of the populations studied, empowers people through education, and fosters human development by building healthy, resilient, and inclusive communities?

Can we create new spaces for action that weave international relations with a sense of care for others, ultimately pursuing the common good through a shared culture that unites nations around healthy and sustainable lifestyles?

Can we move beyond competition and dominance—the divide between the Global North and South—toward cooperation that unlocks the full potential of humanity? Can we inspire a culture of self-care, a commitment to something greater than ourselves, a culture of wonder, and an awareness of the beauty within us and in the world around us?

Can we shift from a society that simply treats illness to one that actively keeps people physically and mentally healthy (a strategic investment), encouraging them to live more active and fulfilling lives?

If cooperation is understood as the awareness of being part of a larger, interconnected system, then it is not merely a strategy, but it can be seen as the very foundation of existence itself.

4.1 Appendix - publications and main conferences

List of newspaper articles related to the research project.

Venerdì di Repubblica (National Italian Newspaper), Gazzetta dello sport (National It), Giornale di Brescia (local It), Bresciaoggi (local It), Malindi Kenya (local Ke).

List of Manuscripts

1. Four months daily Rifampicin compared to three months daily "Rifampicin/Isoniazid for the treatment of tuberculosis infection in asylum seekers, Matteelli et al., Clinical Microbiology and Infection, European Society of Clinical Microbiology and Infectious Diseases, https://doi.org/10.1016/j.cmi.2025.02.037
2. Cascade of care for TB infection in persons newly diagnosed with HIV in Italy, Matteelli et al., Int J Tuberc Lung Dis. 2024 Nov 1;28(11):557-559. doi: 10.5588/ijtld.24.0209.
3. Going to the source, CAI - Club Alpino Italiano (Italian Alpine Club) 2024, Di Rosario.
4. Screening for tuberculosis infection among migrants: a cost-effectiveness analysis in the Italian context, Matteelli et al., *Antibiotics* 2023, *12*(4), 631; https://doi.org/10.3390/antibiotics12040631
5. Manuscript: COVID-19 effect on TB presentation and outcome, The International Journal of Tuberculosis and Lung Disease, Matteelli et al., 2022 Apr 1;26(4):375-377. doi: 10.5588/ijtld.22.0036.

Other publications:

- Article "Mutual learning nella collaborazione scientifica tra Università: il progetto UNITAFRICA", di Sabrina Sorlini, Gianluca Di Rosario e Pius Peter Mgeni – volume INTERCULTURAL SERVICE LEARNING: Educare alla cittadinanza globale
- Article "Andare alla sorgente", all'interno della rivista CAI Brescia Adamello, anno 2024
- Article "Il progetto "ritmo dei passi" alla conquista delle montagne e dei più giovani" all'interno del volume: le giovani generazioni tra presente e futuro, STRUMENTI PER UNA SCUOLA CHE CAMBIA, ASVIS e AICS

List of posters

1. A new place for a new future: the example of the Great Green Wall, Di Rosario, 2022 CUCS Naples
2. The reliability of modified posturography to test dynamic sitting balance in patients with spinal cord injury, Tsai et al. – 2018 Mount Sinai Hospital, 2018, PM&R

Main conferences attended

- Event moderator "Festival of Peace", 2024 Brescia
- Speaker UISG (International Union of Superiors General) 2023 Rome
- Speaker IIC (Italian Cultural Institute) 2023 Nairobi
- Speaker SIMIT (Italian Society of Infectious Diseases) 2022 Rome
- Speaker CUCS 2022 Naples
- Speaker CeTAmb LAB Unibs 2021-24
- Towards the Economy of Francesco, 2020 Brescia
- Conference for the Rights of Persons with Disabilities - United Nations (NYC) 2019

Main Training courses

- National Advanced Training Course: Anci Sport & Health City Manager
- 'Environmental design and integration in international cooperation' - Unesco Chair University of Trento (2022)
- BLSD certified rescuer - Ethica Education Centre (2021)

- ‘Social enterprise camp planet&people’ - Fondazione Cariplo & Fondazione San Paolo (2021)
- SMAE Unibs - ‘Master in Mobility Management’ (2021)
- University for Peace - ‘Builders of Peace’ (2021)
- Laudato si animator’ - 2021
- ASviS and Milan City Council - ‘School on the Wellbeing and Sustainability of Cities’ (2021)
- CLab Entrepreneurship lab Unibs (2020)
- ‘Cultural operators and accessible tourism’ - Cooperativa Tempo Libero (2020)
- ‘Civil protection and emergency management’ - CISOM Brescia (2019)

Sitography (ns)

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