Preventing Multimorbidity with lifestyle interventions in Sub-Saharan Africa: A new challenge for public health in Low and Middle income countries.

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Abstract
Objectives: Low and Middle Income Countries are experiencing a fast-paced epidemiological rise in clusters of non-communicable diseases (NCDs) such as diabetes and cardiovascular disease, forming an imminent rise in multimorbidity (MMD). However, preventing MMD has received little attention in LMICs, especially in Sub-Saharan African Countries.
Design: Narrative review which scoped the most recent evidence in LMICs about MMD determinants and appropriated them for potential MMD prevention strategies.
Methods: MMD in LMICs is affected by several determinants including increased age, female gender, environment, lower socio-economic status, obesity, and lifestyle behaviors, especially poor nutrition and physical inactivity.
Results: MMD public health interventions in LMICs, especially Sub-Saharan are currently impeded by local and regional economic disparity, underdeveloped healthcare systems, and concurrent prevalence of communicable diseases. However, lifestyle interventions that are targeted towards preventing highly prevalent MMD clusters, especially hypertension, diabetes and cardiovascular disease, can provide an early prevention of MMD, especially within Sub-Saharan African countries with emerging economies and socio-economic disparity.
Conclusion: Future public health initiatives should consider targeted lifestyle interventions and appropriate policies and guidelines in preventing MMD in LMICs.

1. Background and Objectives
Global mortality among adults are primarily caused by preventable non-communicable diseases (NCDs) of cardiovascular disease (CVD), cancer, respiratory disease and diabetes, with related annual mortality records showing 17.9,

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9, 3.9 and 1.6 million respectively for each disease [1]. Of those, 85% (15 million) NCDs-related mortalities are in low and middle income countries (LMICs) [1]. However, recent reports have shown LMICs suffer a more rapid increase in mortality or disability burdens attributable to multiple NCDs (e.g. cancer, diabetes chronic respiratory disease, mental and substance use disorders) from 45% between 1990 and 2010, to 67% between 2010 and 2017, which is a higher rise rate than NCDs in high-income countries (HICs) [2-4]. The majority of LMICs are based in the Sub-Saharan African region, which represents countries with a similar disease profile characterised by emerging and re-emerging infectious CDs such as malaria, HIV/AIDS and tuberculosis, and under-resourced health systems. Recent epidemiological transition from CDs to multiple NCDs in Sub-Saharan Africa signifies a higher risk of mortality and disease-related disability than other global regions over the coming decades [5,6]. Therefore, there is a strong case for early prevention of NCDs multimorbidity in LMICs, especially Sub-Saharan African countries.

Multimorbidity (MMD) is defined as a phenomenon where two or more chronic conditions exist concurrently in the same individual, such as diabetes, respiratory disease, cancer and CVD [7,8]. MMD is often referred to in the context of age-related NCDs, or a concomitant disability related to NCD burdens within an ageing population, which persist over the time causing physical and mental health decline and premature mortality [5,9]. Cohort studies have often focused on HICs, whilst demonstrating over 66% MMD prevalence in older adults (<55 years old), with increased hospital visit burdens and healthcare cost [10-12]. However, within LMICs, especially Sub-Saharan Africa, poverty and CDs prevalence are likely to add to MMD burdens. For example, poverty indicated by a 0.5% decrease in economic growth has been associated with 10% increase in multiple NCDs [13], and is coupled with little knowledge about MMDs models of care and prevention in LMICs [14].

Recent limited data from the Sub-Saharan African region shows an emerging trend in the prevalence of MMD, which may be preventable if addressed early. For example, Uganda reported 36.9 and 26.4% prevalence of pre-hypertension and hypertension respectively, which was explained by modifiable factors of overweight and obesity (body mass index, BMI ≥ 25 kg.m^{-2}) [15]. Such high prevalence was close to a 31% median (range of 17% - 40%) reported across 31 Sub-Saharan African LMICs using the same WHO STEP-wise NCDs survey approach (sociodemographic questionnaires, physical examination and biochemical assessments) [16]. The increased MMD prevalence (e.g. CVD, diabetes, chronic respiratory disease and cancer) in LMICs is likely to be explained by modifiable lifestyle risk factors, including unhealthy diets, physical inactivity, obesity, tobacco and alcohol use [13]. However, initial MMD preventative attempts in LMICs was faced by increased healthcare costs, which could further impede poverty-reduction strategies and exacerbate a vicious cycle of poverty, ill-health and underdevelopment [17]. However, future interventions in Sub-Saharan Africa could address a cluster of emerging NCDs forming MMD (e.g. diabetes and CVD) through lifestyle interventions, especially when such approaches are personalised towards local needs. This narrative review summarises key epidemiological MMD determinants and highlights specific public health challenges related to MMD prevention strategies, especially through lifestyle in LMICs placing emphasis on Sub-Saharan Africa, and its future regionally-relevant health policies.

2. Methodological approach:

This narrative review focused on preventing MMD through mapping its determinants with potential lifestyle prevention approaches in Sub-Saharan African LMICs. The key terms "multimorbidity" or its variants were searched on PubMed, Embase, EBSCO, CINAHL, Cochrane database, and revealed a total number of 6058 articles, which were narrowed down to 1065 when "non-communicable and communicable disease in low and middle income countries", and to 212 articles when synonymous terms "NCD and infectious diseases in low and middle income countries" were searched. The search was further narrowed down to 79 (inc. 5 reviews and 7 systematic reviews) when both "multi morbidity" and "low and middle income countries" were searched, and all were published in the last 10 years. Most of these studies focused on the prevalence and selected determinants of MMD using cross-sectional surveys or national database. The search terms "prevention of multimorbidity in low income countries" revealed only 19 results and when "lifestyle prevention of multimorbidity" was included, only 4 studies were found covering an association between MMD and a single aspect of lifestyle such as "socio-psychosocial aspects", while no study has previously addressed a potential role of lifestyle prevention of MMD in low and middle income countries. Therefore, this narrative review scoped all relevant literature including those found in this search to highlight a) key determinants of MMD and b) future scope for MMD prevention using lifestyle interventions in LMICs.

3. Determinants of MMD and its increased burden in LMICs

The last ten years have seen an increased focus on MMD prevalence and associated determinants in LMICs. Table 1 summarizes key MMD determinants across representative LMICs from different global regions and population groups (e.g. Sub-Saharan Africa, Asian region) based on cross-sectional, national surveys and systematic reviews (Table 1).

Table 1 Insert here

The summarized evidence (Table 1) suggests a higher prevalence amongst populations within LMICs compared with HICs, which could be explained by modifiable lifestyle factors. Below is a critical summary of the main MMD determinants in LMICs.

3.1 Age

Older age is a known predictor of MMD and associated disabilities. A worldwide increase in life expectancy above 75 years of age was concurrent with an increased prevalence of MMD's cluster of diabetes, hypertension, and CVD, and associated healthcare cost [17-21]. A recent estimate of MMD prevalence amongst older individuals in a HIC showed 67.5% [19]. Systematic reviews showed age to be positively associated with frequent patterns of two or more metabolic, cardiovascular and physical chronic conditions in global [20], and European cohorts [21]. The latter analysis including over 70 million patients within primary care settings between 1961 and 2013 across 12 countries indicated disparate age-dependent prevalence, where MMD was highly prevalent in older adults (95.1% in those ≥ 65 years old) than in younger adults (12.9% in those ≥18 years old). However, it was apparent in those studies that, together with older age, MMD is also determined by socio-economic status (e.g. higher MMD prevalence associated with low economic status), alongside

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sex (female sex), and mental health issues [20,21]. Furthermore, poorer LMICs have reported a more rapid age-dependent rise in MMD, especially within Sub-Saharan African countries experiencing a simultaneous rapid economical and age growth [18,19]. Thus, prevention should target MMD in LMICs regions with such a rapid growth.

There is already evidence of reported age-dependent economic disparity between LMICs and HICs. A cross-sectional analysis within 28 countries showed a low MMD prevalence of 7.8% when all ages were combined in LMICs compared with 66.5% in HICs, but this rose considerably with age (to around 21%), and such prevalence was associated (non-linear relationship) with country's GDP [22]. An economic disparity coupled with an ageing population in HICs vs. LMICs may reflect different MMD burdens. For example, an analysis of a single LMIC (Bangladesh) showed a significantly higher MMD prevalence of 56.4% amongst older (>65 years old) individuals, and a higher prevalence in females (64.18%) than males (54.17%) [23]. The most prevalent conditions were hypertension (33.0%), diabetes (27.6%), ischemic heart disease (12.0%), and chronic obstructive pulmonary disease (9%) [23]. However, this remains a lower prevalence in comparison with HICs, which showed a prevalence of hypertension, dyslipidemia, diabetes, pain disorders, depression, heart failure, cancer, and dementia among the older adults of 60.6%, 51.2%, 25.2%, 34.0%, 12.0%, 14.0%, 8.6%, and 8.4%, respectively [24]. A more recent comparison of pooled MMD prevalence showed 37.9% (95% CI: 32.5–43.4%) of MMD in HICs compared with 29.7% (26.4–33.0%) in LMICs [25]. Such age-dependent discrepency in MMD burdens between HICs and LMICs may be explained by differences in age expectancy since a significant portion of people affected by NCDs in low- and middle-income economies die before reaching the age of 70 years old [26].

3.2 Hypertension

There is a higher prevalence of hypertension among adults in LMICs (31.5%, 1.04 billion people) than in HICs (28.5%, 349 million people) [27]. Hetrogenity of prevalence was explained by variations in the levels of risk factors for hypertension, such as high sodium intake, low potassium intake, obesity, alcohol consumption, physical inactivity and unhealthy diet [27]. Hypertension is a risk factor for ischemic heart disease, which is responsible for 71% of global mortalities [28]. For diabetes (fasting blood glucose ≥ 6.1 mmol.l^{-1}), a wider range of hetrogenicity was reported with a prevalence range from 3% in Togo and Benin to 23% in Niger, and a median of 8% across the Sub-Saharan region, which was also explained by lifestyle factors (e.g. dietary intake habits, physical activity) [17]. This suggests that lifestyle interventions focused on an MMD cluster involving hypertension could be useful also for preventing diabetes in LMICs. However, most Sub-Saharan Africa LMICs, with recent affliction of hypertension also suffer from inadequate diagnosis, awareness, or treatment strategies [29]. In one study, an average of only 27% of participants knew their hypertensive status and 18% were being treated for hypertension [29]. An analysis of the "Demographic and Health Survey (DHS)" data of 33 countries in the Sub-Saharan African region showed a particularly higher hypertension prevalence in women of reproductive age [30]. This analysis also reported a local disparity, where hypertension was highest among women in Lesotho with (17.3%) and was lowest among women in Burundi (1.0%). Hypertension co-existed with other contrasting health conditions, such as anaemia (60%) which was among Sub-Saharan African

women, especially in Gabon, and obesity, especially in Lesotho (19.9%), Gabon (18.9%) and Ghana (15.6%), but not in Madagascar (1.1%) [30]. Interestingly, this analysis also found that the behavioural or modifiable risk factors of hypertension and obesity were; smoking, fruits, vegetables and alcohol consumption, while the non-modifiable significant factors included age, residence, religion, education, wealth index, marital status, employment and number of children ever born. This suggests an importance of promoting locally-relevant lifestyle behavioural interventions, additionally to screening and treatment to mitigate hypertension and associeted MMD clusters in LMICs.

3.3 Environmental factors and Rural Living
3.3.1 Environmental Factors
Long term negative impact of environmental factors on health outcomes has particularly focused on air pollution associations with the development of chronic asthma, pulmonary insufficiency, CVD, cancer, and diabetes [31,32]. A cross-sectional analysis of 6,392 participants of the Swiss Cohort Study on Air Pollution, Lung and Heart Diseases in adults found an association between long term air pollution exposure and diabetes mellitus [33]. LMICs could experience a greater negative health impact of such environmental factors because of overpopulation and rapid urbanisation coupled with developing industrialisation [34]. For example, some LMICs rely on wood fuel, which still forms a significant part of fuel supply due to poverty, which exposes populations to poorer air quality and increased risk of MMD [35]. There is also evidence of an association between long term indoor exposure to air pollution and cancer in LMICs [36], and CVDs and related mortalities [37]. For example, a cross-sectional study in Kenya involving 5% sample of health visitors at a clinic at Trnava University located in Mukuru slum in Nairobi, reported that environmental conditions were the main determinant of health complaints amongst those visitors [38]. Thus, poor environmental factors, especially air pollution remain a major predictor of MMD in LMICs, and necessitates evidence-based approach when designing lifestyle interventions.

3.3.2 Rural living
Recent evidence suggested urban-rural differences in MMDs in China and Korea, where a 24% of the study population had MMD, with higher proportions in rural areas whilst in China, 31% of the sample had MMD, with significantly higher proportions in the cities [39]. The latter's multivariate analysis also showed that rurality was associated with a lower risk of MMD in both China and Korea, but with a socioeconomic disparity around urban areas in Korea [39]. However, contradictory findings in HICs in southern Europe, reported that those living in a rural area had a higher prevalence of three or more acute diseases, compared with patients with no acute diseases [40]. In a LMIC such as Uganda, key risk factors for NCDs were assessed using a nationally representative survey involving 3,987 participants. It was concluded that the relative risk of living in a rural area significantly increased the risk of having one or two risk factors for multiple NCDs, or MMD, which was 1.6 fold higher compared with living in the urban areas [41]. Limited or equivocal evidence makes it difficult to conclude whether rurality is a cause or just a confounder for MMD in LMICs, which requires further research.

3.4 Lifestyle factors

Lifestyle is a known determinant of MMD in developed HICs. Modifiable lifestyle risk factors such as smoking habits, alcohol consumption, fruit and vegetable consumption, physical activity or their risk factors such as BMI (obesity) have been been all associetd with MMD [13,42]. Health related quality of life is another indicator of MMD, which encompass measures of lifestyle factors, and was found to be negatively associated with MMDs among 18,137 adults in China [43]. LMICs, which suffer from health disparities related to the effects of lifestyle have received limited research attention. For example, an Egyptian cohort showed that lifestyle factors (BMI, fruit and vegetables intake) were major MMD determinants, and the cumulative MMD was related to region, residence, type of residence and land tenure system [44]. No data is currently available on how lifestyle mofiable factors could be targeted to prevent MMD within specific LMICs, despite recent suggested protocols about raising awareness of lifestyle prevention of obesity, physical inactivity, smoking, inappropriate use of alcohol and psychosocial factors (e.g. negative life events, social networks, mental health problems) in LMICs primary healthcare systems [14].

Lifestyle interventions as an MMD prevention strategy need to consider health disparity within LMICs which suffer from concurrent prevalence of NCDs and CDs. Analysis of cross-sectional data from 3889 people enrolled in the Health and Ageing in Africa longitudinal study in South Africa found that the negative MMD association with age, wealth, and lifestyle factors of physical functioning and well-being was due to different epidemiological CDs profile in subgroups [45]. Higher HIV and anaemia prevalence was found in poorer and younger groups. In contrast, higher cardiometabolic conditions prevalence was found in richer and older groups [45]. Such MMD disparity suggests that population targeted lifestyle prevention of MMD in LMICs should consider both CDs and NCDs risk factors. Another study in South Africa [46], found that income was consistently associated with MMD, along with risk factors such as social assistance (Odds Ratio, OR 2.35; Confidence Interval, CI 1.59-3.49), residence (OR 0.65; CI 0.46-0.93), smoking (OR 0.61; CI 0.38-0.96); obesity (OR 2.33; CI 1.60-3.39), depression (OR 1.07; CI 1.02-1.11) and health facility visits (OR 5.14; CI 3.75-7.05). Addressing MMD disparity based on income and welfare issues appears to be more relevant to MMD prevention in LMICs. A symbiotic relationship has also been reported between NCDs, its risk factors and poverty, and due to large healthcare expenditure associated with having MMD [47].

The need for promoting healthy lifestyle behaviours in preventing MMD has been highlighted by others [42, 48]. However, current evidence suggests that economical disparities and the double burden of CDs and NCDs are responsible for determining the contribution of lifestyle factors to MMDs in LMICs. Lifestyle preventative approaches could have positive impact on reducing MMD with targeted interventions considering such disparities.

4. Future scope for MMD prevention through lifestyle interventions in LMICs
Current data about MMD prevention using lifestyle interventions are mainly based on populations in HICs, and all support a strong inverse relationship between healthy lifestyle behaviours and MMD prevalence. For example, a recent prospective cohort study involving 291, 778 participants from seven European countries, showed that the risk of developing MMD (e.g. conditions of CVD and type-2 diabetes) is lower for individuals leading healthier lifestyle featuring increased physical activity levels, dietary habits based on Mediterranean nutritional components, reduced smoking and

lower BMI status [49]. Earlier data from the English Longitudinal Study of Ageing had also associated MMD with multiple unhealthy lifestyle practices, with physical inactivity increasing MMD by 33% [50]. Similar association was reported in a 10-year follow-up of Finnish population-based cohorts between 1982–2012 showing that lifestyle risk factors predict MMD incidence rate [51]. Therefore, the contribution of lifestyle practices in the development of MMD is well reported in HICs [52-54], but not in LMICs.

Global efforts by WHO attempted to control and prevent NCDs through developing a global action plan (2013-2020) [55]. The strategy included nine targets for nations to achieve by the year 2025, focussing on preventing top causes of NCDs (CVD, cancer, type-2 diabetes, chronic respiratory problem) related premature mortality by 25% [28, 55]. Key targets included lifestyle interventions based on promoting reduction in salt intake, tobacco alcohol use, increasing physical activity, increasing technology and building capacity. However, many LMICs do not have the required capacity to implement such globally-derived health promotion initiatives, and suffer from disintegrated health services [2]. This suggests a need for more localised preventative approaches to address MMD. More recent systematic reviews have suggested four approaches specific to LMICs including risk reduction, policy development, advocacy and strengthening of health systems for early diagnosis and treatment of NCDs [13]. WHO has also implemented a 'best buy approaches' intended to support governments to implement NCD interventions [55, 56], including reducing lifestyle-related risk factors (tobacco use, harmful use of alcohol, unhealthy diets and physical inactivity) for CVD, diabetes and cancer [13]. However, this "best buy" initiative has been criticised for a limited focus on health behaviour awareness rather than taking a multi-pronged intervention approach [13]. Such common "downstream" policies (e.g. raising awareness and reducing salt intake to prevent hypertension) have limited effectiveness in changing population's behaviours [57, 58]. More personalised strategies involving multi-faceted (reformulation, branding and media campaigns) and 'upstream' population-wide intervention-based policies are likely to be more effective [58, 59].

Lifestyle intervention in LMICs is likely to be hindered by MMD associated economic disparities within the same LMIC [14], where NCDs among affluent communities and households, is more related to adopting Western lifestyle and dietary habits [60]. Thus, an individualised approach using personalised lifestyle interventions (nutrition-based models, physical activity approaches), should focus on adopting an economical-based model, in which community disparities are addressed. Physical activity prevention is a known strategy for reducing NCDs and MMD [49, 51]. For example, adopting carefully planned personalised physical activity models, structured or unstructured, intense or moderate exercise, can target high-risk individuals with a cluster of CVD and diabetes MMD risks.[61] Personalised approaches that are locally-driven are likely to reduce MMD if informed by culturally relevant nutritional, physical activity and educational strategies as part of a multicomponent lifestyle intervention model [61,62].

Education and counselling is also important, given the lack of knowledge about MMD and its specific context to promoting healthier lifestyle practices, especially consumption of local bioavailable nutrients combined with sedentary reduction and affordable physical activity engagement [63]. Addressing MMD's comorbidities and

risk factors within LMICs is another barrier to promoting lifestyle interventions for MMD prevention. For example, high prevalence of epilepsy in South Africa 7.8 per 1000 people was concurrent with lower levels of physical activity than the general population due to fears that exercise could trigger seizures which predisposes these individuals to a sedentary lifestyle, poor physical fitness and low sport participation [64-66]. Lifestyle behavioural interventions with such challenges require adequate multi-sectorial public health collaboration in LMICs, which in turn adds to LMICs economic burdens [66]. Understanding MMD prevention barriers in LMICs require further research. Nonetheless, lifestyle interventions could form an immediate prevention strategy of MMD in LMICs.

5. Conclusions

LMICs are experiencing a fast-paced epidemiological transition towards MMD, characterized by clusters of NCDs, which requires public health interventions. MMD determinants include increased age, female gender, environment, lower socio-economic status, obesity, and lifestyle behaviors, especially poor nutrition, physical inactivity. However, LMICs, especially Sub-Saharan Africa, suffer from local and regional economic disparity, which hinders health promotion initiatives. Perhaps multicomponent lifestyle interventions targeted towards highly prevalent MMD clusters, especially hypertension, diabetes and cardiovascular disease could provide an early effective prevention of MMD in LMICs, especially within Sub-Saharan African countries with emerging socio-economic disparity. Lifestyle behavioral approaches in Sub-Saharan African can inform public health policies for reducing an imminent MMD rise of in LMICs.

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Author contributions
AA conceptualized, designed, fully wrote, revised and critically edited the manuscript. LAN, BM, and GA contributed to data search and manuscript writing. CI contributed to manuscript critical editing. All authors approved the final version.

Abbreviations
BMI – Body Mass Index
CDs – Communicable Diseases
DHS – Demographic Health Survey
HIC, HICs – High Income Countries
LMIC, LMICs – Low and Middle Income Countries
MMD – Multimorbidity
NCDs – Non-communicable Diseases
CVD – Cardiovascular disease

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1   Table 1 Multimorbidity (MMD) determinants across low and middle income countries (LMICs).

Study type and Region	Overall MMDprevalence, and MMDs included (>2 chronic conditions)	MMDs main determinant identified
Cross-sectional survey, Bangladesh[23]	MMD prevalence (56.5%). MMD: Cumulative Illness Rating Scale (domains of disease including hypertension, ear-nose and throat, upper and lower GI, respiratory, cardiovascular, musculoskeletal)	*Age:* High prevalence in 60-69 y.o. (78.2% with two MMDs, 73.6% with three and 92.95 with four or more MMDs. *Female sex*: (prevalence of 64.2%). *Hypertension*: Higher MMD among hypertensive (95.7%).
Systematic review of 70 community-based surveys, 31 LMICs and 18 HICs[25]	Pooled MMD prevalence in LMICs (43.5%) MMD: 4 to 40 diseases with hypertension, diabetes, arthritis and stroke being four most frequent conditions.	*Female sex:* 21 studies showed higher MMDs prevalence in women than men (e.g. in South Africa 74% vs 26%), 4 studies showing the reverse. *Age:* MMD positively associate with age (e.g. 88.1% in women and 76.3% in men prevalence in > 85 y.o).
Nationwide WHO Stepwise survey for NCD risk factors in Uganda[16, 41]	Overall prevalence of Hypertension was 26.4% MMD: Hypertension and obesity	*Age:* Hypertension was high among ≥ 50 y.o (PRR=3.57). *BMI:* Hypertension prevalence was highest (PRR=1.67) among obese (BMI ≥ 30 kg/m^2). *Rurality, Sex:* Lower hypertension in rural than urban (25.8% vs. 28.2% N.S.). Higher hypertension in men vs. women (28.3% vs. 25.2% N.S.)
Systematic review of 24 LMICs[13]	Overall prevalence not recorded. MMD: cardiovascular disease, type I and II diabetes, chronic respiratory diseases and cancer.	*Lifestyle:* physical inactivity, unhealthy diets, alcohol and tobacco use. *Poverty*: Addressing poverty and development had great potential to impact on NCD prevalence and risk. *Obesity:* obesity and its NCDs risk factors.
Review on global hypertension burden[29]	Higher overall prevalence of hypertension in LMICs (31.5%, 1.04 billion people) than in HICs (28.5%, 349 million people) MMD: Hypertension and obesity	*Lifestyle factors:* high sodium intake, low potassium intake, alcohol consumption, physical inactivity and unhealthy diet. *Obesity*: increases risk of hypertension. *Socioeconomic status:* increases risk of hypertension.
WHO STEPwise and GSHS surveys report in 33	31 surveys indicated obesity median prevalence of 11% (ranged 2% in Madagascar to 25% in Seychelles).	*Sex:* Females are three times more likely to be obese than males (median prevalence of 15% and 5% respectively).

countries in the WHO African Region[16]	Hypertension median prevalence of 31% (17% to 40%). Diabetes indicated (fasting blood glucose ≥ 6.1 mmol/L), prevalence was 8% (3% in Togo and Benin to 23% in Niger). MMD: Obesity, hypertension, diabetes.	Adult males are more likely to be hypertensive than adult females (median 29%). *Lifestyle:* Tobacco use, unhealthy diet, insufficient physical activity and the harmful use of alcohol associated with higher NCDs risk.
A cross-sectional analysis of Demographic and Health Surveys in 33 countries in sub-Sahara Africa region[30]	Hypertension was highest in women in Lesotho (17.3%) and lowest in women in Burundi (1.0%). Anemia was most prevalent in Gabon (60.6%) and obesity was most prominent in Lesotho (19.9%), Gabon (18.9%) and Ghana (15.6%). MMD: Hypertension, anemia and Obesity.	*BMI:* Associated with hypertension and anaemia. *Lifestyle factors*: Smoking, fruits, vegetables and alcohol, exercise were modifiable factors associated with hypertension. *Non-modifiable factors* (Age, residence, religion, education, wealth index, marital status, employment and number of children ever born) associated with hypertension and anaemia.
A Population based survey in China[39]	31% had MMDs, higher proportions in cities. MMD: Hypertension, diabetes, arthritis and stroke	*Rurality:* Associated with reduced risk of MMD *Socioeconomic status:* disparity of MMDs in rural vs. urban China.
A review study in China[43]	Prevalence of MMDs not recorded. MMD: Chronic obstructive pulmonary disease, asthma and lung cancer	*Air pollution:* Cause and aggravating factor of respiratory diseases (chronic obstructive pulmonary disease, asthma), and lung cancer.
Cross-sectional (16,000 clinic visitors), Kenya[38]	Prevalence of MMDs not recorded. MMD: Virosis, acute respiratory infections, and bronchitis	*Environmental conditions:* Air pollution reduction, drinking water provision, and waste management in slums can have an influence on health status.

2   Table abbreviations: BMI – Body Mass Index; CDs – Communicable Diseases; HICs – High Income Countries; LMICs – Low and Middle Income Countries;
3   MMD – Multimorbidity; NCDs – Non-communicable Diseases; PRR - Prevalence Rate Ratios; GSHS – Global School Health Survey. WHO – World Health
4   Organisation. GI- Gastrointestinal. y.o. – years old. N.S. statistically non-significant difference.