How do Non-communicable Disease Risk Factors Compare between Men and Women over the Life Course?

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Abstract

Background

Globally the burden of non-communicable diseases is on the rise, especially in Sub-Saharan Africa. Ghana is one of the countries in Sub-Saharan Africa currently struggling with NCD morbidity, with 43% of all deaths in the country caused by an NCD. Modifiable risk factors such as physical inactivity and tobacco use are behaviours that can make an individual more susceptible to developing an NCD. To better understand the burden of NCDs in Ghana, we compared these modifiable risk factors between men and women in Ghana over the life course.

Methods

Searches were conducted using four different databases (Scopus, Medline, web of science and Pro-Quest Central) to find literature relevant to Ghana, non-communicable diseases, and risk factors. Records were obtained from these databases, duplicates were removed, then these records were screened by title and abstract. 31 full text records were identified in total. 16 of these records were removed whilst 15 records were eligible for inclusion. 5 additional records were obtained through websites and citations. 20 records in total were included for review.

Results

This review found that physical inactivity, harmful diets, and overweight/obesity were the most prevalent risk factors in Ghana and women were worse affected than men. High prevalence of these risk factors was also occurring at increasingly young ages. A 27.3% rise was noted in overweight and obese women from ages 15-19 to 20-29 in 2014.

Urbanisation and nutritional transition have increased sedentary behaviour and high salt and energy dense food consumption, thereby increasing NCD risk. Tobacco use and alcohol consumption were also NCD risk factors for Ghanaians, and both were more prevalent in men than women but overall proved not to be as prominent in Ghana's overall NCD burden.

Conclusion

Ghanaians, particularly women, aged 15-29, were most at risk and should be the targets of policy interventions aiming to reduce exposure to risk factors. This is the period in the life course that saw the largest transition in exposure to risk factors from low to high, and thus by intervening here prevalence of these risk factors and NCD burden can be reduced.

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List of Abbreviations

BMI – Body Mass Index

CVD – Cardiovascular-Disease

DHS – Demographic and Health Survey

HDI – Human Development Index

LMIC – Low- and Middle-Income Country

MeSH – Medical Subject Heading

NCD – Non-communicable Disease

SDG – Sustainable Development Goal

sdLDL- Small dense low-density lipoprotein

SSA – Sub-Saharan Africa

UCL – University College London

WC – Waist Circumference

WHO – World Health Organisation

WHR – Waist to Hip Ratio

Introduction

Background

Non-communicable diseases (NCDs) can be defined as diseases that are non-infectious and non-transmissible among people. Commonly referred to as chronic diseases, NCDs are characterised notably by their long duration and the genetic, physiological, environmental and behavioural factors that lead to their incidence such as poverty, pollution or tobacco use (Kim and Oh, 2013) (WHO, 2021). The term NCD is broad and covers a significant range of diseases from cardiovascular diseases, diabetes and cancers to mental disorders like depression and anxiety (Habib and Saha, 2010). The range of diseases that fall under this heading mean that NCDs are a large part of the global health discourse, being mentioned as one of WHO's 10 global health issues to track in 2021 (WHO, 2020a).

The burden of NCDs can be better understood when viewing the number of deaths and premature deaths that are attributed to them. NCDs kill around 38 million people every year and account for 71% of all deaths globally, with 15 million of these deaths occurring prematurely (Frumkin and Haines, 2019) (Bigna and Noubiap, 2019) (WHO, 2021). With such a high premature mortality burden, addressing NCDs is at the forefront of global health especially as the reduction of NCD burden is vital to the attainment of Sustainable development goal (SDG) 3 (3.4) which includes reducing premature NCD mortality by a third by 2030 (Nugent et al., 2018). In order to combat NCDs, it is necessary to first identify which diseases are causing mortality at the highest rate. Cardiovascular diseases such as stroke and cardiac arrests account for 17.9 million of deaths globally; cancers with 9.0 million; respiratory diseases with 3.9 million and diabetes with 1.6 million (Bigna and Noubiap,

2019). These 4 diseases account for 80% of all premature NCD deaths and subsequently are the main focus of reducing NCD mortality (Bennett et al., 2018) (WHO, 2021).

There are risk factors that can make an individual more susceptible to developing an NCD. These risk factors can be genetic, environmental, or behavioural factors and influence an individual's disposition to these diseases (WHO, 2021). Genetic factors are often associated with an individual's predisposition, and often are linked with environmental factors that can trigger this predisposition. Usually, very few preventative measures can be taken to address these risk factors (Klimek et al., 2016). Behavioural and lifestyle factors are influential in NCD development because they are modifiable. The most common behavioural factors linked with NCDs are tobacco use, physical inactivity as well as harmful diets and excessive use of alcohol (Beaglehole et al., 2011) (Gouda et al., 2019) (WHO, 2021). All of these modifiable factors can contribute to a variety of different NCDs so by further studying them and their prevalence it may be possible to find ways to discourage people from undertaking these behaviours. Studies have shown the existence of evidence-based strategies and brief interventions such as the Plate method for unhealthy eating, that can be used to encourage behaviour change for modifiable risk factors which in turn could lead to the reduction of the NCD burden (Hooker et al., 2018).

Ghana

Ghana is a lower-middle income country in West Africa, with a population of roughly 30 million people, that borders Togo, Ivory coast, and Burkina Faso (BBC, 2020). Ghana is considered one of the most rapidly growing economies in Africa and experienced a GDP growth of $24.855billion from 2015 to 2020 (World Bank, 2020). In comparison, Togo saw a

GDP growth of $3.394billion in this same period (World Bank, 2020). Ghana is ranked in the medium human development category at position 138 out of 189 countries and territories with a Human Development index (HDI) value of 0.611 as of 2019 which is above the average of Sub-Saharan Africa (SSA) of 0.547 (UNDP, 2020). However currently, Ghana is struggling with the burden of NCDs (de Graft Aikins et al., 2012). NCDs account for 43% of all deaths in Ghana with cardiovascular diseases being the most prevalent cause of death, equating to 19% of all deaths in the country (WHO, 2018).

Significance of Project and aims

The overall aim of this project is to gain a better understanding of the disproportionate distribution of NCD deaths in SSA, specifically Ghana, by understanding how modifiable risk factors vary between men and women across the life course. Nearly 77% of all NCD deaths are in low-and middle-income countries, forming an overall of figure 28 million. In the total figure for premature deaths globally, 82% of these occur in LMICs (Allen et al., 2017) (WHO, 2021).

Communicable diseases are prevalent and commonly spread because of the poverty and poor infrastructure in many LMICs, however, in the last 20 years there has been a major trend of increasing NCDs in LMICs (Gouda et al., 2019). Countries in SSA such as Ghana, have seen a surge of NCD prevalence, with the total Disability Adjusted Life Years (DALYs) due to NCDs having increased by 67% between 1990 and 2017 (Gouda et al., 2019). In Ghana as of 2019, four of the top ten causes of death were NCDs (Stroke, Heart disease, diabetes and Respiratory infections) (CDC, 2019). NCDs are projected to overtake mortality and morbidity of infectious diseases in SSA by 2035. Hypertension prevalence is up to 48% in the adult

population, diabetes prevalence currently sits at 22 million and is projected to rise over 42 million in the next 15 years which is the highest global increase projection (Nyirenda, 2016).

This trend of increasing NCD burden has been led by the modifiable risk factors of unhealthy diets, physical inactivity, and hypertension which is an NCD in itself, but is also on the pathway to other NCDs (Bigna and Noubiap, 2019) (Bennett et al., 2018)

WHO have identified that in general men and women experience different risk factors for NCDs at different stages in life. For example, whilst higher percentages of men exhibit more risk associated behaviours in most age groups such as smoking, a higher percentage of women experience biological risk factors such as being overweight and or obesity (WHO, 2020b). As a result, comparing NCD risk factors between men and women over the life course will provide an analysis of the most at-risk subgroups within the overall population of Ghana by sex and age which could be helpful to inform gender and age-specific policy and interventions to address the burden of NCDs in Ghana in the future.

Ghana's national policy for prevention and control of NCDs states that its objectives are: reducing incidence and prevalence of chronic NCDs, exposure to risk factors, morbidity associated with NCDs as well as improving overall quality of life (Ghana Ministry of Health, 2012). This thesis will contribute to addressing one of the objectives from this policy document- "Reduce exposure to risk factors that contribute to NCDs" by exploring the trends of these modifiable risk factors that contribute so vastly to NCDs namely CVD, cancer, diabetes, and chronic respiratory disease. By comparing these risk factors in men and women over the life course, we aim to find out at which point in the life course certain risk factor behaviours commonly occur which will allow us to make intervention recommendations that could aid policy development.

In this thesis, the literature review will be based on peer-reviewed and grey literature relevant to the risk factor behaviour of Ghanaians. One of the aims is to identify common risk factor patterns. Doing this allows for the identification of the most commonly occurring modifiable risk factors in Ghana. The literature reviewed will be relevant to Ghana, NCDs and will refer to age and the life course. Despite the presence of several different types of risk factor, this review will focus exclusively on modifiable risk factors as it will be more practical to target modifiable behaviours through intervention. Little attention and previous policy neglect have been attributed to lack of reliable data as well as limited research and interventions that have been designed to address this have been limited in success (Adu-Gyamfi et al., 2020). This is the knowledge gap that this project aims to contribute towards.

This study will provide further awareness of NCDs in Ghana and add to the growing body of literature focused on NCDs in LMICs, highlighting this shift in the burden of disease for LMICs especially the countries in SSA. **Figure 1** adapted from the WHO model of chronic diseases conceptualises the different levels of causes of NCDs (WHO, 2005). The diagram illustrates the different layers of causes/factors and how these lead to other factors or diseases. Highlighted in yellow are the focal points of this thesis.

Research question and objectives

How do modifiable Non-Communicable Disease risk factors compare between men and women in Ghana over the life course?

Objectives-

- Conduct a systematic database search for literature about Ghana that provides modifiable risk factor information about men and women at different ages
- Extract relevant data that about the difference in risk factors between men and women over the life course
- Identify age and gender subgroups that are most vulnerable to prevalent risk factors
- Make recommendations about policy and interventions that may be useful based on the findings of the review

Conceptual Diagram

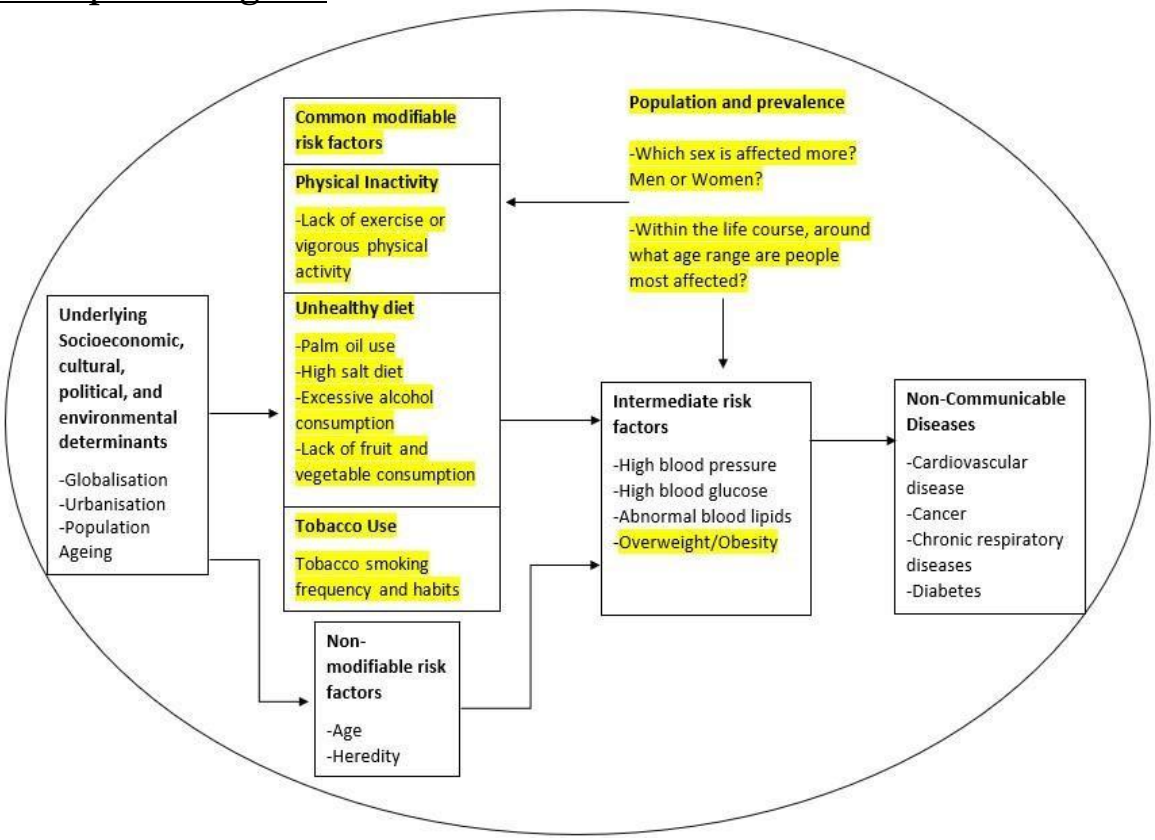


Figure 1. *– Conceptual diagram with focal factors of this thesis highlighted (WHO, 2005)*

Methods

Search Strategy

Four databases were used for this review - Web of Science, Medline, Scopus, and Pro-Quest central, all accessed through UCL's Ovid online system. These databases were employed for the

research because they are global health and biomedicine databases which ensured that as much relevant quantitative and qualitative literature would be available as possible. The search terms and medical subject headings (MeSH) terms employed are shown in **Table 1**.

***Table 1**- Database search terms*

Construct	Search term
Non-communicable disease	"noncommunicable disease" "noncommunicable diseases" OR "noninfectious disease" OR "chronic disease" AND
Ghana	"Ghana" AND
Risk factor	"risk factor" OR "risk factors"

The results of the search were screened by abstract and title to assess their relevance and ensure that that the literature met the inclusion criteria. All the relevant studies were then extracted and organised in the reference management system ENDNOTE X9. In addition to searching databases, the snowballing technique was also used. This technique meant screening references used by other researchers that may be suitable.

Inclusion and Exclusion Criteria

To ensure that the literature was relevant, inclusion and exclusion criteria were required.

The inclusion Criteria for papers were as follows, Papers to be:

(1) peer- reviewed/ Grey literature and published after the year 2000
(2) relevant to Ghana, the big four NCDs (Cardiovascular disease, Cancer, Diabetes, and Chronic respiratory disease) and have reference to risk factors of NCDs
(3) in English

The exclusion criteria are as follows:

(1) Studies that were about Ghana but about communicable diseases and their risk factors.
(2) Studies that focused exclusively on the impact of non-modifiable risk factors relevant to NCDs.
(3) Studies about chronic diseases other than cardiovascular diseases, diabetes, cancer, and respiratory diseases

Studies that met the inclusion criteria were then reviewed and quality assessed before being analysed. Data was extracted from the papers and organised in a data extraction table. For each paper, the important data were extracted and summarised into the table under the relevant subheading.

An extract from the table is shown in **Figure 2.** Each subheading was selected as it pertains directly to the thesis question.

The purpose of this data extraction table was to organise the findings of the searches and the useful information from the results obtained to then be able to identify the patterns or recurring themes of risk factors in the different studies that have taken place about this topic.

Figure 2.- *An extract from the data extraction table*

Citation	Country / geographical coverage	Subject matter relevant to NDCs discussed	Cardiovascular diseases and Hypertension	Diabetes	Respiratory disease	Cancer	Types of risk factor covered	Sample size	Age
BENKESER, R. M., BIRITWUM, R. & HILL, A. G. 2012. Prevalence of overweight and obesity and perception of healthy and desirable body size in urban, Ghanaian women. Ghana medical journal, 46, 66-75.	Accra Ghana	Discusses the prevalence of the risk factor of obesity and overweight amongst Ghanaian women in Accra	y	y	n	n	Obesity and overweight		2814 18+
AFRIFA-ANANE, E., AIKINS, A., MEEKS, K., BEUNE, E., ADDO, J., SMEETH, L., BAHENDEKA, S., STRONKS, K. & AGYEMANG, C. 2020. Physical Inactivity among Ghanaians in Ghana and Ghanaian Migrants in Europe. Medicine and science in sports and exercise.	Ghana and Europe	Discusses the prevalence of physical inactivity amongst Ghanaian immigrants and Ghanaians in urban and rural Ghana	y	y	n	n	Physical activity		5659 25-70

Key findings on risk factors	Key findings on life course	Key findings on men and women	Relevant social and cultural factors described	Paper Quality/ Limitations
This study highlights how disproportionately affected Ghanaian women are by obesity and overweight. With all three criteria for examining obesity,(BMI, WC and WHR) the prevalence for obesity were high. There was a 37.1% overall prevalence, 78.7% according to WC and 78.9% according to WHR. Age as well as growing up in an urban environment were associated with higher risk of being overweight or obese	For the women in this study generally BMI increased with increasing age. (18t o 24=24.2) (25 to 34=26.2) (35 to 55 = 29.7) (>55= 29.4) Marginal difference between last two age categories. Obesity (BMI) prevalence increased by 35% between the ages of 18 and 55 and fell by 3% in the >55. For obesity according to WC, obesity increases with age from 27% at 18-24 to 77.8% at >55. The odds of being overweight or obese at age >55 compared to at 18-24 is 5.01	Study based exclusively on women, no data on men is provided but data provided indicate this risk factor is a major problem for women	Cultural perception of desirable look and body size amongst certain age groups encourage unhealthy habits and weight	Study sample and sampling technique illustrated. Large sample size and large age range.
As a risk factor physical inactivity is important as it is linked to other risk factors such as obesity and overweight. Physical inactivity was found to be prevalent amongst Ghanaians irrespective of their location at the time whether in Ghana or elsewhere. An urban prevalence of 29% and a rural prevalence of 11.2% . Advanced age and overweight/obesity were positively associated with physical inactivity in this study	Physical activity was associated with advanced age notably in urban Ghana for men and the same for rural women. Physical inactivity increased from age groups. Urban Ghanaian men age 40-54 had 1.75 times the odds of being physical inactive compared to 25-39 and 55-70 had 3.90 times the odds. 1.23 and 1.17 for rural Ghana. This trend was not consistent for rural men	In Ghana a higher proportion of women were physically inactive compared with their men counterparts.(25.6% vs 19.3%) Male and female non-migrants had lower portions of inactivity than male and female migrants. Proportion of inactivity was higher in women in urban and rural Ghana with prevalence of 33.3% and 14.3% compared with 17.8% and 6.3% respectively	High levels of inactivity in urban areas attributed to urbanisation and differences between urban and rural areas may be attributed to labour-intensive occupational activities	Study design , sample and sampling strategy justified and explained. Appropriate statistical tests used to analyse results

Results

The results of the search for literature and the screening process are shown in **Figure 3**. The findings from the records retrieved are displayed under the relevant subheadings in the following section. Assessment of the quality of studies found was undertaken to ensure overall reliability of the findings of this thesis. The screening process subsequently included ensuring papers had - measured outcomes in a valid and reliable means and appropriate statistical analysis was used when required. Any concerns about each study were recorded in

a column in the data extraction table. Attention was paid to factors like sample size and sampling strategy.

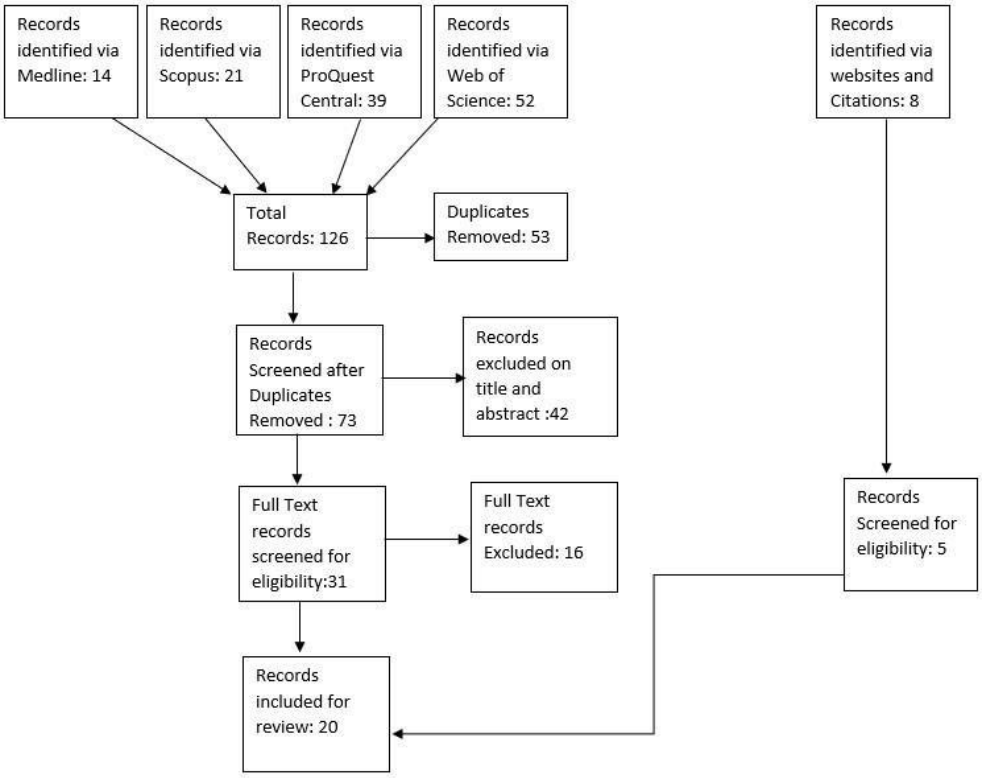


Figure 3.- *Prisma diagram of literature search process*

Diet and food

Diet can be a major risk factor for the development of NCDs. An unhealthy diet caused by excessive consumption of high salt and high fat foods can make an individual more susceptible to developing NCDs such as diabetes and cardiovascular diseases (Medeiros et al., 2012). Aside from leading directly to the NCDs, a poor diet can lead to other NCD risk factors such as being overweight and obesity (NHS, 2019) (Cecchini et al., 2010). It is thus vital to maintain a healthy diet and follow dietary recommendations for general health.

A study by Hall et al on adults aged 18-69 based on a 2002-03 WHO survey suggests that inadequate fruit and vegetable consumption was less prevalent in Ghana than in other LMICs, with inadequate consumption prevalence of 36.6% in men and 38% in women compared to other countries that displayed percentages of 99.3% and 99.2% respectively. Despite being low in comparison, 1 in 3 people having inadequate fruit consumption is still high. There was no consistency in the odds of consumption relative to age (Hall et al., 2009). Higher prevalence of inadequate consumption of fruits and vegetables in Ghana have been noted in research following this study. Minicuci et al found that of the population of Ghanaians aged 50-75+, 68% of this population consumed fruits and vegetables insufficiently with marginal differences between men and women, 66.7% for women compared to 68.9% for men. With increasing age, insufficient consumption increased, 66.4% for 50-64, 69.2% at 65-74 and 70.4% for 75+ (Minicuci et al., 2015). The 2008 Ghana DHS highlights the low consumption of fruits also and states that 78% of women and 87% of men consumed 0-2 servings daily despite WHO recommendations of 5 portions a day (WHO, 2020(c) . Only 28% of women and 21% of men reported consuming fruit on a daily basis. 82% of women and 86% of men reported consuming 0-2 servings of vegetables on a typical day (Ghana Statistical Service - GSS et al., 2009). **Table 2** compares the fruit and vegetable consumption of men and women over the age range of 15-49 and it demonstrates marginal differences in the frequency of consumption of fruit between men and women across all age groups but does show that there is a higher proportion of men consuming vegetables more frequently on average than women as age increases (Ghana Statistical Service - GSS et al., 2015).

Table 2. *Mean consumption of fruit and vegetables between men and women aged 15-49 (Ghana Statistical Service - GSS et al., 2015)*

Age	Mean number of days respondent consumed fruit in the past week (Men)	Mean number of days respondent consumed fruit in the past week (Women)	Mean number of days respondent consumed Vegetable in the past week (Men)	Mean number of days respondent consumed Vegetable in the past week (Women)
15-19	2.9	3.2	3.9	3.4
20-24	3.1	3.3	4.1	3.5
25-29	3.3	3.6	3.7	3.6
30-34	3.3	3.6	4.1	3.6
35-39	3.5	3.3	4.2	3.6
40-44	3.4	3.3	4.2	3.6
45-49	3.4	3.3	4.3	3.6

Salt intake is a factor in the development of hypertension and other cardiovascular diseases and a high salt diet can be a major risk factor (He et al., 2012). Median salt consumption for Ghanaians exceeded the WHO recommendations of <5g a day, in 77% of participants, in a 2020 study. This study found that salt intake was higher in women than in men with a median intake of 8.6 vs 7.5g/day and that salt intake was higher in younger participants (18-49) than it was in older participants (50+) with medians of 9.7 vs 8.1g/day (Menyanu et al., 2020). In the DHS 2014, 84% of women in the survey stated a member of their household had eaten processed foods with salt in the last 24 hours and 70% stated having used high salt bouillon cubes to cook in the preceding 24hours. The survey found that the use of salty foods was high in both urban and rural areas suggesting that this is a national problem and perhaps something that is embedded in the culture of food preparation (Ghana Statistical Service - GSS et al., 2015).

Palm oil is culturally significant to Ghana and as well as agriculturally (Khatun et al., 2020). Despite having health benefits such as being rich in phytonutrients, (May and Nesaretnam, 2014) palm oil has many health risks linked to NCDs. Studies have found that palm oil increases levels of sdLDL whilst other oils decreased it (Utarwuthipong et al., 2009). sdLDL is

the cholesterol linked with heart disease and cardiovascular diseases are the main cause of NCD death in Ghana (WHO, 2018). Despite this risk, Palm oil was the oil used by 62.3% of rural residents and 45.1% for urban residents in 2008 (Ghana Statistical Service - GSS et al., 2009). Research conducted by Bosu regarding west African nutrition and its impacts on NCDs the study states that countries in West Africa are experiencing a nutritional transition of which Ghana is in the final stages meaning an increase in high fat and high energy foods. In Ghana this has meant increased prevalence of unhealthy eating notably in adolescence with 20% of junior high school students aged 12-18 not consuming any fruit at breakfast in the preceding week and only 52% of adolescents eating fruit or vegetables in the preceding week suggesting the early cultivation of unhealthy eating habits beginning in childhood (Bosu, 2015).

Overweight and Obesity

Many NCDs are linked to being overweight (BMI ≥ 25.0-29.9) or being obese (BMI ≥ 30) and both are major risk factors for many NCDs including CVDs, respiratory diseases and cancers.

In Ghana being overweight or obese is possibly the most prevalent risk factor and most dangerous as it is a leading risk factor for CVDs, the biggest killer in Ghana (WHO, 2018).

Amoah's study conducted amongst adults aged 25 and above found that women had on average higher BMI values than men (25.6 vs 22.6 kg/m2). The rate of overweight for women was 27.1% and the rate for obesity was 20.2% compared to 17.5% and 4.6% for men respectively. Amoah made the following quartile ranges for BMI – < 20.6, 20.7-23.3, 23.427.2, 27.3 (kg/m^2)

In all ages of the study more women than men were in the fourth quartile of BMI, 32.9% vs 12% indicating that across the majority of the life course as studied by Amoah overweight and obesity is a bigger problem for women than men (Amoah, 2003). The author was approached for more disaggregated age data but none was provided. Another study of women aged 18 and above in Ghana found that 64.9% of 2,814 participants were either overweight or obese based on BMI, with obesity alone being 37.1% prevalent (Benkeser et al., 2012). **Table 3** illustrates the prevalence of overweight and the increasing prevalence with age, of obesity in Ghanaian women according to BMI, WHR and WC in two different studies.

Table 3*. Prevalence of overweight and obesity amongst women*

	(Benkeser et al., 2012)		(Benkeser et al., 2012)		(Duda et al., 2011)			
Age Group	Over-weight (BMI≥25-29.99)	Obese (BMI≥30)	Over-weight (WC)	Obese (WC)	Age group	(BMI≥30) %	(WC > 88) %	(WHR >0.8) %
18-24	21.6	11.8	25.7	27.0				
25-34	26.7	23.6	22.4	43.2	<50	29.9	42.8	55.4
35-55	29.3	46.1	14.9	74.5				
>55	28.1	43.4	11.1	77.8	>50	40.8	70.1	78.8

The study by Hill et al on the health of urban women also showed a high prevalence of overweight and obesity for women of all age groups as is shown in **Figure 4** (Hill et al., 2007). The overall prevalence of overweight was 27.6% and the overall prevalence of obesity was 34.7%. Of this 34.7%, 17.6% were classed as morbidly obese. Obesity was measured by BMI ≥ 30, waist circumference ≥ 88cm and waist to hip ratio ≥ 0.8.

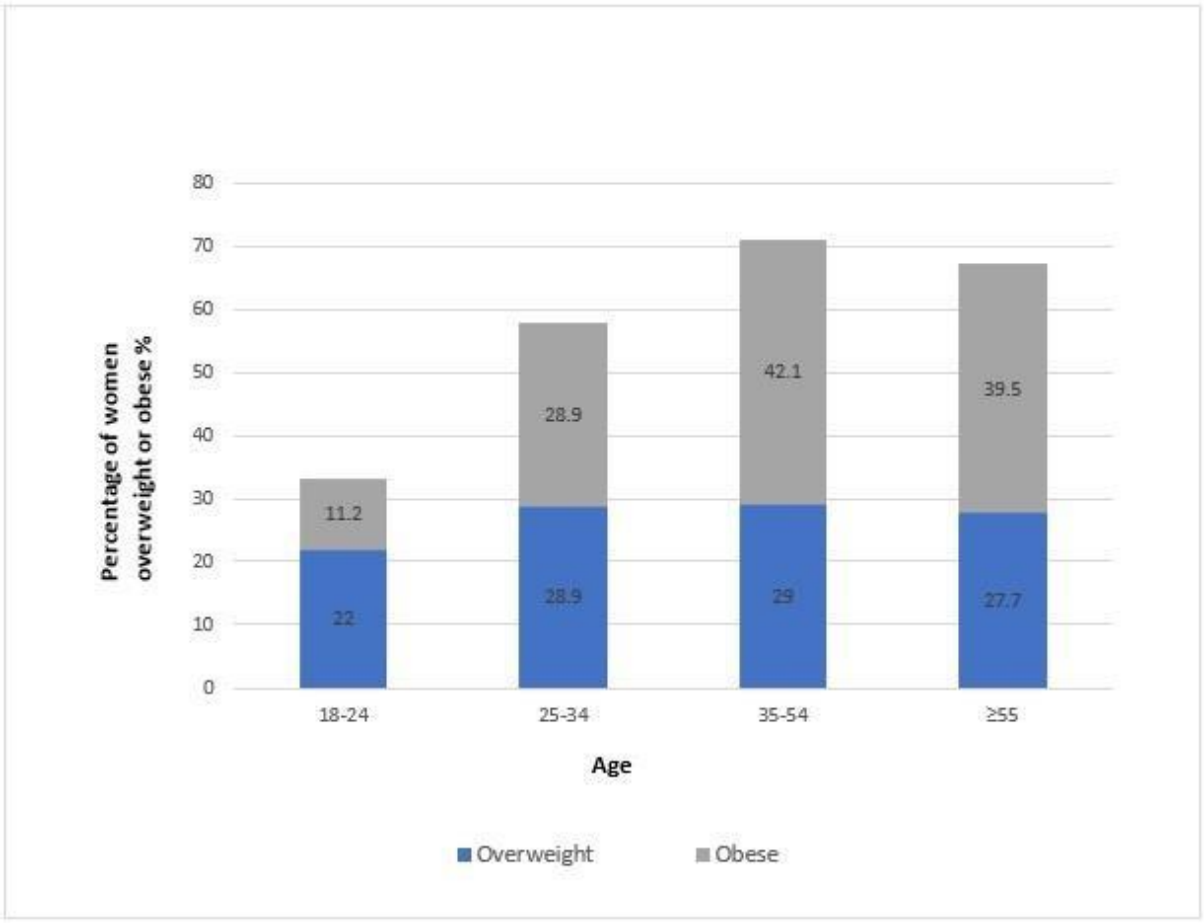


***Figure 4**. Prevalence of overweight and obesity amongst women in Accra by BMI (Hill et al., 2007)*

Duda's study on women's health in Ghana found that obesity, measured by BMI, increases with age. The study found in every category used to measure obesity- BMI, WC and WHR, there was higher percentages for those age ≥ 50 as shown in **Table 3**. In terms of overweight, categorised by BMI>25 which includes obesity, the study found that between the ages of 18-49 there was a prevalence of 55.8%; 71.6% for those 50-64 and 63.5% for women 65+, with 61.5% of women overall having a BMI >25 (Duda et al., 2011).

Obirikorang found that in both rural and urban settings a higher percentage of women than men had BMI > 25. They found that 61.1% of rural women had a BMI>25 compared to 47.9%

of rural men and in the urban environment 100% of women had a BMI>25 compared to 75% of urban men. Obesity followed a similar trend with 33.3% of rural women being obese compared to 10.4% of rural men and 87.5% of urban women being obese compared to 17.9% of urban men (Obirikorang et al., 2015). Nelson et al studied Ghanaians between the ages of 18-80 and found that 54% of the patients were overweight and an 40.4% of patients were obese. Obesity was again most prevalent in women as 45.7% of women were classed as obese compared to the 36% of men (Nelson et al., 2015).

Another study conducted by Gatimu found similar patterns for overweight and obesity amongst adults aged 50+ and with a smaller population aged 18-49. In this study 18% of women were identified as overweight in comparison to 15.2% of men, and in terms of obesity 16.6% of women were classified as obese in comparison to the 9.6% of men (Gatimu et al., 2016).

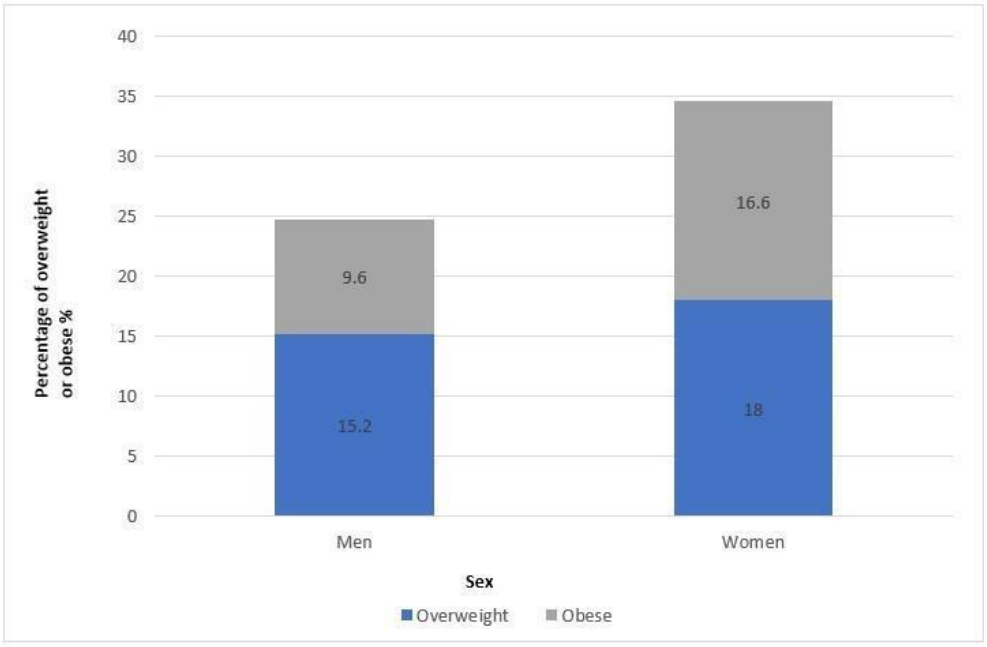


Figure 5.- *Prevalence of overweight and obesity in men and women in Ghana (Gatimu et al., 2016)*

Wu et al compared NCD risk factors in six different countries and found that in Ghana

Central obesity was the number 1 NCD risk factor amongst adults over the age of 50 and **Figure 6** illustrates the data from the study and shows prevalence of central obesity being higher amongst women than men and the prevalence increasing with age for both men and women. Central obesity was measured using WHR and the threshold for qualification was > 0.90 for men and > 0.85 for women. The prevalence of obesity between men and women is also shown in **Figure 6** and it illustrates how obesity is more prevalent in women across all the age ranges listed (Wu et al., 2015).

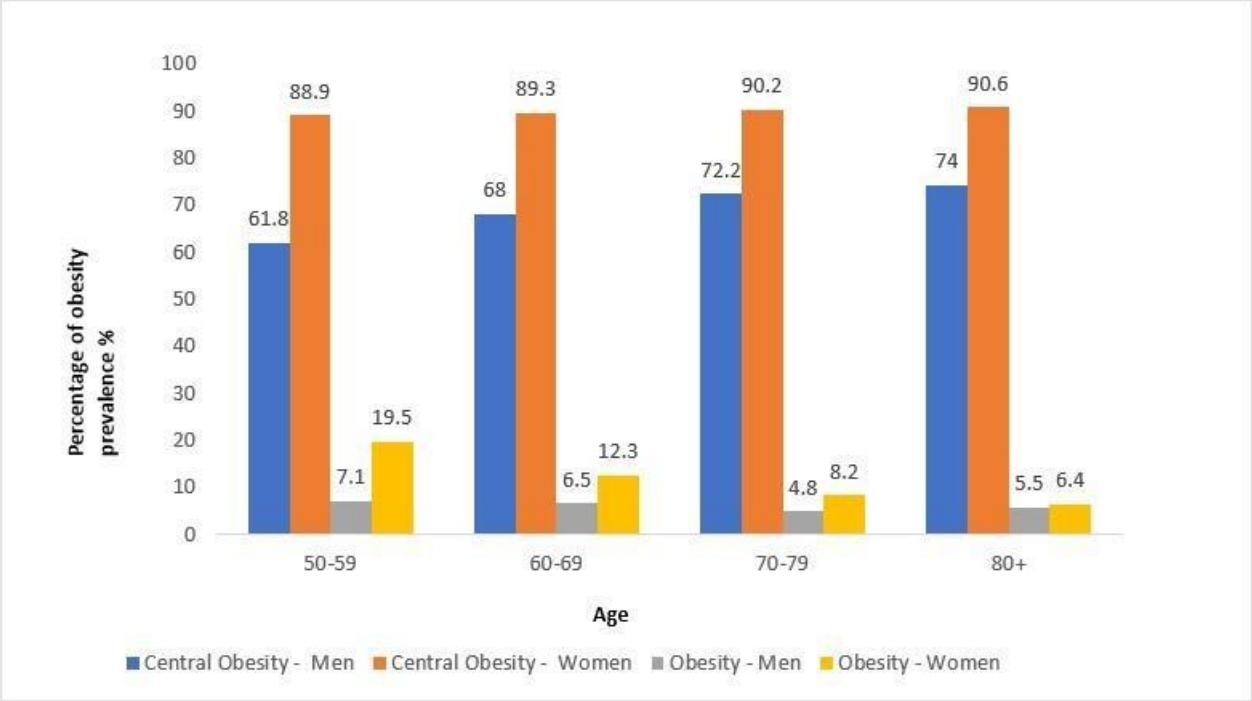
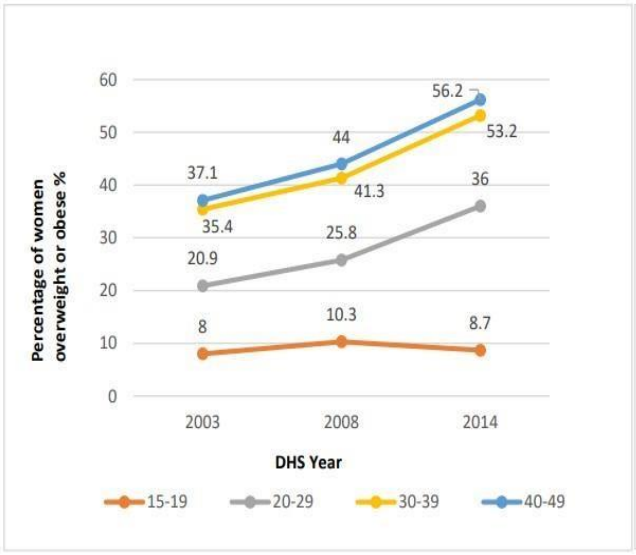


Figure 6. - *Prevalence of obesity and central of obesity in men and women (Wu et al., 2015)*

Afrifa-Anane found the same trend of females being worse affected by overweight and obesity. In the age range 15-24, the stages of adolescence to young adulthood. Women were more likely to be overweight and obese than men, with 17.7% of women classed as overweight compared to 6.8% of men, similarly, 13.3% of women were identified as obese compared with only 2.3% of men (Afrifa-Anane et al., 2015).

Figure 7 illustrates the percentage increase of overweight and obese women from three DHS between 2003 and 2014 for Ghana on the left. On the right is the same data from Nigeria, another SSA LMIC, during a similar time frame for comparison. Ghana has a higher prevalence than Nigeria at every age, in each year, illustrating how Ghanaian women are worse affected. Amongst the most noticeable trends is the linear growth in prevalence for the 20-29 age group in Ghana, that Nigeria does not exhibit (Ghana Statistical Service - GSS et al., 2015, Ghana Statistical Service - GSS et al., 2009, Ghana Statistical Service - GSS et al., 2004, National Population Commission - NPC/Nigeria and ICF International, 2014, National Population Commission - NPC/Nigeria and ICF Macro, 2009, National Population Commission - NPC/Nigeria and ORC Macro, 2004).

DHS 2008 and 2014 show high prevalence of overweight and obesity in women. Approximately 30% of women in 2008 were overweight but by 2014 this had risen to 40%. Women were more likely to be overweight and obese in Ghana than men with a prevalence of 40% compared to 16% respectively (Ghana Statistical Service - GSS et al., 2009, Ghana Statistical Service - GSS et al., 2015). **Figure 8** compares the trend of overweight and obesity in men and women in 2014. Noted is a rise in overweight and obesity prevalence in women from 9% at 15-19 to 56.2% aged 40-49 comparatively, men showed a lower prevalence of 1.7% at 15-19 and 27.5% aged 40-49. Percentage differences between men and women were 7.3% and 28.7% respectively (Ghana Statistical Service - GSS et al., 2015). Data regarding overweight and obesity was available for women in all DHS' but for men was unavailable until 2014.



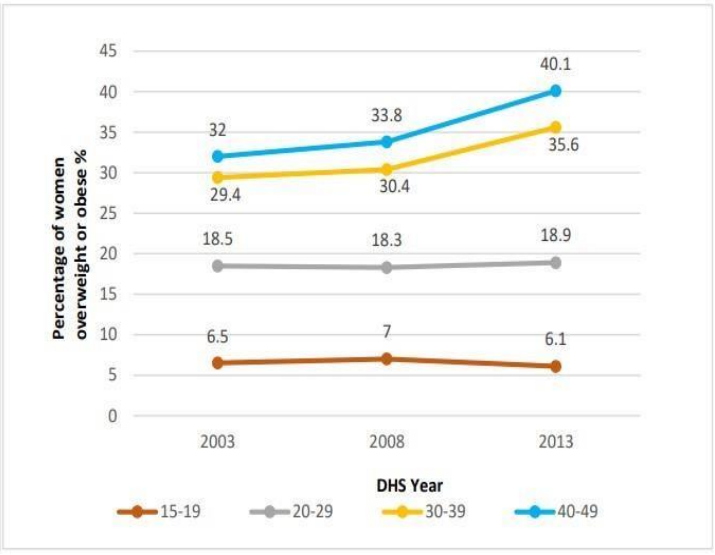


Figure 7. *Percentage of overweight or obese women in Ghana (Left) and Nigeria (Right) from 3 DHS'*

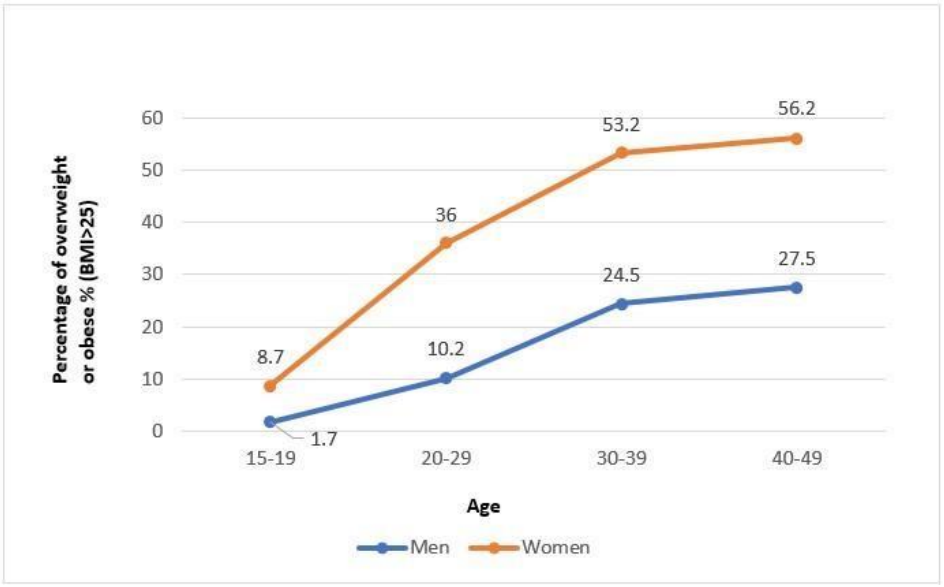


Figure 8- *Prevalence of overweight and obesity in men and women from the 2014 Ghana DHS (Ghana Statistical Service - GSS et al., 2015)*

Smoking and tobacco use

Tobacco use is another risk factor that contributes heavily to the development of NCDs including heart disease and lung cancer (Wagner and Brath, 2012) (WHO, 2005). By reducing

the amount of people that use tobacco it could be possible to then reduce the amount of people likely to develop NCDs. Findings showed that tobacco use was an NCD risk factor for Ghanaians but was not the most prominent factor in Ghana.

The study by Minicuci found that smoking had a prevalence of 8.1% and was more prevalent in men than in women, with 13% of men being daily smokers compared to 2.8% of women. In this study, daily current tobacco use peaked at 8.5% between 65-74 following a value of 8.3% at 50-64 and preceding a value of 7% in the 75+ age group. Another study conducted by Addo et al also found relatively low overall prevalence of smoking amongst their study population with only 9.6% having ever smoked and 3.3% being current smokers. The study which was investigating hypertension in rural Ghana did however find that the odds of developing hypertension was 2.81 times as likely in smokers than in non-smokers (Addo et al., 2006). Another study by Obirikorang in Ghana also explored tobacco use and found an overall smoking prevalence of 4.5%. Disaggregating this, they found that 6.2% of rural men smoked compared to 1.4% of rural women and 10.7% of urban men smoked whilst no urban women smoked (Obirikorang et al., 2015). More men than women smokers were recorded in the study by Tenkorang also with prevalence of 12.3% compared to 2.3% (Tenkorang and Kuuire, 2016). This trend was also found by Gatimu who noted that 12% of men were daily smokers compared to only 3.9% of women. Comparing former smokers, the same pattern was displayed with 28.1% of men being former smokers compared to only 4.5% of women (Gatimu et al., 2016). Wu et al found in adults aged 50+ Ghana had a relatively low overall prevalence of tobacco use of 7.7% compared to prevalence of 46% in other countries in the study. The study found that men were more prevalent tobacco users in every age category

and tobacco use generally increased with age for men as is displayed in **Table 4** (Wu et al., 2015)**.**

Table 4.- *The prevalence of tobacco use and low physical activity for men and women over 4 age ranges (Wu et al., 2015)*

	Tobacco use		Low levels of physical activity	
Age	Men (%)	Women (%)	Men (%)	Women (%)
50-59	11.1	2.0	15.9	21.3
60-69	11.2	3.7	18.6	28.8
70-79	10.7	6.4	29.9	39.4
80+	13.8	3.6	37.5	43.4

Amongst the youth aged 15-24 the same trend was observed by Afrifa-Anane. Men were more likely to have smoked compared to women with a prevalence of 18.2% compared to 11.5% (Afrifa-Anane et al., 2015). Nelson et al supports this trend also in their study conducted Ghanaians aged 18-80. Tobacco use was again more prevalent in men than in women with a prevalence of 6.4% in men compared to 2.9% in women. The Ghana DHS' also explored tobacco use amongst men and women aged 15-49 and found a low prevalence of smoking in both surveys, with smoking prevalence in men even reducing from 2008 to 2014. Despite the limited overall prevalence, tobacco use was still more common in men than in women as is shown in **Figure 9.** (Ghana Statistical Service - GSS et al., 2009) (Ghana Statistical Service - GSS et al., 2015)

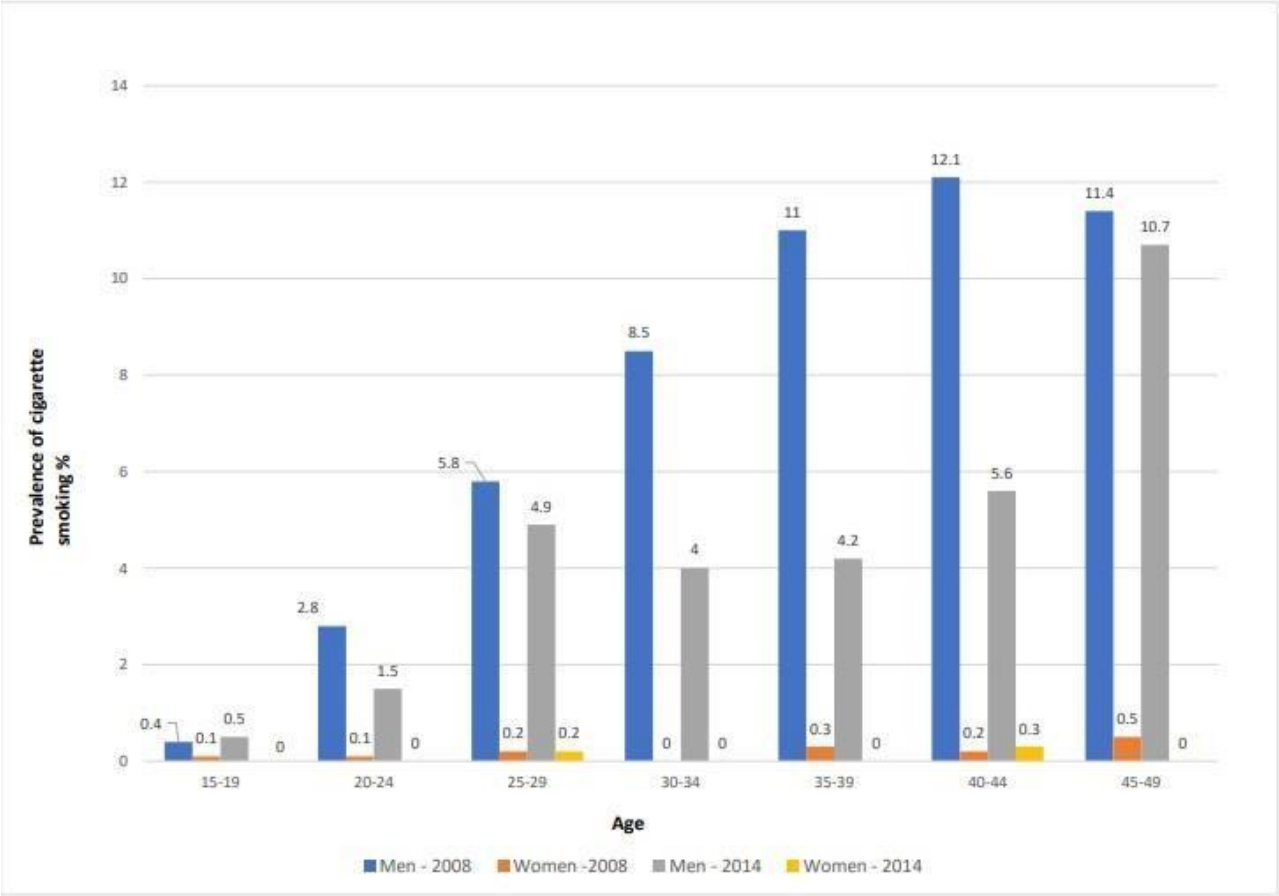


***Figure 9**.- Prevalence of cigarette smoking between men and women (Ghana Statistical Service - GSS et al., 2009) (Ghana Statistical Service - GSS et al., 2015)*

Physical activity

Physical inactivity is a major risk factor for many NCDs but most notably cardiovascular diseases and cancer. Physical inactivity can lead to becoming overweight or obese which are other risk factors for NCDs (Wagner and Brath, 2012). Ghana is currently experiencing the effects of urbanisation and a shift towards a more sedentary lifestyle (Koyanagi et al., 2018). In the Afrifa-Anane study on physical activity of Ghanaians and Ghanaian migrants, they found an overall physical inactivity prevalence of 29% in urban Ghana and 11.2% in rural Ghana. Physical inactivity was higher in women than men in both urban and rural Ghana with prevalence of 33.3% and 14.3% for women compared with 17.8% 6.3% for men respectively (Afrifa-Anane et al., 2020).

Minicuci et al noted that low physical activity was prevalent in the Ghanaian population notably for the older population of adults aged 50 + where physical inactivity increased with age. At 50-64 inactivity prevalence was 19.2%, this increased to 29.6% at 65-74 and further increased in those 75+ to 39.4%. Women were more physically inactive than men with 29.9% of women having low levels of physical activity compared to 21.8% of men (Minicuci et al., 2015). This lack of physical activity amongst the elderly is also shown in the study by Boateng examining risk factors for hypertension in the elderly. Studying adults aged 65+, Boateng found that at this stage in life only 36% of adults continue to engage in vigorous physical activity (Boateng et al., 2015).

Gatimu also displayed the same pattern of women being more physically inactive. 29.2% of women had low physical activity compared to 21.4% of men. In terms of the inverse 66.5% of men had high physical activity compared to 58.6% women (Gatimu et al., 2016). **Table 4**. compares men and women aged 50 and above and shows how women had lower physical activity in every increasing age group in comparison to men (Wu et al., 2015).

Obirikorang compared rural and urban populations aged 20+ and had similar findings. 37.9% of the study population did not exercise at all. Physical inactivity was most prevalent in rural and urban women. 48.6% of rural women were physically inactive compared to 29.2% of rural men and in the urban environment 37.5% of urban women were inactive compared to 32.1% of urban men (Obirikorang et al., 2015).

The same trend was identified by Afrifa-Anane in the study of 15–24-year-olds where women were still more inactive compared to men. 94.7% of women were inactive compared to 70.5% of men (Afrifa-Anane et al., 2015). Another study that incorporated all ages from

18-80 noted an overall prevalence of physical inactivity of 54.3%. This study also encountered a similar pattern in which physical inactivity was more prevalent in women than it was in men. 65.7% of women were inactive compared to 44.8% of men (Nelson et al., 2015).

Alcohol Consumption

Excessive alcohol consumption is also one of the main risk factors for NCDs notably cancer and hypertension. Obirikorang found in the urban setting alcohol use was more prevalent in men than in women at 28.6% compared to 16.7%. The same was noted in the rural population with 29.2% for men and 6.9% for women (Obirikorang et al., 2015). Gatimu found also that more males than females were daily drinkers, 31.4% compared with 11.5%. They found also non-drinking was more prevalent in women than in men with values of 53.4% compared with 33.1% (Gatimu et al., 2016). The same trend in those aged 15-24 by Afrifa-Anane finding that male youth were more likely to be current drinkers than females with prevalence of 42.7% compared with 31.9% (Afrifa-Anane et al., 2015). Alcohol consumption data was available only in the 2008 DHS. The survey showed more men than women aged 15-49 consumed alcohol. Between 15-19 the prevalence for men was 7.5% compared with 6.6% for women. The prevalence and percentage difference between men and women generally increases with age. Age range 45-49 showed this with prevalence of 50.8% for men and 26.0% for women. Men were more frequent and heavier consumers of alcohol with more men than women consuming alcohol 4 or more times in the last 7 days at every age starting at 4.6% and rising to 25.3% for men and 1.1% and peaking at 11.5% for women (Ghana Statistical Service - GSS et al., 2009). Tenkorang also found that more men than women consumed alcohol 5 times or more in a month than women with prevalence of

17.7% vs 4.3% (Tenkorang and Kuuire, 2016).

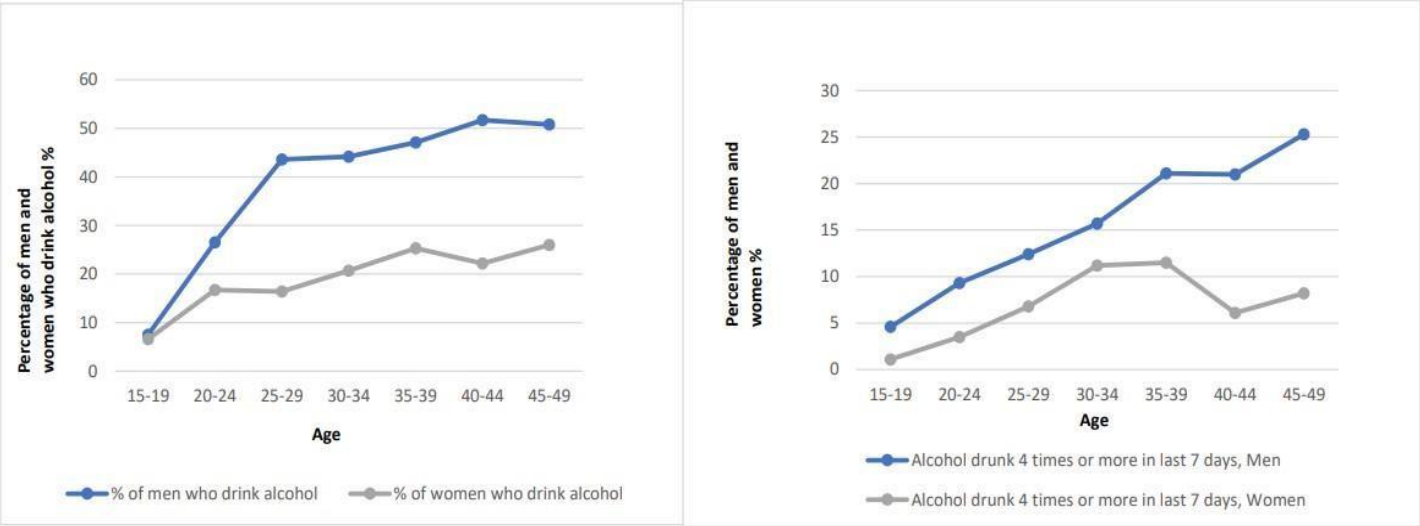


Figure 10.*- Prevalence of men and women who - drink alcohol (left) / drank alcohol 4 times or more in last 7 days (right) (Ghana Statistical Service - GSS et al., 2009)*

Discussion

Key findings

The review of the literature available outlined some trends in risk factors that ultimately give rise to prevalence of NCDs in Ghana. Notable risk factors and the subgroups they affect include - overweight and obesity amongst women in particular post-adolescence; a high prevalence of physical inactivity amongst women all ages; and harmful diets led by insufficient fruit and vegetable consumption, excessive palm oil and salt intake which was prevalent in men and women across all ages. Other risk factors such as alcohol consumption and tobacco use had low overall prevalence. These factors were more common in men than women but proved not to be the most prominent NCD risk factors in Ghana over the life course. In respects to the life course, trends from the data analysed suggest that risk factors

for NCDs are becoming increasingly prevalent amongst the youth and being sustained throughout adulthood and later life. Obesity, harmful diet, and physical inactivity are the most prevalent and threatening risk factors to younger Ghanaians. Increasing prevalence of these risk factors at younger ages is noted and verified by research data and grey literature that together would illustrate the most at-risk subgroups are women between the ages of 15-29, because in this age group we witness the biggest transition in exposure to modifiable risk factors.

Main Discussion

In general, physical activity is higher in men than it is in women (Azevedo et al., 2007), however in Ghana it seems this disparity is becoming greater than is generally seen as is shown in the data. Urbanisation has meant that the Ghanaian population have begun a transition into a more sedentary lifestyle which ultimately is affecting women more than men (Wachira, 2021). Poverty, fears of safety and gendered conceptions about physical activity are among reasons that rates of leisurely physical activity are limited overall, also explaining why we see more activity in men (Doegah and Amoateng, 2019). This adoption of a more sedentary lifestyle is also strongly linked with the increasing overweight and obesity rates which again is disproportionately affecting women at younger ages in the life course. The region of SSA is undergoing a nutritional transition as a consequence of urbanisation from a more plant-based diet to one of high energy, fat and sugar and Ghana is at the forefront of this transition (Abrahams et al., 2011). This high energy intake matched with low activity output means that Ghanaians are becoming increasingly susceptible to weight gain. From the data we see this trend is occurring at increasingly younger ages and being sustained into later years. This nutritional transition also explains the increasingly low uptake

of fruits and vegetables and the high consumption of salt by both men and women throughout the life course. The increased accessibility and convenience of fast foods (Nondzor and Tawiah, 2015) as a result of urbanisation as well as other factors such as cultural cooking practices with the high usage of palm oil as shown in this review as well as perceptions on body sizes explain why the data shows such prevalence of harmful diets. The notion that carrying a heavier body implies good wellbeing and wealth is a cultural factor that encourages harmful dietary habits and discourages activity especially in women because of the desire to have this body size (Agyapong et al., 2020).

Current Policy approach

Prior to 2012 Ghana had no national policy for NCDs despite the rising NCD burden since the 1990s (de-Graft Aikins et al., 2012). In August 2012 a national NCD policy document was published which focused on reducing NCD morbidity. Of the four objectives listed in the document to achieve the overall goal, this thesis was concerned primarily with “Reduce exposure to the risk factors that contribute to NCDs”. The policy aimed to do this by focusing on primary prevention. This meant incorporating policies that relate to diet, physical activity as well as tobacco and alcohol control, health promotion policy that would promote fruit and vegetable intake whilst reducing the intake of energy dense foods and salt by making daily dietary recommendations and targeting takeaways and restaurants through legislation. In schools, the sale of fizzy drinks would be replaced by fruits and students would be discouraged from sweetened drinks. Physical activity policy consisted of endorsing WHO

recommendations and encouraging the general public to engage in normal physical activities (Ghana Ministry of Health, 2012).

Evaluating this policy approach, we see that it has been largely ineffective in helping reduce the burden of NCD in the years since 2012. Data collated in this thesis show that the burden has since increased. Despite outlining generic methods of primary prevention relative to risk factors, the document lacked specificity and clarity surrounding the implementation and regulation of these policies and methods. Research into Ghana's NCD policy approach has shown issues regarding policy implementation and lack of clarity have been amongst the hinderances to reducing the NCD burden (Nyaaba et al., 2020). The institutional challenges of health policy implementation such as the language barrier and different dialects spoken in Ghana were not considered (Amu et al., 2021). Clarity regarding which gender and age groups specifically will be targeted and how this will be ensured is another example of the considerations this policy does not take. Research evidence conveys that "robust" national policies and strategies are essential for the prevention of NCDs and it is clear this is where the policymakers of Ghana fail (Mendis, 2010).

Policy Recommendations

With the knowledge obtained from this study we are now aware of the most threatening modifiable risk factors are overweight/obesity, physical inactivity, and harmful diets. Women are worst affected, and the effects of these factors first begin to take place between the ages of 15-29 and are commonly sustained through the rest of the life course. Addressing the trend here could prevent obesity and physical inactivity at that point and later on in the life course so new interventions should target young women in this age group. Any policy

interventions to be developed must extend past solely dietary based intervention but simultaneously include a component increasing physical activity, in an attempt to counteract the current effects of urbanisation on Ghanaians. To do this it is necessary for policies to have the same fundamental ideas as stated in the previous NCD policy document from 2012, but this time to contain an implementation plan with specific programs and activities, timelines, and accountability in order to deal with the logistical implementation issues which arise in Ghana. Plan monitoring should also be introduced to ensure that regulations are adhered to by the stakeholders involved. Finally, plans to develop sustainable financing and increased awareness of policies are essential to ensure that any interventions to come are feasible and can be maintained in the context (Nyaaba et al., 2020) (Mendis and Fuster, 2009) (Mendis, 2010) .

Limitations and Conclusions

A lack of extensive research conducted on the risk factors of NCDs in Ghana meant that availability of relevant literature was limited. This thesis was thus restricted to beginning its focus on the life course during adolescence around the age of 15 as a result of limited data was available on modifiable risk factors in early childhood which would have provided a better overview of NCDs in the life course. A lot of samples selected for studies that were available were based in the capital city of Accra, it is possible that the data obtained by these researchers is representative predominantly of Accra rather than Ghana as a whole. With the current burden of NCDs in Ghana and the influence of risk factors in this burden it is clear that more research must be conducted on this topic area to provide data for childhood and lesser populated rural areas of Ghana. Nonetheless in comparing the risk factors of men and women over the life course it was possible to identify that the most prominent modifiable

NCD risk factors were physical inactivity, overweight/obesity, and harmful diets. The sex most affected was women and in the life course between ages 15-29 is where we see the transition from low to high prevalence of risk factors which are then commonly sustained for the rest of the life course. In order to address the NCD burden in Ghana it is important to firstly address risk factors that cause them, and the populations worst affected by them as identified in this thesis.

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References

ABRAHAMS, Z., MCHIZA, Z. & STEYN, N. P. 2011. Diet and mortality rates in Sub-Saharan Africa: Stages in the nutrition transition. *BMC Public Health,* 11**,** 801.

ADDO, J., AMOAH, A. G. & KORAM, K. A. 2006. The changing patterns of hypertension in Ghana: a study of four rural communities in the Ga District. *Ethnicity & disease,* 16**,** 894-899.

ADU-GYAMFI, S., TOMDI, L. & AMAKYE-BOATENG, K. 2020. DISCOURSE ON NON-COMMUNICABLE DISEASES INTERVENTIONS IN GHANA (1990-2018). *Journal of Basic and Applied Research International,* 26**,** 17-26.

AFRIFA-ANANE, E., AGYEMANG, C., CODJOE, S. N. A., OGEDEGBE, G. & AIKINS, A. D. 2015. The association of physical activity, body mass index and the blood pressure levels among urban poor youth in Accra, Ghana. *Bmc Public Health,* 15.

AFRIFA-ANANE, E., AIKINS, A., MEEKS, K., BEUNE, E., ADDO, J., SMEETH, L., BAHENDEKA, S., STRONKS, K. & AGYEMANG, C. 2020. Physical Inactivity among Ghanaians in Ghana and Ghanaian Migrants in Europe. *Medicine and science in sports and exercise*.

AGYAPONG, N. A. F., ANNAN, R. A., APPREY, C. & ADUKU, L. N. E. 2020. Body Weight, Obesity Perception, and Actions to Achieve Desired Weight among Rural and Urban Ghanaian Adults. *Journal of Obesity,* 2020**,** 7103251.

ALLEN, L., COBIAC, L. & TOWNSEND, N. 2017. Quantifying the global distribution of premature mortality from non-communicable diseases. *Journal of Public Health,* 39**,** 698-703.

AMOAH, A. G. 2003. Obesity in adult residents of Accra, Ghana. *Ethn Dis,* 13**,** S97-101.

AMU, H., DARTEH, E. K. M., TARKANG, E. E. & KUMI-KYEREME, A. 2021. Management of chronic noncommunicable diseases in Ghana: a qualitative study using the chronic care model. *BMC Public Health,* 21**,** 1120.

AZEVEDO, M. R., ARAÚJO, C. L. P., REICHERT, F. F., SIQUEIRA, F. V., DA SILVA, M. C. & HALLAL, P. C. 2007. Gender differences in leisure-time physical activity. *International journal of public health,* 52**,** 8-15.

BBC. 2020. *Ghana Country Profile* [Online]. Available: https://www.bbc.co.uk/news/worldhttps://www.bbc.co.uk/news/world-africa-13433790africa13433790 [Accessed 31/8/21 2021].

BEAGLEHOLE, R., BONITA, R., HORTON, R., ADAMS, C., ALLEYNE, G., ASARIA, P., BAUGH, V., BEKEDAM, H., BILLO, N. & CASSWELL, S. 2011. Priority actions for the non-communicable disease crisis. *The lancet,* 377**,** 1438-1447.

BENKESER, R. M., BIRITWUM, R. & HILL, A. G. 2012. Prevalence of overweight and obesity and perception of healthy and desirable body size in urban, Ghanaian women. *Ghana medical journal,* 46**,** 66-75.

BENNETT, J. E., STEVENS, G. A., MATHERS, C. D., BONITA, R., REHM, J., KRUK, M. E., RILEY, L. M., DAIN, K., KENGNE, A. P., CHALKIDOU, K., BEAGLEY, J., KISHORE, S. P., CHEN, W., SAXENA, S., BETTCHER, D. W., GROVE, J. T., BEAGLEHOLE, R. & EZZATI, M. 2018. NCD Countdown 2030: worldwide trends in non-communicable disease mortality and progress towards Sustainable Development Goal target 3.4. *The Lancet,* 392**,** 1072-1088.

BIGNA, J. J. & NOUBIAP, J. J. 2019. The rising burden of non-communicable diseases in sub-Saharan Africa. *The Lancet Global Health,* 7**,** e1295-e1296.

BOATENG, G. O., LUGINAAH, I. N. & TAABAZUING, M.-M. 2015. Examining the Risk Factors Associated With Hypertension Among the Elderly in Ghana. *Journal of Aging and Health,* 27**,** 1147-1169.

BOSU, W. K. 2015. An overview of the nutrition transition in West Africa: implications for noncommunicable diseases. *The Proceedings of the Nutrition Society,* 74**,** 466-477. CDC 2019.

CDC in Ghana. Centre for Diseases Control and Prevention.

CECCHINI, M., SASSI, F., LAUER, J. A., LEE, Y. Y., GUAJARDO-BARRON, V. & CHISHOLM, D. 2010. Tackling of unhealthy diets, physical inactivity, and obesity: health effects and costeffectiveness. *The Lancet,* 376**,** 1775-1784.

DE-GRAFT AIKINS, A., ADDO, J., OFEI, F., BOSU, W. & AGYEMANG, C. 2012. Ghana's burden of chronic non-communicable diseases: future directions in research, practice and policy. *Ghana medical journal,* 46**,** 1-3.

DE GRAFT AIKINS, A., ANUM, A., AGYEMANG, C., ADDO, J. & OGEDEGBE, O. 2012. Lay representations of chronic diseases in Ghana: implications for primary prevention. *Ghana medical journal,* 46**,** 59-68.

DOEGAH, P. T. & AMOATENG, A. Y. 2019. Understanding physical activity among young Ghanaians aged 15–34 years. *Cogent Medicine,* 6**,** 1617021.

DUDA, R. B., ANARFI, J. K., ADANU, R. M., SEFFAH, J., DARKO, R. & HILL, A. G. 2011. The health of the "older women" in Accra, Ghana: results of the Women's Health Study of Accra. *Journal of Cross-Cultural Gerontology,* 26**,** 299-314.

FRUMKIN, H. & HAINES, A. 2019. Global environmental change and noncommunicable disease risks. *Annual Review of Public Health,* 40**,** 261-282.

GATIMU, S. M., BENSON WILLIESHAM, M. & MIGUEL SAN, S. 2016. Prevalence and determinants of diabetes among older adults in Ghana. *BMC Public Health,* 16**,** 1.

GHANA MINISTRY OF HEALTH 2012. National Policy for the Prevention and Control of Chronic NonCommunicable Diseases in Ghana. Ministry of Health.

GHANA STATISTICAL SERVICE - GSS, GHANA HEALTH SERVICE - GHS & ICF INTERNATIONAL 2015. Ghana Demographic and Health Survey 2014. Rockville, Maryland, USA: GSS, GHS, and ICF International.

GHANA STATISTICAL SERVICE - GSS, GHANA HEALTH SERVICE - GHS & ICF MACRO 2009. Ghana Demographic and Health Survey 2008. Accra, Ghana: GSS, GHS, and ICF Macro.

GHANA STATISTICAL SERVICE - GSS, NOGUCHI MEMORIAL INSTITUTE FOR MEDICAL RESEARCH - NMIMR/GHANA & ORC MACRO 2004. Ghana Demographic and Health Survey 2003. Calverton, Maryland, USA: GSS, NMIMR, and ORC Macro.

GOUDA, H. N., CHARLSON, F., SORSDAHL, K., AHMADZADA, S., FERRARI, A. J., ERSKINE, H., LEUNG, J., SANTAMAURO, D., LUND, C., AMINDE, L. N., MAYOSI, B. M., KENGNE, A. P., HARRIS, M., ACHOKI, T., WIYSONGE, C. S., STEIN, D. J. & WHITEFORD, H. 2019. Burden of noncommunicable diseases in sub-Saharan Africa, 1990–2017: results from the Global Burden of Disease Study 2017. *The Lancet Global Health,* 7**,** e1375-e1387.

HABIB, S. H. & SAHA, S. 2010. Burden of non-communicable disease: global overview. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews,* 4**,** 41-47.

HALL, J. N., MOORE, S., HARPER, S. B. & LYNCH, J. W. 2009. Global Variability in Fruit and Vegetable Consumption. *American Journal of Preventive Medicine,* 36**,** 402-409.e5.

HE, F. J., CAMPBELL, N. R. & MACGREGOR, G. A. 2012. Reducing salt intake to prevent hypertension and cardiovascular disease. *Revista Panamericana de Salud Pública,* 32**,** 293-300.

HILL, A. G., DARKO, R., SEFFAH, J., ADANU, R. M. K., ANARFI, J. K. & DUDA, R. B. 2007. Health of urban Ghanaian women as identified by the Women's Health Study of Accra. *International Journal of Gynecology & Obstetrics,* 99**,** 150-156.

HOOKER, S., PUNJABI, A., JUSTESEN, K., BOYLE, L. & SHERMAN, M. D. 2018. Encouraging health behavior change: eight evidence-based strategies. *Family practice management,* 25**,** 31-36.

KHATUN, K., MAGUIRE-RAJPAUL, V. A., ASANTE, E. A. & MCDERMOTT, C. L. 2020. From agroforestry to agroindustry: smallholder access to benefits from oil palm in ghana and the implications for sustainability certification. *Frontiers in Sustainable Food Systems,* 4**,** 29.

KIM, H. C. & OH, S. M. 2013. Noncommunicable diseases: current status of major modifiable risk factors in Korea. *J Prev Med Public Health,* 46**,** 165-72.

KLIMEK, P., AICHBERGER, S. & THURNER, S. 2016. Disentangling genetic and environmental risk factors for individual diseases from multiplex comorbidity networks. *Scientific Reports,* 6**,** 39658.

KOYANAGI, A., STUBBS, B. & VANCAMPFORT, D. 2018. Correlates of sedentary behavior in the general population: A cross-sectional study using nationally representative data from six low- and middle-income countries. *PLoS ONE [Electronic Resource],* 13**,** e0202222.

MAY, C. Y. & NESARETNAM, K. 2014. Research advancements in palm oil nutrition. *European journal of lipid science and technology,* 116**,** 1301-1315.
MEDEIROS, F., CASANOVA, M. D. A., FRAULOB, J. C. & TRINDADE, M. 2012. How Can Diet Influence the Risk of Stroke? *International Journal of Hypertension,* 2012**,** 763507.
MENDIS, S. 2010. The policy agenda for prevention and control of non-communicable diseases. *Br Med Bull,* 96**,** 23-43.
MENDIS, S. & FUSTER, V. 2009. National policies and strategies for noncommunicable diseases. *Nature Reviews Cardiology,* 6**,** 723-727.
MENYANU, E. K., CORSO, B., MINICUCI, N., ROCCO, I., RUSSELL, J., WARE, L. J., BIRITWUM, R., KOWAL, P., SCHUTTE, A. E. & CHARLTON, K. E. 2020. Salt and potassium intake among adult Ghanaians: WHO-SAGE Ghana Wave 3. *BMC Nutrition,* 6**,** 54.
MINICUCI, N., BIRITWUM, R. B., MENSAH, G., YAWSON, A. E., NAIDOO, N., CHATTERJI, S. & KOWAL, P. 2015. Sociodemographic and socioeconomic patterns of chronic non-communicable disease among the older adult population in Ghana. *Glob Health Action,* 7**,** 21292.
NATIONAL POPULATION COMMISSION - NPC/NIGERIA & ICF INTERNATIONAL 2014. Nigeria Demographic and Health Survey 2013. Abuja, Nigeria: NPC/Nigeria and ICF International.
NATIONAL POPULATION COMMISSION - NPC/NIGERIA & ICF MACRO 2009. Nigeria Demographic and Health Survey 2008. Abuja, Nigeria: NPC/Nigeria and ICF Macro.
NATIONAL POPULATION COMMISSION - NPC/NIGERIA & ORC MACRO 2004. Nigeria Demographic and Health Survey 2003.
NELSON, F., NYARKO, K. M. & BINKA, F. N. 2015. Prevalence of Risk Factors for Non-Communicable Diseases for New Patients Reporting to Korle-Bu Teaching Hospital. *Ghana medical journal,* 49**,** 12-18.
NHS. 2019. *Obesity* [Online]. Available: https://www.nhs.uk/conditions/obesity/ [Accessed 31/8/21 2021].
NONDZOR, H. E. & TAWIAH, Y. S. 2015. Consumer perception and preference of fast food: A Study of tertiary students in Ghana. *Science Journal of Business and Management,* 3**,** 43-49.
NUGENT, R., BERTRAM, M. Y., JAN, S., NIESSEN, L. W., SASSI, F., JAMISON, D. T., PIER, E. G. & BEAGLEHOLE, R. 2018. Investing in non-communicable disease prevention and management to advance the Sustainable Development Goals. *The Lancet,* 391**,** 2029-2035.
NYAABA, G. N., STRONKS, K., MASANA, L., LARREA-KILLINGER, C. & AGYEMANG, C. 2020. Implementing a national non-communicable disease policy in sub-Saharan Africa: experiences of key stakeholders in Ghana. *Health Policy Open,* 1**,** 100009.
NYIRENDA, M. J. 2016. Non-communicable diseases in sub-Saharan Africa: understanding the drivers of the epidemic to inform intervention strategies. *International Health,* 8**,** 157-158.
OBIRIKORANG, C., DERICK NII MENSAH, O., ANTO, E. O., SAMUEL OPOKU, A. & OPEI, K. A. 2015. Obesity and Cardio-Metabolic Risk Factors in an Urban and Rural Population in the Ashanti Region-Ghana: A Comparative Cross-Sectional Study. *PLoS One,* 10.
TENKORANG, E. Y. & KUUIRE, V. Z. 2016. Noncommunicable Diseases in Ghana:Does the Theory of Social Gradient in Health Hold? *Health Education & Behavior,* 43**,** 25S-36S.
UNDP 2020. Human Development report - The Next Frontier: Human Development and the Anthropocene. United Nation Development Programme: United Nations.
UTARWUTHIPONG, T., KOMINDR, S., PAKPEANKITVATANA, V., SONGCHITSOMBOON, S. & THONGMUANG, N. 2009. Small Dense Low-Density Lipoprotein Concentration and Oxidative Susceptibility Changes after Consumption of Soybean Oil, Rice Bran Oil, Palm Oil and Mixed Rice Bran/Palm Oil in Hypercholesterolaemic Women. *Journal of International Medical Research,* 37**,** 96-104.
WACHIRA, L.-J. 2021. Lifestyle Transition towards Sedentary Behavior among Children and Youth in SubSaharan Africa: A Narrative Review. *Sedentary Behaviour-A Contemporary View*.

WAGNER, K.-H. & BRATH, H. 2012. A global view on the development of non communicable diseases. *Preventive medicine,* 54**,** S38-S41.

WHO. 2005. *Chronic diseases and their common risk factors* [Online]. WHO. Available: https://www.who.int/chp/chronic_disease_report/media/Factsheet1.pdf [Accessed 31/8/21 2021].

WHO. 2018. *Noncommunicable Diseases Country Profiles* [Online]. Available: https://www.who.int/nmh/countries/gha_en.pdf?ua=1 [Accessed 31/8/21 2021].

WHO. 2020a. *10 Global health issues to track in 2021* [Online]. Available: https://www.who.int/news-room/spotlight/10-global-health-issues-to-track-in-2021 [Accessed 31/8/21 2021].

WHO 2020b. Gender and noncommunicable diseases in Europe: analysis of STEPS data. World Health Organization. Regional Office for Europe.

WHO. 2020(c). *Healthy Diet* [Online]. Available: https://www.who.int/newshttps://www.who.int/news-room/fact-sheets/detail/healthy-dietroom/factsheets/detail/healthy-diet [Accessed 31/8/21 2021].

WHO. 2021. *Non-Communicable Diseases* [Online]. WHO.int. Available: https://www.who.int/newsroom/fact-sheets/detail/noncommunicable-diseases [Accessed 2021 2021].

WORLDBANK 2020. Ghana GDP. 2020 ed. World Bank: World Bank.

WU, F., GUO, Y., CHATTERJI, S., ZHENG, Y., NAIDOO, N., JIANG, Y., BIRITWUM, R., YAWSON, A., MINICUCI, N., SALINAS-RODRIGUEZ, A., MANRIQUE-ESPINOZA, B., MAXIMOVA, T., PELTZER, K., PHASWANAMAFUYA, N., SNODGRASS, J. J., THIELE, E., NG, N. & KOWAL, P. 2015. Common risk factors for chronic non-communicable diseases among older adults in China, Ghana, Mexico, India, Russia and South Africa: the study on global AGEing and adult health (SAGE) wave 1. *BMC Public Health,* 15**,** 88.

Supplementary annexes

Data Extraction Table

Citation	Country / geographical coverage	Subject matter relevant to NDCs discussed	Cardiovascular diseases and Hypertension	Diabetes	Respiratory disease	Cancer	Types of risk factor covered	Sample size	Age	Outcomes
BENKESER, R. M., BIRITWUM, R. & HILL, A. G. 2012. Prevalence of overweight and obesity and perception of healthy and desirable body size in urban, Ghanaian women. Ghana medical journal, 46, 68-75.	Accra Ghana	Discusses the prevalence of the risk factor of obesity and overweight amongst Ghanaian women in Accra	y	y	n	n	Obesity and overweight	2814	18+	84.9% of women in the study were either overweight or obese according to BMI and according to waist circumference 78.7% of women were obese. Overweight and obesity is a major problem that is disproportionately affecting women in Ghana
AFRIFA-ANANE, E., AKINS, A., MEEKS, K., BEUNE, E., ADDO, J., SMEETH, L., BAHENDEKA, S., STRONKS, K. & AGYEMANG, C. 2020. Physical inactivity among Ghanaians in Ghana and Ghanaian Migrants in Europe. Medicine and science in sports and exercise.	Ghana and Europe	Discusses the prevalence of physical inactivity amongst Ghanaian immigrants and Ghanaians in urban and rural Ghana	y	y	n	n	Physical activity	5659	25-70	The study reported high prevalence of physical inactivity in Ghanaians in both urban and rural Ghana. The same was found for Ghanaian immigrants living in other countries. Urban Ghanaians displayed a higher prevalence of inactivity than that taken from Sub-Saharan Africa as a whole
Tenkorang, E. Y. and V. Z. Kuuire (2016). "Noncommunicable Diseases in Ghana: Does the Theory of Social Gradient in Health Hold?" Health Education & Behaviour 43(1_suppl): 255-265.	Ghana	Compares a range of risk factors that have socio-economic relevance within the overall topic of non-communicable diseases	y	y	y	y	Obesity, alcohol consumption, tobacco use, physical activity , fruit and veg	5583	50+ (18-49)	The prevalence of NCDs was higher in females than in males (12.9% vs 9.4%) Ghanaian men were more physically active than women, more men than women engaged in vigorous physical activity for at least 10 mins a day. Frequent alcohol use was more common in men than in women, similarly smoking and fruit and vegetable consumption
Addo, J., et al. (2008). "The changing patterns of hypertension in Ghana: a study of four rural communities in the Ga District." Ethnicity & disease 18(4): 894-899. B	Ghana Ga District, Rural Area	Discusses Hypertension prevalence in a rural community in Ghana and identifies some of the risk factors of hypertension including age and gender.	y	n	n	n	Overweight and obesity are easily modifiable and diet related risk factors for hypertension that can be addressed	362	25+	Prevalence of hypertension was 25.4% and of this figure only 32.3% were aware. adjusted odds ratios for developing hypertension for overweight or obesity were 5.8 (95% confidence interval 1.4–24.1) and 6.9 (95% confidence interval 1.7–28.2. he adjusted odds ratio for hypertension for age groups 45–54, 55–64, and ≥65 years were 31.9 (95% confidence interval 1.88–539.11), 31.8 (95% confidence interval 1.8–624.2), and 58.8 (95% confidence interval 2.9–1168.7).
Hall, J. N., et al. (2009). "Global Variability in Fruit and Vegetable Consumption." American Journal of Preventive Medicine 36(5): 402-409.e405.	52 countries including Ghana	Discusses fruit and vegetable consumption in Ghana amongst other countries	y	y	y	y	Fruit and vegetable consumption	4165	18-69	Low Fruit and vegetable consumption in Ghana was not at all as prevalent as expected with very low prevalence of inadequate fruit and vegetable consumption
Boateng, G. O., et al. (2015). "Examining the Risk Factors Associated With Hypertension Among the Elderly in Ghana." Journal of Aging and Health 27(7): 1147-1169. B	Ghana only	The NCD discussed in this study is hypertension especially amongst the elderly. Hypertension is a significant factor for cardiovascular diseases which is one of the big 4 NCDs.	y	y	n	n	Alcohol consumption, physical activity	3,573	50+ ; small sample of 18-49	The results from table 1 show a statistically significant relationship between chronic diseases and hypertension. Respondents who had been diagnosed with arthritis, diabetes and asthma were all more likely to be hypertensive. Engaging in physical activity or the lack of was also a significant factor. This study attempts to also incorporates the significance of less commonly considered risk factors such as Depression.
Hill, A. G., et al. (2007). "Health of urban Ghanaian women as identified by the Women's Health Study of Accra." International Journal of Gynaecology & Obstetrics 99(2): 150-156.	Ghana	The study examines women's health in Ghana for both communicable and non-communicable diseases and looks at the risk factors that can lead to NCDs.	y	y	n	y	Age over 50/menopause at an age younger than 50 and obesity. Hypertension as a risk factor for cardiovascular disease. Little exercise	1,328	18+	The purpose of the study was to provide an assessment of the prevalence of these diseases. The most prevalent conditions included hypertension for 40.2% of the women in the study. Obesity for 34.7% of the women in the study.
DUDA, R. B., ANARFI, J. K., ADANU, R. M., SEFFAH, J., DARKO, R. & HILL, A. G. 2011. The health of the "older women" in Accra, Ghana: results of the Women's Health Study of Accra. Journal of Cross-Cultural Gerontology, 26, 299-314	Ghana, Accra	Discusses NCDs in relation to the general health of women in Ghana. Hypertension, Diabetes amongst other chronic disease and risk factors like overweight and obesity	y	y	n	y	Overweight and obesity measured by BMI,WC and WHR and hypertension	1,321	18+	Risk factors for cardiovascular disease which include hypertension and obesity are very common in the older women they studied. The claimed that although these were higher in older women they were prevalent in the women under age 50 also. The study concluded by saying as the populations age in the developing countries health issues shift to include non-communicable illnesses such as hypertension, diabetes and cancers
Obirikorang, C., et al. (2015). "Obesity and Cardio-Metabolic Risk Factors in an Urban and Rural Population in the Ashanti Region-Ghana: A Comparative Cross-Sectional Study." PLoS One 10(6).	Kumasi, Jachie Pramso, Ghana	There is a surge in non-communicable diseases and this can be attributed to high prevalence of Cardio-metabolic risk factors. The study compares the risk factors for these diseases in urban and rural settings	y	y	y	y	BMI; obesity, smoking, lack of physical activity, low fruit and vegetable intake , high fat and salt intake, hypertension, abdominal obesity and excess alcohol intake	672	20+	Participants in the urban area were more likely to have higher adiposity and also more likely to have high total cholesterol. In the urban area hypertension, diabetes and lifestyle risk factors were more prevalent among males than females. Differences in risk factors by urban and rural residence remained significant after adjustment for gender and age. Obesity and cardio-metabolic risk factors are more prevalent among urban settler highlighting an urgent need to avert the rise of diet and lifestyle related chronic diseases. Occupational physical activity may contribute lower prevalence of cardio-metabolic risk factors in rural compared to urban settings.
AMOAH, A. G. 2003. Obesity in adult residents of Accra, Ghana. Ethn Dis, 13, 97-101	Accra Ghana	Discusses the prevalence of the risk factor of obesity within Accra's population	y	y	n	n	Overweight and obesity	6300	25+	Prevalence of overweight and obesity was high in the Ghanaian population notably among women. Women were in the 4th quartile of BMI in every age category and obesity peaked at the 55-64 age group.
Gatimu, S. M., et al. (2016). "Prevalence and determinants of diabetes among older adults in Ghana." BMC Public Health 16: 1. B	Ghana	Diabetes is a growing problem globally and is one of the leading non-communicable diseases in Ghana especially among older adults. The aim of this study is to determine the prevalence and assess the determinants of diabetes in adults over according to the researcher	n	y	n	n	Alcohol and smoking assessed using WHO stepwise approach to surveillance on the Non-communicable diseases risk factors. Fruit and vegetable consumption using a 24 hour recall	4135	50+	The weighted prevalence of diabetes was 3.95% and the prevalence was higher in females compared to males. (2.16% vs 1.73%). Respondents with low and moderate level of physical activity were 67% and 117% more likely to be diabetic compared to those with high level of physical activity. People that were obese were twice as likely to e diabetic compared to those of normal BMI
Tenkorang, E. Y., et al. (2017). "Examining risk factors for hypertension in Ghana: evidence from the Study on Global Ageing and Adult Health." Global Health Promotion 24(1): 14-26.	Ghana	The study examines looks at the odds of becoming hypertensive in Ghana as they acknowledge that hypertension has become a substantial contributor to morbidity and mortality in Ghana. The study goes on to examine the risk factors. A press statement released by the Ghana health service identified hypertension as the number 1 killer in Ghana with almost 70% of deaths attributed to it. This is inclusive of the fact hypertension is linked to several other NCDs e.g. stroke and diabetes	y	n	n	n	lifestyle factors- frequency of alcohol drinking , vigorous intensive activity,	5565	50+	Ghanaian men who did not consume alcohol in the past 12 months and those who consumed alcohol less than once a moth were significantly more likely to be hypertensive. Men and women who do vigorous intensive activities for more than 10 minutes a day are less likely to be hypertensive is consistent with other studies that suggest moderate to vigorous physical activity could offer protection against the risk of becoming hypertensive. Increased sedentary lifestyle that accompany increased social economic status.

Ghana Statistical Service - GSS, et al. (2015). Ghana Demographic and Health Survey 2014. Rockville, Maryland, USA, GSS, GHS, and ICF International.	Ghana	The Demographic and health survey provides data and information about the population of Ghana. Useful information towards this project include the nutritional information and lifestyle factors and some of the risk factors for non-communicable diseases such as hypertension and obesity	y	y	y	y	Smoking, High salt diet, Hypertension, Consumption of fruits and vegetables	9,396 women, 4,388 men	15-59		Obesity and hypertension were very closely linked and although the overall numbers of hypertension was low it was a serious problem for obese people. In terms of fruit and vegetable consumption on average men and women aged 15-49 consumed fruits on 3/7 previous days and vegetables on 4/7 days. The consumption of salty foods was problem in both urban and rural areas with the use of bouillon cubes at very high prevalence. Being overweight and obesity are big problems in Ghana. Overall 25% of women are overweight and 15% are obese. The proportion correlates with a woman's age. Ages 15-19 is 9% but jumps abruptly to 36% between the ages of 20-29 and to 53% for range 30-39 meaning this an area for intervention. Urban women were substantially more likely to be overweight than their rural counterparts. 49% compared to 28%. Trends in overnutrition notably obesity and being overweight has increased considerably from 2008-2014 from 30% to 40%. the overall prevalence of overweight/obesity in men is only 16%
Ghana Statistical Service - GSS, et al. (2009). Ghana Demographic and Health Survey 2008. Accra, Ghana, GSS, GHS, and ICF Macro.	Ghana	The Demographic and health survey provides data and information about the population of Ghana. Useful information towards this project include the nutritional information and lifestyle factors and some of the risk factors for non-communicable diseases such as hypertension and obesity	y	y	y	y	Smoking, High salt diet, Hypertension, Consumption of fruits and vegetables, obesity, overweight	4,916 women , 4,568 men	15-59		The proportion of overweight women age in Ghana stands at 30% with 9% considered to be obese exclusively. This positively correlates with age as the older women. Urban women were twice as likely to be overweight and obese possibly to be attributed to sedentary lifestyle of urban society. The largest jump is from 15-19 to 20-29 where percentage of people overweight or obese increases from 10.3% to 25.8 %. Fruit consumption was generally around the same percentage regardless of the age range With most people eating fruit3-6 days a week. However in the consumption of fruit the number of services of fruit consumed daily was most commonly 0-2 for all age ranges for women. Ranging from 73.5% (20-24) at the lowest to 82 % (40-44). Meaning whilst many people consumed fruit during the week they were not consuming a lot fruit when they did. a similar trend is visible for men with most servings of fruit at 83.8%(45-49) to 88.5% (30-34). Vegetable consumption 34% of women and 25% of men eat vegetables 0-2 days a week and consumption of vegetables on a daily basis was 24% and 30% respectively. 82% of women and 86% of men reported consuming 0-2 servings of vegetables on a typical day and only 2% and 1% consumed the recommended 5 or more a day.
Wu, F., et al. "Common risk factors for chronic non-communicable diseases among older adults in China, Ghana, Mexico, India, Russia and South Africa: the study on global AGEing and adult health (SAGE) wave 1." BMC Public Health 15: 88. B	China, Ghana, Mexico, Russia, South Africa, India	Study conducted that draws from SAGE wave 1 and consists of adults aged 50 and above from the countries listed. The study examines exclusively behavioural risk factors that are modifiable and yet major contributors to NCDs. The aim of the study is to describe the distribution of main risk factors for NCDs by SES among over 50s	y	y	y	y	Daily tobacco use, unhealthy diet, insufficient physical activity, hermful use of alcohol, obesity, central obesity,	4,305	50+		The study ranks the NCD risk factors covered in the study for each country in terms of their prevalence i the graph. For Ghana the biggest risk factors were Central obesity, Insufficient vegetable and fruit intake, hypertension, low level of physical activity, obesity, current daily tobacco use followed by frequent heavy drinker.
Afrifa-Anane, E., et al. (2015). "The association of physical activity, body mass index and the blood pressure levels among urban poor youth in Accra, Ghana." BMC Public Health 15.	Accra, Ghana	Study that examines some of the risk factors of NCDs for the youth in Accra Ghana. The risk factors include physical activity, blood pressure and body mass index	y	y	n	n	Physical activity, Body mass index, hypertension, Alcohol consumption, Smoking, Overweight and obesity		201	15-24	The study shows that there was a high rate of pre-hypertension and they found a positive association of BMI and BP in the study community.
Bosu, W. K. (2015). "An overview of the nutrition transition in West Africa: Implications for non-communicable diseases	West Africa, Ghana included	Study identifies that countries in West Africa are witnessing a nutrition transition. Countries such as Ghana and Cape Verde are experiencing urbanisation childhood and adult overweight and obesity is becoming more prevalent. Increasing intake of dietary energy. Ghana is in the latter stages of nutrition transition.	y	y	n	n	Obesity, Dietary intake,	N/A	N/A		Dietary intake and obesity are increasingly large risk factors for non-communicable disease and are also very prevalent in the West Africa region. Ghana and Cape Verde are worse of the region being deemed to be in the latter stages of nutritional transition
Nelson, F., et al. (2015). "Prevalence of Risk Factors for Non-Communicable Diseases for New Patients Reporting to Korle-Bu Teaching Hospital." Ghana Medical Journal 49(1): 12-18.	Accra Ghana	Study looks into risk factors for NCDs for new patients reporting to Korle-Bu teaching hospital in Accra Ghana	y	y	y	y	Obesity, Lack of physical activity, hypertension		230	18-80	Obesity level of the study population was 40.4% with 54.3% of people being overweight. Tobacco use was limited to 4.8% but alcohol consumption was high at 64.8% and 54.3% of the population was physically inactive. Less than half the patients had consumed fruits at least 3 days out of a week. Hypertension was 33.8% for men and 35.2% for women.
Miniciuci, N., et al. (2015) "Sociodemographic and socioeconomic patterns of chronic non-communicable disease among the older adult population in Ghana." Glob Health Action 7: 21292. B	Ghana only, All regions	Amongst self reported conditions, Hypertension topped the list with osteoarthritis. A range of NCDs are discussed with focus on the Big 4 but also consideration of other chronic conditions such as Arthritis, Asthma and depression.	y	y	y	y	smoking, alcohol consumption, poor intake of fruits and veg, low levels of activity, obesity, - add or delete to this list from the risk factors section of the paper		4,724	50+	The study provides statistical data from the 4,724 adults aged over 50 years that illustrates the highest prevalence of particular NCDs and risk factors that influence these in this population in Ghana. The study showed a "high burden" of chronic disease in this population and attributed these to high rates of modifiable behaviours. In this paper they mentions prevalence of angina, arthritis, asthma, cataracts, chronic lung disease, depression, diabetes, edentulism but presents analysis of risk factors associated with measured and self-reported hypertension and arthritis
MENYANU, E. K., CORSO, B., MINICUCI, N., ROCCO, I., RUSSELL, J., WARE, L. J., BIRITWUM, R., KOWAL, P., SCHUTTE, A. E. & CHARLTON, K. E. 2020. Salt and potassium intake among adult Ghanaians: WHO-SAGE Ghana Wave 3. BMC Nutrition, 6, 54.	Ghana	Discusses the hypertension risk factor of salt and potassium intake amongst the Ghanaian population	y	y	n	n	Salt and potassium intake		3053	18-49/ 50+	Salt intake amongst Ghanaians was very high with more than three-quarters of participants having salt intakes in excess of the WHO recommendation of <5 g/ day. Frequent consumption of salted foods and high salt use in traditional Ghanaian cuisine remains high. In conclusion poor salt use behaviour is widespread across the Ghanaian population

Key findings on risk factors	Key findings on life course	Key findings on men and women	Relevant social and cultural factors described	Paper Quality/ Limitations
This study highlights how disproportionately affected Ghanaian women are by obesity and overweight. With all three criteria for examining obesity,(BMI, WC and WHR) the prevalence for obesity were high. There was a 37.1% overall prevalence, 78.7% according to WC and 78.9% according to WHR. Age as well as growing up in an urban environment were associated with higher risk of being overweight or obese	For the women in this study generally BMI increased with increasing age. (18≤ o 24<24.2) (25 to 34<26.2) (35 to 55 = 29.7) (>55= 29.4) Marginal difference between last two age categories. Obesity (BMI) prevalence increased by 35% between the ages of 18 and 55 and fell by 1% in the >55. For obesity according to WC, obesity increases with age from 27% at 18-24 to 77.8% at >55. The odds of being overweight or obese at age >55 compared to at 18-24 is 5.01	Study based exclusively on women, no data on men is provided but data provided indicate this risk factor is a major problem for women	Cultural perception of desirable look and body size amongst certain age groups encourage unhealthy habits and weight	Study sample and sampling technique illustrated. Large sample size and large age range.
As a risk factor physical inactivity is important as it is linked to other risk factors such as obesity and overweight. Physical inactivity was found to be prevalent amongst Ghanaians irrespective of their location at the time whether in Ghana or elsewhere. An urban prevalence of 29% and a rural prevalence of 11.2% . Advanced age and overweight/obesity were positively associated with physical inactivity in this study	Physical activity was associated with advanced age notably in urban Ghana for men and the same for rural women. Physical inactivity increased from age groups. Urban Ghanaian men age 40-54 had 1.75 times the odds of being physical inactive compared to 25-39 and 55-70 had 3.90 times the odds. 1.23 and 1.17 for rural Ghana. This trend was not consistent for rural men	In Ghana a higher proportion of women were physically inactive compared with their men counterparts.(25.6% vs 19.3%) Male and female non-migrants had lower portions of inactivity than male and female migrants. Proportion of inactivity was higher in women in urban and rural Ghana with prevalence of 33.3% and 14.3% compared with 17.8% and 6.3% respectively	High levels of inactivity in urban areas attributed to urbanisation and differences between urban and rural areas may be attributed to labour-intensive occupational activities	Study design , sample and sampling strategy justified and explained. Appropriate statistical tests used to analyse results
Risk factor behaviours involving actions such as smoking and drinking were more common in men than in women. Ghanaians who walked and biked were less likely to develop any of the four NCDs under investigation. (stroke, angina, hypertension and diabetes) similar findings were logged for those who drank alcohol more than5 times a month. There were marginal differences between the sexes in fruit and vegetable consumption	Average age of Ghanaian men was higher than that of Ghanaian women. Paper does not hold much content of risk factors relevant to the life course	There were marginal differences in the consumption of fruit and vegetables between men and women. Men averaged 2.24 servings a day compared to 2.14 for women and 1.66 servings of vegetables a day in comparison to 1.63 for women. Walking or biking or 10 mins continuously was more prevalent in men than women 81.2% for men and 72.9% for women and vigorous intensity activity followed the same trend with 59.2% for men and 42.4 for women. Frequent drinking was also more prevalent in men with 17.7% men drinking 5+ times a month compared to 4.3% for women.	None mentioned	Study sample clearly identified, data analysis and statistical analysis conducted appropriately
Modifiable risk factors such as being overweight and obesity were associated with the high rate of hypertension in this community 43.9% of those overweight had hypertension and 40.5% of those obese had hypertension compared to 19.4% of those in the normal BMI range. High odds for hypertension is you were a smoker compared to a non smoker - 1: 2.81	After the age of 45 years females had higher blood pressure than males. The odds for developing hypertension increased with BMI and age. Table 2 shows over the life courses the percentage of hypertension prevalence increasing with age from 6% in <25 to 63.8 % in >65s.	Comparing men and women in terms of hypertension the difference in prevalence was marginal with women having a slightly higher percentage of 25.9% compared to the 24.1% for men. Women did also have a higher average BMI than men with 23.9+/- 5.4 compared to 21.5+/- 2.8.	None mentioned	Small sample size, sampling strategy not very well justified. Appropriate statistical analysis conducted
Prevalence of low fruit and vegetable consumption was significantly lower than presumed and one of the lowest in the study indicating that fruit and vegetable consumption in the country is generally quite good	Poisson regression from the table indicate fluctuation in the consumption of fruit and vegetables. No linear trend with age is shown. (18-29 0.83) (30-39 0.78) (40-49 0.77) (50-59 0.83) (60-69 0.91)	Fruit and vegetable consumption was higher in men. The percentage prevalence of inadequate fruit and vegetable consumption was marginally higher in women at 38% inadequate for women vs 36.6% inadequate for men.	None mentioned	Where the sample is taken from is well identified. Some statistical analysis but not very in-depth
55.39% of the respondents had ever consumed alcohol. 36.01% of the respondents continue to engage in physical activity. 1.06 times more likely to be hypertensive if you consumed alcohol compared to if you did not. The odds ratio of being hypertensive if you engaged in rigorous physical activity was 0.38. Females were 1.95 odds ratio of being hypertensive compared to males	This study focused on adults 65+, only 36% of participants continued to do rigorous physical activity	Little to no comparison between men and women but the odds ratio of being hypertensive	None mentioned	Sampling method explained and analytic methods explained

For NCDs the big risk factors identified in this study were obesity and hypertension which in itself is its own non-communicable disease. Little exercise, hypertension, high level of cholesterol and diabetes as a risk factor for cardiovascular disease. Obese women were significantly more likely than all other women to be hospitalised for an illness. blood pressure also increased with age. the age range of 18-24 - 33.2 % of women were overweight or obese. 25-34 : 57.6% of women were obese or overweight. 35-54: 71.1% of women were overweight or obese. >55 : 67.2% of women were overweight or obese. In total that meant 61.2% of women were overweight or obese	The study acknowledges that increasing age affected health conditions. Increasing BMI was significantly correlated to with increasing age. Women aged 55 and older more women were obese than any other category. The percentage of obesity begins to decline into older age suggesting that obese women do not survive into older age groups.	The study was based solely on women's health so no data on men was available	None mentioned	Relatively large sample size and strategy well explained in depth. Some statistical analysis provided
Risk factors for NCDs such as obesity quantified by WC,BMI and WHR were all higher in older women than younger women. Being overweight or obese was the main risk factor in this study. The overall prevalence of a BMI> 25 was 61.5% and it peaked in the age group of 50-64	There was a higher prevalence of hypertension and diabetes in women older than the age of 50 compared to those younger. 42.4% vs 7.8% for hypertension and 8.1% vs 0.8% for diabetes. Women above 50 had higher BMI, WC and WHR than (40.8, 70.1,78.8 for women above 50) (29.9 , 42.8, 55.4 for women below 50)	Study was focused exclusively on the health of women so no data about men is provided	None mentioned	Relatively large sample size and sample process well explained. In-depth and appropriate statistical analysis conducted
Cardiometabolic factors are responsible for a lot of premature deaths and cardiovascular disease and obesity. Factors such as smoking, low physical activity, low fruit and vegetable intake etc. According to the study the upward trend of cardiometabolic risk factors is likely to be due to an increase in identifiable risk factors amongst the populace. There was a total smoking prevalence of 4.5%, a physical inactivity prevalence of 17.9% and alcohol intake prevalence of 19.2%.	There was no significant distribution in age between the two settlements	BMI> 25 was more prevalent amongst urban females than urban males (100% vs 75%) and similar for rural men and women with percentages of 61.1% vs 47.9% . BMI > 30 was also more prevalent in urban and rural women than urban and rural men.(37.5% vs 17.9 Urban) (33.3 vs 10.4% Rural) Physical inactivity more common in urban and rural women than in urban and rural men. 40.6% vs 29.2% in a rural environment, and 37.5vs 32.1% in an urban environment. Smoking was more prevalent in men than in women in urban and rural environments with the highest prevalence being urban men with 10.7%. Alcohol intake higher in men than women urban and rural. 29.2 vs 6.9% in rural and 28.6% vs 16.7% in urban	Rural lifestyle in Ghana had experienced less effect of urbanisation	Relatively small sample size but study design and study site well explained. Statistical methods employed and ethical considerations take n shown
Obesity is a major risk factor for the development of non-communicable disease. The age standardised prevalence for obesity was 13.6%. BMI was higher in urban residents than in rural residents. Found that overweight and obesity are common in in Ghanaians notably females and the elderly. The highest prevalence for overweight and obesity was found in the 55-64 age group	Obesity increased with age in this study, peaking at the 55-64 year age group. At all ages more females than males prevalent in the 4th quartile of BMI . Author approached for more disaggregated data but no response received	Obesity and overweight were significantly more prevalent in women than in men. The rates of overweight (27.1% vs 17.5%) and obesity (20.2% vs 4.6%) were both higher in women than men. At all ages, more females (32.9%) than males (12%) were placed within the 4th BMI quartile. Women had higher BMI values compared to males (25.6 vs 22.6 kg/m2,)	None mentioned	Relatively large sample size and random cluster sampling employed. Statistical analysis, in depth and appropriate.
The study had a total prevalence od 25.1% for people that had low physical activity. The overall prevalence of daily drinkers and former drinkers was 22.3% and 13% respectively. There was an overall prevalence of 8.1% current daily smokers and 16.8% of people who were former smokers. obesity prevalence was 12.9% and overweight was 16.5%	The prevalence of diabetes among older adults increased with age from 1.13 to 1.57% among 50-59 years olds and 60-69 year olds respectively. Old age was found to be associated increased risk of diabetes among males.	More men than women were daily drinkers 31.4% vs 11.5%. More women than men were non-drinkers 53.4% vs 33.1%. More women than men had low physical activity 29.2% vs 21.4%. More men than women were smokers 12% vs 3.9%. Obesity was higher in women at 16.6% vs 9.6%	Studies in Ghana have linked social determinants and social factors with the behavioural factors of modifiable risk factors	Relatively overall large sample size. Study design well explained, appropriate and in-depth analysis conducted
Lifestyle factors were big in the likelihood of an individual becoming hypertensive. These included vigorous physical activity exercise and unemployment for both men and women. With a lot of people in Ghana their employment is part of their vigorous physical activity.	The study suggests that the changing age structure in Ghana is responsible for the increasing prevalence of diseases such as hypertension as people are ow living longer. Lifestyle changes that accompany economic transformations are leading to this more sedentary lifestyle. The odds of becoming hypertensive was associated with old age	More men than women walked or biked for 10 continuous minutes 81.2% vs 72.9%. More men than women conducted vigorous intensive activity for 10 minutes 59.2% vs 42.4%. More men than women drank more than once a month 39% vs 20.1%.	None mentioned	Study design well explained and justified ad statistical analysis shown.

		Overall 8% of women were told they had high blood pressure, compared to the 4% of men age 15-49. The percentages increased with age especially for women. Obese women and men were more likely then respondents with low BMI to have hypertension. By region blood pressure was highest in women of greater Accra 13% and Ashanti men 7%.. In terms of fruit and vegetable consumption the mean number of fruit consumed a week was fairly even with any difference being minimal, however for vegetable consumption the mean consumption for vegetables was higher for men than for women. The consumption of salty food is also a very high, the percentage of women age 15-49 admitting using any processed food with salt was 82.6% to 86.4% in urban and rural areas respectively and 65.7 % and 72.9% claimed using bouillon cubes respectively Smoking prevalence in men and women is noted to be very little with less than 1% of women using tobacco for all age ranges		
From the DHS it seems that the risk factors most notably detrimental to Ghanaian health and contributing to the NCD burden is the salt intake that contributes to hypertension which is part of the bigger issue of poor diet and overnutrition in both urban and rural areas. Overweight and obesity prevalence also were extremely high and prevalence at younger ages were increasing.	The findings about risk factors indicated with many of the different factors is that they increase with age as seen with smoking and salt consumption. With fruit and vegetable consumption showed consistency and similarity for all age groups. Obesity and overweight were occurring younger and younger we see higher prevalence in the 20-29 age category.	and only 1.3% of women 45-49 smoking otherwise the other age ranges were below 1%. Smoking is more common in men than in women with 4% men using cigarettes or a pipe and 2% using other products. The likelihood of a man using tobacco increases with age. The overall prevalence of overweight and obesity in men was significantly less compared to women. 16% compared to 40% Again the prevalence of obesity for men is higher in urban areas than in rural areas.	Prevalent use of high bouillon cubes in cooking practices. Regional differences in consumption of fish and canned products	Demographic and health survey - Sampling technique inclusive and representetive of all sub-cultures in Ghana
In terms of risk factors like physical activity, participants were asked to recall how much vigorous physical activity they had conducted in the last 7 days. The definition of physical activity was made broad. Results said in the 7 days leading up to the survey 1/3 women and 1/2 men had conducted 3 or more days of activity lasting more than 15 mins whilst the ministry of health recommends exercising at least 30 minutes 3 times a week. 1/2 women and 1/4 men had not done any physical activity lasting mor e than 15 minutes. More rural women than urban women. Consumption of Fruit on a daily basis was 28% for women and 21% for men. 1/3 respondents consumed fruits 0-2 times a week. Smoking was no very prevalent with almost all women and 93 % of men not using tobacco and only 6% saying they currently smoke cigarettes, with young men less likely to smoke than men in their 30s and 40s. Smoking declined from 2003-2007. Alcohol abuse is an increasing concern in Ghana as it one of the biggest risk factors for hypertension and subsequently cardiovascular diseases. Lack of reliable alcohol consumption data meant that respondent were made to answer questions regarding their consumption. (Potential bias) Alcohol consumption and frequency increased with age.	Aside from the consumption of fruit and vegetables, the majority of risk factors get worse or more prevalent with increasing age generally. Overweight and obesity seems to be a problem in women also . Physical inactivity is prevalent in women more than in men and harmful dietary habits are noticeable.	High levels of obesity and overweight were noted in women but data regarding men for this category was not provided. 1 in 3 women were engaged in 3 or more days of physical activity whereas for men this was 1 in 2 men. 1 in 2 women and 1 in 4 men were not engaged in physical activity that lasted at least 15 minutes. consumption of fruit 7 days a week was higher for women than men in every age category from 15-49. Consumption of fruits on a daily basis (7 days) is reported by 28 percent of women and 21 percent of men. Majority of women and men report a low consumption of fruits; 78 percent of women and 87 percent of men typically have 0-2 servings of fruits on a day when fruits are consumed. Only 1 percent of women and less than 1 percent of men reported having the recommended 5 or more servings of fruit a day. ow consumption of vegetables during a typical week; 34 percent of women and 25 percent of men eat vegetables 0-2 days a week. Consumption of vegetables on a daily basis (7 days) is reported by only 24 percent of women and 30 percent of men	Discusses the significance and popularity of palm oil use in Ghanaian cuisine	Demographic and health survey - Sampling technique inclusive and representetive of all sub-cultures in Ghana
The study focuses on risk factors for non-communicable diseases and compares them in six different countries. Ghana is one these countries. Some of the risk factors in Ghana were not very prevalent in comparison to other countries such as tobacco use and smoking which Ghana had a prevalence of 7% compared to the 46.9% of India. The study highlights the most prevalent non-communicable risk factors for Ghana in the study as Central obesity, insufficient intake of fruit and vegetables and hypertension.	This study focuses on older life, specifically ages 50 and above and the study illustrates that not all risk factors necessarily get worse with age. Obesity in women peaks in the age category of 50-59 at 19.5% and reduces with age until 80+ where the prevalence is 6.4%. Other risk factors however follow the trend of becoming more prevalent over the life course such as central obesity in women that starts at 88.9% in the 50-59 age category for women and peaks in the 80+ category at 90.6%.	Prevalence of obesity worse in women than in men in every age category from 50-59 to 80+. For example age category 50-59 women had a prevalence of 19.5% compared to men who had 7.1%. Prevalence in central obesity was also higher for women in every age category. 50-59 for example, women had a prevalence of 88.9% compared to 61.8% for men. Women had a higher prevalence than men in every age category for low physical activity also. Age range 50-59 for example women had a prevalence of 21.3% compared to 15.9% for men. Men were more likely to be heavy drinkers compared to women in every age category for example age range 60-69 men had a prevalence of 3.2% compared to 0.1% for women. Men were also more likely to be tobacco users in every age category for example 60-69 men had a prevalence of 11.2% compared to 3.7% for women	None mentioned	Large sample size and sampling design and strategy well explained. Limited in depth analysis

The prevalence of overweight and obesity coupled with low physical activity provide reasoning for HBP in these areas. Looking at these two main variables indicated that an important variable to HBP is BMI. Systolic and Diastolic BP increased with increasing BMI. Physical inactivity was the most prevalent and extreme risk factor for both sexes with 70.5% of male youth being inactive and 94.7% inactive.	This provides evidence that the development of NCDs particularly cardiovascular diseases start early as is shown by the high percentages of pre-hypertension. Show that at the youth and adolescent men and women are both affected by risk factors but just different factors	The male youth between the ages of 15-24 displayed higher prevalence of pre-hypertension than females. Both types of blood pressure increased with BMI increase and this was significant amongst males. This was consistent with studies of some developed countries where cases of stroke and CVD are reported more among males. Male youth were more likely to be current drinkers. (42.7% vs 31.9%) Male youth were more likely to have smoked (18.2% vs 11.5%) Female youth were more likely to be overweight and obese than males (Overweight- 17.7% vs 6.8%) (Obese- 13.3% vs 2.3%) Female youth were more likely to be physically inactive compared to male youth (94.7% v 70.5%)	None mentioned	Very small sample size. Sampling strategy slightly unclear but statistical analysis undertaken and study design well explained
Study details that adult obesity has increased by 115% since 2004 in the region of West Africa. In Ghana prevalence of overweight/obese women has gone from 12.8% to 29.9%. (1993-2008). In Ghana 20% of junior and senior high school students aged 12-18 years reported not eating any fruit during the preceding week of the survey and 13% did not eat any veg. Only 43% and 52% had eaten any at breakfast. Among the DHS of west /African countries that have DHS data on women BMI, the most rapid increase in overweight/obesity has been in Ghana.	Gives examples of how unhealthy eating habits start young with the fruit and vegetable intake survey. Talks about the high levels of adult obesity stemming from nutrition transition	The risk factors of obesity and hypertension seemed to be a bigger problem in women than in men. The nutritional transition occurring in Ghana is affecting women more than men. Increased consumption of high salt foods and high fat foods is worse affecting women because they are less physically active to burn the calories.	Ghanaian cuisine incorporates a lot of palm oil and salt use through stock cubes. This is increasing with the popularity of junk and fast food	N/A
The prevalent modifiable risk factors identified in this study were the physical inactivity, high alcohol consumption, overweight and obesity and high blood pressure .	Tobacco use started in the age group 12-22. Majority of the obese people were above the age of 44. Raised blood pressure was most prevalent in those 45 and above at 0.46 compared to 25-44 (0.22) and under 25 (0.23)	Tobacco use was more prevalent in men than women.8.4% vs 2.9%. Alcohol consumption was more prevalent in men than women 72% vs 56.2%. Physical inactivity was more prevalent in women than men 65.7% vs 44.8%. Obesity was more prevalent in women than men 45.7% vs 36%. Overweight was also more prevalent in women than men 66.6% vs 44.7%	None mentioned	Relatively small sample size. Systematic random sampling employed and statistical analysis displayed
The study highlights the most prevalent risk factor behaviours in Ghana and shows the trends in these behaviours. Showed under the heading of health behaviours by selected characteristics. Tobacco use at 8.1 % with the prevalence being higher in men than it is in women. Frequent alcohol consumption, insufficient daily intake of fruits and vegetables. Others include low level of physical activity, obesity. Values that illustrate the prevalence of these behaviours is shown in the document	The study suggests that modifiable behaviours such as smoking and excessive alcohol consumption are traits that Ghanaian people continue in older age. Low levels of physical activity and insufficient intake of fruits and vegetables increased with age. 66.4% at 50-64 ; 69.2% at 65-74 ; 70.4% at 75+ for fruit and veg intake. 19.2% at 50-74 ; 29.6% at 65-74 ; 39.4% at 75+ for low physical activity	The study shows higher prevalence in tobacco consumption for men than for women (13% vs 2.6%) . There was no distinction in the insufficient intake of fruit and vegetables between men and women. Women compared to men also demonstrated higher rates of physical inactivity and women also exhibited higher rates of obesity. 29.9% of women had low levels of physical activity compared to 21.8% of men. 13.6% of women were obese compared to 6.3% of men and women also had a higher prevalence of high risk WHR at 89.4% compared to 67%.	None mentioned	Sampling design and strategy identified and justified. Analysis provided
Salt intake is a important risk factor for cardiovascular diseases including hypertension and this stud has illustrated that majority of Ghanaians were overconsuming salt. The median salt intake was 8.3 g/ day, ore than three quarters 77%, of participants had salt intakes above the WHO maximum recommendation of 5 g/d,. Salt intake was higher in those with higher BMI and younger participants compared to older ones.	Amongst mainly adults aged 50 and above the average age for the average salt secretion levels reduces as the consumption of salt increases. The average age for high salt secretion was 58 whilst for low salt it was 64. In the smaller sample of 18-49 used for comparison they found salt intake was higher in the younger people with a daily intake of 9.7g/day vs 8.1g/day	Median salt intake was higher in women compared to men with a prevalence of 8.6g/day compared with 7.5g/day for men. More men than women achieved he WHO' salt recommendation of ≤5 g salt/day	Significance of salt in traditional Ghanaian food is mentioned alongside likelihood to add salt to food after cooking also perceived risk of salt	Sampling design and strategy identified and justified. In depth Analysis provided