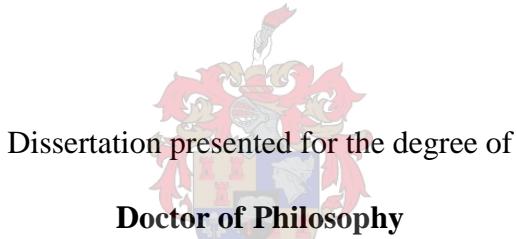


Cardiovascular Disease Risk Factors among School attending adolescents in Rural Nigeria

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Declaration

By submitting this dissertation electronically, I declare that the entirety of the work contained therein is my own, original work, that I am the sole author thereof (save to the extent explicitly otherwise stated), that reproduction and publication thereof by Stellenbosch University will not infringe any third party rights and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

Oduniaya Nse Ayooluwa

Date: March 2016

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Abstract

Background: The prevalence of Cardiovascular Disease (CVD) is increasing in Nigeria, particularly hypertensive heart disease among the working class population. Unfortunately, resources for effective management of CVD at acute stage are sparse and expensive for the average Nigerian making preventive measure the best option for Nigeria. CVD risk factors have been identified in adolescents in many countries but information on CVD risk factors among Nigerian adolescents, especially rural adolescents, are sparse. This study aimed to develop culturally appropriate lifestyle CVD risk factors questionnaire for adolescents in Nigeria and to investigate CVD risk factors and its associates among 15-18 years school attending adolescents in rural Nigeria.

Methods: The study was conducted in rural south west Nigeria, one of the six geopolitical zones of Nigeria. The people living in this area are Yoruba speaking population of Nigeria. The study was conducted in four phases. Phase 1: development of a composite lifestyle CVD risk factors questionnaire through systematic review, expert panel and target population. Phase 2: Cross cultural validation of composite measure developed to facilitate its use among rural adolescents. Phase 3: Pilot study to assess the logistics of the study and to test the reliability of the newly developed questionnaire. Phase 4: investigation into CVD risk factors among adolescents. CVD risk factors such as smoking, alcohol, Physical inactivity, and poor diet using the newly developed questionnaire were assessed. Blood pressure, BMI and waist hip ratio were also assessed using standardized protocol. Data was analyzed qualitatively and quantitatively. Content validation of the questionnaire was done qualitatively using expert consensus and adolescents' feedback. Reliability was tested using ICC (Intraclass Correlation), Kappa and

paired *t test*. CVD risk factors data was analyzed descriptively first, then with Pearson correlation and multiple regressions to determine associations among risk factors at 95% confidence interval (0.05 level of significance). **Result:** European countries showed high prevalence of smoking among adolescents in the systematic review. The prevalence of dyslipidemia ranged from 2.5% of total cholesterol (TC) in rural Iran adolescents to 48.9% high Triglyceride (TG) in rural Mexican adolescents. Overweight and obesity prevalence ranged from 0.6% prevalence in an age (10 y) of a study to 48.7%. Studies from the United States showed a decreasing trend in pre hypertension and hypertension, overweight and obesity. The newly developed composite lifestyle CVD risk factors questionnaire for adolescents had moderate to good reliability. Intraclass correlation (ICC) ranged from 0.3 - 0.7 and 0.3-0.8 in English and Yoruba versions' subscales respectively. Kappa statistics showed moderate to strong agreement in priority questions in English and Yoruba versions. Investigation into the CVD risk factors showed high prevalence and clustering of CVD risk factors; 7.1% adolescents were smokers, 10.2% drank excessive alcohol, 27.9% had low physical activity level, 59.8% consumed high cholesterol diet, 6.1%, consumed low vegetable 8.1% consume low fruit 65.5% had high salt intake, 33.1% had pre hypertension (systolic), 5.5% had pre hypertension (diastolic) 3.2% had hypertension (systolic) 0.8% had hypertension (diastolic). Smoking and drinking were significantly higher in males and physical activity was significantly higher in females. Smoking and drinking were significantly associated in both males and females and the odd of drinking and smoking was more elevated in girls. Systolic pre- hypertension was associated with age and high BMI in boys and was associated with only high BMI in girls. **Conclusion:** Nigerian rural adolescents are at risk of future adult CVD. There is an urgent need to put measures in place to

prevent future epidemic of CVD in adulthood. CVD prevention program for boys and girls should be tailored to address gender specific CVD risk factors.

Dedication

This thesis is dedicated to my loving and ever supportive prayerful husband, Lawrence and my adorable daughters and son who have supported me spiritually, financially and morally to make this PhD a reality.

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GLOSSARY

AHA	American Heart Association
BHF	British Heart Foundation
CDC	Center for Disease Control
CVD	Cardiovascular disease
DBP	Diastolic blood pressure
HDL	High density lipoprotein
HPT	Hypertension
ICC	Intraclass correlation
LDL	Low density lipoprotein
TC	Total Cholesterol
TG	Triglyceride
PA	Physical activity
PAQ-C	Physical activity questionnaire for adolescents

Quotes

“The fear of God is the beginning of wisdom”

The Holy Bible

“Tough times never last but tough people do”

Robert Schuler

Overview of thesis

There are two major styles of thesis writing; the traditional style of writing thesis where research is reported in five or six chapters such as introduction, review chapter, methods chapter, result chapter, discussion chapter and concluding chapter and the article format. The article format is a style where the thesis chapters are presented as articles which have been published or undergoing review in a peer review journal or prepared for a journal publication. The beauty of this format is that the research report has been transformed into articles for publication. Dissemination of research report is very pivotal to utilization of research findings therefore we have adopted the article format for this thesis.

This PhD thesis has four research articles and a review article. The thesis begins with an introductory chapter, a review chapter which is also an article and four research article chapters. A policy chapter follows the article chapters because the findings from the research necessitated a policy chapter which is meant to inform the government of the situation and to advocate for an intervention. The thesis ends with a summary and concluding chapter.

How the thesis chapters are linked

Chapter one is the general introduction of the thesis with the main purpose of justifying the need for the study, the aims of the study and its significance in paving the way for CVD prevention in rural Nigeria. The overarching purpose of the study was to develop composite CVD risk factors questionnaire for adolescents in rural Nigeria and to investigate the prevalence of modifiable CVD risk factors among the rural adolescents in order to plan an effective CVD prevention program for them

Chapter two is the literature review on the global prevalence of CVD risk factors. This chapter justifies the need for this study as the review revealed paucity of well designed studies on prevalence of CVD risk factors among adolescents in Africa, particularly adolescents in rural areas. In Nigeria particularly no study was found among rural adolescents. This review is therefore pivotal to the present study which will lead to future development of preventive program for CVD in Nigeria among rural adolescents

Chapter three is the article from the first phase of the study which focused on development of CVD risk factors questionnaire. It is important to note that CVD risk factors can only be assessed by measures that are familiar to the participants, since modifiable risk factors such as diet, physical activities differ according to cultures, it was necessary to develop a measure for assessing CVD risk factors among these adolescents. The process of development, content validation and reliability of the measure developed is written in article format as chapter three.

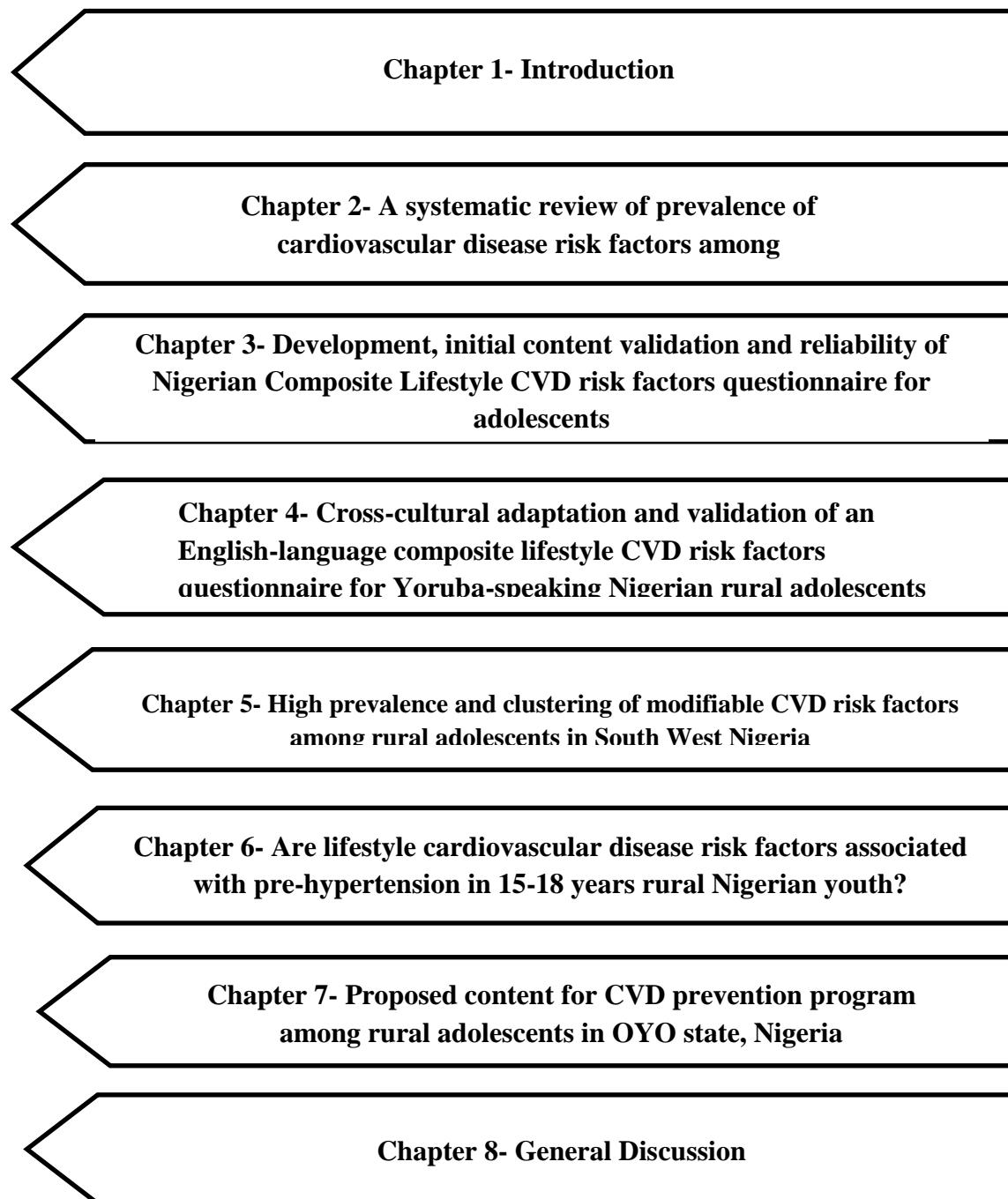
The target population for this study was rural adolescents in South west Nigeria. The people in this part of Nigeria speak Yoruba language. It was deemed necessary to cross- culturally adapt the questionnaire so that the rural adolescents who were not proficient in English language could participate in the study. Therefore chapter four is an article on the cross- cultural adaptation of the questionnaire which is the second phase of the study and findings of the reliability conducted in phase 3

Chapters five and six are made up of the fourth phase of the study; investigation into CVD risk factors. Chapter five reports the prevalence and clustering of CVD risk factors among these rural adolescents and chapter six further explores the CVD risk factors associated with highly prevalent CVD risk factor (pre-hypertension) observed in these rural adolescents.

The findings of the study necessitated the policy brief for Oyo state government, for necessary intervention against future CVD among these adolescents. The policy brief is the chapter seven.

The thesis ends with a summary chapter which is chapter eight

Figure 1: The following diagram provides an overview of the chapters presented in this thesis



Chapter 1

Introduction

Brief overview of the chapter

This chapter introduces the research based on current literature on cardiovascular disease (CVD) and its risk factors globally, in Africa and specifically in Nigeria. It provides the rationale and background for the study. It demonstrates that CVD and CVD risk factors have received much attention in literature in the Western world especially in urban areas even among adolescents. It highlights the gap in literature about CVD and CVD risk factors in the developing countries. There is paucity of published literature on CVD risk factors among rural adolescents globally and particularly in Nigeria. The chapter justifies the need for the study in the Nigerian population and highlights its significance.

Background and Rationale

Cardiovascular disease (CVD) is a significant cause of mortality and disability worldwide (Gaziano 2007). Reports from the Global Burden of Disease Study 2010 revealed that CVD contributed 43% to the global mortality figure. The total global burden of CVD in terms of disability adjusted life years (DALYs) stood at 15% in 2010 (Gaziano *et al.* 2010). CVD is still the leading killer in America, accounting for more than 33% deaths, as more than 2,000 Americans die of CVD every day (AHA 2015). In the United Kingdom, one person experiences a heart attack every three minutes, and CVD underpins 25% of the mortality in the United Kingdom (BHF, 2014). However, the incidence and the percentage of mortality due to CVD are

decreasing in developed countries as a result of effective preventative and disease management strategies. There is growing concern however, about the increasing burden of CVD in Africa (WHO 2011). Economic, social, and cultural factors contribute to increasing prevalence and incidence of CVD in Africa.

CVD accounts for 9.2% of total deaths in the African region in 2001 (WHO 2002), where they are the leading cause of death in those over the age of 45 years (Gaziano 2008). By 2020, the burden of CVD faced by African countries is expected to double (Gaziano 2008). A large proportion of the victims of CVD will be middle-aged people (WHO 2011). CVD accounts for 7-10% of all adult medical admissions to hospitals in Africa. The reported hospital mortality by CVD is high, reaching 9.2% in Cameroon (Tantchou *et al.* 2011) and 21.9% in Tanzania (Maro & Kaushik 2008). Physical inactivity, unhealthy diet, tobacco smoking and harmful use of alcohol are main lifestyle causative factors for CVD in Africa (Mayosi *et al.* 1997).

In Africa, there is paucity of national data on CVD. This is linked to the lack of research, which is associated with a lack of local expertise and limited funding (Mocumbi 2012). Major international research funding agencies are more likely to fund research into endemic infectious diseases than fund research into reducing lifestyle-related diseases such as CVD. Hence, large scale studies on CVD occurrence and risk factors are lacking in Africa (Mocumbi 2012). Studies in developed and some developing countries show high prevalence of CVD risk factors among adolescents both in urban and rural areas (May *et al.* 2012, Freedman *et al.* 2007, Sebanjo & Oshikoya 2012, Mbolla *et al.* 2014).

This research will be conducted in Nigeria, where CVD deaths recently reached 5% of total deaths (WHO, 2011), although CVD was almost nonexistent few decades ago. The age-adjusted death rate from CVD is 121.60 per 100,000 of population and ranks Nigeria #80 in the world. This ranks CVD as number four among the top 20 diseases responsible for mortality in Nigeria (WHO 2011). Our interest in this research is on adolescents because lifestyle habits which lead to CVD usually start in childhood and adolescence and continue into adulthood, therefore CVD prevention program are best introduced at this stage of life.

To our knowledge, in the last decade, there are few published studies on CVD risk factors among Nigerian adolescents which were mainly conducted in urban settings (Ujunwa *et al.* 2013; Senbanjo& Oshikoya 2012, Odunaiya *et al.* 2010, Ansa *et al.* 2005). To date there is no published information on a range of lifestyle and modifiable CVD risk factors among rural adolescents in south west Nigeria. The need to ascertain CVD risk factors among adolescents is pivotal because 49% of the Nigerian population lives in the rural areas (World Bank 2014) and rural populations are generally neglected in research. In addition, Nigeria is a multi ethnic country with diverse cultures. This means that lifestyles differ across various ethnic groups and this could further promote risk behaviors. Unfortunately, CVD and CVD risk factors are not a priority research focus in Nigeria, despite its increasing prevalence. There are scarce health personnel and limited facilities for effective management of CVD in Nigeria. Nigeria has fewer than 50 cardiologists to take care of a population of over 120 million (Ogah *et al.* 2006) and 22% of the Nigerian population are adolescents (UNICEF 2011). Mutable CVD risk factors in Nigeria are no different from those in other countries (e.g smoking, harmful use of alcohol, unhealthy dietary pattern and physical inactivity, hypertension, overweight and obesity).

However socio cultural and economic factors make it necessary to identify the best approach to management in the Nigerian context.

In the light of aforementioned challenges, a CVD prevention program aimed at adolescents is the best option for Nigeria, to make an impact before their behavioral patterns become established. Lifestyle/ modifiable risk factors can be prevented, treated and controlled, hence the need for early detection of risk factors and CVD prevention programs so that adolescents adopt healthy behaviors into adulthood (Selvan & Kupad 2004). Adolescence is a critical temporal window for the development of obesity in adult age. Dietary habits, and risky behaviors, such as smoking and drinking are experimented with and established in childhood and adolescence (Magissano 1998). Physical activity behaviors are also established in adolescence. Researchers have advocated that children and adolescent populations should be the target for cardiovascular risk factors prevention programs because lifestyle risk factors are usually learnt and established during this period. CVD prevention program are thus likely to more effective in this sub - population.

However, cultural and societal factors in rural Nigeria may significantly influence CVD risk factors. In rural Nigeria, cultural factors such as fattening rooms (where ladies are kept and fed until they are fat in preparation for marriage) results in overweight and obesity. Other cultural believes such as early marriage for adolescent girls, cultural disapproval of outdoor sporting activities like jogging and running for ladies results in sedentary lifestyle for adolescents. These factors indicate the need to ascertain the CVD risk factors in rural Nigeria, and explore its demographic, behavioral, socio economic and cultural correlates.

CVD is complex and should be addressed by an inter-professional approach (Lalonde *et al*, 2012). Evidence shows that a team approach including physiotherapy to CVD care is cost effective and results in better prognosis (Zoghbi *et al.* 2004) A systematic review conducted by Frerich *et al* (2012) showed that physiotherapists can effectively counsel patients with respect to lifestyle behavior change at least in the short term. Schuler *et al* (2013) in their systematic review clearly identified the evidence of exercise in the management and prevention of CVD, yet, exercise appears not to have been adequately utilized in the management and prevention of CVD. According to Garry *et al* (2002) basic education in exercise prescription and effectiveness is lacking in medical education and only 6% of US medical schools have core curriculum on exercise. However, exercise is a core subject in physiotherapy and physiotherapists have been effective in managing CVD and CVD risk factors with exercises (Akinpelu *et al.* 1990; Akinremi *et al.* 2012 Maruf *et al.* 2013). According to Ontario Physiotherapy Association (2014), in Canada, Physiotherapists are in the best position by training to assess CVD patients and tailor exercise programs for this complex patient population to help them make essential lifestyle changes. Moreover, Physiotherapists (particularly cardiopulmonary physiotherapists) are the only clinicians who possess the core education and training to provide assessments and exercise interventions for this patient population in acute care, rehabilitation, outpatient, complex continuing care and homecare settings. This is also true in Nigeria, though this may not be applicable to other countries like South Africa where Biokineticists can address CVD risk factors.

Many programs to address childhood and adolescent risk factors have been produced but are mostly confined to developed countries. Before adapting such programs for the rural Nigerian setting, it is important to develop appropriate and culturally acceptable CVD risk factor

measures, and to ascertain the prevalence of CVD risk factors among the rural adolescents in Nigeria. This is important so that appropriate preventative programs can be developed for Nigerian rural and urban adolescents. The main aim of this research project is to develop appropriate composite CVD measure and to ascertain baseline data on CVD among rural adolescents in Nigeria. This is the first step towards understanding the scope of the problem and planning further research and health care interventions.

Statement of the problem

There is limited information on adolescents' cardiovascular health in developing countries, which constitutes a barrier to effective implementation of contextualized CVD prevention program in countries like Nigeria, and particularly in rural areas. In particular, there is a lack of validated measures for assessment of CVD risk factors among adolescents and a lack of studies which consider socio-cultural factors associated with CVD risk factors (Phillipi 2004). There is thus a need to develop appropriate and culturally acceptable CVD risk factor measures and to ascertain the prevalence of CVD risk factors among the rural adolescents in Nigeria, in order to then develop appropriate preventative programs.

Overarching research purpose

The following will demonstrate the overarching research purpose for this research project.

- To develop culturally appropriate composite CVD risk factors questionnaire for Nigerian rural adolescents
- To ascertain the prevalence of life style and other selected modifiable CVD risk factors among Nigerian rural adolescents

- To propose the contents of culturally appropriate prevention programs, and ways in which these could be implemented for rural Nigerian adolescents

Research objectives

- To systematically review lifestyle CVD risk factors questionnaires for adolescents.
- To systematically review development and validation processes of CVD risk factors questionnaire
- To design a Nigeria (rural) specific composite lifestyle CVD risk factor questionnaire specifically for adolescents.
- To validate the questionnaire (face and content) using an expert panel and the target population.
- To translate the questionnaire into a local language (Yoruba).
- To ascertain content validity, test - retest reliability and intra- language reliability of English and Yoruba versions of the questionnaire.
- To ascertain the prevalence of selected CVD risk factors among male and female rural adolescents attending schools in South-West Nigeria.
- To determine association among lifestyle CVD risk factors among rural adolescents
- To propose contextually relevant CVD prevention program among adolescents
- To present a policy brief to the Oyo State governor for CVD prevention program among rural adolescents in Oyo state, Nigeria.

Scope / Limitation

The study scope:

Population

- Adolescents 15- 18 years, who are living in in a rural area in southwest Nigeria, and who are attending schools.

Outcome Measurement

- The use of self-report for assessment of lifestyle CVD risk factors such as smoking and tobacco use, alcohol, physical activity and diet

Focus

- A focus on selected and objectively measureable modifiable risk factors (blood pressure, weight, height, waist circumference, hip circumference, waist hip ratio)

Proposed limitations on data collection

The use of a recall instrument may have introduced recall bias as adolescents may not remember accurately. However in large epidemiological study like this, recall instrument is the best option.

This research will be the first that we know of, to use an expert panel in the College of Medicine of the University of Ibadan. This approach was not familiar to many of the people until the principal investigator introduced it. Thus there is the possibility that errors may be made. However, the principal investigator will send materials and information about the role of experts to the panel members which we hope will address many of their concerns. We cannot use international experts because they would lack local knowledge and contexts

Research significance

This study will lead to the development of the first Nigerian composite lifestyle CVD risk factors questionnaire for adolescents; the availability of this questionnaire may promote the assessment of CVD risk factors among adolescents in Nigeria.

This study will ascertain the prevalence of CVD risk factors among rural adolescents informing the need for a prevention program among this group.

The study will identify how risk factors can be modified in rural Nigerian environments. In particular the study may inform the need for new government policies to promote physical activity and health education in schools.

The availability of a Nigerian composite lifestyle CVD risk factors questionnaire may make it easier for primary health care health workers in rural Nigeria to screen adolescents for lifestyle CVD risk factors.

Definition of terms

Test retest reliability: It is a statistical technique used to estimate components of measurement error by repeating the measurement process on the same subjects (Lavrakas 2008).

Content validity: Content validity examines the extent to which the concepts of interest are comprehensively represented by the items in the questionnaire (Guyatt *et al.* 1993).

Clustering: Co-occurrence of multiple risk factors in an individual (Baruth 2011).

Abbreviations

ICC- Intra-class correlation

CI- Confidence interval

CVD – Cardiovascular disease

Summary of the chapter

This chapter has provided the rationale and background to the study. The next chapter is a systematic review of literature on the prevalence of CVD risk factors among adolescents.

Chapter 2

A systematic review of prevalence of cardiovascular disease risk factors among adolescents

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Brief overview of the chapter

This chapter focuses on the prevalence of modifiable cardiovascular disease (CVD) risk factors among adolescents in different parts of the world. The aim of this chapter was to ascertain the prevalence of modifiable CVD among adolescents in various regions of the world particularly in Africa. The findings of the review show that in Africa particularly, studies on CVD risk factors among adolescents are sparse. Studies conducted among adolescents population in developed countries show that prevalence rate of specific modifiable CVD risk factors differ in various countries, for example while obesity and dyslipidemia are very high in one country, smoking and low physical activity are the major concern in another country. Therefore every country needs to tailor its CVD prevention program to address the specific CVD risk factors. Major limitations of the studies generally were; lack of identification of questionnaires used and their psychometric properties and the merging of children, younger and older adolescents results in the reviews.

Abstract

Objective: The objectives of the review were to systematically identify and critically appraise studies reporting on the prevalence of modifiable CVD risk factors among adolescents from any country in the world and to describe the prevalence of modifiable CVD risk factors among adolescents in different regions of the world in order to identify whether specific risk factor prevention programs should be developed to target specific needs in different regions.

Methods: A comprehensive search was conducted in bibliographic databases available via the Stellenbosch University's library in October and November of the year 2014. Descriptive and cross sectional studies reporting primarily on the prevalence of one or more modifiable CVD risk factors among adolescents in any country of the world were included. Data extracted were entered into Microsoft (MS) Excel spreadsheets. The data could not be pooled together for meta-analysis because of the wide variation of data in terms of age grouping, risk definitions and data collections tools and methods. Therefore the result of the review is presented in a narrative form.

Results: Fifteen studies were included in this review. The majority of the studies were from developed countries. Only two studies were from an African country (Nigeria). The combined age range was 9-20 years. There was high prevalence of modifiable CVD risk factors across the countries. European countries showed high prevalence of smoking among adolescents. The prevalence of dyslipidemia ranged from 2.5% of total cholesterol in rural Iran adolescents to 48.9% high TG in rural Mexican adolescents. Other lipids such as LDL, HDL showed very high prevalence in many countries. Overweight and obesity prevalence ranged from 0.6% prevalence in a study (Addor *et al.* 2003) to 48.7% in another study (Gomez and Huffman 2008). Studies from the United State of America showed a decreasing trend in pre hypertension and

hypertension, overweight and obesity. Few studies identified questionnaires used in assessing lifestyle CVD risk factors but only one study reported its psychometric properties.

Conclusion: This review found a widely varied prevalence of CVD risk factors among adolescents across countries. While United State of America shows a decreasing trend in the last few years, some countries prevalence are very high and there are no data on the CVD risk factors trend among adolescents in most of the countries. There is a need for preventive strategies in different countries with emphasis on CVD risk factors which are highly prevalent in each country. Future studies must separate children data from adolescents' data in order to make meaningful conclusion that will help CVD prevention planning.

Introduction

Adolescence is a period of great change, in terms of physical and emotional maturation (WHO 2015), and establishing lifestyle behaviours that may carry forward into adulthood (Vanhala *et al.* 2005, Magissano *et al.* 1998). Adolescents' health is determined by many factors such as immediate environment (family), individual characteristics, policies and laws, social /cultural values and norms (WHO 2015). This means that adolescents are dependent on adults to a large extent for their life choices until they reach adulthood. If influences are negative, this may lead adolescents to developing health risk behaviors (WHO 2015) which may track into adulthood, and result in adult chronic diseases, such as Cardiovascular Disease (CVD) (Vanhala *et al.* 2005).

CVD is not common in adolescents; however, many of the modifiable risk factors for CVD can commence in adolescence (Washington 1999). These risk factors can include; smoking, harmful use of alcohol, low physical activity, poor dietary pattern, pre hypertension and hypertension, obesity and abdominal obesity (AHA 2006). Studies have shown that many adolescents in developed countries have one or more of the CVD risk factors (Pearson *et al.* 2009, Falkner *et al.* 2008, Hansen *et al.* 2007, Batch & Baur 2005). Of great concern is the increasing prevalence of overweight, obesity and low physical activity among adolescents both in developed and developing countries (Ogden *et al.* 2014, National Center for Health Statistics 2012, Senbajo & Oshikoya 2012, Odunaiya *et al.* 2010). May *et al* (2012) observed obesity prevalence of 20% from 2009-2010 among US adolescents and Odunaiya *et al* (2010) observed low physical activity level among 38% of sub urban Nigerian adolescents. Moreover, within the last 5 years, concerning prevalence of adolescents' pre- hypertension and hypertension has been reported.

(Mbolla *et al.* 2014, Rosener *et al.* 2013, Redwine *et al.* 2012; Acosta *et al.* 2012, Redwine & Daniels 2012). Mbolla *et al* (2014) reported pre hypertension prevalence among 20% of Congolese adolescents and children. Rosener *et al.* 2013, using population based samples of 3248 children in NHANES III (1988-1994) and 8388 children in continuous NHANES (1999-2008) observed that the prevalence of pre hypertension and hypertension among 8-17years adolescents within a 10 year period increased from 15.8% to 19.2% among boys and from 8.2% to 12.6% among girls. Adolescent pre-hypertension is a strong predictor of hypertension in adolescents and adults (Bao *et al.* 1995, Cheng & Wang 2008, Falkner *et al.* 2012, Cao *et al.* 2012). Pre-hypertension progresses to hypertension faster and at a younger age in Blacks compared to Caucasians (Selassie *et al.* 2011). Hypertension is a major risk factor for CVD (Redwine & Daniels 2012, Egan *et al.* 2010) and hypertension is more prevalent in black races.

CVD is a major health problem across the world. It is estimated that by 2030, deaths from CVD will rise from 17.5 million (a report of CVD mortality in 2004) to 23.4 million, an approximate 37% increase from 2004 rates. Given the increasing burden of CVD globally, and in particular in developing countries (Gaziano 2008, WHO 2009), it seems sensible to focus on preventing the development of risk factors among black adolescents in developing countries. This is particularly important because many developing countries are still battling with infectious diseases and HIV (Lambarie & Colson 2006) and cannot afford a wide spread of CVD. Moreover effective intervention in acute care for CVD is not readily available and affordable in developing countries (Joshi *et al.* 2008). Failure to prevent CVD risk factors among adolescents promoted by urbanization and adopted westernized lifestyle (Gaziano 2010) may result in a future adult CVD epidemic in developing countries, which will mirror the current situation in many developed countries (CDC 2015, BHF 2015).

Knowledge of risk factors that lead to the development of CVD has been derived mainly from studies in developed countries such as Framingham heart study (Deaton *et al.* 2011). These results have generally proven to be consistent throughout the world. The INTERHEART study (a multi center study of CVD risk factors) of 27 098 participants in 52 countries also identified nine modifiable risk factors which were found to account for 90% of acute myocardial infarction (AMI) in men and women across all ages and major ethnic groups (Yusuf *et al.* 2004). These risk factors include current smoking, alcohol intake, low fruit and vegetable consumption, hypertension, low exercise, diabetes, psychosocial factors and abdominal obesity. Two reviews on one or more CVD risk factors have been conducted in some countries to determine the country specific prevalence of CVD risk factors (Praveen *et al.* 2013, Maria Gisele dos *et al.* 2008). A systematic review of CVD risk factors among adolescents was conducted by, Mónica *et al* (2009) but the article is in Spanish which gives the article limited readership. However, the prevalence and burden of a wide range of modifiable CVD risk factors among adolescents in developed and developing countries is not available.

Rationale

Investigating the prevalence of modifiable CVD risk factors among adolescents is pivotal to paving the way for effective prevention programs that can reduce the future adult burden of CVD. Despite plentiful information on lifestyle risk factors and CVD in developed countries, to date we are not aware of any systematic review of the literature reporting the prevalence of lifestyle/modifiable CVD risk factors among adolescents. Moreover there is no review of the literature which ascertains differences in risk factors in adolescents from different races, and regions of the world.

Aims

The aims of this review were:

1. To systematically identify and critically appraise studies reporting on the prevalence of modifiable CVD risk factors among adolescents from any country in the world.
2. To describe the prevalence of modifiable CVD risk factors among adolescents in different regions of the world in order to identify whether specific risk factor prevention programs should be developed to target specific needs in different regions.
3. To identify questionnaires used to assess lifestyle CVD risk factors measures and their psychometric properties.

Methods

Search strategy

A comprehensive search was conducted in the following bibliographic databases available via the Stellenbosch University's library between October and November of the year 2014: *Ebscohost, Pubmed, Science Direct, Scopus and PEDro*. Systematic search strategies were developed by one reviewer to identify potentially relevant articles published up to November, 2014. The following search terms were used and applied to different databases “cardiovascular disease” AND “risk factors” AND (“smoking” OR “alcohol” OR “diet” OR “physical activity”) AND (“prevalence” OR “incidence”) AND “adolescents” AND (“rural” OR “urban”). Manual searching was not conducted due to the difficulty in replicating this method.

The titles and abstracts of all potentially relevant studies were screened by one reviewer.

Inclusion and exclusion criteria

Descriptive and cross sectional studies reporting primarily on prevalence of one or more modifiable CVD risk factors among adolescents in any country of the world were included. Analytical studies on CVD risk factors which gave information on the prevalence of the modifiable CVD risk factors were also included. The CVD risk factors included: overweight, obesity, pre hypertension and hypertension, dyslipidemia, low physical activity, alcohol, smoking, poor dietary pattern (low vegetable and low fruit consumption, high salt and saturated fat and cholesterol diet). Participants included in the studies were male and female adolescents between the ages of 9-19 years old from any race. Studies included were published in English language (Nigeria is Anglophone country; English is the official language, there is no state in Nigeria where French is spoken). We excluded the following information from the review; dissertations, conference proceedings, commentaries and letters to editors.

Quality assessment

The quality of the included studies was systematically evaluated using critical appraisal tool for descriptive and cross sectional studies. The critical appraisal tool has 11 items (These questions were adapted from Guyatt GH, Sackett DL, and Cook DJ: Users' guides to the medical literature. II) The questions were in three broad categories: 1) Are the results of the study valid? 2) What are the results? 3) Will the results help locally?

Table 1: Methodological quality appraisal tool Screening Questions for descriptive and cross sectional studies

S/N	Methodological quality appraisal tool Screening Questions			
1	Did the study address a clearly focused issue?	Yes	Can't Tell	No
	<i>HINT: A question can be focused in terms of:</i> – the population(s) studied – the health measure(s) studied (e.g., risk factor, preventive behavior, outcome)			
2	Did the authors use an appropriate method to answer their question?	Yes	Can't Tell	No
	<i>HINT: Consider</i> - Is a descriptive/cross-sectional study an appropriate way of answering the question? - Did it address the study question? Detailed Questions			
3.	Were the subjects recruited in an acceptable way?	Yes	Can't Tell	No
	<i>HINT: We are looking for selection bias which might compromise the generalizability of the findings:</i> - Was the sample representative of a defined population? - Was everybody included who should have been included?			
4.	Were the measures accurately measured to reduce bias?	Yes	Can't Tell	No
	<i>HINT: We are looking for measurement or classification bias:</i> - Did they use subjective or objective measurements? - Do the measures truly reflect what you want them to (have they been validated)?			
5.	Were the data collected in a way that addressed the research issue?	Yes	Can't Tell	No
	<i>Consider:</i> – if the setting for data collection was justified – if it is clear how data were collected (e.g., interview, questionnaire, chart review) – if the researcher has justified the methods chosen – if the researcher has made the methods explicit (e.g. for interview method, is there an indication of how interviews were conducted?)			
6.	Did the study have enough participants to minimise the play of chance?	Yes	Can't Tell	No
	<i>Consider:</i> – if the result is precise enough to make a decision – if there is a power calculation. This will estimate how many subjects are needed to produce a reliable estimate of the measure(s) of interest.			

7.	How are the results presented and what is the main result?	Yes	Can't Tell	No
	<p><i>Consider:</i></p> <ul style="list-style-type: none"> – if, for example, the results are presented as a proportion of people experiencing an outcome, such as risks, or as a measurement, such as mean or median differences, or as survival curves and hazards – how large this size of result is and how meaningful it is – how you would sum up the bottom-line result of the trial in one sentence 			
8.	Was the data analysis sufficiently rigorous?	Yes	Can't Tell	No
	<p><i>Consider:</i></p> <ul style="list-style-type: none"> – if there is an in-depth description of the analysis process – if sufficient data are presented to support the findings 			
9.	Is there a clear statement of findings?	Yes	Can't Tell	No
	<p><i>Consider:</i></p> <ul style="list-style-type: none"> – if the findings are explicit – if there is adequate discussion of the evidence both for and against the researchers' arguments – if the researcher have discussed the credibility of their findings – if the findings are discussed in relation to the original research questions 			
10.	Can the results be applied to the local population?	Yes	Can't Tell	No
	<p><i>HINT: Consider whether</i></p> <ul style="list-style-type: none"> - The subjects covered in the study could be sufficiently different from your population to cause concern. - Your local setting is likely to differ much from that of the study 			
11.	How valuable is the research?			write comments here
	<p><i>Consider:</i></p> <ul style="list-style-type: none"> – if the researcher discusses the contribution the study makes to existing knowledge(e.g. do they consider the findings in relation to current practice or policy,or relevant research-based literature?) –if the researchers have discussed whether or how the findings can be transferred to other populations 			

Level of evidence of included studies was determined using a hierarchy system of evidence proposed by the Scottish Intercollegiate Guideline Network (SIGN). This is shown in Table 2.

Table 2: Scottish Intercollegiate Guideline Network (SIGN) hierarchy of evidence

Level	Description
1++	High-quality meta-analyses, systematic reviews of RCTs, or RCTs with very low risk of bias
1+	Well-conducted meta-analyses, systematic reviews of RCTs, or RCTs with low risk of bias
1	Meta-analyses, systematic reviews of RCTs, or RCTs with a high risk of bias
2++	High-quality systematic reviews of case-control or cohort studies
2+	High-quality case-control or cohort studies with very low risk of confounding, bias, or chance, and high probability that the relationship is causal
2	Well-conducted case-control or cohort studies with low risk of confounding, bias, or chance, and a moderate probability that the relationship is causal
3	Case-control or cohort studies with a high risk of confounding, bias, or chance, and a significant risk that the relationship is not causal
4	Non-analytical studies (e.g., case reports, case series)
	Expert opinion

Data extraction and handling

Data extracted were entered into Microsoft (MS) Excel spreadsheets. The following data were extracted from included studies: author name(s), year of publication, country of publication, population description, study setting, study design, data collection tool (questionnaire and objective measures), rural or urban setting, sample size, age group/ range, gender, number of CVD risk factors assessed with their risk definitions, test retest reliability, content validity and other psychometric properties of questionnaires used, prevalence of CVD risk factors. Prevalence of each CVD risk factors included in the review was assessed; CVD risk factors

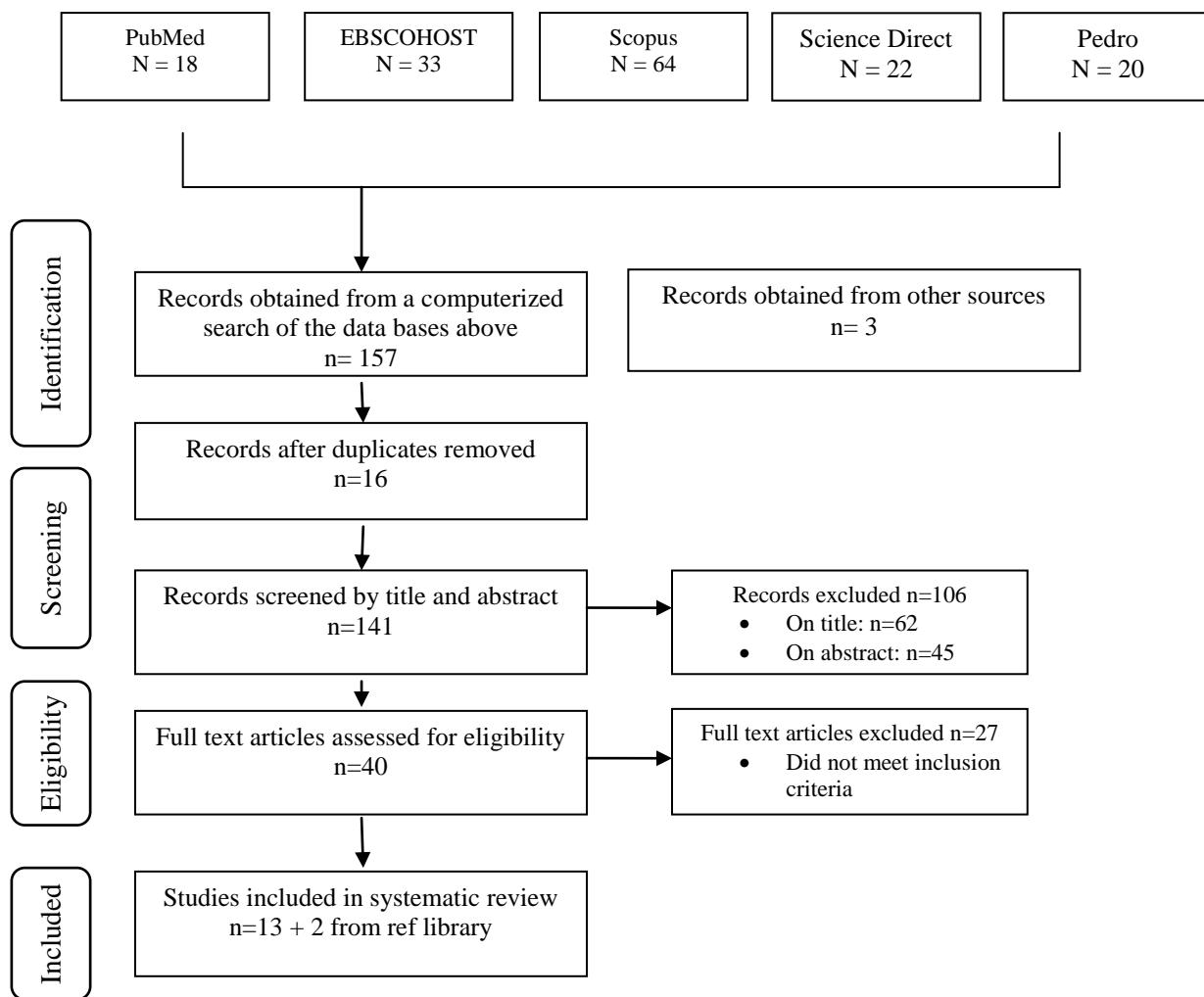
prevalence was assessed irrespective of the risk definition used in any study. The data could not be pooled together for meta-analysis because of the wide variation of data in terms of age grouping, risk definitions and data collections tools and methods. Therefore the results of the review are presented in a narrative form.

Results

The results of the comprehensive search of literature into the prevalence of CVD risk factors among adolescents across the world is illustrated Figure 2. A total of 15 studies were included in this review.

Search results; Overall, this search yielded 157 potentially relevant articles of which 40 remained after removal of duplicates. Studies were selected by title, then by abstract and by full length by first reviewer who also did the search. The full length articles were screened by a second reviewer. Twenty seven studies were rejected at this stage because two studies were study protocols, two were duplicate we did not pick up initially, the remaining did not meet the inclusion criteria as the data for children and adolescents were combined. Fifteen studies were finally included in the review. Thirteen studies were included in the review from the data base search. Thirteen studies were selected after reading the full length and screened for quality using critical appraisal tool for descriptive and cross sectional studies. Three other studies from the reviewer's reference library were screened and two were included. These studies were deemed important in the review and were not captured in the search. The use of authors' reference library has been observed in another systematic review.

Standardized data extraction tables were created using Microsoft Excel. Information related to the study design; year of publication, country where the study was conducted, number of participants, age, gender, modifiable CVD risk factors investigated in each study, population used whether school based or hospital patients, rural, urban, questionnaire used, prevalence of the risk factors among male and female. The database search and the result is depicted in the figure below.



Abbreviations: n= total number

Figure 2: PRISMA flow diagram of literature search: General description of included studies.

Methodological quality assessment: All fifteen studies were retained after critical appraisal. The studies had good methodological quality. A major limitation in nine studies (Ochoa –Avilles *et al.* 2012, Monge & Beita 2000, Wijesuriya *et al.* 2012, Gomez & Huffman 2008, Lenhart *et al.* 2014, Yamamoto- Kimura *et al.* 2012, Kelishade *et al.* 2006, Buchan *et al.* 2003, Odunaiya *et al.* 2010) was that of power calculation. One study lacked inclusion of power calculation in sample size determination (Buchan *et al.* 2003) because it was a sampling of convenience while the remaining eight studies calculated sample size but were not clear what statistical power was used to calculate the sample size. Methodological assessment of the studies is presented in Table 3.

Table 3: Methodological quality assessment of included studies

Study ID.	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11
Ochoa-Aviles et al	yes	yes	Yes	yes	yes	Can't tell-no power calculation for sample size	yes	yes	yes	yes	good
Moeini et al	yes	yes	Yes	Can't tell; Questionnaire validation not included	yes	Yes	yes	yes	yes	yes	good
Candidoetal	yes	yes	Yes	Can't tell; interview not validated	yes	Yes	yes	yes	yes	yes	good
Monge and Beita	yes	yes	Yes	Can't tell; questionnaire validation not included	yes	Can't tell; power calculation not included	yes	yes	yes	yes	good
Wijesurija et al	yes	yes	Yes	Can't tell; questionnaire validation not included	yes	Can't tell; no power calculation	yes	yes	yes	yes	Good
Muller-Riemenschneider	yes	yes	Yes	ditto	yes	Yes	yes	yes	yes	yes	Good
Gomez and Huffman	yes	yes	Yes	ditto	yes	Can't tell; power calculation not included	yes	yes	yes	yes	good
Lenhart et al	yes	yes	Yes	yes	yes	Can't tell; power calculation not included	yes	yes	yes	yes	good
Yamamoto-Kimura et al	yes	yes	Yes	Can't tell; questionnaire validation not included	yes	Can't tell; no power calculation	yes	yes	yes	yes	good
May et al	yes	yes	Yes	yes	yes	Yes	yes	yes	yes	yes	good
Kelishade et al	yes	yes	Yes	yes	yes	Can't tell; (sub sample of the population)	yes	yes	yes	yes	good
Addor et al	yes	yes	Yes	Can't tell; questionnaire validation not included	yes	Yes	yes	yes	yes	yes	good
Buchan etal	yes	yes	Yes	yes	yes	No; convenient sampling	yes	yes	yes	yes	good
Odunaiya et al	yes	yes	Yes	yes	yes	Can't tell; power calculation not included	yes	yes	yes	yes	good
Ujunwa et al	yes	yes	Yes	yes	yes	Yes; population sampling	yes	yes	Can't tell	yes	good

General description of the studies

The 15 studies in this review are from 11 countries. Six (40%) of the studies (Muller-Riemenschneider 2010, Gomez & Huffman 2008, Lenhart *et al.* 2014, May *et al.* 2012, Addor *et al.* 2003, Buchan *et al.* 2012) were from developed countries; US (Gomez & Huffman 2008, Lenhart *et al.* 2014, May *et al.* 2012) Europe (Muller-Riemenschneider 2010, Addor *et al.* 2003, Buchan *et al.* 2012). Seven studies were from upper middle income countries (Ochoa-aviles *et al.* 2012, Moeini *et al.* 2012, Candido *et al.* 2009, Monge & Beita 2000, Wijesuriya *et al.* 2012, Yamamoto-Kimura *et al.* 2012, Kelishade *et al.* 2006) and two from an African country (Odunaiya *et al.* 2010, Ujunwa *et al.* 2013) The studies were published between 2003 and 2014. Ten studies were published between 2012 and 2014.

Two studies (Moeini *et al.* 2012, Odunaiya *et al.* 2010) investigated one CVD risk factor each. The remaining 13 studies investigated more than one risk factor each. CVD risk factors studied were dyslipidemia (Ochoa-aviles *et al.* 2012, Candido *et al.* 2009, Monge & Beita 2000, Muller-Reimenschneider *et al.* 2010, Yamamoto-Kimura *et al.* 2012, May *et al.* 2012, Kelishade *et al.* 2006, Buchan *et al.* 2012) hypertension and pre hypertension (Ochoa-aviles *et al.* 2012, Candido *et al.* 2009, Monge & Beita 2000, Muller- Reimenschneider 2010, Gomez & Huffman 2008, Yamamoto- Kimura 2012, May *et al.* 2012, Kelishade *et al.* 2006, Addor *et al.* 2003, Buchan *et al.* 2010, Ujunwa *et al.* 2013) obesity and overweight, (Ocha –Aviles *et al.* 2012, Candido *et al.* 2009, Monge & Beita 2000, Wijesuriya *et al.* 2012, Muller- Reimenschneider 2010, Gomez & Huffman 2008, Lenhart *et al.* 2014, Yamamoto- Kimura 2012, May *et al.* 2012, Kelishade *et al.* 2006, Addor *et al.* 2003, Buchan *et al.* 2010). Smoking (Moeini *et al.* 2012, Monge & Beita, 2000, Muller- Reimenschneider 2010, Lenhart *et al.* 2014, Yamamoto- Kimura 2012, Addor *et al.* 2003).

al. 2003) physical activity (Candido *et al.* 2009, Monge & Beita, 2000, Wijesurija *et al.* 2012, Lenhart *et al.* 2014, Yamamoto- Kimura 2012, Addor *et al.* 2003, Odunaiya *et al.* 2010) and diet (Monge & Beita 2000, Lenhart *et al.* 2014, Bucchan *et al.* 2012). Alcohol was considered only in one study. There were only two studies from Africa which were from Nigeria (Odunaiya *et al.* 2010, Ujunwa *et al.* 2013).

All studies included male and female adolescents. The combined age range for the included studies was 9 to 20 years. The combined sample size was 40 540 adolescents. The majority of the studies were conducted among school adolescents in school setting within urban areas. One study (Gomez and Huffman, 2008) was conducted in pediatric clinic. All studies were cross-sectional design (n=15; 100%). of the included studies, nine studies (60% Moeini *et al.* 2012, Monge & Beita 2000, Wijesurija *et al.* 2012, Muller- Reimenschneider 2010, Lenhart *et al.* 2014, Yamamoto- Kimura 2012, Addor *et al.* 2003, Buchan *et al.* 2010, Odunaiya *et al.* 2010) used questionnaires, one study (Monge & Beita 2012) used interview, 5 studies(Ochoa-Aviles *et al.* 2012, Gomez & Huffman 2008, May *et al.* 2012, Kelishade *et al.* 2006,Ujunwa *et al.* 2013) used only objective measures because they did not assess lifestyle risk factors. Majority of the study used probability sampling; multistage cluster sampling, one study used population sampling method. Table 4 shows the general description of the studies included in the review

Table 4: General description of the included studies

Study ID	Year	Country	Population description	Study setting	Urban/rural	Sampling method	Age range/ (years)	Gend er	N
Ochoa-Aviles et al	2012	Ecuador	High school adolescents	school	Urban/rural	Two stage cluster design	10-16	F/M	770
Moeini et al	2012	Iran	School adolescents	school	Not provided	Cluster random	14-20	F/M	1161
Candidoetal	2009	Brazil	School adolescents	School	Not provided	Random sampling	10-14	F/M	487
Monge and Beita	2000	Costa Rica	School adolescents	schools	Urban and rural	Random sampling	12-18	F/M	328
Wijesurija et al	2012	Sri Lanka	School adolescents	school	Not provided	Random sampling	10-19	F/M	Not provided
Muller-Riemenschneider	2010	Germany	German adolescents	school	Not provided	Random sampling	11-17	F/M	6817
Gomez and Huffman	2008	US	Hispanic adolescents in US	Pediatric clinic	Not provided	Random sampling	12-16	F/M	100
Lenhart et al	2014	US	Adolescents	school	Urban	n/a	9-12 grade	F/M	805
Yamamoto-Kimura et al	2012	Mexico	School adolescents	school	Urban/ rural	Random	12-16	F/M	3121
May et al	2012	US(1999-2000)	High school adolescents	school	Urban	Stratified multistage Random sampling	12-19	F/M	3,383
May et al	2012	US(2001-2002)	High school adolescents	school	Urban	Stratified multistage Random sampling	12-19	F/M	3,383
May et al	2012	US (2003-2004)	High school adolescents	school	Both	Stratified multistage Random sampling	12-19	F/M	3,383
May et al	2012	US(2005-2006)	High school adolescents	school	Urban	Stratified multistage Random sampling	12-19	F/M	3,383
May et al	2012	US (2007-2008)	High school adolescents	school	Urban	Stratified multistage Random sampling	12-19	F/M	3,383
Kelishade et al	2006	Iran	School adolescents	Schools	Urban/rural	random	6-18	F/M	4,811
Addor et al	2003	Swiss	adolescents	Not provided	Not provided	Two stage Cluster sampling	9-19	F/M	3,636
Buchan et al	2012	Scotland	Children and adolescents	Schools	Urban	convenience	16.4 mean	F/M	106
Odunaiya et al	2010	Nigeria	Adolescents	Schools	Semi urban	Population	14-19	F/M	1000
Ujunwa et al	2013	Nigeria	Adolescents	Schools	Urban	random	10-18	F/M	2694

Key: F – Female; M-Male; US- United States

The prevalence of certain CVD risk factors reported by selected studies are shown in tables 3-9. The most common CVD risk factors studied was overweight and obesity (Ocha –Aviles *et al.* 2012, Candido *et al.* 2009, Monge & Beita 2000, Wijesuriya *et al.* 2012, Muller-Reimenschneider 2010, Gomez & Huffman 2008, Lenhart *et al.* 2014, Yamamoto- Kimura 2012, May *et al.* 2012, Kelishade *et al.* 2006, Addor *et al.* 2003, Buchan *et al.* 2010). Diet was the least studied CVD (Monge & Beita 2000, Lenhart *et al.* 2014, Buccchan *et al.* 2012). The prevalence of each risk factor and the risk definitions for each study and measurement tools are included in the tables. For obesity, all studies used percentiles cut off for risk definition, for pre hypertension and hypertension prevalence; the risk definition was the same in all the studies. For physical activity and smoking; the risk definition were so varied among studies. Only one study assessed alcohol among adolescents. Prevalence of each CVD risk factor varied from country to another as depicted in tables 4-9.

Prevalence of risk factors

Dyslipidemia

Dyslipidemia is an abnormal amount of lipids (e.g. cholesterol and/or fat) in the blood. In developed countries, most dyslipidemias are hyperlipidemias; that is, an elevation of lipids in the blood. This is often due to diet and lifestyle. Dyslipidemia was assessed by eight studies. The studies all used the standard protocol of enzymic methods to measure lipid profile of adolescents. Risk ascertainment used were the same in five studies (Ochoa-Aviles *et al.* 2012, Candido *et al.* 2009, Monge & Beita 2000, Muller-Reimenschneider *et al.* 2010, May *et al.* 2012). One study (Kelishade *et al.* 2006) used age and gender specific percentile cut off to ascertain risk.

Lipid profiles assessed included, total cholesterol (TC), Low density lipoproteins (LDL-C), High density lipoproteins (HDL-C) and triglyceride (TG). The prevalence of dyslipidemia was high in many studies. The prevalence of dyslipidemia ranged from 2.5% of total cholesterol in rural Iran children (Kelishade *et al.* 2006) to 48.9% high triglyceride in rural Mexican youth. Other lipids such as LDL, HDL showed very high prevalence in many countries as shown in table 5.

Table 5: Prevalence of dyslipidemia among adolescents (n = 12 studies)

Study	MEASUREMENT	RISK DEFINITIONS	LIPID PROFILE (BOYS)%	LIPID PROFILE (GIRLS) %	LIPID PROFILE (URBAN)%	LIPID PROFILE (RURAL)%
Ochoa-Aviles et al	Colorimetric enzymic method	TC>200mg/dl, LDL>130mg/dl, HDL<35mg/dl, TG>150mg/dl	TC=17.6, LDL=10.7, HDL=5.7, TG=13.8	TC=19.5, LDL=10.9 HDL,14.4,TG17.2	TC=15.1, LDL= 7.6, HDL=6.7, TG=11.8	TC=27.4, LDL= 18.9, HDL=18.9, TG=25.3
Candido et al	Colorimetric enzymic method	TC>200mg/dl, LDL>130mg/dl, HDL<35mg/dl, TG>150mg/dl	High chol =36.9%,LDL =5.8%,LDL =18.6%			
Monge and Beita	Colorimetric enzymic method	TC>200mg/dl, LDL>130mg/dl, HDL<35mg/dl, TG>150mg/dl	LDL=13%,HDL=34%,TC/HDL L=13%			
Muller-Riemenschneider	AHA guideline	TC>200mg/dl, LDL>130mg/dl, HDL<35mg/dl, TG>150mg/dl	Male and female dyslipedemia;11y=28.5, 12y=24.8, 13y=21.0, 14y=20.6, 15y=23.5, 16y=26.4,17y=34.7			
Yamamoto-Kimura et al	AHA guideline	TC>200mg/dl, LDL>130mg/dl, HDL<40mg/dl, TG>110mg/dl			Male; public- LDL=7.0, HDL=34.1, TG=21.6, TC/HDL ratio=15.2. private; LDL=10.3, HDL=32.1, TG=18.8, TC/HDL ratio=17.4. Female; public- LDL=7.4,34.2,TG=28.2,TC/HDL=16.4	Male;LDL=4.9,HDL=48.9, TG=28.6, TC/HDL=11.2 Female; LDL=5.2, HDL=39.0,TG=42.1,TC/HDL=16.2
May et al	AHA guideline	Borderline ; \geq 110 mg/dl to \leq 129mg/dl LDL >130 mg/dl, HDL<35mg /dl,TG>150mg/dl	LDL, borderline=14%, high=9%, HDL=9			
May et al	AHA guideline	Borderline ; \geq 110 mg/dl to \leq 129mg/dl LDL >130 mg/dl, HDL<35mg /dl,TG>150mg/dl	LDL18%, LDL, high 9%.HDL=8			
May et al	AHA guideline	Borderline ; \geq 110 mg/dl to \leq 129mg/dl LDL >130 mg/dl, HDL<35mg /dl,TG>150mg/dl	LDL borderline=13%, High=6%,HDL= 6%			
May et al	AHA guideline	Borderline ; \geq 110 mg/dl to \leq 129mg/dl LDL >130 mg/dl, HDL<35mg /dl,TG>150mg/dl	Borderline=15%, High=7%, HDL=3%			
May et al	AHA guideline	Borderline ; \geq 110 mg/dl to \leq 129mg/dl LDL >130 mg/dl, HDL<35mg /dl,TG>150mg/dl	Borderline=13.5%, High= 6%, HDL=3%			
Kelishade et al	Enzymic method	TC,LDL-C or TG higher than 95 th percentile of age and gender specific	10-13 years =High TC= 6.2%, LDL-C=9.1, HDL-C=27.1, TG= 19.1 . 14-18 years ;TC =3.2, LDL -C=4.2,HDLC=22.3, TG=15.1	10-13 years; TC=5.1, LDL-C= 8.2HDL-C=.3 6 .0,TG = 23.2. 14-18years; TC=5.1, LDL-C= 5.1, HDLC=17.1, TG= 16.1	10-13years;TC=5.4, LDL-C=8.4, HDL-C=33.1 TC=21.6. 14-18years; TC=4.1, LDL-C= 5.2, HDL-C= 20.2, TG=15.2	10-13years TC=4.1, , LDL-C=7.1, ,HDL-C=19.2,TG= 20.4,14-18Y;TC=2.5,LDL-C=4.5 HDL-C=19.1,TG=14.6,
Buchan et al	Enzymic method	Male;TC;>4.73mmolL,LDL>3.18mmol L. Female; TC;>5.2mmolL, LDL;3.34	Male and female; TC = 41, HDL = 4.0,HDL = 6,0 , TG=<1			

Key: TC-total cholesterol, TG- triglyceride, LDL- low density lipoprotein, HDL-High density lipoprotein.

Prevalence of overweight and obesity among adolescents

Overweight and obesity were determined by Body Mass Index (BMI). Twelve of the studies included BMI in their measurement. All overweight and obesity studies (Ocha –Aviles *et al.* 2012, Candido *et al.* 2009, Monge & Beita 2000, Wijesuriya *et al.* 2012, Muller-Reimenschneider 2010, Gomez & Huffman 2008, Lenhart *et al.* 2014, Yamamoto- Kimura 2012, May *et al.* 2012, Kelishade *et al.* 2006, Addor *et al.* 2003, Buchan *et al.* 2010) used BMI percentiles to ascertain risk level. The percentile risk levels used differed in one study (Muller – Reimenscheneider, 2010), The studies generally used $>/=95^{\text{th}}$ for obesity while one study (Muller -Reimenscheneider) used 97^{th} percentile for obesity cut off point. The BMI percentile used were either as recommended by WHO or CDC. Two studies presented overweight and obesity in every age among adolescents (Muller- Reimenschneider 2010, Addor *et al.* 2003) and one study categorized adolescents into younger and older adolescents (Wijesuriya *et al.* 2012). Four studies considered the result of urban and rural adolescents separately (Ochoa –Aviles *et al.* 2012, Yamamoto- Kimura *et al.* 2012). Six studies (Wijesuriya *et al.* 2009, Muller- Reimenschneider *et al.* 2010, Gomez & Huffman 2008, May *et al.* 2012, Addor *et al.* 2003, Buchan *et al.* 2012) presented overweight and obesity separately while others did not. All the studies assessed BMI in male and female adolescents but many of the studies did not present the results of male and female separately. Overweight and obesity prevalence ranged from 0.6% to 48.7%. The result of overweight and obesity prevalence is shown in table 6.

Table 6: Prevalence of Overweight and obesity among adolescents

Study	Measurement	Risk definition	Overweight (male)%	Overweight (female) %	Obesity (male)%	Obesity (female)%	Urban (%)	Rural (%)
Ochoa-Aviles et al	BMI	international standard by Cole et al	17.3	18.7	2.4	1.9	Overweight=19.2, obesity= 2.1	Overweight= 13.9, obesity= 1.8
Candido et al	BMI percentiles Waist circumference percentiles	<5 th percentile=underweight, 5th - >85 th =normal, 85 th -94 th =overweight, >/ =95 th = obesity. Abdominal obesity; ≥75 th	10-14 y=4.9	10-14 y=4.7	10-14y= 2.6	10-14 y=3.2		
Monge and Beita	BMI percentile(WHO)	85 th -89 th = overweight, 90 th percentile= obese					Male overweight ;21 , female;22, obesity male;13, female;13 and female overweight =21.5, obesity= 13	Male;16, 24, Obesity male;5.0 Female;13.0
Wijesuriya et al	BMI percentile	Age and gender specific by Cole et al	Male and female overweight and obesity; 10-14y= 19. 7.0,15-19y= 15.3					
Muller-Riemenschneider	BMI percentile	>/=97 th percentile of German reference population			11y=6.0,12y=7.5,13y= 7.4,14y=9.115y=7.8, 16y=8.0, 17y=7.7	11y=6.5,12y=9.0,13y=6. 6, 14y=8.0, 15y=8.1, 16y=8.3,17y=10.9		
Gomez and Huffman	BMI percentile	<5 TH percentile=underweight,5 th - >85 th =normal, 85 th -94 th =overweight,>/ =95 th = obesity.	male and female overweight and obesity;48.7					
Lenhart et al	BMI percentile CDC	<85 TH percentile,85 th -94 th ;intermediate, >/=95 th ;poor	Male and female=17.9		Male and female=15.8			
Yamamoto-Kimura et al	BMI	Age and gender specific cut off by Cole et al					MOW; 20.3 MOB; 5.7. FOW; 23.5, FOB;4.7	MOW;8.8, MOB; 2.9, FOW;14.9, FOB; 2.9
May et al	CDC (199-2000)	<5 TH percentile= underweight,5 th - <85 th =normal, 85 th -94 th =overweight, ≥95 th = obesity	Male and female=15.0		Male and female=18.0			
May et al	CDC (2001-2002)	<5 TH percentile= underweight,5 th - <85 th =normal, 85 th -94 th =overweight, ≥95 th = obesity	Male and female=14.0		Male and female=16.0			
May et al	CDC (2003-2004)	<5 TH percentile= underweight,5 th - <85 th =normal, 85 th -94 th =overweight, ≥95 th = obesity	Male and female= male and female=17.0		Male and female=19.0			
May et al	CDC (2005-2006)	<5 TH percentile= underweight,5 th - <85 th =normal, 85 th -94 th =overweight, ≥95 th = obesity	Male and female=16.0		M/F ; 19.0			
May et al	CDC (2007-2008)	As above	M/F(OW/OB) ; 15.0		Male and female=20.0			

Kelishade et al	CDC	< 5 th percentile =underweight ,5 th - <85 th ;normal,85 th – < 95 th overweight, ≥95 th - obesity	MOW/MOB;10-13years; 13.5, 14-18years;14.2	FOW/FOB;10- 13years= 20.1, 14- 18years;20.0			Male and female;10- 13y=19.0.0, 14- 18y=17.1.0	Male and female 10-13y;17.1 , 14-18y= 17.2
Addoretal	BMI percentile	International Percentile specific for age and gender by Cole et al 2000	9years=17.1,10y=14.6,11y=1 3.4,12y=13.9, 13y= 12.5, 14y= 14.0,15y= 11.3,16y=10.7, 17y=12.0, 18- 19years=10.9	9y=18.8, 10y=16.5, 11y=15.9,12y=11.7,13y =10.1, 14y=12.7, 15y=9.8, 16y=10.9, 17y= 11.0, 18-19y=12.2	9y=2.4, 10y= 0.6, 11y=0.6, 12y=2.8, 13y=2.9, 14y= 2.5, 15y=4.3, 16y=1.1, 17y=1.6,18-19years= 1.1	9y=3.9,10y= 4.6, 11y=2.3, 12y=2.0, 13y=0.0, 14y=2.1, 15y=0.0,16y=1.0, 17y=1.4, 18-19y=1.6		
Buchan et al	BMI Percentile	As above	Male and female=18		Male and female =3			

Key:**MOW;** Male overweight**FOW;** Female overweight**MOB;** Male obesity**FOB;** Female obesity

Prevalence of pre hypertension/hypertension among adolescents

Eleven (73.33%) studies in the review assessed pre hypertension and hypertension among adolescents (Ochoa-aviles *et al.* 2012, Candido *et al.* 2009, Monge & Beita 2000, Muller-Reimenschneider 2010, Gomez & Huffman 2008, Yamamoto- Kimura 2012, May *et al.* 2012, Kelishade *et al.* 2006, Addor *et al.* 2003, Buchan *et al.* 2010, Ujunwa *et al.* 2013). Adolescents risk was ascertained using percentiles in all the eleven studies and blood pressure was measured using digital method in two studies and auscultatory method (sphyg) method was used in seven studies (Ochoa-aviles *et al.* 2012, Monge & Beita 2000, Gomez and Huffman 2008, Yamamoto-Kimura 2012, Kelishade *et al.* 2006, Addor *et al.* 2003, Ujunwa *et al.* 2013), while two studies (Muller- Reimenschneider *et al.* 2010, May *et al.* 2012) did not report measurement tool. Risk was ascertained by percentile in all the studies and all the studies had the same range for pre hypertension and hypertension ((Ochoa-aviles *et al.* 2012, Candido *et al.* 2009, Monge & Beita 2000, Muller- Reimenschneider 2010, Gomez & Huffman 2008, Yamamoto- Kimura 2012, May *et al.* 2012, Kelishade *et al.* 2006, Addor *et al.* 2003, Buchan *et al.* 2010, Ujunwa *et al.* 2013). . Four studies (Ochoa-aviles *et al.* 2012, Monge and Beita 2000, Yamamoto- Kimura 2012, Kelishade *et al.* 2006) considered both urban and rural adolescents in the assessment of pre hypertension and hypertension. Pre hypertension and hypertension were assessed separately in four studies (Candido *et al.* 2009, May *et al.* 2012, Kelishade *et al.* 2006, Ujunwa *et al.* 2013) and the prevalence ranged of pre hypertension ranged from 0.4%- 27% while hypertension ranged from 1.2 to 9%. This shown in table 7.

Table 7: Prevalence of pre hypertension and hypertension among adolescents (n= 15 studies)

Study	Measurement	Risk definition	Male prevalence (%)	Female prevalence (%)	Urban prevalence (%)	Rural prevalence (%)
Ochoa-Aviles et al	sphyg	>90 th percentile adjusted for age, eight and gender	3.0%	9.4%	Male and female=6.1	Male and female=6.7
Candido et al	Omron blood pressure monitor	90 th -95 th =pre HPT, >95 th -99 th =HPT 1,>99 TH =HPT 2	Pre HPT=0.4, HPT 1= 1.2, HPT 2=2.4	pre HPT=0.6%, HPT1=1.2%, HPT 2= 1.6		
Monge and Beita	mercury sphyg	National task force recommendation	Male and female HPT=2.7%		Male=0, female=2.3	Male=6, female=2.7
Muller-Riemenschneider	Not included	95 th percentile of national age and gender specific recommendation	HPT; 11y= 6.4, 12y=.8.7, 13y= 10.9 ,14y=14.6, 15y=14.6, 16y= 13.8, 17y=17.2	HPT;11y= 6.9, 12y=9.0, 13y=8.0, 14y=6.9, 15y=8.6, 16y=8.1, 17y=7.3		
Gomez and Huffman	Sphygnomanometer	90 th <95 th =pre HPT, >/=95 th =HPT	Male and female; pre PHT=27%, HPT=9%			
Yamamoto-Kimura et al	Sphyg	>95 th percentile adjusted for age, eight and gender	8.7%	7.6%	Male; public =9.8, private=11.6, Female ; public=11.0, private= 7.0	Male public= 4.7, female public= 4.9
May et al	Not included	90 th <95 th =pre HPT, >/=95 th =HPT		Male and female pre; HPT=12%, HPT=5%		
May et al	ditto	90 th <95 th =pre HPT, >/=95 th =HPT		Male and female ;Pre HPT=11%, HPT=4%		
May et al	ditto	90 th <95 th =pre HPT, >/=95 th =HPT		Male and female; male and female; Pre HPT=10%, HPT=3%		
May et al	ditto	90 th <95 th =pre HPT, >/=95 th =HPT		Male and female; Pre HPT=12%, HPT= 4%		
May et al	ditto	90 th <95 th =pre HPT, >/=95 th =HPT		Male and female; Pre HPT=10%,HPT= 3%		
Kelishade et al	Mercury sphyg	>90th percentile	Pre/HPT (10-13Y)=6.3%, 14-18Y=8.1%	pre/HPT; 10-13y=.4.1%, 14-18y= 3.2%	Pre HPT/HPT;10-13years=5.4, 14-18 9.1	Pre-HPT/HPT 10-13years =4.1%, 14-18=6.8%
Addor et al	Mercury sphyg	Height adjustment method		10y=15.6%,11y=14.0%,12y=7.7%,13y=11.0 %,14y=15.5%,15y=18.4% 16y=19.3%,17y=18 .6%,18-19y=23.8%,		
Buchan et al	Automated monitor	Not included	Pre HPT/HPT=12%			
Ujunwa et al	Sphyg	90 th <95 th =pre HPT, >/=95 th =HPT	PreHPT=14.3% HPT=3.8%	Pre HPT=20.1%,HPT=6.9%		

HPT- Hypertension, PHPT- Pre hypertension, HPT1- Hypertension stage 1, HPT 2-Hypertension Stage 2

Prevalence of physical inactivity

Physical activity was assessed by six studies (Candido *et al.* 2009, Monge & Beita 2000, Wijesuriya *et al.* 2012, Lenhart *et al.* 2014, Yamamoto- Kimura 2012, Addor *et al.* 2003, Odunaiya *et al.* 2010) in this review. Five of the six studies used a questionnaire to assess physical activity level through frequency of sport practice (Addor *et al.* 2012), active days in the last seven days and participation in sport or leisure time physical activity, hours spent in sedentary activities. One study assessed physical activity level using step test. Risk ascertainment was different in each study; one study used cardio respiratory fitness score (Monge & Beita 2000) and another study (Wijesuriya *et al.* 2012) used non participation in sport /leisure time physical activity. Prevalence of physical inactivity ranged between 5.9 %-79.3%. The least prevalence of physical inactivity was observed in rural Mexican adolescents, while the highest was observed in urban Brazilian adolescents (Candido *et al.* 2009). Prevalence of low physical activity ranged between 9.0% (Swiss adolescents) and 38% (Nigerian sub urban adolescents). These findings are shown in table 8.

Table 8: Prevalence of physical inactivity among adolescents

Physical activity	Measurements	Risk definition	Sedentarism/inactivity	Low physical activity	Urban	Rural
Candido <i>et al</i>	Hours spent watching tv, video games and computers	More than 2 hrs a day	79.3			
Monge & Beita	Havard step test	Score of ≥ 3 in fitness= sedentary or inactivity	Girls; 76.5%, boys;31.5%			
Wesuja <i>et al</i>	Participation in sport and /leisure time physical activity	Not participating in sport /leisure time activity is inactive		F ;10-14 years =39.9% F;15-19Years =51% M;10-14 Years =14.5%, 15-19 =20%		
Lenhart <i>et al</i>	days active for 60 minutes in the last seven days	0-1 day= poor or low activity		23.5%		
Yamamo	Participation in sport or leisure time activity	No participation in sport or leisure time physical activity; sedentary			Male; public school; 14.0, private school; 19.2. Female; public ; 40.8, private; 44.5	Male; 5.9 Female; 29.3
Addor <i>et al</i>	Frequency of sport practice	Never practicing sport were ; inactive		10-- 12=NA, 13=12.6%,14 =9.0%,15 =11.6%,16 =9.6%,17=10.5%18-19=17.0%		
Odunaiya <i>et al</i>	PAQ-A	Score of-- in the questionnaire ;low PA		38%		

Prevalence of smoking among adolescents

Six studies (Moeini *et al.* 2012, Monge & Beita 2000, Muller- Reimenschneider 2010, Lenhart *et al* 2014, Yamamoto-Kimura *et al.* 2012, Addor *et al.* 2003) examined smoking in adolescents. One study (Muller- Reimenschneider *et al.* 2010) used interviews to assess smoking, while five studies (Moeini *et al.* 2012, Monge & Beita 2000, Lenhart *et al.* 2014, Yamamoto-Kimura *et al.* 2012, Addor *et al.* 2003) used questionnaires. Smoking risk was ascertained differently in each of the studies. One study (Lenhart *et al.* 2014) ascertained risk as current smoking irrespective of number of cigarette, one study used frequency in the last 30 days and another ascertained as daily smoking and weekly smoking. A study assessed smoking among adolescents in urban and rural and type of school (private or public). The prevalence of smoking ranged between 0.2% among 11 year olds (Muller- Reimenschneider *et al.* 2010) and 47.1% (among 17 year olds in a study). Three studies (Muller-Reimenschneider 2010, Yamamoto-Kimura *et al.* 2012, Addor *et al.* 2003) reported very high prevalence of smoking among adolescents (Refer to table 9).

Table 9: Prevalence of smoking among adolescents (n= 6 studies)

Study	Measurement	Risk definition	Smoking yes or no	Smoking daily	Smoking 2-4 times a week	Urban (Smoking 2-4 times weekly)	Rural (Smoking 2-4 times weekly)
Moeini <i>et al</i>	Questionnaire; questions not clear	Not clear	10.2				
Monge & Beita	Frequency of cigarette currently smoked	Smoking daily and frequency of smoking in a week		Male; 6.1%, Female; 1.0	Male and Female; 11	14	8
Muller	Using interviews and questionnaire, current smoking	Current smoking regardless of the number of cigarette	11y=0.2, 12y=1.6, 13y=8.5, 14y=12.8, 15y=2 5.0, 16y=43.3, 17y 43.1				
Lenhart <i>et al</i>	Frequency and volume of smoking in the last 30 days	Smoked in the last 30 days; current smoker	Current smoking; Male and female; 8.2%				
Yamamoto <i>et al</i>	Questions on frequency and volume of cigarette	Smoking at least one cigarette in the last week				Male; public school =7.0, private school =20.5. Female; public=5.6, private=27.0	Male= 8.6% Female= 3.4
Addor <i>et al</i>	Questions on volume and frequency of smoking	More than one cigarette / day were regular smokers		Regular smokers 13 y =7.4%, 14y =9.5%, 15y =20.4%, 16y =21.2%, 17 y=22.9%, 18-19 y =29.3%.			

Prevalence of poor dietary pattern among adolescents

Three studies (20%) (Monge & Beita 2000, Lenhart *et al.* 2014, Buchan *et al.* 2012) assessed dietary factors in our review. The studies measured diet using food diary and questionnaires. Diet was assessed by frequency of specific dietary components. One of the three studies assessed fruit consumption, vegetable consumption and intake of soft drinks while the other two studies (Monge & Beita 2000, Buchan *et al.* 2012) examined the amount of total fat and saturated fat consumed by adolescents. Diet was a risk if adolescents consumed saturated fat >10% and total fat>30%. Prevalence of risky diet based on risk definition in the studies ranged from 18.1% to 93%. One study (Monge & Beita 2000) considered male and female prevalence of poor diet separately while 2 studies (Monge & Beita 2000, Buchan *et al.* 2012) presented prevalence of poor diet of male and female adolescents together. This data is illustrated in table 10.

Table 10: Prevalence of Poor dietary pattern among adolescents (n= 3 studies)

Diet	Measurement	Risk definition	Male	female	Urban	rural	
Monge & Beita	3-day food record	Saturated fat intake >10%	38	40.5	40.5	28.5	Male =39%
Lenhart <i>et al.</i>	Frequency of can drinks, 100% fruit juice, fruit, green salad, potatoes, carrot, other vegetable in the last seven days	Neither five a day nor soda less than daily	Male and female;18.1%				
Buchan <i>et al.</i>	Food diary, food frequency; average kilo calorie	>30% total fat, >10% saturated fat in the diet (WHO,2003)	Male and female ; total fat=79%, saturated fat=93%	79%			

Questionnaires used in assessing lifestyle CVD risk factors

Nine (66%) out of the fifteen studies (Moeini *et al.* 2012, Monge & Beita 2000, Wijesurija *et al.* 2012, Muller- Reimenschneider 2010, Lenhart *et al.* 2014, Yamamoto- Kimura *et al.* 2012, Addor *et al.* 2003, Buchan *et al.* 2012, Odunaiya *et al.* 2010) used questionnaires to ascertain some lifestyle risk factors among adolescents. Three out of the nine studies (Lenhart 2014, Buchan *et al.* 2012, Odunaiya *et al.* 2010) identified the questionnaires they used but only one (n=14) study included the psychometric properties of the questionnaires. Four studies (Ochoa – Aviles *et al.* 2012, Gomez & Huffman 2008, May *et al.* 2012, Ujunwa *et al.* 2013) used only objective measures therefore questionnaires were not applicable. This is denoted as (NA) in those studies. This information is illustrated in table 11.

Table 11: CVD risk factor Questionnaires and psychometric properties

Study	Questionnaire	Author	Reliability	Content validity	Other psychometric properties	Risk factors measured
Ochoa-Aviles <i>et al</i>	No questionnaire	N/A	N/A	N/A	N/A	Objective measures
Moeini <i>et al</i>	Smoking	Moeini et al	Not included	Not included	Not included	Smoking
Candido <i>et al</i>	Interview	N/A	N/A	N/A	N/A	PA,
Monge & Beita	Unpublished questionnaire	Not included	Not included	Not included	Not included	Smoking, diet and objective measures
Wijesuriya <i>et al</i>	Unidentified	Not included	Not included	Not included	Not included	PA and objective measures
Muller-Riemenschneider	Unidentified	Not included	Not included	Not included	Not included	Smoking, PA and objective measures
Gomez and Huffman	N/A	N/A	N/A	N/A	N/A	Objective measures
Lenhart <i>et al</i>	Youth risk behavior questionnaire		Not included	Not included	Not included	Smoking and diet/objective measures
Yamamoto-Kimura <i>et al</i>	Unidentified questionnaire	Not included	Not included	Not included	Not included	Smoking, PA and objective measures
May <i>et al</i>	N/A	N/A	N/A	N/A	N/A	Objective measures
May <i>et al</i>	N/A	N/A	N/A	N/A	N/A	Objective measures
May <i>et al</i>	N/A	N/A	N/A	N/A	N/A	Objective measures
May <i>et al</i>	N/A	N/A	N/A	N/A	N/A	Objective measures
May <i>et al</i>	N/A	N/A	N/A	N/A	N/A	Objective measures
Kelishade <i>et al</i>	N/A	N/A	N/A	N/A	N/A	Objective measures
Addor <i>et al</i>	Unidentified questionnaire	Not included	Not included	Not included	Not included	Smoking, PA, objective measures
Buchan <i>et al</i>	Food diary PAQ-A(published)	Not included	Not included	Not included	Not included	PA, diet and objective measures
Odunaiya <i>et al</i>	PAQ-A	Kowalski et al	yes	yes	Yes	PA
Ujunwa <i>et al</i>	N/A	N/A	N/A	N/A	N/A	- HPT and pre HPT, overweight and obesity

Discussion

The review presents a systematic overview of the prevalence of modifiable CVD risk factors among adolescents. It also presents the questionnaires (measures) used in ascertaining these modifiable CVD risk factors. The review shows that many studies (Mbolla *et al.* 2014; Haas *et al.* 2012, Fredman *et al.* 2007) failed to meet the inclusion criteria because they combined the data of children and adolescents. This shows that adolescents' cardiovascular health has not been separated from children cardiovascular health in many countries. Studies have shown that adolescents' cardiovascular health is a public health concern (Haas *et al.* 2012, Ujunnwa *et al.* 2013, Sorof *et al.* 2004, McNiece *et al.* 2010). Few studies described the questionnaires they used in assessing lifestyle CVD risk factors among adolescents and only one study (Odunaiya *et al.* 2010) included the psychometric properties of the questionnaire used.

Prevalence of CVD risk factors

Overweight and obesity is projected to increase in prevalence and it is already at epidemic proportion in developed countries (Batch & Baur 2005, Wang & Lobstein 2006). The findings of our review show a wide range of overweight and obesity prevalence across settings. Irrespective of the standard of measurement in the study, overweight and obesity were very high in majority of the studies (Ocha –Aviles *et al.* 2012, Candido *et al.* 2009, Monge & Beita 2000, Wijesuriya *et al.* 2012, Muller- Reimenschneider 2010, Gomez & Huffman 2008, Yamamoto- Kimura, Kelishade *et al.* 2006, Addor *et al.* 2003, Buchan *et al.* 2010). This implies varying levels of

prevalence of overweight and obesity epidemic and the need for each country to develop tailored intervention to address this problem.

Pre hypertension and hypertension in this review show a wide range of prevalence rate. Pre hypertension is a precursor to hypertension therefore early intervention to reduce or stop pre hypertension will reduce the burden of hypertension in future.

Higher prevalence rates were observed in many studies from middle income countries compared to US. This may be because, America has developed many programs to prevent or reduce health risk behaviours among children and adolescents (Hayman *et al.* 2015). These strategies are not common in many developing countries. The high prevalence of pre-hypertension and hypertension also shows the epidemiological transition taking place in low and middle income countries. While countries like the US are working on risk behavior reduction among adolescents, adolescents in middle income countries are adopting westernized lifestyle characteristics which are a precursor to risk factors to hypertension. Pre-hypertension and hypertension are prevalent in the adolescents studied (Ochoa-aviles *et al.* 2012, Candido *et al.* 2009, Monge & Beita 2000, Muller- Reimenschneider 2010, Gomez & Huffman 2008, Yamamoto- Kimura 2012, May *et al.* 2012, Kelishade *et al.* 2006, Addor *et al.* 2003, Buchan *et al.* 2010, Ujunwa *et al.* 2013). Pre-hypertension has higher prevalence rate generally than hypertension in majority of the studies.

High prevalence of dyslipidemia was observed in all the studies which assessed dyslipidemia (Ochoa-aviles *et al.* 2012,Candido *et al.* 2009, Monge & Beita 2000, Muller-Reimenschneider *et al.* 2010, Yamamoto-Kimura *et al.* 2012, May *et al.* 2012, Kelishade *et al.* 2006, Buchan *et al.* 2012). This is in agreement with a study conducted among children and adolescents population

(DeFranca & Alves 2006). Studies have shown that this risk factor is precipitated by poor dietary patterns (which are rapidly changing among adolescents as a result of westernization and urbanization) and it is tracked to adulthood. This means that many adolescents progress into adulthood with dyslipidemia, which is a precursor to CVD. Unfortunately, data from low income countries are not available in this review as many low income countries may not have the required laboratory facilities. To test for CVD is also not yet a priority research focus in many developing countries, as infectious diseases i.e. HIV/AIDS etc. remain rife. In the US, a considerable decrease in dyslipidemia profile was reported among adolescents (May *et al.* 2012), because of health education and promotion programs that have been put in place. The high prevalence of dyslipidemia calls for CVD prevention programs for adolescents and surveillance in the developing world, targeted at rural and urban youth.

We observed a concerningly high prevalence of smoking among European adolescents in this review. This is in agreement with similar studies conducted among children and adolescents in Europe (Hublet *et al.* 2006, Neto & Cruz 2003). This is not the case in other developed countries like US where smoking prevalence among adolescents and adults have been declining (May *et al.* 2012). This may be because US has put a lot of measures in place through policies and health education to reduce or prevent tobacco use and smoking. Among adolescents and adults there is a lower prevalence of smoking in middle income countries in this review. This is similar to the trends in some studies among children and adolescents (Haas *et al.* 2012, McNiece *et al.* 2010). However this low prevalence of smoking presents a unique opportunity for primordial prevention programs in Africa and other developing countries. Primordial prevention is the prevention of risk factors and it is relevant where risk factors are at low prevalence rate. This is why many countries in Africa will benefit from primordial prevention.

Physical inactivity and low physical activity have very high prevalence rates among adolescents population in this study. According to WHO (2009), more than a third of young people in the world are not sufficiently active to safeguard their health. The high level of sedentarism observed among adolescents in this study is probably promoted by technology where young people spent long hours watching television or playing computer games. Physical inactivity is responsible for high level of mortality in the world through chronic diseases. This calls for a concerted effort to improve physical activity level of adolescents as these behaviors continue into adulthood, ensuing into diseases such as CVD.

Adolescents' dietary pattern is a major predisposing factor to CVD. Results from the few studies (Monge & Beita 2000, Lenhart *et al.* 2014, Buchan *et al.* 2012) that assessed diet in this review show that there is a high prevalence of poor dietary patterns among adolescents. The prevalence rate of poor dietary patterns is a concern as the majority of adolescents consume saturated fat which is a precursor to hypercholesterolemia. Studies in both developed and developing countries have reported poor dietary patterns among children and adolescents (Kotecha *et al.* 2013, Tayel *et al.* 2013, Sebastin *et al.* 2010). The majority of the studies in the review did not assess diets of adolescents, probably because of the difficulty in obtaining appropriate measures for diet in different populations. This should be addressed in future research.

CVD risk factors questionnaires

Out of Nine studies (Moeini *et al.* 2012, Monge & Beita 2000, Wijesuriya *et al.* 2012, Muller-Reimenschneider 2010, Lenhart *et al.* 2014, Yamamoto- Kimura *et al.* 2012, Addor *et al.* 2003, Buchan *et al.* 2012, Odunaiya *et al.* 2010) which used questionnaires for data collection, only study (Odunaiya *et al.* 2010) described the questionnaires used and its psychometric properties. Some studies that

described their questionnaire had no report of psychometric properties assessed. It appears validation of questionnaires for assessing CVD risk factors are not given adequate attention. Although there are many standardized questionnaire for assessing physical activity, diet, smoking and alcohol, these questionnaires were not utilized by many authors. Only a few studies used a standardized/published questionnaire such as Physical Activity Questionnaire for adolescents (PAQ-A).

Challenges in conducting the present review

A major challenge in conducting this review is linked to the lack of studies considering only adolescents population. Several studies on CVD risk both in developed and developing countries combine children and adolescents population without separating their findings between these age groups. Though these studies were well conducted, they did not give the actual prevalence rates of CVD risk factors among adolescents. Studies of CVD risk factors among adolescents need to categorize adolescents or take each age as a category since a lot of growth occurs during adolescence. This growth is associated with many behavioral changes (WHO 2015). Therefore there is a need to conduct studies investigating CVD risk factors among adolescent populations specifically. The adolescent populations should be grouped as young and older adolescents because of differences in growth and maturation in adolescence.

In addition, there is limited research on adolescents from developing nations. Currently there is no published information on the CVD risk factors among rural African adolescents.

Conclusion

Despite the plentiful information available on CVD risk factors in the developed countries and some developing countries, there is a paucity of data specifically for adolescent populations which may not assist in planning effective prevention program for the population. This review highlights the need for every country to acquire the necessary data of prevalence for CVD risk factors specifically for adolescents' population and specifically for children population. Identification of valid and reliable questionnaires for assessing lifestyle risk factors is necessary for valid assessment of CVD risk factors. There is sparse information on adolescents from developing nations. Currently there is no published information on the CVD risk factors among rural African adolescents.

Conflict of Interest

We declare no conflict of interest

Chapter 3

Development, initial content validation and reliability of Nigerian Composite Lifestyle CVD risk factors questionnaire for adolescents (English version)

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Abstract

Background

Cardiovascular disease risk (CVD) factors affect every age category including adolescents in developing nations. Prevention strategies are effective only when there are epidemiological data for the targeted populations. The collection of such data is only made easy with composite lifestyle CVD risk factors measures that are culturally sensitive and acceptable among the target populations. Nigeria has over 150 million people of which 22% are adolescents between the ages of 10 and 19 years. Adolescent population and the health of adolescents are pivotal issues and are the focus of attention globally.

Objective

The objective of the study was to develop a culturally sensitive and friendly composite lifestyle CVD risk factors questionnaire for adolescents in Nigeria.

Methods

A systematic review was conducted to identify existing, published questionnaires from which items could be selected. Content and face validation were conducted using an expert panel and a sub-sample of the target population. Data for the content analysis was analyzed qualitatively and test retest was done to assess the reliability of the newly developed questionnaire. Kappa statistics used to assess agreement of responses on the first and second administration of questionnaire.

Results

Based on the comments received from experts, the questions were restructured, simplified, clarified, formatted, some questions were added and expert reached a consensus. Kappa showed fair to moderate agreement in 65% of the questions and perfect agreement in one question.

Conclusion

The CVD risk factors questionnaire has acceptable content validity and reliability and should be used to assess CVD risk factors among adolescents in Nigeria. The questionnaire is called the Nigeria composite lifestyle CVD risk factors questionnaire for adolescents.

Introduction

Cardiovascular disease (CVD) is a global problem and is responsible for one tenth of disability-adjusted life years in low and middle-income countries and 18% in high-income countries. CVD is a notable cause of mortality in developing countries[1] and a marked increase is expected over the next few years[1,2] The burden of CVD in developing nations is attributed to increased longevity, urbanization and lifestyles changes[1]

Lifestyle related risk factors are associated with CVD mortality. Many of the lifestyle related risk factors for CVD are observed in adolescents[3,4]. Childhood and adolescent behaviors such as dietary habit, smoking and alcohol use typically extend into adulthood [1]. During adolescence, dietary habits and risky behaviors, such as smoking and drinking, are experimented and often life-long patterns are established [5-7]. The importance of adolescent health and its role in the burden of CVD is the focus of attention globally[8,9]. It is advocated that adolescents should be targeted for CVD prevention programs[10-12].

There is the need to establish the CVD risk profile of youths from developing nations particularly regions where little is known about CVD since most CVD preventative programs are confined to developing nations. Variations in cultural and society related risk factors and beliefs, particularly in rural areas and paucity of information among adolescents and a lack of studies which consider socio-cultural factors associated with CVD risk factors among this group[13] imply that existing programs cannot be easily transposed to developing countries . There is thus a lack understanding of the range of risk factors that expose adolescents to CVD

Traditionally modifiable, lifestyle risk factors have been assessed individually [14-16]. According to Glassgow et al [17] each of the CVD risk factors is a risk factor for some other illnesses and chronic diseases and mortality such as diabetes, and cancer. This may explain why individual risk assessment is common. Planning a preventive or intervention program(primordial prevention, primary prevention and secondary prevention) for CVD needs consideration of the composite risk factor profile. Assessment of each lifestyle CVD risk factor with an instrument will make population based studies and intervention among this sub-population a herculean task. The authors conducted an extensive literature search using seven databases from inception to

2012 and found no published CVD risk factors questionnaire developed in Nigeria either for adult or adolescents population. Therefore, the development of composite lifestyle CVD risk factors measure for adolescent population is advisable. Careful consideration is however required to ensure that the composite risk factors assessment tool is culturally sensitive and acceptable to adolescents in their respective locations and culture. To our knowledge and to date there is no composite validated measure that assesses lifestyle CVD risk factors for adolescents in Nigeria. The aim of this study was to develop an appropriate and culturally acceptable CVD composite risk factor measure to ascertain the prevalence of lifestyle CVD risk factors among adolescents in rural Nigeria.

Methods

Ethical approval was obtained from the Stellenbosch University Health Research Ethics Committee, South Africa. Permission to conduct the study was obtained from local educational authority and principals of the selected secondary school for the reliability study. Adolescents and parents of adolescents were informed of the research and written/verbal consent was obtained from the parents and assent from the students. Purposive sampling was used to select 21 adolescents who attend private schools and whose parents are graduates in order to have adolescents who are proficient in English language. They were between 15 and 18 years old. The study was conducted at the Department of Physiotherapy College of Medicine and places where those adolescents could be located.

Item generation and design of draft questionnaire

A systematic review was conducted between August and September 2008 and updated in August 2012 using electronic databases accessible via the Stellenbosch University library: Pubmed, Cinahl, Psych Info, Proquest, Sport discuss and Cochrane as these are appropriate databases with studies related to the topic and the key words. The following key words were used; CVD, CVD risk factors, questionnaires, smoking, alcohol, drinking, physical activity and diet.

Thirty eight questionnaires were identified from the systematic review and eight questionnaires were selected based on four criteria which were adapted from recommendations in choosing

measuring instruments from Glassgow et al¹⁷ Based on the outcomes of the systematic review, a draft composite lifestyle CVD risk factors questionnaire was designed using eight questionnaires namely; 1) The **Youth Health Survey** by Gilmer et al [18] which was developed as part of school-based longitudinal study to assess and track behavior and attitudes related to CVD risk factors in children and adolescents. Psychometric properties of the subscales were as follows: Physical activity: internal consistency 0.74, test retest reliability 0.70; Diet: internal consistency: 0.84, test retest 0.79; Smoking : Spearman rho correlation : 0.89 [18] A **New Measure of Smoking Initiation and Progression among Adolescents** by Sun et al[19]. Content validity was done using adolescents. Test-retest reliability for overall sample was: 0.85, male 0.83, female 0.87 [19]. 3) **Alcohol Use Disorder Identification test (AUDIT)** [20]. Studies show sensitivity of the AUDIT between 0.6- 0.9, and high values of reliability. It has been validated in Nigeria among youths in the university[21]. 4) **Instrument for Monitoring Adolescent Health Issues** [22]. Questions show moderate to high test retest reliability in subscales. 5) **Adolescent Smoking Uptake Continuum**[23] is used for assessing smoking likely hood and established smoking. It has been found to have acceptable validity, reliability and sensitivity in various populations [23]. 6) **Youth Risk Behavior Surveillance System Questionnaire(YRBSS)** [24] for monitoring adolescent health. Studies have reported moderate to high validity and reliability [25,26]. 7) **Physical Activity Questionnaire for Adolescents** [27]. It was developed to measure the level of physical activity among high school adolescents. It has shown consistent high validity and moderate reliability. 8) **Food Intake Questionnaire by Johnson et al, 2001**[28]. Pearson correlation ranged from 0.42-0.76 for various food groups.

Design of the draft **Nigeria Composite Lifestyle CVD Risk Factors Questionnairefor adolescents**

Demographic questions were taken from the Youth Risk Behavior Surveillance System (YRBSS). Questions for the smoking subscale were taken from Smoking Uptake Continuum, Youth Health Survey and YRBSS. Questions for the alcohol subscale were taken from Alcohol Disorder Use Identification Test(AUDIT- 3) and another question was added by authors. Questions for the Physical activity subscale were taken from YRBSS, Physical Activity

Questionnaire for Adolescents(PAC-A). Questions for the Nutrition subscale were taken from Food Intake Questionnaire. Other items were added by authors. These questions were taken from these specific questionnaires because they were in line with the content coverage of the questionnaire being developed for example, smoking intention and likelihood were seen in smoking uptake continuum. Changes were made in different subscales by the expert panel and the questionnaire was formatted to improve its appearance and face validity.

Validation by expert panel

The draft questionnaire was given to a panel of experts to ascertain its face and content validity. The validation process in this study was conducted in line with the validation processes of questionnaires by Kingston et al [29] and John et al [30]. Particularly, validation of the questionnaire was carried out using guidelines stipulated by Beaton et al and Boyton et al [31,32]. Purposive sampling was used to recruit experts from Cardiology, Physiotherapy, Exercise Physiology, Nutrition and Psychiatry. Specialists from these departments at the University of Ibadan were asked for the names of academics who have worked extensively and published in the subject area of this research. These experts were professionals who have published at least one international paper in the area of selected CVD risk factors assessment, questionnaire development, cross-cultural validation or validation studies in the last five years. Other experts who had not published at the time of the study were specialists and professionals involved in lecturing/clinical consultancy and research supervision at postgraduate level. The purpose of the expert panel was to ascertain the utility and applicability of the CVD risk factor questionnaire among Nigerian adolescents in terms of language appropriateness, knowledge of activity and experiences. Nigeria is a multilingual developing Country in Africa with over 150 million people of which 22% are adolescents. Nigerians are not native speakers of English language though English language is the country's official language. Therefore questionnaires developed in English for Nigerians need to be culturally adapted more so items were selected from previous questionnaires that were not developed by Nigerians or for Nigerians. The experts carried out cultural adaptation of the English version of the questionnaire using the guidelines by Beaton et al [31] and checklist for questionnaire development by Boyton et al [32] to ascertain that there is no ambiguity or double-barrel question and that questions in the questionnaire

covered all the content areas. The Beaton et al [31] consider the following issues; semantic equivalence, idiomatic equivalence, experiential equivalence and conceptual equivalence.

At the panel meeting, the first author, who was the convener of the meeting explained the purpose of the meeting, the purpose of the questionnaire- for monitoring, what dimension each subscale was addressing as there are various dimensions in all the subscales because they were complex health phenomena. The process of validation was done by subscale, each subscale being handled by the expert in that field and contributions by other experts were encouraged.

Following the consensus (based on relevance of the questions to objective of the questionnaire and language appropriateness) of the experts after the meeting, a penultimate version was developed with all the amendments, clarifications, simplifications, additions and formatting effected. This version was then used for further content validation (pre testing) among the adolescent group.

Validation by adolescents (pre-testing)

The pre-testing was conducted in the target population in Ibadan (Ibadan North Local Government Area of Ibadan City in South-Western Nigeria). Twenty one adolescents were selected using sample of convenience (adolescents in teenagers's class of a church) participated in the pre-testing procedure of the questionnaire. They were male and female Nigerian adolescents between the ages of 15- 18 years who are proficient in English language. The penultimate version of the questionnaire was administered by a physiotherapist who is one of the teenagers' mentors in the church. The physiotherapist informed the adolescents of the purpose of the pretest and validation process. All volunteer adolescents were given the penultimate version and a feedback questionnaire. It was decided that the feedback questionnaire would be used and not a focus group in order to allow the adolescents to express themselves freely. The semi-structured questionnaire was used to note any difficulties adolescents experienced in interpreting and completing the penultimate version of the CVD questionnaire. Adolescents were asked to note specific questions/sections that they had difficulty with, questions they thought were not necessary and questions they thought should be added. Adolescents were requested to write their suggestions on the space provided on the feedback questionnaire. The semi-structured feedback

questionnaire and the penultimate version of the CVD risk factors questionnaire were collected for analysis of content.

Reliability

The reliability study was conducted in a secondary school at Egbeda Local Government Area Oyo state, Nigeria. One hundred and fifteen adolescents from a public secondary school participated in this study. All adolescents between 15 and 18 years in the school were invited to the study. The 115 adolescents were all consenting participants of about 150 adolescents in the age group studied. The participants were given the questionnaire to complete and 48 hrs afterwards another copy of the questionnaire was given to each participant. Seven days interval or more as usual in other studies[33] was not appropriate in this study because the questionnaire had seven- days recall i.e the participants were asked what they did or ate in the last seven days.

Data analysis

The data for the content validation was done qualitatively using content analysis. This method is very useful in analysis of semi-structured questionnaires like the one used for feedback from the adolescents. Test-retest reliability using intraclass correlation (ICC) for the five subscales was carried out. ICC 0- 0.2 is poor, 0.3-0.4 is fair, 0.5-0.6 is moderate, 0.7-0.8 is strong or very good correlation and >0.8 is almost perfect correlation [34]. In order to use ICC, some items of the questionnaire were scored to determine specific CVD risk factors. Scoring was done for every subscale but there was no overall score because the questionnaire is a profile scale. Kappa statistics was also used to asses percentage agreement between the first and second administration of questionnaire.

Results

A total of 38 questionnaires were identified out of which eight were selected for aggregation of questions because they met the criteria the authors had set. Nigeria composite lifestyle CVD risk factors questionnaire for adolescents was developed (see appendix). The questionnaire is a 33 item profile scale with six subscales which are; demographic subscale, CVD indicators subscale, smoking subscale, alcohol subscale, physical activity subscale and nutrition subscale. The scales

of measurement are nominal and ordinal scales. Scores for various subscales were determined to assess the prevalence of each CVD risk factor.

Table 1 shows the experts' input in various subscales of the questionnaire

	Clarification	Amendment	Addition	simplification	formatting
demo		Changed to yy for year, mm for month, dd for day. Q3 option ungraded changed to other grades			Formatting was done to improve the appearance by using new times romans, creating tables and boxes where necessary
Sub 2	Q6 examples were given as running, playing football and pounding to clarify Q7 little exercise was clarified as climbing the stairs and walking for ten minutes		Q9 a new question was added by the expert panel	Q5 exerted was replaced with when you exercise	
Sub 3		Q14 Condition for smoking in future such as; when you are grown up and or have money was added			

Sub 4	Introductory statement was changed from liquor to hot drinks with examples as ogogoro Q21 – standard drink was clarified in volume as a bottle of coke(35cl) used in Nigeria.	Nos of the questions changed as there was an additional question in CVD indicators subscale.			
Sub 5		<p>Q27 Was restructured to read practical PE in the time table(in the school curriculum)</p> <p>Q28; Was restricted to read practical PE on the field (experience) not just in the curriculum</p> <p>Q29; Was restructured to read how many sporting competition/ inter house sport did you take part? with usual examples such as sprint, relay, football</p>	Boxes were provided for all the various frequency of questions in the subscale		
Sub 6		that a table be created for food frequency to make it easier for adolescents to complete that			

	section Q30;Common breakfast cereal in Rural Nigeria was made the first on the list, rice crispice was excluded it is not even a usual breakfast cereal in Nigeria, other food types was written with their product; yam and yam products instead of listing all the product of yam such as elubo, pounded yam, asaro. Cassava and cassava products.			
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Reliability in different subscales ranged from $r = 0.3$ to 0.7 as shown in table 2. Kappa statistics showed fair to moderate agreement in 65% of the questions in subscale2-6, perfect agreement in one question, slight agreement in 13% of the questions and slight disagreement in 13% of the questions., this is shown in table 3

Table 2 Reliability values (ICC) in various subscales of the questionnaire

Subscale	ICC
CVD Indicators	0.6
Smoking	0.5
Alcohol	0.7
Physical activity	0.3
Nutrition	0.3

Table 3 . Kappa statistics for all items in CVD indicators, smoking, Alcohol, physical activity and nutrition

Questions	% agreement	Kappa
5	67.8%	.2
6	77.9%	.5
7	79.2%	.3
8	94.7%	.5
9	95.5%	-ve
10	63.2%	.3
11	93%	.2
12	94.7%	.12
13	74.5%	.03

14	99.3%	-ve
15	98.3%	-ve
16	95.7%	-ve
17	95.7%	.3
18	98.3%	.5
19	-----	-----
20	96.3%	.3
21	88%	.1
22	99%	.9
23	49.6%	.1
24	-----	-----
25	51%	.2
26	51.3%	.2
27	64.8%	.5
28	50.5%	.2
29	51%	.31
30	35.8%	.1
30	31.8%	.1
30	37.6%	-
30	39%	.2
30	44%	.2
31	75.4%	.5
32	67.2%	.5
33	72.2%	.4

Discussion

This study was carried out to develop an instrument called “Nigeria Composite Lifestyle CVD Risk Factors Questionnaires For Adolescents” for monitoring adolescents’ Cardiovascular health. Nigeria like most developing countries suffers the double burden of infectious and non communicable disease. However due to lack of resources, the country is not fully awake to solving the problem of CVD which is highly prevalent. Adolescents lifestyle presently will result in CVD epidemic in future as such there is the need to monitor adolescents heart health. The development of the instrument went through various rigorous stages. The questionnaire addresses basic behavioural issues in adolescents lifestyle which constitute CVD risk factors. The dimensions assessed in this questionnaire in relation to CVD and monitoring of adolescents heart health were smoking likelihood, established smoking, hazardous drinking, dietary pattern; fruit and vegetable intake, salt intake and food preference, physical activity level and sedentary living, physical education in school curriculum, practical physical education and CVD indicators in lifestyle of adolescents which will help in monitoring adolescents heart health and evaluate intervention programs. This is the first questionnaire developed to assess and monitor adolescents heart health in Nigeria. The Nigeria CVD risk factors questionnaire is meant to assess CVD risk factors profile of adolescents and not CVD risk. CVD risk is done by computation of certain risk factors including serum lipids which is not considered in this questionnaire. This questionnaire will enable clinicians assess CVD risk factors profile of adolescents and clustering of such CVD risk factors among adolescents.

Validation

Face and content validation of the questionnaire are acceptable having gone through expert panel and target population i.e the adolescents . This implies that the relevant content areas were covered and there was no ambiguity in questions. This is in agreement with Terwee[38]. Internal consistency of this questionnaire could not be assessed because each subscale looks at many dimensions [38] for example, smoking subscale assesses smoking likelihood/ intention, established smoking and smoking volume. Each of the dimension is important especially in development of CVD prevention program for adolescents to address specific issues.

Adolescent comment on adding questions on sex shows that adolescents' sexual health in Nigeria needs to be given urgent attention. Comment also shows adolescents lack adequate knowledge on reproductive health however this is beyond the scope and objective of this questionnaire. It could also be that adolescents do not have adequate knowledge of CVD risk factors. Knowledge of a disease condition and experiences by expert/target population are relevant issues and are very necessary for validation of an instrument [38]. Feedback of adolescents during pre-test could inform the researcher about the knowledge of adolescents regarding the condition. Adolescent's feedback of inclusion of questions on sex may indicate that the adolescent does not have adequate knowledge of CVD risk factors or that the adolescent could just be curious. However, since adolescents were given feedback questionnaires and Nigeria composite lifestyle CVD risk factors questionnaire, they were expected to make their suggestions in relation to content coverage which they had been informed. Failure to do this adequately could be attributed to poor knowledge of condition in question, religious bigotry as in the case of alcohol or curiosity to know other things important to adolescents like sexual and reproductive health. An adolescent's suggestion to remove all questions in alcohol subscale indicate that some Nigerian adolescents are not knowledgeable about CVD risk factors. We also think this adolescent may be very religious as this response could be a product of his/her religious inclination which is a common feature among Nigerians generally. However, according to Beaton et al, authors can only revise a question when 2 or more adolescents have problem with a question therefore we did not revise the questions based on one adolescent's comment.

Poor understanding of adolescents about CVD, could have negative influence on content validation if only the target population were involved in validation process. However the process of development involved literature review, expert panel and adolescents as such validation process was rigorous enough to produce a valid questionnaire, this is supported by Terwee [38]. Another important issue raised by an adolescent is temptation to smoke. This we interpret to mean in our cultural context peer pressure. We opine that there is a need to assess influence of peer pressure in adolescents risky behaviour. This has been supported by various studies on why adolescents smoke[35-37]. However the present questionnaire is not developed to capture this important problem but we recommend this for subsequent questionnaire.

Reliability

The reliability ranged from slight to strong agreement. Kappa showed very good percentage agreement in majority of the questions, however kappa was relatively low and moderate for many questions. This is in agreement with Korean YRBSS and CDC reliability studies of YRBSS [24]. Some questions had negative kappa which could be genuine. Many items in nutrition and physical activity showed low kappa value. This we think could be due to rural adolescents feeding habits and physical activity pattern not being stable because of poverty level. In rural communities daily feeding depends on how much a person has as such feeding pattern may not be established. We opine that food diary may be a more reliable method of assessing nutrition and physical activity log may be very useful in assessing physical activity. Generally reliability studies in adolescents shows that to have high reliability value for questionnaires, adolescents must perceive what is being done as important to ensure that they do not complete the questionnaire in a hurry, thereby having many errors or deliberately giving false information. There may be need to conduct other reliability studies of this questionnaire in urban and other rural areas of Nigeria. Intraclass correlation ranged from fair to very good reliability in various subscales. Most stable response was in alcohol subscale. This could be because, most of the adolescents had never taken alcohol. Physical activity and Nutrition subscales were the least stable. This could be because their feeding pattern and physical activity pattern are determined by economic power and available facilities. Both Kappa and ICC show low values in these subscale. According to Terwee[38] ICC is considered important clinically if it is 0.7 . Reliability values using prevalence rates at 2 different times will be useful to further determine the reliability of the instrument since it is for monitoring heart health.

Availability of Valid and reliable Nigeria composite lifestyle CVD risk factors questionnaire is very pertinent clinically and in epidemiology. With increasing prevalence of CVD in Nigeria, assessment of CVD risk factors among adolescents who come to clinic for other medical conditions will be enhanced. Population based study of adolescents cardiovascular health will also be enhanced. Findings from such hospital based studies and population based studies will lead to development of CVD prevention program thereby ensuring future heart health of Nigerians. This questionnaire can also be adapted in other African countries, particularly west Africa for monitoring adolescents cardiovascular health.

Conclusion

Nigeria Composite Lifestyle CVD Risk Factors Questionnaire for Adolescents is a valid and fairly reliable questionnaire to assess lifestyle CVD risk factors among adolescents in Nigeria. Further validation may be necessary to establish and improve psychometric properties of the questionnaire.

Recommendation

Further validation and reliability studies of this questionnaire is necessary. Translation of the questionnaire into local languages in Nigeria is important and will enhance its utility among rural adolescents in various parts of Nigeria

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Chapter 4

Cross-cultural adaptation and validation of an English-language composite lifestyle CVD risk factors questionnaire for Yoruba-speaking Nigerian rural adolescents

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Brief overview of the chapter

This chapter focuses on cross cultural adaptation of the composite questionnaire developed in English language among Yoruba rural adolescents. The utility of any instrument is affected by language. Therefore to enhance the utility of the composite questionnaire, the process of cross - cultural adaptation into Yoruba language was undertaken. This involved the use of translators who were proficient both in English and Yoruba languages and expert panel. Beaton guideline for cross cultural adaptation was used for the cross-cultural adaptation process reported in this chapter. The outcome of this chapter is the Yoruba version of the Nigerian composite CVD risk factors questionnaire for adolescents. It is presented in this chapter as an article under review in African population study.

Abstract

Background

Self-assessment of lifestyle risk factors must be culturally, linguistically and contextually relevant to support believable responses. This paper reports on a study which is a previously developed an English-language composite lifestyle cardiovascular risk factor questionnaire into an African language (Yoruba), and tested its psychometric properties in a Nigerian rural adolescent population.

Methods

Translation of the English version of the questionnaire into Yoruba was undertaken by professional translators. The translated questionnaire was presented to 21 rural Nigerian adolescents who were fluent in both languages, to assess validity, in terms of comprehensibility and clarity. A test-retest reliability study of both language questionnaires was then conducted among 150 dual-language rural adolescents, using two occasions of testing for each questionnaire, administered two days apart. Time taken to complete the questionnaires was measured. Agreement between repeated data was analysed using intraclass correlations (ICCs), Cohen's Kappa (κ) and paired *t* tests.

Results

ICCs ranged between 0.4-0.8, κ ranged from 0.10 to 0.6 and there were no significant differences between means. Yoruba questionnaire versions were completed in 15-20 minutes, and the Yoruba version was considered culturally appropriate and acceptable for rural Nigerian adolescents.

Conclusion

The Yoruba translation of the Nigerian composite lifestyle risk factors questionnaire performs at least as well as the original English version in terms of validity and reliability and took a shorter time to complete than the English version.

Introduction

Cardiovascular disease (CVD) poses significant health burdens in all nations (Murray & Lopez 1996). It is the leading cause of death in all World Bank developing regions, with the exception of sub-Saharan Africa (Matthers *et al.* 2001). There has been a steady increase in growth in CVD burden in developing countries, which largely reflects an increase in the prevalence of lifestyle risk factors such as sedentary behaviors, poor diets, and higher body mass index, alcohol and tobacco use. In developing countries a relatively younger population is afflicted by CVD (Gaziano 2007).

Lifestyle factors are significant predisposing risks for CVD (AHA 2006, Stewart *et al.* 2006, Yusuf *et al.* 2004). Increasing lifestyle CVD risk factors will jeopardize in future the cardiac health of black Africans, as many of these risk factors have been seen in black African adolescents (Mbolla *et al.* 2014, Senbanjo& Oshikoya 2012). High prevalence of lifestyle risk factors have been observed in South Africa and other African countries (Sliwa *et al.* 2008; Tibazarwa *et al.* 2009), but information is sparse on lifestyle CVD risk factors in Nigeria, which is the most populous black African country(www.oecd.org, 2015).

Lifestyle risk factors are usually assessed with self-reported questionnaires. There are many questionnaires assessing lifestyle risk factors, and most are in English. Most questionnaires assess one lifestyle CVD risk factor, for instance Alcohol Use Disorder Identification Test (AUDIT) and Physical activity questionnaire for adolescents (PAC- A) Saunders *et al.* 1993; Kowalski *et al.* 1997).

The utility of an instrument in assessing lifestyle risk factors depends on its availability in local languages, and its applicability to local settings. Many English health measuring instruments have been translated into other languages to enhance utility and uptake (Morris *et al.* 2012; Odole & Akinpelu 2010, Nakimuli-Mpungu 2012). However, many lifestyle health measures for adolescents are only available in English (Gilmer *et al.* 1996, Stanton *et al.* 2000, Sun *et al.* 2005). In many African countries, adolescents are generally expected to understand English even though they are not native speakers of English, because many are expected to speak English in school. This expectation is challenging to rural adolescents in developing countries who may not have the opportunity to learn or speak English, and to adolescents who are not in school. For instance, in Nigeria, only about half of the adolescent population (54.2% males, 54.3% females) are school attending adolescents (UNICEF 2011). Thus self-reporting lifestyle risks with English-language questionnaires in non-English-speaking Nigerian rural adolescents may not be possible, or provide plausible answers.

Nigeria is a multilingual nation with three major languages namely; Yoruba, Igbo and Hausa and more than five hundred dialects (Lewis *et al.* 2013). The South-western part of Nigeria comprises six states (provinces) and the local language of this tribe is Yoruba, spoken by 22 million Nigerians. The Yorubas constitute a major tribe in Nigeria and Yoruba language is also spoken in some West African countries such as Benin republic, Togo, Sierra Leone and in Cuba. It is argued that traces of the language can also be found in communities as far away as Brazil (Quintessential 2013). Nigeria has a population of over 150 million of which the adolescent population is 22% (UNICEF 2011). Most adolescents in rural areas are proficient only in their local language because many of them do not attend school. Thus in order to establish their lifestyle risks for CVD, there is a need to cross- culturally adapt the English health measuring

instrument (Nigeria composite lifestyle CVD risk factors questionnaire for adolescents) in order to enhance their utility in the South western part of Nigeria, and for use in other West African countries.

The Nigerian composite lifestyle CVD risk factors questionnaire for adolescents was developed in English, for Nigerian adolescents. The questionnaire is for assessing CVD risk factors among adolescent group and to underpin evaluation of future intervention programs to decrease CVD risk. The Nigeria composite lifestyle CVD risk factors questionnaires has six subscales; socio-demographic subscale, CVD indicators subscale which asks questions on common signs and symptoms of CVD such as breathlessness and chest pain, smoking subscale, alcohol subscale, physical activity subscale and nutrition subscale. The process of development, initial content validation and reliability of the English version has been described earlier (Odunaiya *et al.* 2014). The instrument has acceptable content validity and test retest reliability ranges from 0.3-0.7 in all the subscales. Though this questionnaire was developed for Nigerian use and it is valid for Nigerian adolescents, only those who are proficient in English language are able to complete this questionnaire. Thus to make it available to a larger number of adolescents, it needs to be available in Yoruba language.

This paper reports on the process of cross-cultural and cross-language validation, and the reliability of the Yoruba and English language questionnaires on repeat testing.

Methods

Ethics: Ethical approval was obtained from Stellenbosch University research ethics committee, South Africa. Permission was obtained from the local education authority and the principal of a

government owned secondary school at Egbeda local government a rural area in Oyo State, Nigeria. Informed consent was obtained from adolescents and their parents.

Location: The cross-cultural component of the study was based at College of Medicine, University of Ibadan, Nigeria. Data was collected at Egbeda community high school, in a rural area in Oyo state.

Process 1: Translation: Translation from English to Yoruba was undertaken using the guideline by Beaton *et al*, (2000). Two bilingual translators (whose mother tongue was Yoruba language and who were proficient in English) with different profiles and backgrounds were involved in the process of translation. Only one of the two translators was informed of the concepts being examined in the questionnaire. The other translator was not informed of the concept, and he was neither from a medical background, nor did he work in a medical institution. The two translators met to compare and synthesize their translations, so that only one translation was produced. The synthesized version was then given to an independent third translator who was blinded to the process of translation to date. This translator back-translated the Yoruba version of the questionnaire back to English. This step was important to highlight any inconsistencies or conceptual errors in translation, and to ensure that the translated version reflected the same item content and intent as the English version.

Process 2: Content validation (Consultation with experts): The principal investigator sent the translated questionnaire to three language and validation expert for their input and all experts sent their comments to the principal researcher. Based on these comments, the questionnaire was given back to the translator to assign symbols to each word as necessary. For example ere becomes éré.

Process 3: Content validation (pre-testing among adolescents): Adolescents attending the participating high schools were selected (sample of convenience) to participate in content validation of the Yoruba-language questionnaire. They were asked to comment on its comprehensibility and clarity. Adolescents were asked to identify any question they did not understand. Furthermore adolescents were asked to list any question they felt needed to be added to, or excluded from the questionnaire. Beaton proposed 30-40 people as sample size for pretesting. According to ISPOR (2014), there is no rule to the sample size for content validation, and for interview, but 20-30 is the usual number. We involved 21 adolescents in the content validation. An interview was conducted with each adolescent using an interview guide. The purpose of the interview was to determine if the adolescents understood the questions and that there were no question ambiguity.

Process 4: Test-retest reliability: Reliability of responses to the questionnaire was assessed using test-retest design principle. A minimum sample size of 108 participants was deemed adequate for reliability of 0.9 using ICC at 95% confidence interval confidence interval of 0.15). 150 questionnaires were distributed to cater for incomplete questionnaires, On Day 1, participants were given the English version of the questionnaire to complete first, then 30 minutes later, they were given the Yoruba version. For re-test, 48 hrs afterwards (Day 3), they were given another copy of the English version, followed by Yoruba version. 48 hours time delay was used instead of seven days time delay. This is because using seven days time delay (8th day) would not be appropriate because the questionnaire had seven days recall.

Data management: The questionnaires had subscales which were scored, therefore intraclass correlation (ICC) was used to determine the subscale reliability. In addition we explored the

reliability of each questions by using Cohen's Kappa statistics to test agreement between first and second administration of the questionnaire. Since all the questions could not be tested by Kappa statistics because some were on ordinal scale, paired t test was used to test mean difference at the first and second administration

Data analysis

Intraclass correlations (ICC), Kappa (κ) statistics and paired t-tests were applied to determine reliability. Agreement was sought for the priority questions (risk exposure) between the first and second administrations of each language questionnaires Kappa (95%CI) was calculated for binary scored variables, and ICC and paired t tests were used for ordinal scales with more than two response options. If there was a low Kappa or ICC score, or significant differences between tests one and two, then the responses to that question were not considered to be reliable.

Results

Translation process: There were no major disagreements in content and context in the translation process. However a major issue that needed to be addressed was that of symbols called(ami ori oro) assigned to words which were missing in the synthesized translation. Yoruba language is a tonal language (a language with different pitches for a word which gives the word different meaning depending on the pitch), thus words spelt similarly but meaning different things are distinguished by giving symbols to the specific letters of alphabet which would guide the pronunciation of the word and therefore the meaning. These symbols were not given in the

forward translation and the expert insisted that the symbols be given to words(example is Èwù and Éwú). These two words are spelt the same way but mean different things.

Back translation was very wordy making up to nine pages of document instead of seven as the original English version, but there were no disagreement in the meaning.

Content validation (pretesting); Content validation: Twenty-one students participated in this step. This sample reflected boys and girls aged 15-18 years. All invited students participated. The students did not recommend any changes to the Yoruba language questions, and the students found all questions comprehensible and clear.

Reliability testing: There were one hundred and one adolescents aged 15-18 years participated. Mean age was 16.2 ± 0.99 years with 49.6% males and 50.4 % females. The students completed the Yoruba version of the questionnaire more quickly than the English version (10 to 15 minutes, and 15-20 minutes respectively). We noted the time it took the student who finished completing the questionnaire first and the student who was the last to finish for both English and Yoruba versions. This gave us the time range for completing both English and the Yoruba versions. Considering the Yoruba version of the questionnaire, the ICC ranged between 0.4 and 0.8 in the subscales (See Table 1). The highest reliability estimate was found in the alcohol subscale (0.8) and the least reliability estimate was observed in smoking subscale (0.4).

A 62% of the items had $> 70\%$ agreement in repeated responses, Seven items showed kappa values of 0.4- 0.6. Two items showed substantial kappa agreement (>0.6) and one item in alcohol subscale showed perfect agreement ($k=1$). Other items especially in smoking and physical activity subscales showed poor 0.1-0.19 kscores.

Table 1: ICC for each subscale of Yoruba version of the Composite Lifestyle CVD Risk factors Questionnaire for Nigerian adolescents

CVD SUBSCALES	ICC	95% CI's
CVD indicators	0.6	0.3-0.7
Smoking	0.4	0.08-0.6
Alcohol	0.8	0.6-0.9
Physical activity	0.4	0.2-0.6
Nutrition	0.7	0.6-0.9

Table 2 shows the intra-language reliability (English versus Yoruba languages). The ICCs indicate that the alcohol sub-scale had the highest intra language reliability (0.8) while smoking was the least intra-language reliability (0.2).

Table 2: Intra-language reliability between the Yoruba and English languages

CVD SUBSCALES	ICC	95% CI's
CVD indicators	0.6	0.5-0.8
Smoking	0.2	0.1-0.5
Alcohol	0.8	0.7-0.8
Physical activity	0.4	0.3-0.7
Nutrition	0.5	0.3-0.7

Table 3 shows kappa statistics for Yoruba version. Two questions in CVD subscale showed good kappa agreement (0.57,0.53), one question in smoking subscale showed good agreement(0.8) and the others showed poorer agreement. One question in alcohol susbcale showed perfect agreement and others showed moderate agreement. In nutrition subscale all the questions showed moderate agreement. Questions that involved the adolescents recalling the number of times they had undertaken a particular activity had low kappa generally while binary questions had moderate to good kappa values.

Table 3: Agreement between the 1st and 2nd administration of Yoruba version of the questionnaire

Questions	% Agreement	Kappa(CI)
Difficulty in breathing during exercise	71.3	.15(-0.5-0.3)
Chest pain during exercise	80.6	.57(0.41-0.73)
Difficulty in breathing with no exercise	85.8	.53(0.33-0.73)
Either parent with CVD	93.6	.19(-0.17-0.56)
Smoking intention in future	74.3	.81
PE in school time table	72.1	.43(0.25-0.61)
Adding salt at table	83.4	.64(0.48-0.74)

There was no significant difference (in the mean difference of scores of questions) between the first and second administration of the Yoruba version of the questionnaire as shown in table 4.

Table 4: Reliability testing of selected questions using paired t test of mean difference between 1st and second administration

Questions	Test 1 x(SD)	Test 2 x(SD)	P value
Smoking in the last 30 days	1.0(0)	Test:1.01(0.09)	0.32
Volume of smoking	1.02 (± 0.19)	1.03 (± 0.22)	0.53
Smoking everyday in the last 30 days	1.13(± 0.59)	1.18 (± 0.75)	0.62
Frequency of six drinks in an occasion	1.09 (± 0.49)	1.11 (± 0.54)	0.79
Frequency of 60 mins exercise per day in the last week	1.45 (± 1.27)	1.33 (± 0.90)	0.27
Physical Activitytype and frequency in the last week	6.78 (± 8.84)	6.89 (± 9.5)	0.92
Frequency of practical PE in the last week	1.70 (± 1.2)	1.64 (± 1.1)	0.69
Meat frequency in the last week	5.63 (± 1.9)	5.75 (± 2.0)	0.63
Breakfast cereal frequency in the last week	4.50 (± 2.35)	4.44 (± 2.11)	0.84
Vegetable frequency in the last week	6.9 (± 2.04)	6.15 (± 2.16)	0.89
Fruit frequency in the last week	5.77 (± 1.87)	5.82 (± 2.02)	0.82
Food preference	1.77 (± 0.55)	1.74 (0.53)	0.71

Key: x- mean difference; SD- Standard Deviation; P- Statistical significance

Discussion

This is the first known study that reports on the translation and psychometric testing process, to make the Nigerian composite Lifestyle CVD risk factors questionnaire for adolescents available to rural Nigerian adolescents in their local language. Yoruba based on the test findings, it appears to provide a useful tool for future research into CVD risk factors among Nigerian adolescents whose English is inadequate to answer the original questionnaire version. Availability of health measurements questionnaire in local language will facilitate quick and accurate assessment of lifestyle CVD/non communicable disease risk from rural adolescents in south west Nigeria and other West African countries where Yoruba language is spoken.

Translation: The careful forward and back translation process provided a robust Yoruba version of the questionnaire, which adolescents found to be easy to understand and quicker to complete than the English version. The back translation was wordier than the original version .This may be due to the volume of English vocabulary of the translator and choice of words, however the context and concept were in consonance with the original version.

Reliability: The Yoruba version of the questionnaire had higher reliability values than the English version. This may be so because the adolescents understood the Yoruba version better and their responses were more consistent in the Yoruba version of the questionnaire being their mother tongue. This is in agreement with the findings of Odole & Akinpelu 2008, and Odole & Akinpelu 2010; who found better reliability values in Yoruba, Igbo and Hausa versions of IKHOAM, an outcome measure developed in English for Nigerians. People think and reason in their mother tongue even if they understand English language (Youthpass 2015). Communication

in foreign languages also calls for skills such as mediation and intercultural understanding. An individual's level of proficiency will vary between the four dimensions (listening, speaking, reading and writing) and between the different languages, and according to that individual's social and cultural background, environment, needs and/or interests (Youth pass 2015). This underscores the need to make questionnaires available in local languages of the people as this will facilitate obtaining accurate and quick results. The lower stability of measure in smoking subscale might be due to the fact that rural Nigerian adolescents' smoking pattern is not established because they cannot afford to buy cigarettes at will. It could also be due to response error. This happens when adolescents just pick any option without giving it a thought because they do not understand the importance of the investigation, or they are in a hurry. Moderate reliability was observed in physical activity and CVD indicator subscales. Physical activity also is determined by several factors such as availability of recreational facilities both at school and home. Very good reliability was observed in the alcohol and nutrition subscales of the Yoruba version of the questionnaire. Alcohol subscale had most stable responses. This may be because majority of Nigerian adolescents do not drink alcohol, thus they do not have to think about the number of drinks to write, in the response options. Adolescent nutrition is dependent on their parents. This makes their response option quite stable. However smoking intention and likelihood shows excellent kappa agreement. We observed the reliability of alcohol subscale was very good both in English and Yoruba version. However since the assessment of CVD risk factors entails using all the subscales, Yoruba version of the questionnaire can be used for rural adolescents.

As observed in English language questionnaire, the reliability was moderate in majority of the subscales, as the adolescents had variable reliability estimates in the subscales. This has been

observed in many questionnaires for lifestyle risk factors of adolescents (Bae *et al.* 2010, Zulig *et al.* 2006). The test-retest reliability estimates of the Nigeria composite lifestyle CVD risk factors questionnaire is, in part, comparable with those of the Korean youth risk web based survey (KYRWBS) and Youth Risk Behavior Surveillance (YRBSS) questionnaire. First, the reliability estimates were different across CVD risk factors subscales. Our study showed that the lifestyle risk factors which are more time- and situation-dependent, such as physical activity, had lower reliability estimates. Secondly, the indices which used specific time frames as a reference period had lower reliability estimates than the indices which used lifetime reference periods among Nigerian, Korean and American adolescents. This may be so because, remembering events during the specific time intervals requires more complex cognitive demands than remembering events experienced over a lifetime (Bae *et al.* 2010). However, Korean and United States studies showed more stability in smoking behavior which is different from Nigerian adolescents. We opine that this may be also due to the fact that many responses in smoking had specific time reference. Moreover rural adolescents do not have financial ability to buy tobacco and tobacco products as desired. This may also mean that they have not established a ‘usual’ smoking pattern.

Intra-language correlation: Intra- language correlations ranged from fair to good. The subscales that were good were CVD and alcohol. The Yoruba version of the questionnaire performs similarly to the English version even in the most variable subscales (smoking and physical activity). We suggest that future reliability studies of this questionnaire be conducted in urban areas among adolescents where the poverty level is not high, and lifestyle patterns may be more established and thus more consistently measured. We also believe that a reliability study in

this community could be conducted a few hours apart to be certain that the adolescents have minimal response error. This time frame however, may incur recall biases. We also note that adolescents should be advised on the importance of the study and the need for consistency in their response in order to get accurate information.

We suggest that the Yoruba version of the questionnaire should be used among rural Nigerian school going adolescents to obtain accurate information in a short time.

Conclusion

The Yoruba version of Nigeria composite lifestyle CVD risk factors questionnaire for adolescents has good content validity, and moderate to strong test-retest reliability. It is simple and efficient to deliver. Having a health measurement questionnaire available in a widely-spoken local language such as Yoruba will assist us to accurately assess and monitor adolescents' heart health in rural south western Nigeria and other west African countries where Yoruba language is spoken. The indices with very low reliable estimates need further validation to determine inclusion or exclusion in subsequent version of the questionnaire.

Implication of Findings

There is a need to make health measures available in local languages for adolescents in rural areas in Africa, to facilitate obtaining accurate information within a short time. Future research is necessary to translate the questionnaire to other local Nigerian languages such as Igbo and Hausa.

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Conflict of Interest

We declare there is no conflict of interest.

Chapter 5

HIGH PREVALENCE AND CLUSTERING OF MODIFIABLE CVD RISK FACTORS AMONG RURAL ADOLESCENTS IN SOUTH WEST NIGERIA: IMPLICATION FOR GRASS ROOT PREVENTION

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Brief overview of the chapter

This chapter focuses on prevalence of modifiable CVD risk factors investigated among adolescents. The prevalence and the clustering of CVD risk factors among male and female rural adolescents and its implication for CVD prevention among the adolescents population is emphasized. Observation of high prevalence of CVD risk factors among these rural adolescents is surprisingly comparable to those observed in developed countries in certain risk factors such as pre- hypertension and physical inactivity. Other CVD risk factors are lower than what is observed in developed countries. It is worthy to note that dietary factors are the most prevalent lifestyle CVD risk factors and this is important information in CVD prevention planning. This is presented as a paper report in this chapter and it has been published in BMC, Public health.

Abstract

Background: Cardiovascular disease (CVD) is an immense global problem with serious economic and social consequences. Modifiable risk factors for CVD have been identified internationally in adolescents where early intervention programs have the potential to reduce CVD risk on individual and population levels. In developing countries such as Nigeria, little is known about the prevalence of modifiable CVD risk factors among adolescents especially in the rural areas.

Methods: This paper reports on a cross-sectional survey of modifiable CVD risk factors among rural adolescents in South-West Nigeria. All 15- 18 years old adolescents in all the schools of Ibarapa central were approached and all those who assented and consented to participate in the study were involved. A total of one thousand and five hundred adolescents participated in the study. Measurements of CVD risks factors taken were; smoking, physical activity, alcohol, dietary pattern using a questionnaire previously developed by authors. Other CVD risk factors such as waist hip ratio and Body Mass Index (BMI) were taken using standardized instruments. Data were analyzed descriptively.

Results: Data from 1079 adolescents (56.5% males and 53.5% females) were analyzed. Mean age of male was $16.4 \text{ years} \pm 1.14 \text{ years}$ and mean age for female was $16.29 \text{ years} \pm 1.13 \text{ years}$. Adolescents showed clustering of CVD risk factors with about 72% having between two and four risk factors. A total of 102 clustering patterns were reported. The most common clustering pattern (19.6%) included high animal lipid and salt diet.

Conclusion: There is high level of clustering of CVD risk factors among rural adolescents in

Southwest Nigeria. The most common clustering pattern was biased towards dietary factors. The high prevalence of CVD risk factors among rural adolescents in Southwest Nigeria suggests that urgent primary prevention programs are required to prevent the next generation of adult Nigerians from suffering of CVD.

Key words: CVD, modifiable, Risk factors, adolescents, rural Nigeria

Background

Cardiovascular disease (CVD) is on the increase in developing countries (Yach *et al.*, 2007) causing twice as many deaths as HIV, malaria and tuberculosis combined (Lopez & Matthers 2006). CVD is more prevalent in the working- age population (Gaziano 2007) resulting in large social and economic burden. The increase in CVD burden in developing countries is largely the result of an increase in the prevalence of CVD risk factors.

National and high quality studies in CVD are sparse in Africa. However, CVD accounts for about one in every ten deaths (WHO 1999). Most of the CVD deaths in Africa occur among younger people when compared to Europe and North America, with about half of cardiovascular diseases (CVDs) due to causes other than atherosclerosis (Moran *et al.* 2013). Though the burden of CVD in Sub-Saharan Africa is currently lower compared to Europe and North America, increased urbanization and lifestyle changes may result in an increase in the CVD burden in future and in Nigeria, CVD is fourth among the top twenty diseases responsible for mortality (WHO 2011).

People dying of CVD have major modifiable risk factors which include high blood pressure, abnormal lipids and diabetes mellitus (American Heart Association 2006, World Heart Federation 2012, Yusuf *et al.* 2004, Stewart *et al.*, 2006, Sliwa *et al.* 2008 & Tibazarwa *et al.* 2009). Many of these risk factors are caused by unhealthy lifestyle and habits; as such they are sometimes referred to as lifestyle risk factors. These lifestyle risk factors which include smoking, tobacco and excessive alcohol use, poor dietary patterns and physical inactivity have been

observed in adolescents and adults in both developed and developing countries (May *et al.* 2012; Barret *et al.* 2013, Velasquez-Rodriguez *et al.* 2014, Ansa *et al.* 2001, Odunaiya *et al.* 2010).

Investigating CVD risk factors among adolescents is important because adolescence is a critical temporal window for the development of obesity in adult age (Maggisano *et al.* 2005). Dietary habits, and risky behaviors, such as smoking and drinking are experimented with and established in childhood and adolescence (Vanhala *et al.* 1998). Furthermore researchers have advocated that children and adolescent populations should be the target for cardiovascular risk factors prevention programs (Selvan & Kurpad 2004) because lifestyle risk factors are usually learnt and established during this period. CVD prevention programs are thus likely to be more effective in this subpopulation. Modifiable risk factors can be prevented, treated and controlled, hence the need for early detection of risk factors and CVD prevention programs so that adolescents adopt healthy behaviors into adulthood (Selvan and Kupad 2004). This is particularly important in rural regions where there are very limited facilities and health personnel to manage CVD (Phillipi 2004).

There is paucity of information on the prevalence of modifiable CVD risk factors among rural adolescents in Nigeria. Few studies have identified the prevalence of CVD risk factors in urban adolescents (Senbanjo & Osikoya 2012, Oyewole & Oritogun 2012). This lack of information is a barrier to the effective implementation of a CVD prevention program in Nigeria and particularly in the rural areas. There is a need to investigate the prevalence of modifiable CVD risk factors among rural adolescents in Southwest Nigeria in order to plan CVD prevention programs for them.

This study is the first study which seeks to investigate a wide range of modifiable CVD risk factors among rural adolescents in south west Nigeria. The study aims to investigate the prevalence, clustering and pattern of clustering of modifiable CVD risk factors such as; smoking, alcohol use, physical inactivity, unhealthy dietary behaviors such as low fruit and vegetable consumption, high animal fat/cholesterol diet and high salt consumption among male and female rural adolescents in Southwest Nigeria. Other modifiable CVD risk factors investigated include high body mass index (BMI) and abdominal obesity. This investigation is necessary in order to plan effective and appropriate CVD prevention program for this population. We hypothesized that there will be high prevalence of modifiable CVD risk factors among male and female rural adolescents and there will be no significant difference in the prevalence rate of CVD risk factors between male and female rural adolescents in Southwest Nigeria.

Methods

Ethical consideration: Ethical approval was obtained from Stellenbosch University Health Research Ethics Committee (No 8/09/257, 2009). Approval was obtained from the local educational authority in Ibarapa central local government area of Oyo State Nigeria. A letter of approval from the local inspector of education was taken to the Principals (Head teachers) of all schools in Ibarapa Central local government, Oyo state, Nigeria where the study took place. This was necessary for the head teachers to know that the local inspectorate of Education had given approval for the study. Permission to conduct the study in the schools and to involve the adolescents in the study was obtained from the principals of various schools. The principals were informed about the study; they in turn called parent-teacher association meetings where the

principals explained the research to the parents present. Principals also informed adolescents about the study at general school meetings. The principals gave written proxy informed consent in addition to verbal consent from the parents. This is culturally acceptable as principals are seen as guardians of the students. The institutional ethics committee was informed of this process and it was approved.

Study design: A cross-sectional survey was conducted.

Participants: Participants were aged 15-18 years. Participants had to be able to read and write either English or Yoruba and had no learning difficulties (cognitive impairment).

Sample size calculation: The sample size of 1600 was estimated, based on a cluster design effect of 5.8, an ICC of 0.5 to adjust for prevalence estimation and 90% power for analytical analyses. This calculation was based on an initial approximate estimate of 5,400 15-18 years old adolescents in the rural community. This sample size was calculated prior to the time of data collection. Sampling was originally planned in class clusters (i.e. whole classes selected would be invited to participate). Classes in the schools in this region generally contained adolescents of mixed age (10-20 years). Of the 5400 adolescents in the region, about 2500 adolescents attend school. All 22 schools in the region were included. Based on information from school principals regarding the large numbers of students likely to be absent from class on any day (due to truancy or illness), it was decided to invite all students aged 15-18 years at all schools in the region. Since 1500 surveys had already been printed based on the estimated sample size calculation, it was administered to all eligible participants for whom we received consent.

Study setting: The study was conducted in all secondary schools in Ibarapa central local government. The local government comprised two villages, Igboora and Idere. This region has an estimated population of 57,000 people.

Measurement tools

- *CVD risk factor questionnaire*

A specifically developed and validated questionnaire (Appendix 1) was used to measure CVD risk factors. Data for lifestyle CVD risk factors were collected using the Nigeria composite lifestyle CVD risk factors questionnaire for adolescents developed by Odunaiya *et al* (2014) to monitor adolescent cardiovascular health in Nigeria. The questionnaire is a 33 item profile scale with six subscales which are; demographic subscale, CVD indicators subscale, smoking subscale, alcohol subscale, physical activity subscale and nutrition subscale. The scales of measurement are nominal and ordinal scales. The CVD indicator subscale sought to find out adolescents who had parents and close relatives with CVD or receiving treatment for CVD. Other dimensions of this subscale assessed breathlessness and chest pain during rest or exercise. The smoking subscale assessed likelihood of smoking in future and current smoking with number of cigarettes in the last 30 days. The alcohol subscale assessed number of standard drinks taken at any time drinking. The physical activity subscale assessed frequency (number of times in the last week) and intensity of exercise in the last week and was categorized as low moderate and high. Nutrition subscale assessed food frequency in the last week and was categorized as low, moderate and high consumption of any food type. The intra-class correlation coefficient (ICC) was used as an estimate of reliability of the questionnaire. For the English version of the questionnaire, the ICC was 0.65 in CVD indicator section, 0.70 in alcohol section, 0.50 in

smoking section, 0.46 in physical activity section and 0.3 in nutrition section. According to Fleiss 1999, ICC; 0-0.2 is poor, 0.2- 0.4 is fair, 0.4-0.6 is moderate and 0.6-0.75 is good and >0.75 is excellent. Smoking and physical activity were moderate while CVD subscale and alcohol subscales had good reliability. The nutrition subscale had fair reliability for the English version. In the Yoruba version: CVD indicator ICC was 0.6, smoking, 0.4 alcohol 0.8, physical activity 0.4 and Nutrition 0.7. The Yoruba version showed moderate to very good reliability using classification. Judging from the reliability values, the Yoruba version showed a more consistent estimate. This may be because adolescents had better understanding of questions in the Yoruba language than in English language. This is expected because the adolescents in the study are rural adolescents and because generally people interpret words in their mother tongue better. We used the Yoruba version of the questionnaire in the study as it had better reliability than the English version of the questionnaire (except for adolescents who specifically requested for English questionnaire). For this paper we did not explore CVD indicator subscale in detail as it was not the aim of this paper. CVD indicators were included in the questionnaire to help identify adolescents with higher risk and family history. The indicators such as breathlessness at rest and during exercise are not modifiable risk factors therefore; they were not explored in detail.

- *Body mass index (BMI) measurement*

Weight was measured with a digital scale and height was measured with a T-bar (by a trained research assistant in the adolescents' classrooms or halls where all the measurement were carried out). Subjects wore light clothing without shoes for all measurement. The weight reading was recording to the nearest kilogram. Height was recorded as the nearest centimeter. BMI was

calculated using center for disease control BMI calculator and using the population BMI percentile; $\leq 5^{\text{th}}$ percentile is underweight, $5^{\text{th}} \leq 85^{\text{th}}$ percentile is normal weight, $85^{\text{th}} \leq 95^{\text{th}}$ percentile is overweight and $\geq 95^{\text{th}}$ percentile is obesity.

Waist Hip Ratio; Waist circumference was measured at the point of umbilicus while hip circumference was measured at the widest point of the hip (CDC).

Definition of exposures (modifiable risk factors)

The modifiable risk factors included smoking, excessive alcohol use, low physical activity level and poor nutritional factors, overweight and obesity determined by BMI and abdominal obesity determined by waist hip ratio.

The specific exposures to modifiable risk factors were defined as follows:

1. Smoking: smoking of any amount of cigarettes/tobacco in the last 30 days (Muller-Reimenschneider, 2010).
2. Excessive alcohol: 5 standard drinks or more on a day you decide to go drinking (Saunders et al, 1993).
3. Low physical activity: activities are less than five days a week with less than 60 minutes exercise a day (WHO, 2010).
4. High animal lipid diet: Eating meat (red meat, organ meat etc.) five times per week or more (National Heart Foundation, Australia 1999).

5. Low vegetable diet: Not eating vegetables for at least five times per week (Pederson et al, 2012).
6. Low fruit diet: Not eating fruit for at least five times per week (Pederson et al, 2012).
7. High salt diet- High salt intake was defined as adding excessive salt portions to food to already salt loaded foods during the cooking process.
8. High BMI: 85th-≤95th percentile was considered as overweight and \geq 95th percentile was considered obese.
9. Abdominal obesity: (waist hip ratio in males: \leq 0.90 cm and females: \leq 0.85cm were defined as the at risk exposure (CDC). These values are cut off point for adult abdominal obesity. We used this because, there are no nationally representative cut off point for adolescents in Nigeria.

Statistical analysis

The data were descriptively analyzed using means and standard deviations. Prevalence was expressed as percentages and where appropriate, the 95% confidence intervals (CI's) were determined. Chi squared analysis was used to determine if risk factors differed significantly between genders ($p<0.05$ was set as the level of significance). Pearson correlation coefficients were used to assess correlation between risk factors. All analyses were done using STATA version 12.

Results

Response rate

All questionnaires were returned because the adolescents were assembled in classes and supervised by one of the authors and teachers in the school to complete the questionnaires. 1500 adolescents returned the questionnaire resulting in 100 % return rate. Weight, height, waist circumference and hip circumference were measured in 1390 adolescents. Of the 1390 adolescents who completed the objectives measurements and returned the questionnaire, 1079 (77.6%) were analyzed. Therefore, data of 311 adolescents were not included in the analysis because some sections of the questionnaire were not completed (possible from adolescents who could not read and write in English or Yoruba) and some of the adolescents who completed the questionnaires were older than 18 years and the data were thus also excluded.

Sample demographics

The sample consisted of 46.5% males and 53.5% females. The mean weight was $47.9\text{kg} \pm 8.9$ for male and $48.9\text{kg} \pm 7.6$ for females. Mean BMI $18.4 \text{ kg/m}^2 \pm 2.1 \text{ kg/m}^2$ for males and $19.5 \text{ kg/m}^2 \pm 2.5\text{kg/m}^2$ for females. Mean waist circumference was $68.0\text{cm} \pm 5.1\text{cm}$ for male and $65.0\text{cm} \pm 4.3\text{cm}$ for female. Mean Waist Hip ratio was 0.8 for male and 0.78 for female.

CVD indicators

Table 1 indicates the prevalence of CVD indicators. Familial factors (relatives with CVD; relatives seeing a doctor for CVD) were notably high. The prevalence was also relatively equally distributed between males and females.

Table 1: CVD indicators

	Prevalence% (95%CI)	Prevalence % Female	Prevalence % Male
Get tired even when not exercising (n=1079)	53.5 (50.5- 56.5)	51.2 (n=577)	56.1 (n=502)
Chest pain when exercising (n=1073)	58.0 (54.6- 60.6)	55.5 (n=575)	60.8 (n=498)
Difficult breathing after little exercise (n=1074)	59.8 (56.6-62.4)	56.9 (n=575)	63.1 (n=499)
Relatives with CVD (n=1073)	89.1 (86.6-90.4)	89.1 (n=574)	88.8 (n=499)
Relatives seeing doctor for CVD (n=1069)	89.5 (86.8-90.6)	90.1 (n=571)	88.8 (n=498)

Modifiable CVD risk factors

Table 2 illustrates the prevalence of modifiable risk factors for the sample. High salt and animal lipid diet was most prevalent in the sample. Gender differences were also noted for four factors (smoking, alcohol, obesity and physical activity).

**Table 2: Prevalence (%) of modifiable CVD risk factors among adolescents by sex
(*significant gender differences)**

CVD risk factors	Prevalence (95%CI)	%	Prevalence (95%CI)	%	Prevalence (95%CI)	%
	Group		Male		Female	
Smoking/tobacco*	7.14 (5.59- 8.68)		10.2 (7.5-12.8)		4.5 (2.8-6.2)	
Excessive alcohol use*	10.2 (8.3-12.0)		16.3 (13.1-19.6)		4.9 (3.1-6.6)	
Low fruit diet	8.4 (6.7-10.1)		10.4 (7.7-13.0)		6.8 (4.7-8.8)	
Low vegetable diet	6.0(4.6-7.4)		6.8 (4.6-8.9)		5.4 (3.5-7.2)	
High salt diet	65.7 (62.9-68.6)		63.0 (58.8-67.2)		68.3 (64.5-72.1)	
High animal lipid diet	59.6 (56.7-62.5)		61.2 (56.9- 65.4)		58.2 (54.2- 62.3)	
High BMI*	15.1 (12.9-17.2)		15.0 (11.8-18.1)		15.2 (12.3-18.2)	
Abdominal obesity	3.7(2.6-4.8)		1.8 (0.6- 3.0)		5.4 (3.5-7.2)	
Low physical activity*	27.9 (25.2-30.6)		21.9 (18.3-25.5)		33.1 (29.3-37.0)	

Clustering of risk factors

A total of 1029 participants had one or more risk factor. The most common single risk factor was “high salt” intake (9.3%). The mean number of risk factors per participant was 2.1 (SD 1.1) for the group. Among females the mean number of risk factors was 2.1 (95%CI’s 1.6-2.2) and among boys it was 2.1 (95%CI’s 1.9-2.2). There was not a significant gender difference. Only 4.6% of the subjects reported no risk factors and 24.1% reported one risk factor (table 3).

Table 3: Prevalence of number of risk factors per adolescent (n=1079)

Number of risk factors	Prevalence (%) Group	Prevalence (%)	Prevalence (%)
		Girls	Boys
0	4.6	4.3	5.0
One	24.1	23.1	25.3
Two	39.0	39.5	38.4
Three	23.7	24.3	23.1
Four	6.5	6.8	6.1
Five	1.9	1.6	1.8
Six	0.3	0.5	0.2

A total of 102 risk factor patterns were reported (patterns consisted of at least two risk factors), indicating wide individual variability in CVD risk profiles. The five most common clustering patterns are presented in Table 4. The five most common clustering patterns account for about 35% of the participants.

Table 4: Most five common risk factor clustering patterns within the total sample (n=1079)

Risk factor clustering	Prevalence (%)	
High animal lipid, high salt	19.6%	
High animal lipid, high salt, high BMI	6.1%	
High animal lipid, high salt, low physical activity	4.2%	
High salt, low physical activity	3.9%	
High animal lipid diet, low physical activity	2.6%	

Correlation between risk factors

The correlations between most risk factors were weak. Compared to any other two risk factors, there was a stronger correlation between smoking and alcohol as well as low vegetable and low fruit intake (table 5).

Table 5: Correlation between risk factors

	Smoking	Alcohol	Low fruit	Low vegetable	High salt	High animal lipid	High BMI	Abdominal obesity	Low physical activity
Smoking									
Alcohol	0.31								
Low fruit	0.01	0.01							
Low vegetable	0.01	-0.01	0.26						
High salt	0.09	-0.08	-0.01	-0.00					
High animal lipid	0.0	0.02	-0.17	-0.20	-0.06				
High BMI	-0.08	-0.04	0.03	-0.03	-0.03	-0.00			
Abdominal obesity	-0.05	-0.03	-0.04	-0.05	0.04	0.02	0.03		
Low physical activity	-0.01	-0.04	0.13	0.18	-0.10	-0.22	-0.01	0.01	

Discussion

This is the first study of rural adolescents in Nigeria to establish the prevalence of a wide range of modifiable CVD risk factors. The findings showed adolescents have a wide range of unique clustering patterns and the most common clustering pattern was a high animal lipid and salt diet. This means adolescents eat a food high in cholesterol and saturated fat and also take a lot of sodium in their diet therefore CVD is looming in rural Nigeria.

Demographics

We have captured about 60% of the school going adolescent population from this rural region in Nigeria. However, since many rural adolescents do not attend school, our findings may not be applicable to adolescents who are not at school. Regarding adolescents attending schools, we think, adolescents who did not participate might not have provided very different responses because the study captured majority of adolescents and all the rural adolescents had similar socio-economic backgrounds and environmental exposures.

More females participated in the study than males. This is because absenteeism from school was more common among male adolescents resulting in more females being available to participate in the study. Reasons for male absenteeism at school were not explored in this study. Many questionnaires were not used for analysis because they were over 18 years. Many of the adolescents in senior classes were over 18 years because many rural adolescents start school late and some have academic challenges. Therefore they spend more time in high school than expected. Implications of this problem is not within the scope of this study.

CVD indicators

Many adolescents in this study had CVD indicators such as chest pain during exercise and chest pain even at rest. Many of the adolescents had close relatives seeing a doctor for CVD and this could possibly indicate that familial factors may play a role. It is also important to note that chest pain could hinder the participation in physical activity. Though CVD indicators are not the focus of this paper, it should be explored in detail in a related paper.

Clustering of CVD risk factors

The majority of adolescents had more than one CVD risk factor. This is a very high prevalence of clustering of CVD risk factors among these rural adolescents. Clustering of CVD risk factors here refers to adolescents having more than one risk factor. Clustering of CVD risk factors exposes an individual to a greater risk of CVD than having a single risk factor. The presence of clustering of risk factors for CVD indicates the need for concerted efforts for reduction and prevention of CVD risk factors among these rural adolescents. This can be achieved by health education on diets, cooking to preserve nutrients, negative effects of excess salt intake. The health education on CVD can be included in school curriculum. According to Mayosi & Commerford, (2006) and Ntsekhe & Damasceno (2013) the low prevalence of CVD in Africa presented a unique opportunity for primordial prevention of CVD in Africa. Presently CVD is increasing in Africa and atherosclerotic risk factors are increasing both in rural and urban areas (Ntsekhe & Damasceno 2013). It is important to emphasize that, with this increase in CVD and CVD risk factors, CVD prevention program especially in rural areas where CVD prevalence is still low is critical to prevent future CVD epidemic in rural Nigeria.

It is important to note that a wide range of clustering patterns was reported. This may imply that the clustering patterns are still developing during adolescents and that more consistent and persistent patterns will emerge at a later stage as the adolescents grow into adulthood.

Nutritional clustering pattern

Poor dietary pattern was the most prevalent CVD risk factor observed among the adolescents in this community. Diet consisting of high animal fat and salt consumption were the most common

clustering pattern. Adolescents in this study have established poor dietary patterns as seen in other studies (Harnack *et al.* 2003; McNaughton *et al.* 2008). The findings from this study show that young people are no longer continuing with cultural and local dietary pattern which are rich in vegetable diet and less saturated fat. This may be due to urbanization and westernization. In the past, rural dwellers in Nigeria had good dietary patterns compared to the city dwellers. Presently, adverts from media promote western diets and rural adolescents may think this pattern of feeding is associated with civilization and affluence. A combination of high salt intake and high animal lipid diet gives us a great concern because high animal lipid diet and high salt diet are major risk factors for atherosclerotic heart disease and hypertension. Of further concern is the fact that many of these adolescents might migrate to urban areas either for studies or for better employment opportunities. This will further increase their risk because there are more opportunities for high lipid and high salt diets through the fast food restaurants in the cities. Hence, there is an urgent need for CVD prevention programs among rural adolescents before they migrate to urban centres. In order to address nutritional problems observed, health education on diets and healthy food preparation should be taught in schools

Current smoking

The prevalence of current smoking observed in this study is low compared to the ones observed in advanced countries (Sliwa *et al.* 2008; Tibazarwa *et al.* 2009). This is encouraging though one in every ten adolescent male is a smoker (Table 2). The majority of the adolescents have tried smoking at one time with more adolescent males trying smoking than females and some may have intention to smoke more in the future. This intention to smoke could be influenced by

advertisements in the media where smoking is associated with stardom and rural adolescents feel smoking is one of the ways of showing greatness and affluence. This implies that adolescents in this study may smoke once they have the opportunity. This finding supports the findings of Muula & Mpabulungi (2007) who observed that many young people are picking up the smoking habit in Africa. The fact that few of the adolescents are current smokers in this study may be due to poverty, as the majority have tried smoking and some intend to smoke in the future. There is a need for an educational program to educate rural adolescents in Nigeria about the dangers of smoking. The health education program could be built into CVD prevention programs for rural adolescents.

Alcohol

The excessive alcohol use among these adolescents was low compared to data from developed countries (Johnston *et al.* 2003; Harford *et al.* 2006). This could be because hazardous drinking brings stigmatization and it is against cultural values especially in the south west. However, there is a high level of poverty in this rural community, as such this may affect the level of alcohol consumption. However, the finding implies that one in every ten adolescents consumes alcohol at a level that is detrimental to health. This calls for concerted effort to address the issue and prevent further problems.

Physical activity

Many of the adolescents had low levels of physical activity. This is in agreement with WHO findings which show that less than one third of adolescents globally are active enough to

safeguard their future health. It also supports findings among US adolescents (CDC 2014, Pearson *et al.* 2009). It also corroborates the study among suburban adolescents in Nigeria (May *et al.* 2012). It is believed generally in Nigeria, without empirical data, that the rural people are adequately physically active. This finding negates this belief. Low physical activity observed in this study is quite high though not as high as observed in developed countries. Low physical activity observed in this study may be enhanced by school curriculum, evident in lack of physical education in many schools and the adolescent lifestyle of hours spent in watching TV and playing video games with no planned / voluntary participation in physical activity program. Physical education in schools needs enhancement through national school policy as done in developed countries and even some developing countries. There is a need to explore why physical education is not included in the school time table and where there is physical education on the time table, why there is no implementation. High rates of CVD are inevitable unless there is an urgent prevention program put in place.

Obesity

Prevalence of overweight or obesity among our study participants was low compared to findings from developed countries (Stewart *et al.* 2006, Sliwa *et al.* 2008, Tibazarwa *et al.* 2009). While obesity is low now among these rural adolescents, with sedentary living and poor dietary pattern of high animal fat diet and fried food preference, given a short time and poverty alleviation, obesity might become a serious concern as it is in developed countries now. It is therefore time for a prevention program. More females were obese. This corroborates studies which report prevalence of overweight and obesity more in females than males (Ogden *et al.* 2012; Freedman

et al. 2007). It is important to note that women are expected to be fat as a sign of good health and good nourishment in many rural areas in Nigeria; this myth is entrenched in rural adolescent girls therefore many rural Nigerian adolescents are not likely to see overweight or obesity as a problem. In order to correct this myth, adolescents in rural Nigeria need health education. This health education will include; what CVD is, its risk factors especially obesity, socio economic implications and how to prevent them.

Abdominal obesity

Abdominal obesity was observed in this study. Abdominal obesity has been found to be strongly associated with CVD in previous studies (Cavalcanti *et al.* 2010; Rafraf *et al.* 2013). Some of the adolescents had waist hip ratio above normal. This implies prevalence of abdominal obesity among this rural adolescents. It is however, surprising to see that adolescents who have normal weight and even underweight had abdominal obesity. This could be protein malnutrition but high calorie resulting in storage of excess fat and calorie in the abdomen. Studies have shown that abdominal obesity is associated with CVD risk therefore efforts should be made to address this problem by adequate health education on calorie intake among rural adolescents.

Prevalence rate of CVD risk factors between male and female adolescents

Excessive use of alcohol and smoking were significantly higher in male adolescents than female adolescents while obesity and physical inactivity were significantly higher in female adolescents than male adolescents. The finding from this study on smoking prevalence and gender

contradicts findings from Global Youth Tobacco Survey (GYTS) study which observed more smoking among female than male adolescents in Ibadan, a city in south west Nigeria (Ekanem, 2008). This could be because this study was conducted among rural adolescents who may still be influenced strongly by cultural values in contrast to the adolescents in the GYTS study who live in urban areas and are becoming more westernized in their lifestyle. In Nigeria women are not expected to engage in drinking, in fact it is almost a forbidden thing for a woman to drink alcohol in public places like restaurants especially in rural areas. Smoking is also associated with sex because women are virtually forbidden to smoke; smoking in women is linked with social vices such as prostitution. This may be the reason for alcohol and smoking being higher among male gender in this study. However, it is important to note that smoking and alcohol were prevalent (though low) among female adolescents. This implies that young girls even in rural Nigeria are dropping some traditional beliefs and picking up some westernized lifestyle. Low physical activity and obesity were significantly higher in females. This may be because women are expected to be fat and a girl child in rural Nigeria grows up believing that she needs to be fat. Also low physical activity was significantly associated with female adolescents. The need for a holistic, comprehensive and gender related CVD prevention program in rural Nigeria is indicated.

Limitations

Future research should also involve rural adolescents who are not attending schools and those who attend school but are not proficient in English or a local language to complete the questionnaires. This will improve the generalizability of the findings. All responses were self-reported in our study. Risk factors such as salt intake may need a different strategy. In Nigeria,

it is routine to add salt while preparing food. However, future studies may need to engage parents or caregivers who prepare food to obtain more insight regarding the amount of salt added. In addition, we also did not consider salt included in processed food. Another limitation was that we did not classify meat (which can be high lipid meat or lean meat which is low in saturated fat), although consumption of lean meat in Nigeria is uncommon. Consumption of lean meat poses less risk than high lipid meat; therefore, it should be considered in future research. In our study, we did not measure level of physical activity (or level of fitness) objectively and this is recommended in future studies. Although we have tested the psychometric properties of the questionnaire, we did not test reliability of the objective measures and this should be done in future research. In addition, for our study we included the use of adult cut off for abdominal obesity therefore future studies should consider using adolescents' specific cut off point for abdominal obesity among Nigerian adolescents.

Conclusion

CVD risk factor clustering is common among rural adolescents. A high salt and animal fat diet is the most prevalent CVD clustering pattern among school attending rural adolescents. Although smoking and alcohol were prevalent among this sample of rural Nigerian adolescents, it is less prevalent than what is observed in developed countries. The low prevalence of some of the risk factors such as; smoking and alcohol consumption gives a unique opportunity to develop, implement and trial primordial and primary prevention programs in rural areas. While

all CVD factors should be addressed, such programs should consider dietary aspects as a priority focus for these rural, Nigerian adolescents.

We recommend that similar studies be conducted in other geopolitical zones of Nigeria considering that Nigeria is multiethnic with diversities of culture and diet. This means that risk factors prevalence rates may differ in different zones and clustering patterns may also differ. This may mean that CVD prevention program in one region may be different from tailored from CVD prevention in another region as the program will be tailored to meet each zone's specific needs.

Authors' contribution

NA Conceptualization, data collection, analysis, first draft, revisions and final manuscript

QL Conceptualization, analysis, revisions and final manuscript

KG Conceptualization, revisions and final manuscript

OS Revision and final manuscript

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Conflict of interest

We declare that there is no conflict of interest.

Chapter 6

Are lifestyle cardiovascular disease risk factors associated with pre-hypertension in 15-18 years rural Nigerian youth? : A cross sectional study-

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. Are lifestyle cardiovascular disease risk factors associated with pre-hypertension in 15-18 years rural Nigerian youth? Across sectional study

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Brief overview of the chapter

The chapter focuses on modifiable risk factor highly prevalent among Nigerian rural adolescents. This risk factor identified is pre hypertension. Incidentally, hypertensive heart disease is the most prevalent of heart disease in Nigeria, therefore observation of pre hypertension which is a precursor to hypertension and hypertensive heart disease is very informative. Therefore this chapter explored pre hypertension and its association with other lifestyle risk factors, age and gender. Findings show that factors associated with pre hypertension among males and female rural adolescents differ among rural adolescents in this study. This informs the need to tailor prevention program accordingly. This is presented as an article and has been recommended for publication subject to necessary corrections in BMC cardiovascular disorders.

ABSTRACT

Background: Cardiovascular disease (CVD) is a public health concern worldwide. Hypertensive heart disease is predominant in Nigeria. To effectively reduce CVD in Nigeria, the prevalence of, and factors associated with, pre-hypertension in Nigerian youth first need to be established.

Methods: A locally-validated CVD risk factor survey was completed by 15-18 year olds in a rural setting in south-west Nigeria. Body Mass Index (BMI), waist-hip ratio and systolic and diastolic blood pressure was measured. Putative risk factors were tested in gender-specific hypothesized causal pathways for overweight/obesity, and for pre-hypertension.

Results: Of 1079 participants, prevalence of systolic pre-hypertension was 33.2%, diastolic pre-hypertension prevalence approximated 5%, and hypertension occurred in less than 10% sample. There were no gender differences, and no significant predictors of systolic pre-hypertension were identified. Considering high BMI, older age was a risk for both genders, whilst fried food preference was female-only risk, and low breakfast cereal intake was a male-only risk.

Conclusion: Rural Nigerian adolescents are at-risk of future CVD because of lifestyle factors, and high prevalence of systolic pre-hypertension. Relevant interventions can now be proposed to reduce BMI and thus ameliorate future rural adult Nigerian CVD.

Key words: lifestyle CVD risk factors, pre hypertension, adolescents, rural, Nigeria

INTRODUCTION

The emerging epidemic of cardiovascular disease (CVD) in developing countries is a serious public health concern, particularly because CVD mortality in developing countries is higher in younger people than in developed countries [1,2].

In Nigeria, CVD is fourth amongst the top 20 diseases responsible for mortality [3]. Hypertension, a precursor of hypertensive heart disease, is present in up to 46% Nigerian adult population, and in an increasing percentage of Nigerian adolescents [4,5]. Pre-hypertension has many complications including heart disease, stroke and kidney failure [6]. Hypertension can be linked with lifestyle risk factors such as smoking, harmful use of alcohol, low physical activity and high cholesterol diet, as well as non-modifiable risk factors such as advancing age and family history [7,8].

Adolescent pre- hypertension is receiving increasing attention in the literature [9-11]. Adolescent pre-hypertension is a strong predictor of hypertension in adults [10], and progression from pre-hypertension to hypertension occurs faster, and at a younger age, in black people compared to Caucasians [12]. Consequently, investigating pre-hypertension in Nigerian adolescents is critical to inform effective interventions to reduce future adult CVD burden. Studies in developed countries have explored CVD risk factors and socio-economic factors associated with pre hypertension in urban adolescents [13-15]. However, only a few studies in Nigeria have investigated prevalence of hypertension and pre hypertension in urban adolescents [5,16-17], and no study has ascertained the prevalence of pre-hypertension and associated lifestyle risk factors among Nigerian rural adolescents. This paper reports on the first-known study in adolescents

attending schools in rural Nigeria, of the prevalence of pre-hypertension and hypertension, and its associated lifestyle factors.

METHODS

Ethics approval: Ethics approval was provided by Stellenbosch University Health Research Ethics Committee (No 8/09/257, 2009), and from the local educational authority in Ibarapa central local government area of Oyo State, Nigeria. School principals also gave permission, and presented the research to parent association meetings to facilitate informed consent and participation. Many adolescents in this community live with illiterate family members, thus verbal consent was accepted from parents /guardians. Written consent for each participant was also obtained from school principals, as in Nigerian culture they act as guardians to adolescents whilst in school.

Sampling frame

Study setting: The study was conducted in 22 secondary schools in Ibarapa central local government. Twenty-three schools were initially identified through the local Inspectorate of Education Office, however during the research, one school closed. The Ibarapa central local government comprises two villages, Igboora and Idere. These have an estimated population of 57,000 (containing approximately 15,000 adolescents aged 10-19 years). It was estimated that 5400 of the population aged 15-18 years, would be attending secondary schools in the area at the time of the study.

Sample size calculation: An initial sample size of 1600 students was estimated, based on a cluster design effect of 5.8, an ICC of 0.5 to adjust for prevalence estimation and 90% power for

analyses. This calculation was based on the Nigerian adolescent CVD prevalence literature [5,16,17], and the estimated number of adolescents attending schools in the area. Sampling was originally planned in class clusters (i.e. whole classes selected would be invited to participate). Classes in the schools in this region generally contained adolescents of mixed age (10-20 years). However, based on information from school principals regarding the numbers of students likely to be absent from class on any day (truancy, illness, work etc), sampling was amended to a more practical approach, to invite all students aged 15-18 years in all participating schools. Thus the 1500 surveys that had already been printed would be distributed on a ‘first come first served’ basis, and an additional print was undertaken in case more surveys were required.

Sampling and data capture: All 15-18 year olds in the participating schools were invited to join the study, during an address at assembly in each school by the principal investigator. She met with interested adolescents and surveys were distributed. These were collected immediately after completion. The 1500 initially printed surveys were exhausted, and no further students came forward to participate, thus none of the additional surveys were required. Participants were present at school on the day of testing, agreed to complete the survey in class, had no obvious learning disabilities, and were able to complete the survey in either English or Yoruba language (the native local language)

Study design: Cross sectional survey.

Study measures

Lifestyle CVD risk factors: A specifically-developed and validated questionnaire for this rural Nigerian adolescent population measured lifestyle CVD risk factors by self-report [21]. The questionnaire used a 33 item profile scale with six ordinal or nominal subscales (demographics,

CVD indicators, smoking, alcohol, physical activity and nutrition). The CVD indicator subscale identified family history of CVD, and was not used in this paper because adolescents may not have been aware of this information. The survey is included as Appendix 1.

After completing the survey, objective measurements of blood pressure (BP) and anthropometrics were taken by the principal researcher and two trained research assistants.

Body mass index (BMI): Subjects wore light clothing without shoes. Weight was measured with a regularly-calibrated digital scale, and recorded to the nearest kilogram. Height was measured with a T-bar, and recorded to the nearest centimetre. BMI was calculated as weight (kgs)/height² (metres).

Waist-Hip Ratio: Waist circumference was measured at the point of umbilicus, while hip circumference was measured at the widest point of the hip (both in centimetres). Waist-hip ratio was calculated as waist measurement divided by hip measurement.

Blood Pressure: BP was measured with an automated sphygmomanometer. Acceptable psychometric properties of this instrument have been reported [18, 19]. This instrument has the advantage of eliminating the observer error found in the auscultatory method. BP was taken after ten minutes or more rest, following measurement of lifestyle factors, and anthropometrics. To be measured, adolescents sat on a chair with their arm resting on a table at heart level. The appropriate adolescent cuff size was used. BP was measured once on participants' right arm. If BP was not within normal limits it was recorded again after a further 10 minutes rest and the average value used. We presumed that this might address any anxiety introduced by participating in the study. BP was then categorized as normal, pre-hypertensive or hypertensive ranges using African norms (see Table 1).

Table 1.Blood pressure cut off for Africa recommended by International forum for Hypertension in Africa for people 15 years and older (IFHA, 2004) [20]

Normal blood pressure	Systolic <120 mm/Hg	Diastolic <80 mm/Hg
Pre-hypertension	Systolic= 80-89mm/Hg	Diastolic= 120-139mm/Hg
Hypertension	Systolic \geq 140mm/Hg	Diastolic \geq 90 mmHg
Stage 1 hypertension	Systolic=140 -159mm/Hg	Diastolic=90- 99mm/Hg
Stage 2 hypertension	Systolic=160 -179mm/Hg	Diastolic \geq 100

Data management: Risk levels for study measures were defined as:

1. Smoking: any cigarettes/tobacco in the last 30 days
2. Alcohol: Any alcohol consumption
3. Low physical activity: less than 60 minutes exercise less than five days a week
4. High animal lipid diet: Eating meat (red meat, organ meat etc) five times per week or more
5. Low vegetable diet: Not eating vegetables at least five days a week
6. Low fruit diet: Not eating fruit at least five days per week
7. High salt diet- defined as adding additional salt to food

8. High BMI: Overweight was determined for those in the $85^{\text{th}} \leq 95^{\text{th}}$ %, and obesity was determined for those $\geq 95^{\text{th}}$ [22, 23]. For interest, underweight was determined as those in the $\leq 5^{\text{th}}$ % of the population distribution.
9. Abdominal obesity: There are no cut-off points for waist-hip ratio for Nigerian adolescents. Thus, the adult cut-offs were applied (waist-hip ratio: males ≥ 0.90 ; females ≥ 0.85 [24].

Assessing associations: The CVD risk factors were initially regressed against themselves, to identify collinearity. Gender differences were identified in preliminary analysis in BMI, nutritional pattern, alcohol and tobacco intake, thus gender-specific causal pathways were determined *a priori*, using an interim fatness outcome measure (body mass index and waist-hip ratio), and a final outcome measure of systolic pre-hypertension. Predictor variables were tested for associations with the fatness indicators (comprising alcohol, low physical activity and poor dietary patterns). *A priori* directional associations were constructed for systolic pre-hypertension, with an interim outcome of fatness (and its associates of diet, alcohol and physical activity), as well as other variables potentially independently associated with systolic pre-hypertension (age, salt intake, tobacco, low physical activity). Composite gender-specific causal pathways were proposed, and tested using univariate and multivariate regression models.

Statistical analysis: Data were descriptively reported using means and standard deviations, or percentages and 95% confidence intervals (CIs) as appropriate. Univariate logistic regression models tested individual causal models, with findings reported as odds ratios (ORs) and 95% CIs. Gender-specific step-wise multivariate models were constructed for systolic pre-hypertension, using high BMI as the primary exposure and taking into account other significant predictors from the univariate models, according to *a priori* reasoning, and the strength of

association with systolic pre-hypertension. The value of adding each subsequent predictor variable to the model was determined by the amount of change in the likelihood ratio. A significant influence of the new variable exerted a change in likelihood ratio larger than the critical chi-square value associated with the degrees of freedom [25]. Moreover, potential confounders were identified as a change of 10% or greater in the primary association between high BMI and systolic pre-hypertension [26]. All analyses were undertaken using SAS Version 9.2.

RESULTS

There were 1079 participants whose data could be analysed. Responses to invitation, participation in the study and data integrity are reported in Figure 1.

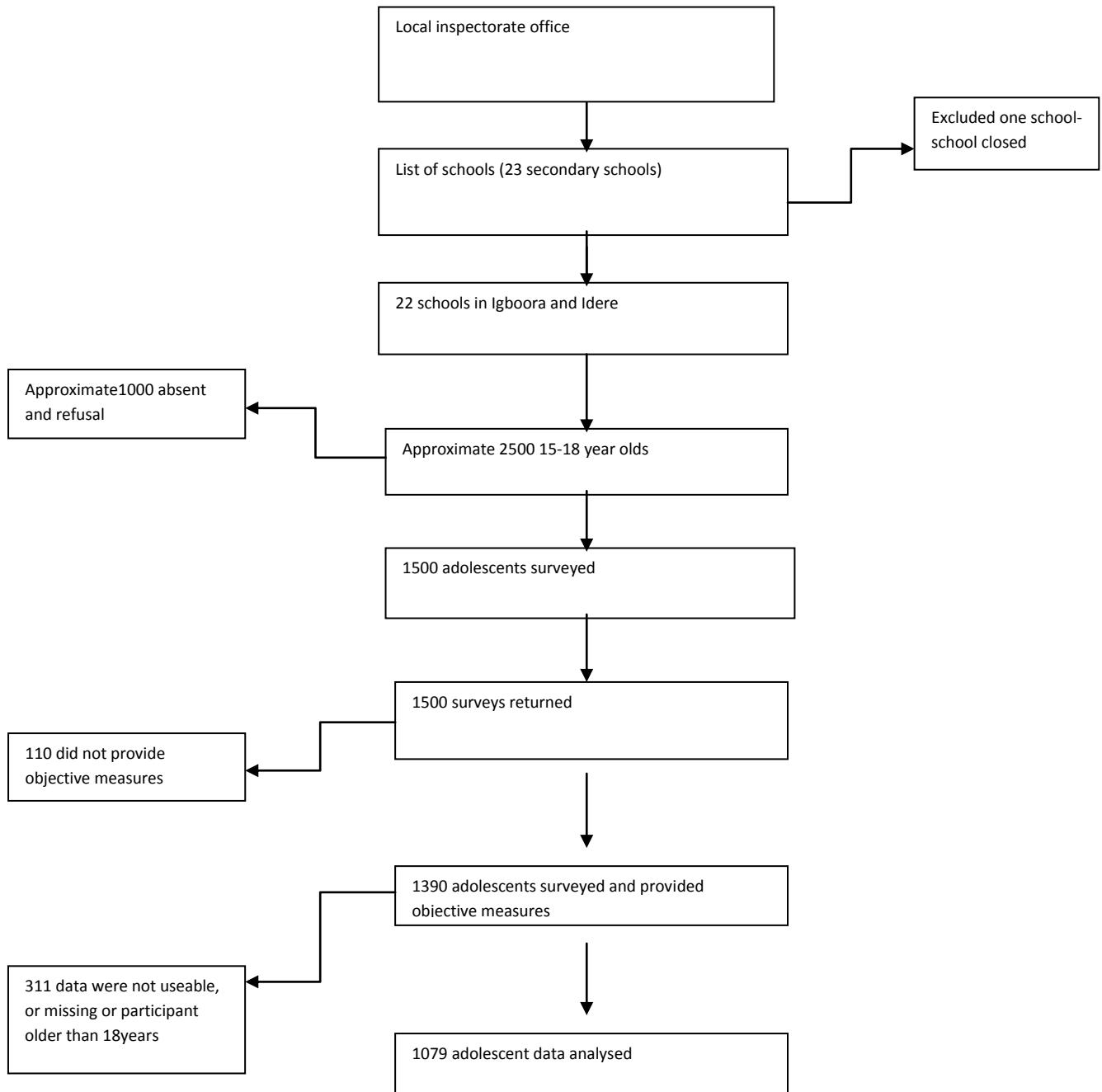


Figure 1. Study consort diagram

Sample descriptors: The sample comprised 53.5% females and 46.55% males. Overall, there was a high prevalence of systolic pre-hypertension (33.2%), with much lower diastolic pre-

hypertension prevalence (5.5%). Systolic hypertension was 4.4% overall, and diastolic hypertension was 0.8%. Table 2 reports on gender-specific participant characteristics, as well as classifications of fatness, pre-hypertension and hypertension.

Table 2: Participant characteristics

Key ** indicates significant differences

Physical characteristics	Boys Mean (SD)	Girls Mean (SD)	Gender differences (<i>p value</i>)
Age (years)	16.4 (1.1)	16.3 (1.2)	p>0.05
Height (cm)**	160.7 (9.4)	158.3 (6.1)	p<0.05
Weight (kgs)	48.8 (8.3)	49.5 (7.3)	p>0.05
Waist circumference (cm)**	26.3 (2.0)	25.5 (1.7)	P<0.05
Hip circumference (cm)**	30.8 (2.5)	33.0 (2.6)	p<0.05
Waist-hip ratio	0.8 (0.5)	0.8 (0.6)	p>0.05
BMI**	18.8 (2.6)	19.7 (2.4)	p<0.05
• Underweight %	9.6	9.7	p<0.05
• Normal weight%	75.5	75.1	p<0.05
• Overweight %	3.6	10.6	p<0.05
• Obese%	11.4	4.7	p<0.05
Systolic BP	116.6 (12.3)	115.4 (11.2)	p>0.05
• pre-hypertension %	31.4	34.9	p>0.05
• hypertension%	5.7	3.2	p>0.05

Diastolic BP**	64.4 (8.5)	66.5 (8.9)	P<0.05
• pre-hypertension%	4.2	6.7	p>0.05
• hypertension%	0.8	0.9	p>0.05

Modifiable CVD risk factors are described in Table 3. Prevalence of dietary risk factors was high for both males and females. Prevalence of any smoking and alcohol consumption were significantly higher in males than females, whilst females had significantly lower physical activity than males.

Table 3.Prevalence (%) of modifiable CVD risk factors among adolescents by gender
(*significant gender differences)

Key * indicates significant gender differences

CVD risk factors	Male (%) (95%CI)	Female (%) 95% CI	Total % (95%CI)	sample
Smoking/tobacco*	10.2 (7.5-12.8)	4.5 (2.8-6.2)	7.1 (5.6-8.7)	
Alcohol use*	16.3 (13.1-19.6)	4.9 (3.1-6.60)	10.8 (8.4-12.0)	
Low fruit diet	10.4 (7.7-13.0)	6.8 (4.7-8.8)	42.2 (39.0-44.0)	
Low vegetable diet	6.8 (4.6-8.9)	5.4 (3.5-7.2)	32.1 (29.5-35.1)	
High salt diet	63.0 (58.8-67.2)	68.3 (64.5-72.1)	65.0 (62.0-67.0)	

High animal lipid diet	61.2 (56.9-65.4)	58.2 (54.2-62.3)	59.8	(57.0-63.0)
Overweight*	15.0 (11.8-18.1)	15.2 (12.3-18.2)	15.2	(12.3-18.2)
Obesity*	1.8 (0.6-3.0)	5.4 (3.5-7.2)	5.7 (3.5-7.2)	
High waist-hip ratio*	0.9 (0.6-1.3)	29.5 (17.6-36.6)	15.3	(13.2-17.5)
Low physical activity*	21.9 (18.3-25.5)	33.1 (29.3-27.0)	27.7 (25.2-30.6)	

Association between modifiable CVD risk factors: There were significant gender-specific associations between CVD risk factors. High cholesterol diet was associated with low fruit consumption, low breakfast cereal, low vegetable consumption and low physical activity among females, whilst high cholesterol diet was associated with low fruit and low vegetable consumption (but not low breakfast cereal) among males. Alcohol and smoking were strongly associated for males and females (See Tables 4A and 4B).

Table 4A: Associations among modifiable risk factors for females

Key: Brown shading indicates significant positive associations, grey shading indicates significantly protective associations

	Chol diet	Fruit	Vege	Alcohol	Smoking	Break fast	Food prep	activity	salt
Chol diet		2.8 (1.4- 5.4)	7.2 (3.4- 15.1)	0.6 (0.2- 1.9)	1.1 (0.3- 3.5)	2.3 (1.2- 9.6)	0.8 (0.4- 1.5)	2.5 (1.1- 6.6)	1.3(0.1- 2.6)
Fruit			7.5 (5.0- 18.0)	1.1 (0.7- 1.7)	1.2 (0.5- 2.7)	5.5(3.4- 9.7)	0.9 (0.7- 1.3)	1.8(1.2- 2.7)	0.8(0.6- 1.2)
Vege				1.1 (0.7- 1.9)	1.2 (0.5- 2.9)	7.9(4.1- 15.7)	0.9 (0.6- 1.3)	2.7(1.8- 4.3)	0.7 (0.5- 1.1)
alcohol					10.2(4.4- 23.8)	1.2 (0.7- 2.2)	0.9 (0.5- 1.4)	0.9 (0.5- 1.5)	0.6 (0.4- 0.9)
Smoke						0.6 (0.2- 1.4)	1.3 (0.6- 3.2)	1.0 (0.4- 2.5)	0.4 (0.2- 0.9)
Breakfast							1.3(0.8- 1.9)	0.5 (0.3- 0.8)	1.2(0.8- 1.8)
Food preference								0.8 (0.6- 1.2)	1.2(0.8- 1.6)
Activity									0.8 (0.5-1.1)

Table 4B: Associations among modifiable risk factors in males

	Chol	Fruit	Vege	Alcohol	Smoking	Break fast	Food prep	Activity	salt
Chol		3.1 (1.1- 8.8)	2.4(0.9- 6.2)	0.7(0.2- 2.3)	NA	1.8(1.5- 6.5)	0.7(0.3- 1.8)	1.8(0.6- 5.2)	2.1(0.7- 6.6)
fruit			0.2(0.1- 0.3)	0.8(0.5- 1.2)	1.3(0.7- 2.6)	0.2(0.1- 0.3)	0.7(0.5- 1.0)	0.5(0.4- 0.8)	1.2(0.8- 1.7)
vege				0.7(0.5- 1.1)	0.8(0.4- 1.5)	0.9(0.6- 1.5)	0.9(0.6- 1.4)	0.4(0.3- 0.7)	0.9(0.6- 1.5)
alcohol					6.7(3.3- 13.5)	0.5(0.3- 0.9)	0.8(0.5- 1.3)	1.0(0.7- 1.6)	0.8(0.5- 1.2)
smoking							0.7(0.4- 1.4)	0.7(0.4- 1.4)	0.6(0.3- 1.2)
breakfast							1.3 (0.8- 2.0)	0.6(0.4- 0.9)	0.9(0.6- 1.5)
Food preps								1.1(0.7- 1.6)	0.8(0.5- 1.2)
Activity									1.1(0.8- 1.6)

Association between BMI and waist hip ratio, and modifiable CVD risk factors: Considering high BMI (overweight and obesity combined), the association with older age was significant for males (17 or 18 years) and females (18 years) compared with younger age groups. Fried food preference was a significant predictor for females, while low intake of breakfast cereals was significant for males (See Table 5). Considering high waist-hip ratio, high cholesterol diet was protective only for males (OR 0.2 (0.04-0.9)). All other risk factors for this fatness measure showed no significant association. The non-significant findings are presented in Appendix 2, for interest.

Table 5: Associations between High BMI and individual CVD risk factors for males and females

Key: Brown shading indicates significant positive associations

CVD risk factors	High (CI)	BMI-Males High (CI)	BMI-Females High (CI)
Age 15 (default)	1	1	
Age 16	1.2 (0.5-2.7)	1.2 (0.6-2.4)	
Age 17	2.6 (1.2-2.6)	1.9 (0.9-3.8)	
Age 18	2.8 (1.3-5.6)	2.3 (1.3-4.5)	
Physical activity	1.0 (0.6-1.7)	1.1 (0.6-1.8)	
Cholesterol diet	4.3 (0.6-32.3)	0.9 (0.4-2.1)	
Low vegetable	0.9 (0.6-1.6)	0.7(0.4-1.2)	

Low fruit	1.2 (0.7-1.9)	0.9 (0.6-1.5)
Alcohol	0.9 (0.5-1.6)	0.6 (0.3-1.4)
Breakfast cereals	1.7 (0.9-3.2)	0.8 (0.5-1.4)
Food preference	0.9 (0.6-1.6)	1.5 (0.9-2.4)

Associates of pre-hypertension: For males, three significant associates of systolic pre-hypertension were identified; aged 17 or 18 years compared to younger ages, high BMI (overweight and obesity) and any alcohol consumption. For diastolic pre-hypertension, high BMI was the only significant risk factor. For females, only one significant association was identified, for both systolic and diastolic pre-hypertension (high BMI). Findings are reported in Table 6.

Table 6: Gender-specific associates of age and modifiable CVD risk factors with pre-hypertension

Predictor Variable	Systolic Pre-hypertension		Diastolic Pre-hypertension	
	OR (95%CI)	OR(95%CI)	OR(95%CI)	OR(95%CI)
	Males	Females	Males	Females
Age	15	1	1	1
	(Default)			
	16	1.5 (0.8-2.6)	1.5 (0.12.4)	0.6 (0.1-2.6)
	17	2.4 (1.3-4.2)	1.2 (0.7-2.4)	1.1 (0.3-4.1)
	18	3.9 (2.3-6.9)	1.6 (0.9-2.7)	1.3 (0.4-4.3)
BMI	high	4.2 (2.4-7.3)	2.4 (1.5-3.9)	3.0 (1.1-8.3)
				2.6 (1.2-5.5)

Waist-hip	Males >1	0.7 (0.2-2.4)	1.4 (0.7-2.7)	Not calculable	0.7 (0.2-2.9)
	Females >				
	0.85				
Tobacco	Any	0.9 (0.5-1.7)	1.2 (0.5-2.9)	Not calculable	1.3 (0.3-5.8)
Alcohol	Any	1.6 (1.0-2.4)	0.9 (0.6-1.6)	1.0 (0.3-2.9)	0.7 (0.3-2.3)
Phys activity	low	0.7 (0.5-1.1)	0.8 (0.5-1.1)	0.4 (0.2-1.1)	0.8 (0.4-1.6)
Cholesterol	high	4.3 (0.6-32.3)	1.8 (0.8-3.7)	0.8 (0.1-6.2)	2.9 (0.4-21.9)
Vegetables	low	0.9 (0.6-1.6)	1.0 (0.7-1.5)	0.9 (0.3-2.9)	0.8 (0.4-1.7)
Salt	High	1.1 (0.8-1.7)	0.9 (0.7-1.4)	1.2 (0.4-3.2)	0.9 (0.4-1.8)
Food prep	Fried/roast	1 (0.7-1.5)		2.0 (0.6-6.2)	
Fruit	Low	0.8 (0.6-1.2)		0.9 (0.3-2.3)	
			1.3 (0.9-1.8)		1.9 (0.9-4.3)

During step-wise modelling to determine multiple associates for pre-hypertension, using the significant predictors identified from univariate analyses, only high BMI and age retained significant associations for males, whilst High BMI retained its significant association for females (See Tables 7A and 7B).

Table 7A: Stepwise regression modelling for systolic pre hypertension

Variable	OR (95%CI)	LL ratio (df)	P value	Chi2>critical value
<i>Males</i>				
BMI	High	3.6 (2.2-6.0)	26.8 ₍₁₎	P<0.05 Yes(>3.84)
BMI		3.2 (1.9-5.3)	43.5 ₍₂₎	P<0.05 Yes (>5.99)

+Age	Older(17or18)	2.2 (1.5-3.3)**			
BMI		3.2 (1.9-5.4)	47.5 ₍₃₎	P<0.05	No (<6.25)
+Age		2.2 (1.5-3.2)**			
+ alcohol	any	1.5 (1.0-2.3)			

Females

BMI	High	2.1 (1.3-3.4)	9.4 ₍₁₎	P<0.05	Yes>3.84
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Table 7B: Associations between High Waist hip ratio and each of CVD risk factors among boys and girls

CVD risk factors	High W/Hip boys (CI)	High W/Hip girls (CI)
Age 15 (default)	1	1
Age 16	0.9 (0.2-3.3)	0.8 (0.3-1.9)
Age 17	0.5 (0.1-2.9)	0.7 (0.3-1.7)
Age 18	0.2 (0.02-1.8)	1.5 (0.7-3.4)
Physical activity	0.9 (0.3-3.1)	0.9 (0.4-1.7)
Cholesterol diet	0.2 (0.04-0.9)	1.7 (0.4-7.3)
Low vegetable	0.9 (0.3-3.1)	0.9 (0.4-1.7)
Low fruit	0.4 (0.1-1.4)	0.6 (0.3-1.2)
Alcohol	0.5 (0.1-2.4)	1.0 (0.4-2.4)

Breakfast cereals	0.1 (0.5-31.5)	0.6 (0.3-1.2)
Food preference	0.2 (0.2-1.7)	1.1 (0.6-2.1)

DISCUSSION

This is the first known study in Nigeria investigating BP in rural adolescents, and associations between pre-hypertension and modifiable CVD risk factors. Systolic pre-hypertension was concerningly high for both male and female adolescents, and consistent associations were identified between systolic pre-hypertension and high BMI and older-aged adolescents. The findings from this study should be applicable to adolescents living in other Nigerian rural districts because of the comprehensive sampling approach, and the large number of respondents. However a caveat is that it captured data only from students attending school, therefore pre-hypertension prevalence and CVD risk information for adolescents who attend school infrequently, or not at all, are not reflected here. The information from this study provides however, the beginnings of an evidence-base for planning effective intervention studies for at-risk rural Nigerian adolescent populations. Studies conducted in developed countries among adolescents have found similar associations between pre-hypertension, BMI and age [8-11], however the information from international studies could not be used to plan programs for adolescents in rural Nigeria for reasons such as local relevance, indigenous factors and other socio cultural influences on risk behaviors.

Characteristics of participants: We recognise a gender-imbalance in our sample, probably related to adolescent females' greater willingness to participate, and higher female enrolments and attendance in rural schools [27]. Personal communication from school principals suggested

that adolescent males were more likely to truant from school, than females. There were also more fifteen years olds in the study than any other age group. This could be because younger adolescents were more likely to be attending school than older adolescents, and perhaps were more easily convinced to participate in the study than their older counterparts.

Prevalence of pre hypertension: The high prevalence of pre-hypertension in our sample reflects similar findings of other African studies. Pre hypertension among adolescents in semi-urban and urban southeast Nigeria was observed as 22.2% and 25% respectively [17], whilst prevalence of pre hypertension in poor urban youth in Accra, Ghana, was reported as 32.3% [28]. However the prevalence of pre hypertension in our study is higher than prevalence of pre hypertension observed in developed countries (15.7%) [29] and 4.7% Systolic BP, 6.8% Diastolic BP [30]. The high prevalence of pre-hypertension among our rural adolescents, and the similarity of our findings to other African studies, supports concerns about a pending epidemic of hypertension and CVD in rural Nigeria [4].

Direction of Association: We propose that in our study population, high BMI is an interim outcome of a directional association for pre-hypertension for both females and males, and that older adolescents are more at-risk of high BMI and subsequent pre-hypertension than younger adolescents. This being said, theorising appropriate causal pathways that integrated lifestyle factors and modifiable CVD risks with pre hypertension was challenging. For instance, associations between risk factors were different for adolescent males and females, and explaining these associations meant drawing on local knowledge and contexts. In both genders, alcohol was strongly associated with smoking. This relationship has been documented in other countries [31-34]. However this finding was new for rural Nigeria, as women are not expected to drink or smoke. It is generally believed in Nigerian communities, that women who drink are usually also

involved in other social vices, thus such women may have significantly more at-risk behaviours, than the average man. This is not just a Nigerian finding. Morgen et al [31] found elevated risk drinking and smoking among women, particularly in women with an early sexual debut. It is important for future studies into risk mitigation for pre-hypertensive Nigerian adolescent females to explore associated risk behaviors in order to make a real difference to future adult CVD.

Dietary and activity findings: High cholesterol diet was associated with low fruit intake, low vegetable intake, low breakfast cereal intake and low physical activity in females, while for males, high cholesterol diet intake was associated with low fruit and low vegetable intake. This means that most poor dietary behaviours were linked. There is therefore, the need to educate Nigerian adolescents to eat balanced meals with lots of fruits and vegetables. However, high cholesterol diet intake was associated with high physical activity for males. This means that males with high cholesterol diets were likely to be more active than males with lower cholesterol diets. This requires more research to understand it.

Females on the other hand, who had poor dietary patterns, also had low physical activity levels. This is more readily explained. The high BMI finding for our adolescent females reflects a culture where African women are expected to be fat to show evidence of good care by their husbands. This belief is entrenched in a girl child especially in rural areas. Female physical activity (other than daily activities) is unusual, as a woman jogging in the street in a rural Nigerian setting could be perceived to be insane or being under a spell. Many religious practices do not encourage women to engage in sporting activities because it is not perceived to be feminine. Thus local contexts are essential when attempting to understand CVD risk factors, and how they could be addressed when planning prevention programs in Nigeria.

High BMI and diet: For high BMI, fried food preference was associated for females and low breakfast cereal intake was associated for males. In a systematic review that included breakfast type, eating cereal was independently associated with lower BMI [35].

Associations between pre hypertension and CVD risk factors: We found that pre hypertension was independently associated with older adolescents (aged 17 and 18), compared to being aged 15 years. This concurs with adolescent studies conducted elsewhere (for instance China, Philippines, Ghana) [36-39]. However, a study in the Congo [40] did not observe significant association between pre hypertension and age among adolescents. Apart from questions about study design and sampling which require critical appraisal of adolescent studies on this topic, this suggests that factors that determine adolescent pre-hypertension and hypertension may differ from place to place. This is another reason why the Nigerian rural context needs to be taken into account when planning effective interventions.

Limitations of the study: *Causality:* The study was cross sectional, and thus we cannot infer causal relationships from the findings. *Artifacts in reading BP:* The second measurement of BP was undertaken for adolescents with high first readings, to ensure that we truly were measuring high BP and not an artifact incurred from study participation anxiety. Taking the average of the two measures was our way of addressing this potential bias. We do not know however, whether the artifact remained in some participants in the second reading. *Biochemistry:* We did not assess biochemical profiles of adolescents such as lipid profiles, thus our fatness measures are proxies for cholesterol.

CONCLUSION

Our findings support a future CVD epidemic among adults in rural Nigeria because of the alarming prevalence of adolescent pre-hypertension. We suggest that rural Nigerian adolescents should be regularly screened for pre hypertension and other lifestyle CVD risk factors, and educated about why screening, and intervention, is necessary. This paper provides evidence to support urgent development and implementation of culturally-appropriate CVD prevention programs in rural Nigeria. Since factors associated with BMI and pre hypertension were not the same for males and females, we propose that these CVD prevention programs should place gender-specific emphases on dietary habits, smoking and alcohol consumption, and physical activities. There is a need to further explore the influences of psychosocial, socioeconomic, familial and cultural factors on adolescent CVD risk factors in order to further fine-tune screening and intervention programs.

Competing interest

We declare that we have no competing interest

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Chapter 7

Proposed content for cardiovascular disease (CVD) prevention program among rural adolescents in OYO state, Nigeria

Purpose: To present the research findings to policy makers and advocate for CVD prevention programs for adolescents in schools

Brief overview of the chapter

This chapter is written as a policy brief. Policy briefs are document for policy makers. CVD prevention program in the rural community studied is a necessity and the government has to be involved. However, the government need research information and recommended steps to implement the findings of the research. Therefore this chapter gives the policy maker the overview of what CVD is, the persons affected, economic and social implication and recommended steps for action. This is presented as a policy brief to Oyo state governor, the province where the adolescents are located.

From:

Odunaiya NA

To:

The executive Governor of Oyo state

POLICY BRIEF

Introduction

News of sudden death from cardiac arrest is all too common in Nigerian newspapers, state and national television broadcast. Whilst few cases of sudden death receive an autopsy, most show undiagnosed cardiovascular diseases (CVD). Moreover, many Nigerians live with risk factors for cardiovascular disease including hypertension. Hypertensive heart disease is now the leading cause of heart disease in Nigeria which was not the case three decades ago (Akinboboye *et al.* 2003).

Three to four decades ago, cardiovascular disease was a disease of developed countries, but it is no longer the case. WHO (2011) showed that coronary heart disease is 4th ranked among the top 20 diseases responsible for mortality in Nigeria. We simply cannot afford this, considering the dwindling economy, poor health care facilities and inadequate health care personnel in Nigeria; with over 160 million people, Nigeria does not have the resources to manage lifestyle diseases such as heart disease. There are far more important communicable diseases to focus on. Moreover, there are fewer than one hundred cardiologists and ten cardiothoracic surgeons in Nigeria, and inadequate numbers of other health care personnel trained to manage heart diseases.

Cardiovascular disease is a disease of lifestyle or ‘choice’. It takes time to develop, and is related to modifiable risk factors, such as smoking, poor dietary and exercise habits, stress and

excessive alcohol intake. Many of these behaviours have been observed in childhood and adolescence (Maggisano *et al.* 2008, Falkner *et al.* 2010). Thus, changing risk behaviours to prevent heart disease onset among adolescents in Nigeria could be a potent method for preventing future adult heart disease, and reducing the burden on scarce Nigerian health resources.

Early primary care prevention programs for heart disease have been implemented in developed countries with remarkable results. According to American Heart Association (2006), significant risk factors for CVD are smoking, alcohol, low physical activity, overweight and obesity, abdominal obesity, high lipid consumption, low fruits and vegetable intake. There are no reliable National data about the prevalence of CVD risk factors in Nigeria; however the small amount of existing data shows a high prevalence of these risk factors among adolescents, particularly those in rural areas (Ansah *et al.* 2004; Odunaiya *et al.* 2010; Senbanjo & Oshikoya 2012). Since half of all first heart attacks are fatal, prevention is critical to reducing morbidity, mortality and health care costs related to heart disease. Adolescence is the key age at which to begin to accomplish this goal.

Nature and magnitude of the problem

Our research leads us to believe that certain lifestyle heart disease risk factors in Nigeria among rural adolescents are more prevalent than that observed in developed countries. In the study we conducted at Ibarapa local government of Oyo State, of rural adolescents 15 to 18 years, we observed a high prevalence of poor dietary patterns, especially food rich in cholesterol, high salt intake, low fruit and vegetable consumption. We found pre-hypertension prevalence

approximating 34%, smoking prevalence around 7% and pathological alcohol intake in 1:10 young people. The prevalence of pre-hypertension is higher than what is observed in developed nations. Our study also showed high prevalence of physical inactivity, and abnormal waist hip ratio. Many rural schools in Oyo state do not have physical education classes in their timetable, and of those that do have such classes, many do not practice regular physical activities. Our findings run contrary to a common belief in Nigeria that rural people generally do not have a high prevalence of cardiac risk factors, because they have natural diets and are physically active because they are farmers. Studies on physical activity levels show that physical activity levels are decreasing among adolescents in urban and rural areas in Nigeria (Akinroye *et al.* 2010, Odunaiya *et al.* 2010, Senbanjo & Oshikoya 2010). Of course no one risk factor is responsible for heart disease, but there are common risk factors for many other diseases, including diabetes, cancer and respiratory diseases. Moreover, these risk factors affect health and physical well-being of adolescents, their academic pursuits, and mental well-being. An adolescent who smokes and drinks alcohol could easily become involved in crime, or risky sexual behaviors, resulting in incarceration, unwanted pregnancies and/or dropping out of school. In fact our study found that absenteeism from school was seen as the ‘norm’ among many rural adolescents. This absenteeism may be effect of risky behaviors of smoking and drinking among these rural adolescents. This is a tragedy and greater consequences are looming except prevention are put in place.

Persons affected

In Nigeria there is the potential for all sections of the populations to be affected. Hospital data and few existing population data show that children, adolescents and adults can be affected by

lifestyle risk factors and resultant lifestyle disease. Children and adolescents are vulnerable as they depend on adults for a lot of their life choices e.g- feeding of adolescents is dependent on parents, and physical education in school is dependent on the availability of teachers and government policies. Studies on children and adolescents are essential as these are critical periods in growth and development, when many behaviors are experimented with, and established (Maggisano *et al.* 2008, Selvan & Kupad 2004).

Cardiovascular Disease (CVD) Risk factors

A major and independent non-modifiable risk for heart disease is family history specifically, involving a primary relative who died before age 55 in males, or 60 years in females. Primary relatives are parents, grandparents, and blood-related aunts and uncles. Features of family history of heart disease are angina, positive angiography, myocardial infarct, ischemic stroke and claudication (British Heart Foundation, 2015). Other non-modifiable risk factors for CVD are gender and age.

There are however many modifiable risk factors, with the most robust being overweight/ obesity, lipid abnormalities, high blood pressure and pre hypertension, diabetes and tobacco use (Daniels *et al.* 2011, Grunddy 1999). These factors have been identified consistently through decades of animal model experiments, human epidemiologic studies, and randomized clinical trials of lifestyle modifications and medications. The increasing prevalence of overweight has been well documented among children and adolescents as becoming a significant health concern (Ogden *et al.* 2014, Gaeini *et al.* 2011, Mohammed oupour-Arhajani *et al.* 2004). Moreover, studies have confirmed a significant association between increased childhood BMI and increased risk for

adult CVD. The association is stronger for boys, but increases with age for both boys and girls (O'Donelle & Elosu, 2008, Imai *et al.* 2014). Our Nigerian Ibarapa study on adolescents confirmed a strong cross-sectional association between overweight and obesity, with high systolic and diastolic pre hypertension.

Some studies suggest that blood pressure is increasing is positively correlated with overweight in children and adolescents. Hypertension and pre hypertension in children and adolescents observed in Nigeria have been on the increase (Bugaje *et al.* 2005, Ujunwa *et al.* 2013). Generally in Nigerian hospitals, blood pressure in children and adolescents is not screened routinely, as it is for adults. Heart studies in developed countries have shown that atherosclerotic lesions in adolescents are correlated with commonly accepted risk factors, such as elevated low-density lipoprotein cholesterol (LDL-C), low high-density lipoprotein cholesterol (HDL-C), hypertension, smoking and obesity.

Economic consequences of CVD risk factors (lifestyle risk factors; smoking and alcohol)

Social: Adolescents who smoke and drink may become addicts. People who are addicted very often turn to crime as a means of paying for their addiction. This can involve stealing or fraud to obtain the funds necessary to sustain their lifestyle. This can start with stealing from their parents, teachers and friends. People who have developed an addiction to alcohol very often engage in drunken, anti-social behavior, usually in town and city centers around the country. Addicts are usually the culprits of street fights creating more problems for the police to deal with.

Adolescents who smoke and drink have other psychosocial problems. Some are involved in substance abuse, risky sexual behavior which results in unwanted pregnancy for some girls. Unwanted pregnancy means a girl will drop out of school and her future is jeopardized and the girl becomes a social problem. These girls may then go into early marriage or prostitution. In fact during the study we were informed by school principals of many girls who had drop out of schools as a result of unplanned pregnancy. This means that social consequences of adolescents risky behavior associated with smoking and drinking are already in rural Nigeria. Studies have shown that girls who drink and smoke are also into risky sexual behavior (Morgen et al, 2008). In our study, we found out that despite the fact that drinking and smoking are against cultural norms in Nigeria especially for girls, there were girls who smoke and girls who drink excessive alcohol among adolescents who participated in the study. It is therefore not surprising that unwanted pregnancy is prevalent and among these school going rural adolescents. Our country is not only at risk of CVD through these risk factors but also at risk of losing young people who would have become great people in the society, after their education and would have contributed significantly to economic development.

Nigeria does not have national data on the economic consequences of smoking, drinking, obesity, physical inactivity and all other risk factors but data from developed countries is a warning we should heed. According to the cancer organization (www.cancer.org 2014) the tobacco industry is one of the most profitable businesses in the US, making billions of dollars every year. But the costs of smoking are far higher than the income from cigarette sales. The US Centers for Disease Control & Prevention estimated that in 2004, smoking led to health costs and productivity losses totaling an average of \$10.47 per pack sold and used in the US. More recent

numbers show that annual smoking-attributable economic costs in the US are estimated to be between \$289 to 332.5 billion. This total includes:

- \$132.5 to 175.9 billion for direct medical care of adults
- \$151 billion for lost productivity due to premature deaths

The Importance of Cardiovascular Disease Risk Reduction for Adolescents

Atherosclerosis, the pathophysiological process that underlies heart disease, can begin in childhood and accelerate during adolescence. This progression occurs whether or not an individual has a genetic predisposition to early heart disease. Familial hypercholesterolemia is the best characterized genetic form of atherosclerosis. Fifteen percent of teens with familial hypercholesterolemia have peripheral lipid deposition demonstrable on physical examination in the form of skin lesions, known as xanthomas, or eye lesions, known as corneal arcus. Half of familial hypercholesterolemia patients have peripheral lipid deposition by their thirties and cardiac disease begins to be observed about a decade later. Studies such as the Pathobiological Determinants of Atherosclerosis in Youth (PDAY) and the Bogalusa study have shown that atherosclerotic lesions in adolescents are correlated with commonly accepted risk factors, such as elevated low-density lipoprotein cholesterol (LDL-C), low high-density lipoprotein cholesterol (HDL-C), hypertension, smoking and obesity. Prevention is critical to reducing morbidity, mortality and health care costs related to heart disease, and adolescence is the key age at which to begin to accomplish this goal.

Recommended cost effective steps

Surveillance: We recommend annual assessment of adolescents for height, weight, BMI and blood pressure and an interview assessment of familial risk factors for heart disease and risk factors. Height, weight and BMI should be plotted and compared against reference values for Nigeria. In addition, composite Nigerian adolescent-specific questionnaire to identify physical activity level, smoking, alcohol and nutritional problems among adolescents are needed to ascertain prevalence of modifiable lifestyle risk factors.

Screening: Adolescents who are overweight and obese should be screened comprehensively for family history for CVD, obesity and Type 2 diabetes. Blood pressure screening should be routinely done for adolescents who go to hospitals and clinic for any health condition and regular checks can also be done at school.

Tobacco Reduction Programs: Aims of tobacco reduction program should include

- Prevention of commencement of tobacco use among young people (primary prevention)
- Help current smokers quit (secondary prevention).

Because of gender differences in drinking and smoking, health education and prevention programs should be gender-specific.

Comprehensive Health education programs: Adolescents need adequate and timely information about CVD, and risks, to support positive lifestyle choices. Education programs needs to address physical activity, smoking, alcohol and nutrition as lifestyle risk factors. Other modifiable risk factors to be addressed are overweight and obesity especially because of cultural

belief about female fatness. Health education packages could be made available in various forms (print, newspaper and television specifically targeted to adolescents), using simple and culturally relevant language. Moreover heart health education should be included in school curriculum.

Promotion of physical activity through enhancement of Practical physical education classes:

There is a need for education policy support for regular practical physical education classes in rural schools. Many rural schools do not have adequate numbers of teachers overall, particularly specialist physical activity teachers. Policy support for overall implementation of physical education at school should result in improved or increased physical activity levels at school, which hopefully could carry forward into leisure time.

Counseling: Behavioral change counseling is pivotal in primary health care to encourage adolescents to manage lifestyle risk factors. Behavioral change counseling for adolescents should include:

- Simple recommendations, encouraging small changes at a time
- Encourage a reduction of intake of ‘bad’ food rather than immediate cessation of poor eating behaviours. Adolescents should be encouraged to limit the frequency or portion size of unhealthy foods rather than stop them totally, so as to make change practicable.
- Beginning with goal setting, by identifying what the adolescent wants to work on first, even if it may not be the most important concern in the health counsellor’s view. This could include finding out from adolescents about their perceived barriers for healthy lifestyles.
- Encouraging weight training for adolescents who wish it, starting with light weights with a high number of repetitions after instruction.

- Encouraging adolescents to spend less time watching television or at the computer.
- Stressing the importance of smoking prevention or cessation.
- Determining what role the family should play in lifestyle choices. Many adolescents need family involvement and support to change their eating and exercise habits. If the adolescent does not want parental involvement, focus on what is eaten outside the home. For adolescents who are not yet ready to make menu choices that differ from those of their friends, focus on what is consumed at home.
- Encouraging adolescents to increase intake of fruits and vegetables

Food vendors training and food inspection:

Training of food vendors on healthy food and preparation and food inspection by appropriate authority will ensure availability of healthy food at school for adolescents, and demonstrate school support for healthy hearts

Summary

It is expected that by 2020, 80% of heart disease globally will be from developing countries. Many of the risk factors that give rise to heart disease begin in childhood and adolescence. Healthy eating, regular physical activity and avoidance of tobacco and alcohol use are associated with reduced risk for heart disease. Given the life-long impact of an adolescent's health status and health behaviors, it is imperative for health care professionals, health plans, as well as adolescents and their families, to understand these risk factors, and how they can establish and maintain healthy lifestyle choices and behaviors.

The burden and costs to the Nigerian health care system of lifestyle ‘choice’ diseases are immense and will continue to rise unless affirmative and evidence-based action is taken now. Nigeria cannot afford to manage an increasing prevalence of heart disease with its scarce health resources. The cost of preventing CVD and CVD risk factors is lower than the cost of curing or managing it. In the first place CVD cannot be cured; therefore it is a lifelong management. Therefore, I appeal to the executive governor, to embark on CVD prevention programs because for us in Nigeria “Prevention is better than cure”.

Chapter 8

General Discussion: Summary of key issues

Brief overview of the chapter

This chapter summarizes the study conducted, the key findings of the study and their implications. It further elucidates the significance of the study and its important contribution to knowledge in the area of CVD epidemiology and prevention. It also highlights the future direction of research in CVD epidemiology and prevention among Nigerian rural adolescents. Based on the findings of this study, the need to address CVD risk factors among rural adolescents in Nigeria is critical.

Introduction

Cardiovascular Disease (CVD): the global burden and Nigeria's situation: CVD remains a global problem. The incidence and the percentage of mortality due to CVD are decreasing in developed countries as a result of effective preventative and disease management strategies. There is growing concern however, about the increasing burden of CVD in Africa (AHA 2013; WHO 2011). Economic, social, and cultural changes contribute towards increasing prevalence and incidence of CVD in Africa. CVD is an adult disease but the risk factors can start in childhood and adolescence. Poor dietary pattern and other risky behaviours such as smoking and drinking are usually experimented or established in adolescence (Magissano *et al.* 2008). Several studies have been conducted to assess risk factors for CVD in adults in developed and developing countries. However, there is paucity of information on adolescents' cardiovascular health in developing countries.

CVD risk factors prevalence among adolescents:

The findings of the systematic review (Chapter 2) conducted to ascertain the prevalence of CVD risk factors among adolescents shows a paucity of information on the prevalence of CVD risk factors among adolescents specifically in rural areas. Various studies conducted both in developed and few developing countries merge data for children and adolescents. This limitation poses a problem in intervention. According to WHO (2015), adolescence is a unique period in the development of people and it affects physical, emotional and psychological well-being. It is totally different from childhood; this difference informs the need to separate adolescents and children data in cardiovascular health research. Moreover, there are stages of development in adolescence which may make younger adolescent different from older adolescents in behavior.

We therefore recommend that future studies of adolescents' cardiovascular health should be specific to adolescents and not children and adolescents. Studies should also consider sub-groups of adolescents such as younger and older adolescents to identify any difference in risk factors prevalence among the sub-groups.

In our systematic review, because data were merged for children and adolescents, we had few studies that met the inclusion criteria. Fifteen included studies from 12 countries reveal that CVD risk factors prevalence is decreasing in the US where preventive strategies are in place for adolescents (Stice *et al.* 2007, May *et al.* 2012) while it is on the increase in middle income countries as earlier stated by Gaziano (2008). Important to note is that dyslipidemia and obesity are the leading CVD risk factors among adolescents. Smoking prevalence is very high in studies from Europe and lower in middle income countries. The need for each country to plan a CVD prevention program for adolescents is obvious; however, the intervention should target risk

factors representative of each country. One major problem observed in many studies was that little attention was paid to having valid measures for lifestyle CVD risk factors such as smoking, drinking, nutrition and physical inactivity. In addition, risk definitions of lifestyle risk factors vary among studies. It is therefore important for future studies to identify measures and determine their psychometric properties. Having identified the need to have valid measures for lifestyle risk factors based on our review, we developed a measure for assessing CVD risk factors among rural adolescents in Nigeria.

Measurement tools: how valid and reliable are they?

Measures are very important in research because they are the tools to obtain information (Terwee *et al*, 2007). Accuracy of information obtained depends on how valid and reliable a measure is which are dependent on development process. From our review (chapter 2), many studies do not report the validity and reliability of instrument neither do they report the development processes of the measures. Lifestyles are determined by many factors including culture, religion and societal norms, it therefore means measures of lifestyle risk factors should be environment and culture friendly. This makes it a necessity for measures for assessment of lifestyle risk behavior to be developed or adapted to every location.

We developed a cultural friendly measure (Chapter 3) for assessing CVD risk factors among rural adolescents in Nigeria (Odunaiya *et al*. 2014). The process of development went through several stages; systematic review of measures and psychometric properties, item selections, validation by expert panel, validation by target population and reliability testing by adolescents' population.

The instrument is valid (by expert consensus and target population comment qualitative analysis) and had moderate reliability in all the subscales.

English version of Nigerian friendly questionnaire: is it valid for rural adolescents?

The Nigerian friendly composite questionnaire was developed in English because English language is the official language although not the mother tongue of Nigerians. Rural adolescents are disadvantaged educationally; therefore many of them may not be proficient in English language. In order to ensure that the instrument was available to rural adolescents who were our primary target in this study, we did a cross-cultural validation adapted to get a Yoruba version of the measure (chapter 4). The Yoruba version appeared to have a higher reliability estimate than the English version. This is not surprising because people think and reason in their mother tongue even if they understand the English language. Communication in foreign languages also calls for skills such as mediation and intercultural understanding. An individual's level of proficiency will vary between the four dimensions (listening, speaking, reading and writing) and between the different languages, and according to that individual's social and cultural background, environment, needs and/or interests (youthpass 2015). This underscores the need to make questionnaires available in local languages of the people as this will facilitate obtaining accurate and quick results. We therefore recommend that measures should be made available in the local language of countries where the mother tongue is not English language. This is the only means to obtaining accurate information from the adolescents concerned. This will also serve adolescents who are not in school; the local language questionnaire can be interviewer administered for adolescents who are not in school but English language questionnaire cannot be administered even by interviewer to adolescents, however, the local language questionnaire has

to be tested among the non school going adolescents before it is used for data collection. We recommend that adolescents in some poor countries in developing countries who are not in schools but are learning some trades should not be excluded from studies because they cannot read or write English.

Assessment of CVD risk factors among rural adolescents:

With an availability of both English and Yoruba version of the instrument we investigated the prevalence of CVD risk factors among Nigerian rural adolescents (Chapter 5). We found a high prevalence of pre-hypertension, physical inactivity, low fruit and vegetable consumptions, high cholesterol diet and high salt intake among adolescents. Pre hypertension prevalence in this study was higher than what was observed in developed countries (Macniece *et al.* 2012, Haas *et al.* 2012). We know that in Nigeria hypertension prevalence ranges from 8%-46% among adults (Ogah 2012) and hypertensive heart disease is the most prevalent form of heart disease in Nigeria (Chukwuneke 2008). This finding informs us where we need to start our war against heart disease: during adolescence and may be childhood instead of waiting to manage hypertension in adulthood when target organ damage would have taken place since adolescence period.

Many adolescents also had poor dietary pattern shown in high salt consumption, low fruit consumption and low vegetable consumption. This poor dietary pattern could have predisposed the adolescents to pre hypertension observed in this study. According to Mayo clinic (2015), high salt, low fruits and low vegetable consumption are risk factors for pre –hypertension and hypertension. Magnesium, calcium and potassium which are very necessary in the maintenance of blood pressure (Mayo clinic 2015) are mostly derived from fruits and vegetable in the local

area studied. In addition, overweight and obesity observed among these rural adolescents is another factor which could affect blood pressure. Overweight and obesity are associated with atherosclerotic changes which result in elevated blood pressure. The rate of pre hypertension observed in this study if not controlled will track into the future as hypertension and will cause future CVD epidemic among rural people

Since pre hypertension was very high (about 1/3 of the adolescents in the study), we went further to explore the pre hypertension and factors associated with it (Chapter 6). This fifth article tested the hypothesis that pre hypertension will not be significantly associated with modifiable CVD risk factors. The results of the findings show that pre hypertension was significantly associated with high BMI (Overweight and Obesity), being aged 17, or 18 for boys. Exploring the associations among risk factors and pre hypertension for boys and girls showed that causal pathways for development of pre hypertension which can track on to become hypertension in these populations are different in boys and girls. While overweight and obesity were associated with pre hypertension and hypertension for both boys and girls, alcohol alone was associated with pre-hypertension for boys. Being an older adolescent (age 17 years, age 18 years) were also associated with pre hypertension for boys while being a younger adolescent (age 15 years, age 16 years) was not associated with pre hypertension and hypertension. Fried food preference predicts overweight and obesity for girls and low breakfast cereal predicts obesity for boys. Intervention or prevention program for these rural adolescents should be tailored differently for boys and girls

Based on the findings we proposed a CVD prevention program (chapter seven). The proposed CVD prevention is a policy chapter addressed to executive governor of Oyo State; the State where the rural adolescents in this study are. The policy chapter recommends CVD prevention program for these rural adolescents, using multidisciplinary approach. Specifics of the CVD

prevention program include; Health education and specific information to address some cultural beliefs which could influence the development of CVD example, being overweight in girls seen as evidence of good living, outdoor physical activity for ladies which are not encouraged. To address the problem of nutrition; food vendors training in heart health food and frequent visit by health visitors in school should be encouraged. This policy should enhance physical education and encourage workers in rural areas with incentives so that they can stay in rural areas.

Reflections: This research project provides new and important information regarding hypertensive states, and modifiable CVD risk factors, among rural adolescents in Southwest Nigeria. It is clear from the study findings that without specific targeted intervention into adolescent cardiovascular health now, Nigeria will face an epidemic of adult CVD within the next decade, particularly in rural areas. Whilst some information was available in the peer-reviewed literature on urban Nigerian adolescent CVD risks, this research is the first to describe rural young people's lifestyle choices, their body mass indexes and hypertensive states. This research provides an evidence-based framework upon which to mount intervention studies in the near future, which aim to decrease CVD risk in Nigerian adolescents, in an attempt to reduce future adult CVD burden in Nigeria.

In summary, the new knowledge produced by this research comprised:

- An English language comprehensive CVD risk factor questionnaire for Nigerian adolescents
- A validated translation of this questionnaire into Yoruba. This questionnaire can now be used in other African countries where Yoruba is spoken.

- Information on the prevalence of hypertensive states in rural Nigerian adolescents, which indicated that systolic pre-hypertension, was the most prevalent hypertensive condition. Systolic pre-hypertension is a recognized precursor for hypertension, and hypertensive heart disease. Thus some 1:3 of our sample of rural Nigerian youth are at-risk, right now, of future heart disease. Whilst the prevalence was low, there was evidence of established hypertension in approximately 5% of our sample.
- Information on modifiable CVD risk factors among this rural adolescent population, which highlighted that there was a lower prevalence of high BMI (overweight and obesity) than in other adolescent populations around the world, although a similar percentage of underweight adolescents. Underweight is a predictor of CVD in the future, and therefore should not be ignored in the overt focus on lifestyle choices.
- High BMI was associated with high meat intake (a proxy for high cholesterol), low breakfast cereal for boys and fried food preference for girls and low exercise patterns.

Smoking and drinking were strongly related, and many adolescents indulged in these risk behaviours every few days. This is concerning given that the sample was aged 18 years and younger. These adolescents are still developing physically, mentally and emotionally and regular drinking and smoking will have significant health effects.

Adding salt occurred commonly with other poor food choices, in particular when eating meat. Given her background, the researcher knew that adding salt (to already salted food) was a common behavior when eating Nigerian meals, and thus to reduce additional salt intake would require significant behavioural change.

Publications: The study yielded five articles for publication which are presented as chapters in the thesis. Two of the articles have been published, one accepted for publication, one under review and the fifth article has been prepared for a journal.

Recommendations and directions of future research

- The CVD risk factor information proposed in this study should be validated in other Nigerian cultures and settings, to make it available for all rural adolescents in Nigeria.
- There is the need to also investigate CVD risk factors among urban adolescents
- Investigation of CVD risk factors in geopolitical zones in Nigeria because nutrition and religious beliefs vary in different parts of the countries
- CVD prevention program is a necessity for these rural adolescents to prevent future adult CVD epidemic in this rural adolescents
- Prospective studies are necessary to determine the predictors of pre-hypertension and hypertension and other risk factors among adolescents.

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Appendix 1

PARTICIPANT INFORMATION LEAFLET AND CONSENT FORM FOR USE BY PARENTS/LEGAL GUARDIANS

TITLE OF THE RESEARCH PROJECT: Cardiovascular disease risk factors among adolescents attending schools in rural Nigeria.

REFERENCE NUMBER:

PRINCIPAL INVESTIGATOR: Nse A Odunaiya

ADDRESS: Department of Physiotherapy, College of Medicine, University college hospital, Ibadan, Nigeria.

CONTACT NUMBER: +2347035082510

Your child (*or ward, if applicable*) is being invited to take part in a research project. Please take some time to read the information presented here, which will explain the details of this project. Please ask the study staff or doctor any questions about any part of this project that you do not fully understand. It is very important that you are fully satisfied that you clearly understand what this research entails and how your child could be involved. Also, your child's participation is **entirely voluntary** and you are free to decline to participate. If you say no, this will not affect you or your child negatively in any way whatsoever. You are also free to withdraw him/her from the study at any point, even if you do initially agree to let him/her take part.

This study has been approved by the **Committee for Human Research at Stellenbosch University** and will be conducted according to the ethical guidelines and principles of the international Declaration of Helsinki, South African Guidelines for Good Clinical Practice and the Medical Research Council (MRC) Ethical Guidelines for Research.

What is this research study all about?

Occurrence of heart diseases is increasing around the world and also in Nigeria and there are some behaviours young people have now that can make them develop heart disease in future. The study intends to develop a questionnaire to find out the behaviours of young people that can make them develop heart disease in future. The questionnaire is being developed according to Nigerian culture and a local Nigerian language , Yoruba. It will be used to find out number of young people who have

behaviours that can cause heart disease in future. Some health measurements such as weight, height, blood pressure and amount of fat will also be taken. The information that will be obtained from this study will be used to plan program to prevent young people from having behaviors that can cause heart disease in future.

Why has your child been invited to participate?

Many young people are found in secondary schools. Some secondary schools have been selected to participate in the study and the principal of the schools have given approval for young people in these schools to participate in the study. Your child is in the selected school.

What will your responsibilities be?

By agreeing to your child's participation in the study, your child will complete a questionnaire made up of six sections. The questionnaire will ask about health behaviors that can cause heart diseases. Other health measurement will also be taken such as; weight, height, percent body fat and blood pressure

Will your child benefit from taking part in this research?

Yes, your child will be able to know his/ her health status; such as blood pressure, weight, height and amount of fat in his or her body. He or she will also know if he/she has a risk of having heart disease in future by participating in the study.

It will also provide a means of planning a program to prevent heart disease in future for other young people.

Are there any risks involved in your child taking part in this research?

There are no risk in your child's taking part in the study.

If you do not agree to allow your child to take part, what alternatives does your child have?

Your child could go to the health center and to assess some of the measures to be assessed in the study at some cost.

Who will have access to your child's medical records?

The information will treated as confidential. When information obtained is reported in thesis or published no personal information will be included.

What will happen in the unlikely event of your child getting injured in any way, as a direct result of taking part in this research study?

There are no risk of injury involved in this study.

Will you or your child be paid to take part in this study and are there any costs involved?

You or your child will not be paid to take part in the study, but your child's transport and meal costs will be covered for each study visit. There will be no costs involved for you if your child do take part.

Is there any thing else that you should know or do?

- You should inform your family practitioner or usual doctor that your child is taking part in a research study. (*Include if applicable*)
- You should also inform your medical insurance company that your child is participating in a research study (*Include if applicable*)
- You can contact Dr...Odunaiya..... at tel 07035082510..... if you have any further queries or encounter any problems.
- You can contact the Committee for Human Research at 021-938 9207 if you have any concerns or complaints that have not been adequately addressed by your child's study doctor.
- You will receive a copy of this information and consent form for your own records.

Assent of minor

I (*Name of Child/Minor*)..... have been invited to take part in the above research project.

- The study doctor/nurse and my parents have explained the details of the study to me and I understand what they have said to me.
- They have also explained that this study will involve (*describe any invasive procedures including taking of blood, putting up of drips etc.*)
- I also know that I am free to withdraw from the study at any time if I am unhappy.
- By writing my name below, I voluntary agree to take part in this research project. I confirm that I have not been forced either by my parents or doctor to take part.

.....
Naam van child

.....
Independent witness

(To be written by the child if possible)

Declaration by parent/legal guardian

By signing below, I (*name of parent/legal guardian*)

agree to allow my child (*name of child*) who is

years old, to take part in a research study entitled (*insert title of study*)

I declare that:

- I have read or had read to me this information and consent form and that it is written in a language with which I am fluent and comfortable.
- If my child is older than 7 years, he/she must agree to take part in the study and his/her ASSENT must be recorded on this form.
- I have had a chance to ask questions and all my questions have been adequately answered.
- I understand that taking part in this study is **voluntary** and I have not been pressurised to let my child take part.
- I may choose to withdraw my child from the study at any time and my child will not be penalised or prejudiced in any way.
- My child may be asked to leave the study before it has finished if the study doctor or researcher feels it is in my child's best interests, or if my child does not follow the study plan as agreed to.

Signed at (*place*) on (*date*) 2005.

.....
Signature of parent/legal guardian

.....
Signature of witness

Declaration by investigator

I (*name*) Odunaiya Nse declare that:

- I explained the information in this document to
- I encouraged him/her to ask questions and took adequate time to answer them.
- I am satisfied that he/she adequately understand all aspects of the research, as discussed above

- I did/did not use a translator (*if a translator is used, then the translator must sign the declaration below*).

Signed at (*place*) on (*date*) 2005.

.....
Signature of investigator

.....
Signature of witness

Declaration by translator

I (*name*) declare that:

- I assisted the investigator (*name*) to explain the information in this document to (*name of parent/legal guardian*) using the language medium of Afrikaans/Xhosa.
- We encouraged him/her to ask questions and took adequate time to answer them.
- I conveyed a factually correct version of what was related to me.
- I am satisfied that the parent/legal guardian fully understands the content of this informed consent document and has had all his/her questions satisfactorily answered.

Signed at (*place*) on (*date*) 2005.

.....
Signature of translator

.....
Signature of witness

Appendix 2

NIGERIA COMPOSITE LIFESTYLE CVD RISK FACTORS QUESTIONNAIRE FOR ADOLESCENTS

Thank you for agreeing to complete this questionnaire which is about health behaviours that can cause heart disease. We have developed it to get information from you about things you do that may affect your heart health.

The information we are getting from you will be used to develop programs that will help young people like you. There are no wrong and right answers, so answer the questions based on what you know.

The answers you give will be kept secret and will only be used for research purpose.

Kindly read every question thoroughly and tick the right box. Use a pencil so you can erase any answer you tick by mistake.

INSTRUCTIONS FOR COMPLETING QUESTIONNAIRE

- ◆ Use HB pencil only
- ◆ Tick your answer in the appropriate box.
- ◆ Where required, complete on dotted line provided.
- ◆ If you change your answer, erase your old answer completely.
- ◆ Each section deals with a different aspects such as personal details, etc.,

SECTION 1

Personal information

1. Gender: Male Female

2. Date of Birth:(yyyy)/.....(mm)/.....(dd)

3. How old are you ?

- 12 years old or younger
- 13 years old
- 14 years old
- 15 years old
- 16 years old
- 17 years old
- 18 years old or older

4. In what class are you?

- JSS3 grade
- SSS1 grade
- SSS2 grade
- SSS3 grade
- Other grades

SECTION 2

CVD indicators and family history of CVD

5. Do you get tired easily even when you don't do exercise? Yes No

6. Do you have chest pain when you do exercises such as running, playing football, pounding? Yes No

7. Do you find it difficult to breathe after a little exercise such as climbing stairs, walking about for 10 minutes? Yes No

8. Do either of your parents or close relation have heart disease? Yes No

9. Do any of your parents or close relation receive treatment from a doctor for heart disease, hypertension or diabetes? Yes No

SECTION 3

Tobacco usage

- 10.** Answer NO if you have never smoked and do not intent to smoke in future (else answer YES) Yes No
- 11.** You have tried cigarette smoking, even one or two puffs Yes No
- 12.** How old were you when you smoked a whole cigarette for the first time?
- I have never smoked a whole cigarette
 - 8 years old or younger
 - 9 or 10 years old
 - 11 or 12 years old
 - 13 or 14 years old
 - 15 or 16 years old
 - 17 years old
 - 18 years old or older
- 13.** You have tried smoking, but not smoked in the past 30 days Yes No
- 14.** Do you intend smoking in the future? Yes No
- 15.** During the past 30 days, on how many days did you smoke cigarettes?
- 0 days
 - 1 or 2 days
 - 3 to 5 days
 - 6 to 9 days
 - 10 to 19 days
 - 20 to 29 days
 - All 30 days
- 16.** During the past 30 days, on the days you smoked, how many cigarettes did you smoke per day?
- I did not smoke cigarettes during the past 30 days
 - Less than 1 cigarette per day
 - 1 cigarette per day
 - 2 to 5 cigarettes per day
 - 6 to 10 cigarettes per day
 - 11 to 20 cigarettes per day
 - More than 20 cigarettes per day
- 17.** You have smoked cigarettes daily, that is, at least one cigarette every day for 30 days? Yes No

18. During the past 30 days, on how many days did you use **chewing tobacco, snuff or smoke raw tobacco?**

- 0 days
- 1 or 2 days
- 3 to 5 days
- 6 to 9 days
- 10 to 19 days
- 20 to 29 days
- All 30 days

SECTION 4

Alcohol usage

The next 4 questions ask about drinking alcohol. This includes drinking beer, wine, and hot drink such as ogogoro. For these questions, drinking alcohol does NOT include drinking a few sips of wine for religious purposes.

19. How often do you have a drink containing alcohol?

- Never
- Monthly
- 2 - 4 times a month
- 2 - 3 times a week
- 4 or more times a week

20. How old were you when you had your first drink of alcohol (more than a few sips)?

- I have never had a drink of alcohol other than a few sips
- 8 years old or younger
- 9 or 10 years old
- 11 or 12 years old
- 13 or 14 years old
- 15 or 16 years old
- 17 years old or older

21. How many standard drinks of alcohol (1 standard drink is about 350 ml or equivalent of one bottle of small coke) do you have on a typical day when drinking?

- 1 or 2
- 3 or 4
- 5 or 6
- 7 to 9
- 10 or more

22. How often do you have six or more drinks on one occasion?

- Never
- Less than monthly
- Monthly
- Weekly
- Daily or almost daily

SECTION 5

Physical activity

- 23.** During the past 7 days, on how many days were you physically active for a total of **at least 60 minutes per day?** (Add up all the time you spend in any kind of physical activity that increases your heart rate and makes you breathe hard some of the time.)

- 0 days
- 1 day
- 2 days
- 3 days
- 4 days
- 5 days
- 6 days
- 7 days

- 24.** Which of the following activities have you done during the past seven days?

	0	1-2	3-4	5-6	7 or more
Skipping	<input type="checkbox"/>				
Rowing, canoeing	<input type="checkbox"/>				
Brisk walk	<input type="checkbox"/>				
Bicycling	<input type="checkbox"/>				
Jogging or running	<input type="checkbox"/>				
Aerobics	<input type="checkbox"/>				
Swimming	<input type="checkbox"/>				
Baseball or soft ball	<input type="checkbox"/>				
Football	<input type="checkbox"/>				
Dance	<input type="checkbox"/>				
Badminton	<input type="checkbox"/>				
Volley ball	<input type="checkbox"/>				
Table tennis	<input type="checkbox"/>				
Lawn tennis	<input type="checkbox"/>				
Basket ball	<input type="checkbox"/>				
Soccer	<input type="checkbox"/>				
Cricket	<input type="checkbox"/>				
Gardening /farming	<input type="checkbox"/>				
Others	<input type="checkbox"/>				

- 25.** On an average school day, how many hours do you watch TV?

- I do not watch TV on an average school day
- Less than 1 hour per day
- 1 hour per day
- 2 hours per day
- 3 hours per day
- 4 hours per day
- 5 or more hours per day

26. On an average school day, how many hours do you play video or computer games or use a computer or handset for something that is not school work? (including activities such as computer games, and the Internet.)

- I do not play video or computer games or use a computer for something that is not school work
- Less than 1 hour per day
- 1 hour per day
- 2 hours per day
- 3 hours per day
- 4 hours per day
- 5 or more hours per day

27. Do you have Physical education (PE) practical in your school time table? Yes No

28. In an average week when you are in school, on how many days do you go to Physical Education (PE) practical classes?

- 0 days
- 1 day
- 2 days
- 3 days
- 4 days
- 5 days

29. During the past 12 months, on how many sporting competition/inter house sport did you take part? (Example; football, sprint, relay)

- 0 teams
- 1 team
- 2 teams
- 3 or more teams

SECTION 6
Nutritional information

30. How many times a week do you eat each food on this list below?

	Days per Week						
	1	2	3	4	5	6	7
MEAT							
Pork							
Turkey							
Liver							
Kidney							
Other organ meat (intestine, etc)							
Meat pies/pastries							
Ready meals							
Beef (cow meat)							
Goat							
Chicken							
BREAKFAST CEREALS							
Pap (from millet, guinea corn etc)							
Golden morn							
Corn flakes							
Any other brands							
VEGETABLES							
Salad vegetables							
Leafy green vegetables (E.g. green, ugwu, waterleaf, ewedu)							
Green peas							
Carrot							
Pepper							
Baked beans							
Beans							
Soya beans							
Other							
FRUITS							
Garden eggs							
Oranges							
Bananas							
Grape fruits							
Pawpaw							
Mangoes							
Cashew							
Apples							
Other							
Other FOOD							
Cassava and cassava products							
Yam and yam product							
Plantain							
Bread							
Eggs							
Fish							
Ice cream							
Rice							
Pasta/Noodles/Spaghetti							

31. Do you add salt to food at table if salt was already added to food during the cooking process? Yes No
32. How much salt do you eat compared to other young people like you?
 More salt
 Less salt
 Same amount of salt
33. How do you prefer your food cooked? (E.g meat, fish, egg, plantain)
 Boiled
 Fried
 Roasted

This is the end of the survey.

Thank you !!

ÌWÉ AŞÈBÉÈRÈ LÓRÍ ÀWỌN OHUN TÍ Ó N FA EWU C.V.D

LÁÀÁRÍN ÀWỌ ỌDÓ LANGBA NÍ NÀÌJÍRÍÀ

A dúpé pé o gbà láti fí ọwó sí ìwé aşebéèrè yií, èyí tí ó ní şe ìwádíí nípa ipò ìlera rẹ tí ó lè şe okùnfà àìsàn ọkàn. A şe àgbékalè rẹ láti gba ìròyìn nípa àwọn nñkan tí ó ní şe tí ó le nípa lórí ìlera ọkàn rẹ.

Àbájáde ìwé aşebéèrè yií ni a ó lò láti şe àgbékalè ètò tí yóò ran àwọn ọdó langba bí i tìré lówó. Dáhùn àwọn ibéèrè náà bí ó bá şe yé ọ sí, şé kò sí pé ìdáhùn kan tònà tábí kò tònà.

Gbogbo àşírí inú ìdáhùn rẹ kò ní lu síta, işé ìwádíí níkan ni a ó fí şe.

Ka ọkòòkan àwọn ibéèrè wonyí dádadáa kí o sì fa ìlà síwájú èyí tí ó tònà nínú àwọn àlàfo tí a pèsè sílè. Pénsù ni kí o lò, kí ó ba lè rorùn láti lè şe àtúnṣe níbi tí ó bá yẹ.

ÀWỌN ÀKÍYÈSÍ FÚN DÍDÁHÙN ÌWÉ AŞÈBÉÈRÈ YIÍ

- Lo pénsù níkan
- Fa ìlà síwájú èyí tí ó tònà níkan àlàfo tí a pèsè sílè.
- Şe àkòsílè ìdáhùn rẹ ní àwọn àlàfo tí a pèsè sílè
- Bí ó bá şe àşìşe nígbà tí ó ní dáhùn ibéèrè kan, rí i dájú pé o pa ìdáhùn àkókó ré pátápátá şáajú àtúnṣe rẹ.
- Ìpín kòòkan dá lórí ohun ọtòòtò bí àpẹẹrẹ ọrò nípa ara rẹ àti bẹ́ bẹ́ lọ.

ÌPÍN KÌÍNÍ

Nípa Olùdáhùn

1. Okùnrin ni ó tàbí obìnrin? [] okùnrin [] obìnrin
2. Ojó ìbí rẹ? Odún _____ Osù _____, Ojó _____
3. Qomọ ọdún mélòó ni ó? _____
 - [] qomọ ọdún méjìlá tàbí mi ò tí ì tó béké
 - [] qomọ ọdún métálá
 - [] qomọ ọdún mérìnlá
 - [] qomọ ọdún márùn-ún-dín-lógún
 - [] qomọ ọdún mérindínlógún
 - [] qomọ ọdún métàdínlógún
 - [] qomọ ọdún méjìdínlógún
4. Kíláàsì wo ni o wà? _____
 - [] JSS 3
 - [] SS 1
 - [] SS 2
 - [] SS 3
 - [] Ìpele kíláàsì miíràn

ÌPÍN KÉJÌ

ÀMÌ C.V.D ÀTI ÌTỌPA ÌTÀN RÈ NÍNÚ EBI

Àwọn ibéèrè ipín yíí ní se ìwádìí nípa àwọn àmì C.V.D àti ìtọpa bójá ohun tí ó ní fa ewu rẹ wà nínú ẹbí rẹ tàbí kò sí.

5. Sé ó máa ní tètè rẹ ó nígbà tí o kò bá se işé agbára kankan? [] Béké ni [] Béké kó
6. Sé ó máa ní írora nínú eegun àyà nígbà tí o bá ní se eré idárayah. Bí àpeere, eré sisá, bóòlù gbígbá, gígun nñkan? [] Béké ni [] Béké kó
7. Sé o máa ní işoro láti mí dáadáa léyìn tí o bá ti se eré idárayah díè? (Bí àpeere gígun pèpépe, nínasè kiri fún bí i işejú mewàá). [] Béké ni [] Béké kó
8. Njé ọkan nínú òbí tàbí ibátan rẹ ní àìsàn ọkàn rí? [] Béké ni [] Béké kó

9. Njé ọkan níní òbí tàbí ìbátan rẹ ti tọ dòkítà lọ fún ìtójú lórí ọkan nínú àwọn àìsàn yíí rí? (èjè riru, àtògbẹ, ìtò súgà). [] Béè ni [] Béè kó
10. Sé o kò mu sìgá rí? Àti pèlú pé, sé o kò ní i lókàn láti mu ún ní ojó iwájú? [] Béè ni [] Béè kó
11. Sé o ti mu sìgá rí, bí kò tilè ju fífà á léèkan tàbí èèmejì lọ? [] Béè ni [] Béè kó
12. Qmọ ọdún mélòó ni ó nígbà tí o mu ọpá sìgá kan tán fún ìgbà àkókó rí?
- [] N ò mu ọpá sìgá kan tán rí
 - [] ọdún méjọ sí ìsàlè
 - [] ọdún mésàn-án sí méwàá
 - [] ọdún mókànlá sí méjìlá
 - [] ọdún métalá sí mérìnlá
 - [] ọdún méèdógún sí mérìnlóngún
 - [] ọdún métàdínlóngún
 - [] ọdún méjídínlóngún sókè
13. O ti mu sìgá rí, àmọ́ sá, o ò tí ì fi énu kàn án ní nñkan bí i ọgbón ojó séyìn bẹè ni o kò ní i lókàn láti mu ún ní ojó iwájú? [] Béè ni [] Béè kó
14. Sé o ní i lókàn láti mu sìgá ní ojó iwájú (nígbà tí ó bá dagba tàbí nígbà tí o bá ní owó lówó)? [] Béè ni [] Béè kó
15. Ojó mélòó ni o fi mu sìgá ní àárín ọgbòn ojó séyìn?
- [] mi ò mu sìgá rará ní àárín ọgbòn ojó séyìn
 - [] ojó kan tàbí méjì
 - [] ojó méta sí márùn-ún
 - [] ojó méfà sí mésàn-án
 - [] ojó méwàá sí mókàn-dín-lóngún
 - [] ogúnjó sí ojó mókàn-dín-lóngbòn
 - [] gbogbo ọgbòn ojó
16. Ọpá mélòó ni o mu ní àwọn ojó tí o mu sìgá láàárín ọgbòn ojó séyìn?
- [] N ò mu sìgá láàárín ọgbòn ojó séyìn
 - [] N kò mu tó ọpá sìgá kan lójúmó
 - [] ọpá sìgá kan ní mo mu lójúmó
 - [] ọpá sìgá méjì sí márùn-ún lójúmó
 - [] ọpá sìgá méfà sí méwàá lójúmó
 - [] ọpá sìgá mókànlá sí ogún ọpá lójúmó
 - [] ó ju ogún ọpá lójúmó

17. Ní ojoojúmó ni o máa ní mu sìgá, ó kéré tán òpá sìgá kan lójoojumó fún ọgbòn ojó.

- [] Béè ni [] Béè kó

18. Ojó mélòó o fi mu aásà, fín tábà tábí mu ìkòkò láàárín ọgbòn ojó séyìn?

- [] kò sí ojó kankan
[] ojó kan tábí méjì
[] ójó méta sí márùn-ún
[] ojó méfà sí mésàn-án
[] ojó méwàá sí mókàn-dín-lógún
[] ogúnjó sí ojó mókàn-dín-lóbòn
[] gbogbo ọgbòn ojó

ÌPÍN KÉRIN

ÒRÓ OTÍ LÍLE

Àwọn ìbéèrè mérin wònyí ní şe ìwádìí nípa otí mímu bí i bíà, wáinì, àti otí líle bí i ògógóró. Ìwádìí otí mímu yí kò ní í şe pèlú wáinì fèrè tí à ní ta sí énu fún oúnje alé Olúwa tábí ìwúre.

19. Báwo ni mímu otí líle şe wópò nínú ohun mímu rẹ tó?

- [] N kí í mu ún
[] Ní osòosù
[] Ìgbà méjì sí mérin láàárín oṣù
[] Ìgbà méjì sí méta láàárín ḥsè
[] ìgbà mérin tábí ju béè lò ní àárín ḥsè

20. Ọdún mélòó ni ó nígbà tí o kókó mu otí fún ìgbà àkókó yàtò fún titó fèrè otí wò?

- [] ọdún méjọ sí ìsàlè
[] ọdún mésàn-án sí méwàá
[] ọdún mókànlá sí méjìllá
[] ọdún métálá sí mérinlá
[] ọdún méèdógún sí mérin-dín-lógún
[] ọdún métà-dín-lögún
[] Ọdún métàdínlögún sókè

21. Sọ iye tábí òdiwòn otí líle tí o máa ní mu ní ojó tí o bá mu otí pèlú gbèdéke 350ml, tí í şe ìgò kòkákòlà.

- [] òkan sí méjì

- [] métá sí mérin
- [] márùn-ún sí méfà
- [] méje sí mésàn-án
- [] méwàá tàbí ju békè lọ

22. Báwo ni o şe wópò tó fún ọ láti şe àdàlù ọtí bí i méfà tàbí ju békè lọ pò léèkkan náà?

- [] kò wáyé rí
- [] kò tó oşù kan
- [] Ní oşooşù
- [] ó férè jé ojoojúmó

ÌPÍN KARUN-ÚN

ÒRÒ IŞÉ ŞÍŞE

23. Ojó mélòó ni o fi şe eré ìdárayá láàárín ọsè kan sényin, tí o sì lo, ó kéré tán, ọgóta ışejú láàárín ojó kan (şe àkọsílè gboogbo àkókótí o fi şe işé àşekára tó mú kí o máa mí túpe túpe tí ọkàn rẹ náà sì nì pì pì pì).

- [] kò sí ojó kankan
- [] ojó kan
- [] ojó méjì
- [] ojó métá
- [] ojó mérin
- [] ojó márùn-ún
- [] ojó méfà
- [] ojó méje

24. Èwo nínú àwọn ojúşe wònyí ni o şe láàárín ojó méje sényin.

S/N	Ojúşe	0	1-2	3-4	5-6	7 tàbí ju békè lọ
i.	Okùn fífò/láká-ñ-láká					
ii.	Títú òbèlè ọkò ojú omi					
iii.	Sísáré rìn					
iv.	Gígun kéké ológeere					
v.	Pípòsèsè sáré					

vi.	Síséè mí				
vii.	Lílúwè nínú omi				
viii.	gbígbá bóòlù àfesègbá				
ix.	Ijó jíjó				
x.	Bàdibíntíñì				
xi.	Bóòlù àfowógbá				
xii.	Bóòlù ẹléyin lórí tábílì (tébú téníñì)				
xiii.	Lóónú téníñì				
xiv.	Bóòlù àfowógbá alágbaámólè tí à n jù wọnú apèrè tó wà lókè				
xv.	Eré bóòlù aláfesègbá (sókà)				
xvi.	Kíríkéètì				
xvii.	Iṣé àgbè tábí oko dida				
xviii.	Àwọn ojúše mìíràn				

25. Wákàtí mélòó ni o fí n wo èrø móhùnmáwòrán (télifíshàn) ní àwọn ojó tí o máa n lọ sí ilé-èkó?

- [] ó dín ni wákàtí kan ní ojoojúmô
- [] wákàtí kan ní ojoojúmô
- [] wákàtí méjì ní ojoojúmô
- [] wákàtí métá ní ojoojúmô
- [] wákàtí mérin ní ojoojúmô
- [] wákàtí márùn-ún tábí ju béké lọ ní ojoojúmô

26. Wákàtí mélòó ni o máa lò láti fí ñe eré idárayá lórí fídíò tábí èrø ibánisòrò alágbeeká
ati eré idárayá lórí èrø ayélujára fún nñkan tí ó yàtò sí iṣé tí a fún ọ ní ilé-èkó rẹ ní
àwọn ojó tí o máa n lọ sí ilé-èkó?

- [] èmi kí ñe eré idárayá lórí tábí kòmpútà béké ni n kí ñ lo èrø ibánisòrò tábí èrø
ayélujára fún nñkan mìíràn yàtò fún iṣé ilé-èkó
- [] ó dín ní wákàtí kan ní ojoojúmô
- [] wákàtí kan ní ojoojúmô
- [] wákàtí méjì ní ojoojúmô
- [] wákàtí métá ní ojoojúmô
- [] wákàtí mérin ní ojoojúmô

[] wákàtí márùn-ún tàbí ju béké lọ ní ojoojúmó

27. Sé àkókò wà fún eré ìdárayá àfísojúše (P.E) nínú àté ètò èkó ní ilé-èkó yín?

[] béké ni [] béké kó

28. Ojó mélòó ní àárín ọsè kan ni e fí máa ní lọ sí orí pápá ìshéré fún ìdánilekóó lórí eré ìdárayá àfísojúše (P.E) ní àwọn ojó tí o máa ní lọ sí ilé-èkó?

[] a kí í lọ rará

[] ojó kan

[] ojó méjì

[] ojó méta

[] ojó mérin

[] ojó márùn-ún

29. Láàárín ọdún kan, ìyen oṣù méjìlá sényin, ìgbà mélòó ni o kópa nínú ìdíje oníléjilé níú àwọn eré bí i bóyòlù aláfésègbá, eré sisá, eré àságbağı.

[] n ò kópa rará

[] èèkan

[] èèmejì

[] èèmèta

[] ó ju èèmèta lọ

ÌPÍN KEFÀ

ÒRÒ NÍPA OÚNJE AŞARA-LÓORE

30. Èèmelòó ní àárín ọsè ni o máa ní je ọkòòkan nínú oúnje wònyí?

	Iye ojó láàárín ọsè						
	1	2	3	4	5	6	7
ERAN							
Eran Eledè							
Eran tòlótòló							
Èdò							
Kíndínrín							
Tinú ẹran bí ifun, abbl							
Ìpanu bí àwọn oúnje tí a fí ìyèfun fúlápà se							
Oúnje pápáàpá (Àdirlé)							

Eran Ògúnfe						
Eran Málúù						
Eran Adié						
ÀWỌN OÚNJĘ BÍ JÉRÓ						
Èkọ pípòmu bí i jéró, abbl						
Gólúdínní mọ̀ (Golden Morn)						
Ìyéfun tí a fi àgbàdo şe (cornflakes)						
Àwọn orísi jéró miíràn						
ÀWỌN ORÍSI ÈFÓ						
Tòmáti, létúùsì, kábéèjì						
Àwọn èfó eléwé gírìní bí tètè, úgú, gbúre, abbl						
Èwà gírìní						
Káróqòtì						
Ata ilè						
Àkàrà						
Èwà						
Èwà sóyà						
Àwọn orísi miíràn ní pàtó						
ÀWỌN ÈSO						
Ìgbá						
Osàn						
Ògèdè jíjé						
Gírepù						
Ìbépé						
Máángòrò						
Kaşú						
Ápùùlù						
Àwọn miíràn ní pàtó						
ÀWỌN ORÍSI OÚNJĘ MIÍRÀN						
Ègé àti àwọn oúnjẹ miíràn tí à ní rí láti ara rè						
Isu àti àwọn oúnjẹ tí à ní rí láti ara rè						
Ògèdè agbagba						

Búrédì						
Eyin						
Eja						
Áìsì-kirimù (ice cream)						
Írèṣì						
Pásítà/ Índómì/Sìpàgétì						

31. Şe o maa n fí iyò sí oúnje ti iyò kò bá dùn ún nígbà tí o bá fé jéun ní orí tábìlì? [] béké
ni [] béké kó
32. Şe òdiwòn bí o şe n jẹ iyò tó tí a bá fí ó wé àwọn ọdó mìíràn bí tìre.
[] Mò n jeyò jù wón lò
[] Mi ò jeyò tó wón
[] kò sí iyàtò nínú bí a ti n jeyò
33. Ọnà wo ni ó maa n té ọ lórùn jùlọ láti gba şe àwọn oúnje rẹ (bí i ẹran, ejà, eyin, ọgèdè
agbagba?
[] sísè
[] díndín
[] Yíyan

Níbí ni isé ìwádìí náà parí sí. E şe!!

Appendix 4

Stellenbosch University <https://scholar.sun.ac.za>



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22 May 2009

MAILED

Ms NA Odunaiya
Div of Physiotherapy
4th flr, teaching bld
Stellenbosch University
Health Sciences Faculty
7505

Dear Ms Odunaiya

"Cardiovascular disease risk factors among rural adolescents in Nigeria."

ETHICS REFERENCE NO: N08/09/257

RE : PROVISIONAL APPROVAL

It is my pleasure to inform you that the abovementioned project has been provisionally approved on 22 May 2009 for a period of one year from this date. You may start with the project, but this approval will however be submitted at the next meeting of the Health Research Ethics Committee for ratification, after which we will contact you again.

Notwithstanding this approval, the Committee can request that work on this project be halted temporarily in anticipation of more information that they might deem necessary to make their final decision.

Please quote the abovementioned project number in all future correspondence.

Please note that a progress report (obtainable on the website of our Division) should be submitted to the Committee before the year has expired. The Committee will then consider the continuation of the project for a further year (if necessary). Annually a number of projects may be selected randomly and subjected to an external audit.

Please note that in line with the recent changes to research ethics guidelines, including the Declaration of Helsinki, the CHR requires that all researchers specifically request and motivate for a "waiver of informed consent" for retrospective clinical audits.

Federal Wide Assurance Number: 00001372
Institutional Review Board (IRB) Number: IRB0005239

The Health Research Ethics Committee complies with the SA National Health Act No.61 2003 as it pertains to health research and the United States Code of Federal Regulations Title 45 Part 46. This committee abides by the ethical norms and principles for research, established by the Declaration of Helsinki, the South African Medical Research Council Guidelines as well as the Guidelines for Ethical Research: Principles Structures and Processes 2004 (Department of Health).

22 May 2009 14:25

Page 1 of 2



Fakulteit Gesondheidswetenskappe - Faculty of Health Sciences



Verbind tot Optimale Gesondheid · Committed to Optimal Health
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Yours faithfully

A handwritten signature in blue ink.

MRS ELVIRA ROHLAND

RESEARCH DEVELOPMENT AND SUPPORT

Tel: 021 938 9677 / E-mail: elr@sun.ac.za

Fax: 021 931 3352



Fakulteit Gesondheidswetenskappe • Faculty of Health Sciences



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Tel.: +27 21 938 9075 • Faks/Fax: +27 21 931 3352

Appendix 5

Dear Sir/Ma,

CARDIOVASCULAR DISEASE RISK FACTORS ASSESSMENT AMONG RURAL ADOLESCENTS IN NIGERIA

The above research project is for an award of PhD in Physiotherapy, at the Stellenbosch University, Republic of South Africa. The study aims to develop an appropriate and culturally sensitive composite Cardiovascular disease (CVD) risk factor questionnaire for rural adolescents in Nigeria and to determine the prevalence of selected CVD risk factors among rural adolescents in South western Nigeria.

CVD is increasing in prevalence in Nigeria. Some behaviors such as smoking, drinking, physical inactivity and diet are risk factors for CVD. However, these risk behaviours are learnt and established at young age.

Many instruments have been developed for specific CVD Risk factors but they are not valid for Nigerian adolescents, besides there are no composite CVD risk factor questionnaires for Nigerian adolescents, therefore there is need to develop a composite measure and ascertain the prevalence of CVD risk factors among adolescents. In order to ensure that the instrument has acceptable content validity, a panel of experts will sit to assess the necessary psychometric property using guideline by Beaton et al (2000) and guideline for questionnaire development by Bowman et al (2007).

Based on your work, experience in scales development, validation studies and specialization in specialty areas represented in various subscales of the instrument,

We hereby invite you to be a member of the panel.

Thank you for anticipated co operation

Yours truly,

Nse A Odunaiya

B Sc (Hons) Physio, Med (Exercise Physiology)

PhD candidate, Stellenbosch University RSA.

Prof Quinette Louw (Supervisor)

Stellenbosch University, R S A

Prof Karen Grimmer(supervisor)

University of South Australia

Australia

Appendix 6

LETTER TO THE SCHOOL PRINCIPALS

To whom it may concern:

CARDIOVASCULAR DISEASE RISK FACTORS ASSESSMENT AMONG RURAL ADOLESCENTS IN NIGERIA

The above research project is for an award of PhD in Physiotherapy, at the Stellenbosch University, Republic of South Africa. The study aims to develop an appropriate and culturally sensitive composite CVD risk factor questionnaire for rural adolescents in Nigeria and to determine the prevalence of selected CVD risk factors among rural adolescents in south western Nigeria.

Cardiovascular disease (CVD) is increasing in occurrence in Nigeria. Some behaviors such as smoking, drinking, physical inactivity and diet are risk factors for CVD. However, these risk behaviors are learnt and established at young age therefore there is need to develop measures and ascertain the occurrence of CVD risk factors among adolescents.

The adolescents in your school will be required to complete the CVD questionnaire. Some health measurement such as weight, height, blood pressure and percent body fat, waist and hip circumference will also be taken.

We hereby seek your permission to involve your school in this study.

Thank you for your anticipated co operation

Yours sincerely,

Nse A Odunaiya
B Sc (Hons) Physio, Med (Exercise Physiology)
Ibadan

Prof Quinette Louw
Stellenbosch University

Prof Karen Grimmer

University of South Australia

Appendix 7



Ethics Letter

31-Jul-2014

Ethics Reference #: N08/09/257

Title: Cardiovascular disease risk factors among rural adolescents in Nigeria.

Dear Dr Nse ODUNAIYA,

At a review panel meeting of the Health Research Ethics Committee that was held on 18 June 2014, the progress report for the abovementioned project has been approved.

If you have any queries or need further help, please contact the REC Office 0219389207.

Sincerely,

REC Coordinator
Mertrude Davids
Health Research Ethics Committee 1

A handwritten signature in black ink, appearing to read 'MD' or a similar initials, positioned above the typed name Mertrude Davids.