

## Cardiovascular Disease Risk Factors among Secondary School Students: A Review

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### ABSTRACT

**Background:** Cardiovascular diseases (CVDs) are the number one cause of death worldwide. An estimated 17.5 million people died worldwide in 2012 due to CVDs, representing 31% of all global deaths. In Ghana, CVDs were responsible for 14% of institutional deaths. Risk factors for coronary heart disease and stroke begin in childhood that develops in adulthood. The aim of this paper is to review CVD risk factors among secondary school students, prevalence and primary prevention of the disease.

**Methods:** Detailed English-language literature search published between 2001 to present was conducted from Pub Med, Google Scholar and Cochrane library that identified ninety five published articles in exploring CVD risk factors among adolescent secondary school students. Eighty two of the papers were research articles from Ghana, Sudan, Congo, Nigeria, USA, UK, China, Canada, Turkey, Holland, and Poland, while thirteen were reports from World Health Organization (WHO), Institute of Medicine (IOM), Ghana Ministry of Health, and Ghana Health Service.

**Results:** Most of the studies found that risk factors associated with CVDs among students included: physical inactivity, unhealthy diet, smoking, and alcohol. The studies also showed that these risk factors begin in childhood and accelerate during the adolescent age. These lead to overweight, obesity and hypertension and subsequently to CVDs in adulthood. Also, students are becoming hypertensive, though the condition was thought to affect people in their adulthood.

**Conclusion:** Cardiovascular diseases are the leading cause of death in Ghana and worldwide, and risk factors of the disease are seen among secondary school students. Awareness and understanding risk factors could help public health professionals and the Ghana Health Service develop the appropriate interventions that will be targeted towards these populations.

**Keywords:** Risk factors of CVDs, prevalence, secondary school students, adolescents, prevention, Ghana

### BACKGROUND

According to the World Health Organization (WHO), cardiovascular diseases (CVDs) are the number cause of death worldwide.<sup>[1]</sup> An estimated 17.5 million people died worldwide in 2012 due to CVDs, representing 31% of all global

deaths.<sup>[2]</sup> The disease affects a third of adult population in the world making it the largest epidemic ever known to mankind.<sup>[3]</sup>

Sub-Saharan Africa was the only WHO region where CVD-related deaths increased significantly between 1990 and 2013<sup>[4]</sup> and

has since become the leading cause of CVD morbidity and mortality.<sup>[5]</sup>

The increasing global epidemic is due to genetic and lifestyle changes mainly in physical inactivity, unhealthy diet, tobacco use and alcohol consumption.<sup>[6-9]</sup> Risk factors for coronary heart disease and stroke begin in childhood that develops in adulthood.<sup>[10]</sup> This is because the risk factors for the development of CVDs are not only peculiar to adults but these behaviors begin as early as in childhood and adolescent age.<sup>[11]</sup>

In Ghana, the Ministry of Health (MOH) reported that CVDs were responsible for 14% of total deaths in 2008.<sup>[12]</sup> However, risk factors of CVDs have been increasing among students in Ghana and has become epidemic.<sup>[12,13]</sup> The risk factors lead to health conditions such as overweight, obesity, hypertension and eventually CVDs. The aim of this paper is to determine based on literature review CVD risk factors among secondary school students, prevalence and primary prevention of the disease.

## METHODS

To conduct a review of cardiovascular disease risk factors among adolescents' secondary school students, literature searches were performed for studies that were relevant to CVD risk factors among students from 2001 to present using PubMed, Google scholar, and Cochrane library. We also searched the reference list of identified articles for further studies. Strategy employed was series of terms used to identify articles of interest using the keyword search. The keywords used included: prevalence of CVDs, CVD risk factors among students in Ghana (physical inactivity, unhealthy diet, smoking, alcohol, overweight, obesity, and hypertension), epidemiology of CVDs, and primary prevention. To understand the current situation of CVD risk factors among secondary school students, search articles and reports were limited to studies that conducted after 2000 and published from

2001. Studies included randomized controlled trials, cohort studies, cross sectional and case control study design that were conducted in schools, communities or outpatient settings. The searched was also included if they were published in the English-language in the specified period.

## RESULT

A total of 97 published articles were selected for inclusion into this study. Eighty four<sup>[84]</sup> of the papers were research articles from Ghana, Sudan, Congo, Nigeria, USA, UK, China, Canada, Holland, Turkey, Poland, and Uruguay while the remaining thirteen<sup>[13]</sup> were reports from WHO, IOM, Ghana Ministry of Health, and Ghana Health Service. Majority of the studies found that risk factors of CVDs among students were mainly: physical inactivity, unhealthy diet, smoking, and alcohol. Others included overweight, obesity, and hypertension. The studies also showed that these risk factors begin as early in childhood and the adolescent age. These however, lead to metabolic changes such as overweight, obesity, and hypertension and later to CVDs during adulthood. The studies also revealed that hypertension is becoming a major problem among students, though the condition was thought to affect people in their adulthood. Most of the studies also revealed that knowledge of CVDs and its risk factors among students and the youth were generally low.

## DISCUSSION

### 4.1 Epidemiology of Cardiovascular Disease

Cardiovascular diseases are projected to cause more deaths due to maternal and perinatal conditions, infectious and nutritional diseases combined by 2030 worldwide.<sup>[14]</sup> The number of global deaths as a result of CVDs rose by a third between 1990 and 2010, and in 2015 one in three deaths were due to CVDs.<sup>[15]</sup> The disease was perceived to be a disease of the developed nations until recent years where epidemiological evidence has shown

worsening of CVD health globally and more especially in developing nations.<sup>[3]</sup> The worsening of CVDs has been associated with behavior factors such as childhood obesity, unhealthy dietary habits, increased smoking, and increased physical inactivity.<sup>[16]</sup> The disease is also the leading cause of disability in the form of disability adjusted life years (DALYs). There was a total loss of 85 million DALYs in 1990 and projected to reach approximately 150 million by the year 2020.<sup>[17]</sup>

Although, CVDs do not occur in children, the risk factors that bring about the disease begin during the adolescent age. In Ghana, CVDs were the cause of 40.6% deaths due to non-communicable diseases (NCDs).<sup>[12]</sup> A review of autopsy cases (19,289) in Ghana reported that 22.2% of the cases were as a result of CVDs.<sup>[18]</sup> The WHO (7) has indicated that NCD is the cause of 34% of all deaths in Ghana with CVD being the leading cause of NCD death. Also in Ghana, stroke and coronary heart disease (CHD) were ranked as the second and fourth causes of deaths in 2014.<sup>[19]</sup>

## 4.2 Risk Factors of Cardiovascular Diseases among Secondary School Students

Risk factors of CVDs are physical inactivity, unhealthy diet, overweight, obesity, smoking, alcohol consumption, and hypertension.

### 4.2.1 Physical Inactivity

There is an association between physical inactivity and CVDs<sup>[20-22]</sup> and performing some levels of physical activity of at least 60 minutes daily reduces the risk of obesity, blood pressure, and raised blood sugar.<sup>[2,23,24]</sup> Insufficient physical activity is the cause of 30% coronary heart disease (CHD) and 27% diabetes burden.<sup>[23]</sup> A meta-analysis of cohort studies<sup>[25]</sup> reported that moderate and high physical activities could reduce stroke and CHD between 20-30% in men and 10-20% in women. Studies have indicated that levels of physical activity drops during childhood and the drop is even

higher during the adolescent age.<sup>[26,27]</sup> There were 81% adolescents (11-17 years) worldwide who were physically inactive in 2010 and this level is second in Africa with Western pacific (85%) after the Eastern Mediterranean regions (88%).<sup>[1]</sup>

A study among secondary school students by Parobii et al.<sup>[28]</sup> reported that barriers to exercises included the lack of access and availability of physical activity opportunities both within and outside the school premises. A research in 34 countries in five WHO regions which included Ghana among 72845 children (11-15 years) reported that majority of them were physically inactive.<sup>[29]</sup> Owusu<sup>[30]</sup> in a nationwide survey among secondary school students reported that only 18.7% of students were physically active. Another study among 15-24 year old in Ghana reported that 84.1% were physically inactive.<sup>[31]</sup> Mogre et al.,<sup>[32]</sup> reported that 32.2% of students were physically inactive. Another study showed that 17% of the students were physically inactive in Ghana.<sup>[33]</sup>

### 4.2.2 Unhealthy Diet

Unhealthy diets are closely related to CVD risk factors such blood pressure, overweight, obesity, serum cholesterol and diabetes.<sup>[34,35]</sup> There were some 1.7 million deaths globally in 2012 as a results of low consumption of fruits and vegetables.<sup>[1]</sup> It has also been reported that adequate consumption of fruits and vegetables reduces the risk of CVDs.<sup>[36]</sup> Duma-Kocan et al.<sup>[37]</sup> reported in their study that the school going age students are the most vulnerable to poor nutrition. Eating pattern formed during childhood has a long term effect on the adult a person may become.<sup>[38]</sup> Unhealthy eating behaviors are predominantly high among adolescents; for instance, there is low consumption of fruits and vegetables while soft drinks and other sweets are high.<sup>[39]</sup> A review by Pearson and Biddle<sup>[40]</sup> reported of high intake of fried foods and energy dense snacks. Unhealthy eating habits are closely related to peer

pressure. This suggest that the higher the peer pressure, the higher the unhealthy eating habits.<sup>[41]</sup> Salt is major risk factor of hypertension. Consumption of salt globally (5g/day) is higher than the recommended daily intake of between 9-12g per person and too much fat predisposes an individual at high risk of obesity and coronary heart disease.<sup>[7]</sup> A study among secondary school students in Ghana reported that adolescents are likely to be influenced by peers on their food habits.<sup>[41]</sup> Nti et al.<sup>[42]</sup> reported in his study that students' dietary habits in Ghana were poor, while Amoh & Appiah-Brempong<sup>[43]</sup> indicated in their study that the intake of energy dense foods, sweet snacks and sodas were high among secondary school students.

#### 4.2.3 Obesity and Overweight

Obesity has become a major health problem in recent times. Prevalence of obesity is one of the main health challenge of our time because it starts as early as childhood.<sup>[44]</sup> Obesity is an important risk factor of high blood pressure and high cholesterol,<sup>[45]</sup> diabetes<sup>[46]</sup> and CVDs.<sup>[47,48]</sup> Doak et al.<sup>[49]</sup> reported in their study that the increases in the prevalence of childhood overweight and obesity were due to changes in economic, social, and the physical environment that was related to nutritional transition. Black et al.<sup>[50]</sup> reported that overweight children are at a high risk of diseases and premature deaths. On the other hand, children who are obese are at a higher risk of poor physical health, which is a major determinant of psychological and physiological health risk in adult life.<sup>[51]</sup> People who are obese are 50%-70% risk of developing CVDs.<sup>[52]</sup> Again, a higher BMI is associated with a high risk of diabetes, CVDs and premature death.<sup>[53]</sup> A study in Ghana among students reported that 11.7% were overweight while 2.9% were obese.<sup>[33]</sup> In another study by Kumah et al.,<sup>[54]</sup> 12.2% and 0.8% students were overweight and obese respectively. In a nationwide study in Ghana, students who were overweight and obese accounted for 8%.<sup>[12]</sup> Owusu<sup>[30]</sup>

reported in his study that 6.6% and 1.2% were overweight and obese respectively in Ghana. There is some evidence that suggests that lifestyle interventions on modifiable risk factors of CVDs may prevent the onset of obesity and future risk of diabetes.<sup>[55]</sup>

#### 4.2.4 Smoking

Tobacco use has reached epidemic levels and has become a major risk factor of CVDs<sup>[56,57]</sup> and one of the main preventable causes of deaths.<sup>[58,59]</sup> There were about one billion smokers worldwide in 2012 and an estimated 12% and 7% men and women deaths respectively due to smoking.<sup>[1]</sup> People who smoke are 2-3 times at risk of death than those who do not smoke.<sup>[60]</sup> A study in China by Xu et al.<sup>[61]</sup> among secondary school students found that 9% of the students smoke and 81% of the students had not been taught on smoking prevention in school. Rate of smoking among adolescents have been increasing and children are smoking as early as 10 years.<sup>[62]</sup> Tobacco smoke was the cause of 27.1% and 1% deaths among males and females respectively in Ghana in 2010.<sup>[63]</sup> Also, in 2013, 4.5% boys and 2.9% girls smoked cigarette each day. Owusu<sup>[30]</sup> in his study among secondary school students reported that 45.4% smokers tried smoking at age  $\leq 13$  years. Yet another study in Ghana among secondary school students reported that 2.4% and 1.4% males and females respectively were smokers.<sup>[64]</sup>

#### 4.2.5 Alcohol

Alcohol consumption was the cause of 3.8% of worldwide death in 2003.<sup>[7]</sup> Alcohol intake is a major risk factor of CVDs<sup>[65,66]</sup> and high blood pressure<sup>[67]</sup> Alcohol use is the cause of cardiac arrhythmias, cardiomyopathy and hemorrhagic stroke.<sup>[68]</sup> Briasoulis et al.<sup>[67]</sup> reported in their study that alcohol consumption alone is a single risk factor for hypertension. A prospective study<sup>[69]</sup> in Japan among 47,000 women heavy drinkers reported that alcohol consumption was



associated with stroke. The per capita consumption of alcohol in 2010 was 6.2 liters, 6.0 liters and 4.8 liters worldwide, Africa and Ghana respectively. A research among 894 secondary school students in Ghana indicated that 25.1% of the students were consumers of alcohol.<sup>[70]</sup> Another study reported a prevalence of 15.8%.<sup>[30]</sup> Nkyi<sup>[71]</sup> and Adu-Mireku<sup>[72]</sup> in their studies among secondary school students reported that 44.9% and 25.1% respectively consumes alcohol.

#### 4.2.6 Hypertension

People who are hypertensive are at greater risk of developing CVDs<sup>[73,74]</sup> and could reduce morbidity and mortality as a result of CVDs when controlled.<sup>[75]</sup> Global prevalence of hypertension is 22% and this is expected to increase by 2025.<sup>[76]</sup> Similarly, hypertension is highest in the WHO region of Africa (30%) compared to that of the Americas (18%). Also people at age 30 years with hypertension develop CVDs five years earlier.<sup>[77]</sup> According to the GHS,<sup>[78]</sup> prevalence of adult hypertension in Ghana is up to 48% and has been ranked among the top ten outpatient causes of morbidity and mortality. In 2012, there were about 964,724 newly reported cases of hypertension in outpatient department of hospitals in Ghana.<sup>[13]</sup> Prevalence of hypertension has been increasing among children and adolescents and this persists in adulthood.<sup>[79-81]</sup> There are however, limited research on hypertension among secondary school students in Ghana. A study among the youth of 12-24 years in Ghana reported that 4% were found to be hypertensive.<sup>[31]</sup> Some secondary school-based studies have reported prevalence of hypertension of 10.1% in Congo,<sup>[82]</sup> 11% in Sudan,<sup>[83]</sup> and 5.4% in Nigeria.<sup>[84]</sup>

Some studies have shown distribution of hypertension by age and gender. Age is an independent risk factor of developing hypertension and CVDs. In the process of aging there is deterioration in both structure and function of the heart and the vascular system which may lead to

hypertension and subsequently to CVDs (Sung & Dyck, 2012).

A study among students in Turkey found that there was an association between increasing age and hypertension (OR 4.5; 95% CI 2.94–6.96) (Mayega et al., 2012). Gender is also a non-modifiable risk factor of hypertension and CVDs. Men are at greater risk of developing hypertension and CVD than women at pre-menopausal stage but once women get past this stage they become similar with men which is due to loss of female sex hormones at the time of menopause.<sup>[85]</sup> Maas & Appelman (2010)<sup>[86]</sup> reported that CVD develops between 7-10 years later in females than in males and it may be as a result of perceived protection of estrogen in reproductive life which delays the onset of arteriosclerosis in women. A study was conducted to measure calcium volume levels in different chest beds in elderly men and women with severe aortic stenosis. The results showed a significant gender total mean difference of calcium of coronary artery with men having the greatest levels of calcification. The same was for aortic valves calcium with men having the significant higher levels.<sup>[87]</sup>

#### 4.3 Prevention of CVD Risk Factors among Students

Cardiovascular diseases are the leading causes of death in Ghana and despite all the measures put in place to control the condition, the disease keep on rising among adults.<sup>[12,13]</sup> It is also known that risk factors of the disease begin as early as in childhood that persists during adulthood and therefore measures must be taken to tackle the disease right from childhood. Because CVDs are behavioral, it can therefore be prevented if cost effective intervention that reduces risk factors of the disease are made available to secondary school students.<sup>[88]</sup> It is also important to tackle all the risk factors of the disease since tackling some could still predisposes the student to CVDs in adult life. Some studies has shown that interventions in schools yielded positive results<sup>[89,90]</sup> and also a good

environment for health interventions.<sup>[91-93]</sup> To ensure success of interventions, it should be interactive, interesting, and should involve the ministry of education, headmasters, teachers, parent teacher association chairpersons, and parents alike.

These interventions begin with baseline assessments and intervention modules are implemented to tackle risk factors among students. They are mainly in the form of educational components and practical modules to equip students. The educational components could be in the form of general education CVDs, risk factors, prevention amongst others. The practical modules are certain practical skills taught during the study. This could be for instance how to do some form of moderate to vigorous physical activities, taking BMI, and blood pressure using simple readily available equipments. Some interventions aim to train students not to protect themselves from CVDs only, but to act as change agents among their peers and in the home.

Some school-based intervention studies showed positive results at the end of the studies. Cai et al.<sup>[94]</sup> conducted a meta-analysis of interventions to reduce prevalence of hypertension. The results showed a pooled effect of -1.64 mmHg (95% CI: -2.56, - 0.71;  $p = 0.001$ ) for systolic blood pressure and -1.44 (95% CI: - 2.28, - 0.60;  $p= 0.001$ ) for diastolic blood pressure. Mei et al.<sup>[95]</sup> in their meta-analysis of randomized controlled trials undertaken to assess impact of physical activities on BMI. The findings from the study compared to the control showed a reduction in BMI (2.23 kg/m) which was statistically significant ( $p < 0.05$ ). Lonsdale et al.<sup>[96]</sup> conducted a meta-analysis of school based physical activity interventions. The researchers reported that students in the intervention spent a pooled effect of 24% more moderate-vigorous physical activities compared to the control group. Yet another meta-analysis on smoking and alcohol prevention showed that the odds of smoking was lower among students who received

intervention 0.78 (95% CI: 0.62-0.99;  $p= 0.040$ ) and 0.80 (95% CI: 0.65-0.99;  $p= 0.001$ ) for alcohol.<sup>[97]</sup>

## CONCLUSION AND RECOMMENDATION

Cardiovascular disease is a major public health problem in Ghana and one of the leading causes of death. Risk factors of the disease have been increasing among secondary school students. Also, since risk factors of the disease begin in childhood that persist in adulthood, the Ghana Health Service and public health professionals should develop appropriate interventions among secondary school students and adolescents as soon as possible to reduce risk factors of the disease to curb the growing epidemic.

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### Authors' contributions

JA: Search of literature and manuscript writing

SMS: Review of manuscript and supervision

LR: Review of manuscript and supervision

RAM: Review of manuscript and supervision

NI: Review of manuscript and supervision

LA: Review of manuscript and supervision

All authors reviewed and approved the final manuscript.

## REFERENCES

1. World Health Organization. Global status report on noncommunicable diseases 2014 "Attaining the nine global noncommunicable diseases targets; a shared responsibility." Geneva; 2014.
2. World Health Organization. Media Centre: Cardiovascular (CVDs) key facts. 2015 [cited 2015 Nov 21]. Available from: <http://www.who.int/mediacentre/factsheets/fs317/en/>
3. Yusuf S, Wood D, Ralston J, Reddy KS. The World Heart Federation 's vision

- for worldwide cardiovascular disease prevention. *Lancet*. 2015;386:399–402.
4. Roth GA, Forouzanfar MH, Morgan AE. Demographic and Epidemiologic Drivers of Global Cardiovascular Mortality. *N Engl J Med*. 2015;1333–41.
  5. Abanilla PK, Huang K-Y, Shinnars D, Levy A, Ayernor K, de-Graft Aikins A, et al. Cardiovascular disease prevention in Ghana: feasibility of a faith-based organizational approach. *Bull World Health Organ*. 2011;89(9):648–56.
  6. Pearson TA, Blair SN, Daniels SN, Eckel RH, Fair JM, Fortmann SP, et al. AHA Guidelines for Primary Prevention of Cardiovascular Disease and Stroke: 2002 Update: Consensus Panel Guide to Comprehensive Risk Reduction for Adult Patients Without Coronary or Other Atherosclerotic Vascular Diseases. *Circulation*. 2002;106(3):388–91.
  7. World Health Organization. Global status report on noncommunicable diseases 2010, Geneva. 2011.
  8. Ezzati M, Riboli E. Behavioral and Dietary Risk Factors for Noncommunicable Diseases. *N Engl J Med*. 2013;369(10):954–64.
  9. World Heart Federation. Heart fact sheet on Cardiovascular diseases [Internet]. 2015 [cited 2015 Nov 21]. Available from: <http://www.world-heart-federation.org/heart-facts/fact-sheets/cardiovascular-disease-terms/>
  10. Juonala M, Viikari JSA, Kahonen M, Taittonen L, Laitinen T, Hutri-Kahonen N, et al. Life-time risk factors and progression of carotid atherosclerosis in young adults: the Cardiovascular Risk in Young Finns study. *Eur Heart J*. 2010;31(14):1745–51.
  11. Woodgate RL, Sigurdson CM. Building school-based cardiovascular health promotion capacity in youth: a mixed methods study. *BMC Public Health*. 2015;15(421):1–11.
  12. Ministry of Health. Strategy for the Management, Prevention and Control of Chronic Non-Communicable Diseases in Ghana 2012-2016. Accra; 2012.
  13. Ghana Health Service. 2014 Annual Report. Accra; 2015.
  14. Beaglehole R, Bonita R. Global public health: a scorecard. *Lancet*. 2008;6736(08):1–9.
  15. Mahmood SS, Levy D, Vasan RS, Wang TJ. The Framingham Heart Study and the epidemiology of cardiovascular disease: a historical perspective. *Lancet*. 2014;383(9921):999–1008.
  16. Institute of Medicine. Promoting Cardiovascular Health in the Developing World: A Critical Challenge to Achieve Global Health. Washington, DC: The National Academic Press; 2010.
  17. Perk J, Helmut G, Graham I, Reiner Z, Verschuren WMM. European Guidelines on cardiovascular disease prevention in clinical practice (version 2012). *Eur Heart J*. 2012;33:1635–701.
  18. Sanuade O, Anarfi J, Aikins A, Koram K. Patterns of cardiovascular disease mortality in Ghana: a 5-year review of autopsy cases at Korle-Bu Teaching Hospital. *Eur PMC*. 2014;24(1):55–9.
  19. World Health Rankings: Health Profile Ghana [Internet]. 2014 [cited 2016 Jan 26]. Available from: <http://www.worldlifeexpectancy.com/country-health-profile/ghana>
  20. Archer E, Blair SN. Physical Activity and the Prevention of Cardiovascular Disease: From Evolution to Epidemiology. *Prog Cardiovasc Dis*. 2011;53(6):387–96.
  21. Chomistek AK, Manson JE, Stefanick ML, Lu B, Sands-Lincoln M, Going SB, et al. Relationship of sedentary behavior and physical activity to incident cardiovascular disease: Results from the women's health initiative. *J Am Coll Cardiol*. 2013;61(23):2346–54.
  22. Myers J, McAuley P, Lavie CJ, Despres JP, Arena R, Kokkinos P. Physical Activity and Cardiorespiratory Fitness as Major Markers of Cardiovascular Risk: Their Independent and Interwoven Importance to Health Status. *Prog Cardiovasc Dis*. 2015;57(4):306–14.
  23. World Health Organization. Global recommendations on physical activity for health. 2010.
  24. Hills AP, Dengel DR, Lubans DR. Supporting Public Health Priorities: Recommendations for Physical Education and Physical Activity

- Promotion in Schools. *Prog Cardiovasc Dis.* 2015;57(4):368–74.
25. Li J, Siegrist J. Physical activity and risk of cardiovascular disease—a meta-analysis of prospective cohort studies. *Int J Environ Res Public Health.* 2012;9(2):391–407.
  26. Nader PR, Bradley RH, Houts RM, Mcritchie SL, O'Brien M. Moderate-to-Vigorous Physical From Ages 9 to 15 Years. *Am J Assoc.* 2008;300(3):295–305.
  27. Dumith SC, Gigante DP, Domingues MR, Kohl HW. Physical activity change during adolescence: A systematic review and a pooled analysis. *Int J Epidemiol.* 2011;40(3):685–98.
  28. Parobii I, Springer A., Harrell M., Gomensoro L., Fresco M., Alers N, et al. students in Montevideo , Uruguay : A qualitative study. *Int J Child Adolesc Heal.* 2018;11(1):47–56.
  29. Guthold R, Cowan MJ, Autenrieth CS, Kann L, Riley LM. Physical Activity and Sedentary Behavior Among Schoolchildren: A 34-Country Comparison. *J Pediatr.* 2010;157(1):43–49.e1.
  30. Owusu A. Global School-Based Student Health Survey (GSHS): Ghana report. 2008.
  31. Afrifa-Anane E, Agyemang C, Codjoe SNA, Ogedegbe G, de-Graft Aikins A. The association of physical activity, body mass index and the blood pressure levels among urban poor youth in Accra, Ghana. *BMC Public Health.* 2015;15(1):269.
  32. Mogre V, Aneyire ES, Gyamfi EK. Physical activity and BMI status of school-age children in Tamale, Northern Ghana. *Pakistan J Nutr.* 2013;12(5):484–90.
  33. Nyawornota VK, Aryeetey R, Bosomprah S, Aikins M. An exploratory study of physical activity and over-weight in two senior high schools in the Accra Metropolis. *Ghana Med J.* 2013;47(4):197–203.
  34. Verschuren WMM. Diet and cardiovascular disease. *Curr Cardiol Rep.* 2012;14(6):701–8.
  35. Mendonc RDD, Marc A, Gea A, Fuente-arriaga C De, Martinez-gonzalez MA, Cristine A, et al. Ultraprocessed food consumption and risk of overweight and obesity: the University of Navarra Follow-Up ( SUN ) cohort study. *Am J Clin Nutr.* 2016;104(5):1433–40.
  36. Boeing H, Bechthold A, Bub A, Ellinger S, Haller D, Kroke A, et al. Critical review: Vegetables and fruit in the prevention of chronic diseases. *Eur J Nutr.* 2012;51:637–63.
  37. Duma-Kocan P, Barud B, Głodek E, Gil M. Assessment of nutritional habits and preferences among secondary school students. *PubMed.* 2017;68(1):91–7.
  38. Croll JK, Neumark-Sztainer D, Story M. Healthy eating: what does it mean to adolescents? *J Nutr Educ.* 2001;33(4):193–8.
  39. van Kooten M, de Ridder D, Vollebergh W, van Dorsselaer S. What's so special about eating? Examining unhealthy diet of adolescents in the context of other health-related behaviours and emotional distress. *Appetite.* 2007;48:325–32.
  40. Pearson N, Biddle SJH. Sedentary behavior and dietary intake in children, adolescents, and adults: A systematic review. *Am J Prev Med.* 2011;41(2):178–88.
  41. Amos PM, Intiful FD, Boateng L. Factors that were found to influence Ghanaian Adolescents' Eating Habits. *SAGE Open.* 2012;2(4):1–6.
  42. Nti CA, Brown A, Danquah A. Adolescents ' Knowledge of Diet-Related Chronic Diseases and Dietary Practices in Ghana. *Food Nutr Sci.* 2012;1527–32.
  43. Amoh I, Appiah-Brempong E. Prevalence and risk factors of obesity among senior high school students in the Adansi North district of Ghana Prevalence and risk factors of obesity among senior high school students in the Adansi North district of Ghana. *J Community Med Public Heal.* 2017;4(10):3762–9.
  44. Bastien M, Poirier P, Lemieux I, Després J. Overview of Epidemiology and Contribution of Obesity to Cardiovascular Disease. *Prog Cardiovasc Dis.* 2014;56(4):369–81.
  45. Brady C. Decreasing Obesity and Obesity Stigma : Socio-Demographic Differences in Beliefs about Causes of



- and Responsibility for Obesity. *Soc Sci.* 2016;5(12):1–10.
46. Cawley J, Meyerhoefer C, Biener A, Hammer M, Wintfeld N. Savings in Medical Expenditures Associated with Reductions in Body Mass Index Among US Adults with Obesity, by Diabetes Status. *Pharmacoeconomics.* 2015;33:707–22.
  47. Chrostowska M, Szyndler A, Hoffmann M, Narkiewicz K. Impact of obesity on cardiovascular health. *Best Pract Res Clin Endocrinol Metab.* 2013;27:147–56.
  48. Schutter A De, Lavie CJ, Milani R V. The Impact of Obesity on Risk Factors and Prevalence and Prognosis of Coronary Heart Disease — The Obesity Paradox. *Prog Cardiovasc Dis.* 2014;56(4):401–8.
  49. Doak CM, Visscher TLS, Renders CM, Seidell JC. The prevention of overweight and obesity in children and adolescents: a review of interventions and programmes. *Obes Rev.* 2006;7(1):111–36.
  50. Black JA, Park M, Gregson J, Falconer CL, White B. Child obesity cut-offs as derived from parental perceptions: *Br J Gen Pract.* 2015;65(633):234–9.
  51. Robertson W, Murphy M, Johnson R. Evidence base for the prevention and management of child obesity. *Paediatr Child Health (Oxford).* 2016;1–7.
  52. DeBoer MD. Obesity, systemic inflammation, and increased risk for cardiovascular disease and diabetes among adolescents: A need for screening tools to target interventions. *Nutrition.* 2013;29(2):379–86.
  53. Kelly AS, Barlow SE, Rao G, Inge TH, Hayman LL, Steinberger J, et al. Severe Obesity in Children and Adolescents: Identification, Associated Health Risks, and Treatment Approaches. *American Health Association.* 2013. p. 1689–713.
  54. Kumah DB, Akuffo KO, Abaka-Cann JE, Affram DE, Osa E. Prevalence of Overweight and Obesity among Students in the Kumasi Metropolis. *J Nutr Metab.* 2015;2015:1–4.
  55. Obirikorang Y, Obirikorang C, Anto EO, Acheampong E, Dzah N, Akosah CN, et al. Knowledge and Lifestyle-Associated Prevalence of Obesity among Newly Diagnosed Type II Diabetes Mellitus Patients Attending Diabetic Clinic at Komfo Anokye Teaching Hospital, Kumasi, Ghana: A Hospital-Based Cross-Sectional Study. *Diabetes Res.* 2016;2016:1–10.
  56. Filion KB, Luepker R V. Cigarette smoking and cardiovascular disease: Lessons from Framingham. *Glob Heart.* 2013;8(1):35–41.
  57. Katsiki N, Papadopoulou SK, Fachantidou AI, Mikhailidis DP. Smoking and vascular risk: Are all forms of smoking harmful to all types of vascular disease? *Public Health.* 2013;127(5):435–41.
  58. Li K, Yao C, Di X, Yang X, Dong L, Xu L, et al. Smoking and Risk of All-cause Deaths in Younger and Older Adults. *Medicine (Baltimore).* 2016;95(3):e2438.
  59. Thomas RE, Baker P, Thomas BC. Family-based interventions in preventing children and adolescents from using tobacco: A systematic review and meta-analysis. *Acad Pediatr.* 2016;
  60. Carter BD, Abnet CC, Feskanich D, Freedman ND, Hartge P, Lewis CE, et al. Smoking and Mortality - Beyond Established Causes. *N Engl J Med.* 2015;372(7):631–40.
  61. Xu X-L, Zhu R, Sharma M, Deng S, Liu S, Liu D-Y, et al. Smoking attitudes between smokers and non-smoker secondary school students in three geographic areas of China: a cross-sectional survey based on social cognitive theory. *Lancet.* 2015;386:78.
  62. World Health Organization. Cardiovascular Diseases in the African Region: Current Situation and Perspective. 2005.
  63. The Tobacco Atlas Country Fact Sheet, Ghana. 2015.
  64. Mamudu H, Veeranki S. Tobacco Use Among School-Going Adolescents (11–17 Years) in Ghana. *Nicotine Tob Res.* 2013;15(8):1355–64.
  65. Holmes M V, Dale CE, Zuccolo L, Silverwood RJ, Guo Y, Ye Z, et al. Association between alcohol and cardiovascular disease: Mendelian randomisation analysis based on

- individual participant data. *BMJ*. 2014;349(jul10\_6):g4164.
66. Shakeshaft A, Doran C, Petrie D, Breen C, Havard A, Abudeen A, et al. The Effectiveness of Community Action in Reducing Risky Alcohol Consumption and Harm: A Cluster Randomised Controlled Trial. *PLoS Med*. 2014; 11(3).
67. Briasoulis A, Agarwal V, Messerli FH. Alcohol Consumption and the Risk of Hypertension in Men and Women: A Systematic Review and Meta-Analysis. *J Clin Hypertens*. 2012;14(11):792–8.
68. Movva R, Figueredo VM. Alcohol and the heart: To abstain or not to abstain? *Int J Cardiol*. 2013;164(3):267–76.
69. Ikehara S, Iso H, Yamagishi K, Kokubo Y, Saito I, Yatsuya H, et al. Alcohol consumption and risk of stroke and coronary heart disease among Japanese women: The Japan Public Health Center-based prospective study. *Prev Med (Baltim)*. 2013;57(5):505–10.
70. Opong Asante K, Meyer-Weitz A, Petersen I. Substance use and risky sexual behaviours among street connected children and youth in Accra, Ghana. *Subst Abuse Treat Prev Policy*. 2014;9(1):45.
71. Nkyi A. Substance Abuse among Senior High School Students in Ghana. *Int J Soc Sci Educ*. 2014;4(2):346–53.
72. Adu-Mireku S. The Prevalence of Alcohol, Cigarette, and Marijuana Use Among Ghanaian Senior Secondary Students in an Urban Setting. *J Ethn Subst Abuse*. 2003;2(1):53–65.
73. Gooding HC, Mcginty S, Richmond TK, Gillman MW, Field AE. Hypertension Awareness and Control Among Young Adults in the National Longitudinal Study of Adolescent Health. *J Gen Intern Med*. 2014;29(8):1098–104.
74. Kuciene R, Dulskiene V. Associations of short sleep duration with prehypertension and hypertension among Lithuanian children and adolescents: a cross-sectional study. *BMC Public Health*. 2014;14(255):1–8.
75. Falaschetti E, Mindell J, Knott C, Poulter N. Hypertension management in England: a serial cross-sectional study from 1994 to 2011. *Lancet*. 2014;383: 1912–9.
76. Boateng GO, Luginaah IN, Taabazuing M-M. Examining the Risk Factors Associated With Hypertension Among the Elderly in Ghana. *J Aging Health*. 2015;1–23.
77. Rapsomaniki E, Timmis A, George J, Pujades-Rodriguez M, Shah AD, Denaxas S, et al. Blood pressure and incidence of twelve cardiovascular diseases: Lifetime risks, healthy life-years lost, and age-specific associations in 1.25 million people. *Lancet*. 2014; 383(9932):1899–911.
78. Ghana Health Service. 2016 Annual Report. Accra. 2017.
79. Chen X, Wang Y. Tracking of Blood Pressure From Childhood to Adulthood A Systematic Review and Meta – Regression Analysis. *Circulation*. 2008; 117:3171–80.
80. Spagnolo A, Giussani M, Ambruzzi AM, Bianchetti M, Maringhini S, Matteucci MC, et al. Focus on prevention , diagnosis and treatment of hypertension in children and adolescents. *Ital J Pediatr*. 2013;39(20): 1–18.
81. Thompson M, Dana T, Bougatsos C, Blazina I, Norris SL. Screening for Hypertension in Children and Adolescents to Prevent Cardiovascular Disease abstract. *Am Acad Padiatr*. 2013;131(3):490–525.
82. Mbolla BFE, Okoko A., Babela JRM, Bowassa GE, Gombet T, Kimbally-Kaki S-G, et al. Prehypertension and Hypertension among Schoolchildren in Brazzaville , Congo. *Int J Hypertens*. 2014;2014:1–7.
83. Abdalla EAM, Edrees A, Mohammedahmed AA. Prevalence of Hypertension among Secondary School Students in Umbada Area Block 14 ” i n Khartoum State-Sudan. *J Dent Med Sci*. 2016;15(12):74–8.
84. Ujunwa FA, Ikefuna AN, Nwokocha AR, Chinawa JM. Hypertension and prehypertension among adolescents in secondary schools in Enugu, South East Nigeria. *Ital J Pediatr*. 2013;39(70):1–6.
85. Mendelsohn ME, Karas RH. Molecular and Cellular Basis of Cardiovascular

- Gender Differences. *Science* (80-). 2005;308(5728):1583–7.
86. Maas AHEM, Appelman YEA. Gender differences in coronary heart disease. *Netherlands Hear J*. 2010;18(12):598–603.
87. Liyanage L, Lee NJ, Cook T, Herrmann HC, Jagasia D, Han Y. The impact of gender on cardiovascular system calcification in very elderly patients with severe aortic stenosis. *Int J Cardiovasc Imaging*. 2016;32:173–9.
88. Mendis S, Lindholm LH, Anderson SG, Alwan A, Koju R, Onwubere BJC, et al. Total cardiovascular risk approach to improve efficiency of cardiovascular prevention in resource constrain settings. *J Clin Epidemiol*. 2011;64(12):1451–62.
89. Adab P, Pallan MJ, Lancashire ER, Hemming K, Frew E, Griffin T, et al. A cluster-randomised controlled trial to assess the effectiveness and cost-effectiveness of a childhood obesity prevention programme delivered through schools, targeting 6-7 year old children: the WAVES study protocol. *BMC Public Health*. 2015;15(1):488.
90. He FJ, Wu Y, Feng X-X, Ma J, Ma Y, Wang H, et al. School based education programme to reduce salt intake in children and their families (School-EduSalt): cluster randomised controlled trial. *BMJ*. 2015;350:h770.
91. Campbell R, Starkey F, Holliday J, Audrey S, Bloor M, Parry-Langdon N, et al. An informal school-based peer-led intervention for smoking prevention in adolescence (ASSIST): a cluster randomised trial. *Lancet*. 2008;371(9624):1595–602.
92. Khambalia AZ, Dickinson S, Hardy LL, Gill T, Baur LA. A synthesis of existing systematic reviews and meta-analyses of school-based behavioural interventions for controlling and preventing obesity. *Obes Rev*. 2012;13:214–33.
93. Ploeg KA Vander, Maximova K, Mcgavock J, Davis W, Veugelers P. Do school-based physical activity interventions increase or reduce inequalities in health? *Soc Sci Med*. 2014;112:80–7.
94. Cai L, Wu Y, Wilson RF, Segal JB, Kim MT, Wang Y. Effect of Childhood Obesity Prevention Programs on Blood Pressure: A Systematic Review and Meta-Analysis. *Circulation*. 2014;113:1–34.
95. Mei H, Xiong Y, Xie S, Guo S, Li Y, Guo B, et al. The impact of long-term school-based physical activity interventions on body mass index of primary school children – a meta-analysis of randomized controlled trials. *BMC Public Health*. 2016;1–12.
96. Lonsdale C, Rosenkranz RR, Sanders T, Peralta LR, Bennie A, Jackson B, et al. A cluster randomized controlled trial of strategies to increase adolescents' physical activity and motivation in physical education: Results of the Motivating Active Learning in Physical Education (MALP) trial. *Prev Med (Baltim)*. 2013;57(5):696–702.
97. Macarthur GJ, Harrison S, Caldwell DM, Hickman M, Campbell R. Peer-led interventions to prevent tobacco, alcohol and/or drug use among young people aged 11-21 years: A systematic review and meta-analysis. *Addiction*. 2016;111(3):391–407.

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