



UNIVERSITI PUTRA MALAYSIA

***EFFECTIVENESS OF BEHAVIORAL MODIFICATION INTERVENTION
TO REDUCE CARDIOVASCULAR DISEASE RISK FACTORS AMONG
PUBLIC SECONDARY SCHOOL STUDENTS
IN BRONG AHAFO, GHANA***

JOHN AMOAH

FPSK(p) 2019 20



**EFFECTIVENESS OF BEHAVIORAL MODIFICATION INTERVENTION
TO REDUCE CARDIOVASCULAR DISEASE RISK FACTORS AMONG
PUBLIC SECONDARY SCHOOL STUDENTS
IN BRONG AHAFO, GHANA**

By

JOHN AMOAH

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,
in Fulfilment of the Requirements for the Degree of Doctor of Philosophy**

July 2019

COPYRIGHT

All material contained within the thesis, including without limitation text, logos, icons, photographs, and all other artwork, is copyright material of Universiti Putra Malaysia unless otherwise stated. Use may be made of any material contained within the thesis for non-commercial purposes from the copyright holder. Commercial use of material may only be made with the express, prior, written permission of Universiti Putra Malaysia.

Copyright © Universiti Putra Malaysia



Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

**EFFECTIVENESS OF BEHAVIORAL MODIFICATION INTERVENTION
TO REDUCE CARDIOVASCULAR DISEASE RISK FACTORS AMONG
PUBLIC SECONDARY SCHOOL STUDENTS
IN BRONG AHAFO, GHANA**

By

JOHN AMOAH

July 2019

Chairman : Salmiah binti Md Said, MD, M. Comm. Med
Faculty : Medicine and Health Sciences

Globally, cardiovascular disease (CVD) was responsible for 17.5 million deaths, accounting for 46.2% of non-communicable diseases (NCDs) deaths. In Ghana CVDs has been the leading cause of death since 2001. The prevalence of CVD risk factors among adolescents and adults in Ghana has been increasing. The main aim of this study were to develop, implement and evaluate the effectiveness of a behavioral modification intervention program to reduce cardiovascular disease risk factors among secondary school students in Brong Ahafo, Ghana. The study was a single blind cluster randomized controlled trial. Baseline data was collected from 848 students after which schools were evenly randomized using block randomization (1:1 ratio) of two digit blocks (A and B). School-based intervention was implemented using the Information-Motivation-Behavioral skills (IMB) model to reduce CVD risk factors over a period of six months with pre and post intervention evaluations. The intervention module included a health education and physical activity modules in the intervention schools. The control schools went on with their normal school curriculum and were waitlisted for similar intervention after the study. Follow-up data using same questionnaire were collected within two weeks after the intervention was completed. The primary outcomes were knowledge, motivation, behavioral skills, physical activity, smoking, alcohol, dietary intake, while weight, body mass index, and blood pressure were secondary outcomes. Weight, height and blood pressure were measured using standardized equipments by trained health staff. Intention-to-treat analysis was performed after replacing missing values using multiple imputation method. The generalized linear mixed model (GLMM) was used to test the effect of group, time and group-time interactions after controlling for nine potential confounders. The GLMM analyses showed the intervention was significant in attaining 6.85($p<0.001$), 0.90($p<0.001$), 0.94($p<0.001$), 0.77($p<0.001$), 0.72($p<0.001$), 0.47($p<0.001$), 0.56($p<0.001$), and 0.39($p=0.045$) higher total knowledge, motivation, behavioral

skills, physical activity, fruits, vegetables, seafood, and water scores respectively for the intervention group over the control group. The intervention was also significant in reducing -0.15($p<0.001$), -0.23($p<0.001$), -0.50($p<0.001$), -0.32($p<0.001$), -0.90($p<0.001$), -0.87($p<0.001$), -0.38($p<0.001$), -0.63($p<0.001$), -1.63($p<0.001$), -0.61($p<0.001$), and -1.53($p=0.005$) carbohydrates, fats and oils, fried eggs, fried chicken, carbonated drinks, sugar, sweet snacks, salted fish, weight, BMI, and diastolic BP. The ‘odds’ of quitting alcohol use in the intervention group was 1.06 times more than in control group. There was no significant effect for groups on smoking, but group-time interaction was significant ($F(1,101) = 5.07, p=0.027$) and the odds of quitting smoking in the intervention group was 6.13 times more than the control group ($t=2.251, p=0.027$). There was no significant effect of the intervention on reducing systolic BP. The intervention had a positive effect on increasing physical activity levels, promoting healthy dietary habits, reducing smoking habits and alcohol consumption, weight, BMI, diastolic BP and improving CVD knowledge, motivation and behavioral skills among students in the intervention arm of the study but had no effect on systolic BP. The findings from this study is recommended to be adopted as part of the educational curricula in secondary schools in Brong Ahafo, Ghana.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

**KEBERKESANAN INTERVENSI MODIFIKASI TINGKAH LAKU UNTUK
PENGURANGAN FAKTOR RISIKO PENYAKIT KARDIOVASKULAR
DALAM KALANGAN PELAJAR SEKOLAH MENENGAH AWAM
DI BRONG AHAFO, GHANA**

Oleh

JOHN AMOAH

Julai 2019

Pengerusi : Salmiah binti Md Said, MD, M. Comm. Med
Fakulti : Perubatan dan Sains Kesihatan

Secara global, penyakit kardiovaskular (CVD) bertanggungjawab bagi 17.5 juta kematian, bersamaan 46.2% kematian penyakit bukan berjangkit (NCD). Di Ghana, CVD merupakan penyebab kematian utama sejak tahun 2001. Prevalens faktor risiko CVD dalam kalangan remaja dan orang dewasa di Ghana telah meningkat. Tujuan utama kajian ini adalah untuk membangunkan, mengimplementasikan dan menilai keberkesanan program intervensi modifikasi tingkah laku bagi pengurangan faktor risiko penyakit kardiovaskular dalam kalangan pelajar sekolah menengah di Brong Ahafo, Ghana. Kajian ini merupakan percubaan terkawal rawak kluster buta tunggal. Data asas telah dikumpul daripada 848 orang pelajar dari sekolah yang telah dirawak secara sama rata menggunakan perambangan kelompok (nisbah 1:1) bagi dua blok digit (A dan B). Intervensi berasaskan sekolah telah diimplementasi menggunakan model informasi, motivasi dan kemahiran tingkah laku (IMB) bagi pengurangan faktor risiko CVD bagi tempoh enam bulan dengan pra dan pascapenilaian intervensi. Modul intervensi termasuk modul pendidikan kesihatan dan aktiviti fizikal di sekolah intervensi. Sekolah kawalan diteruskan dengan kurikulum sekolah biasa mereka dan telah disenarai-tunggukan bagi intervensi yang serupa selepas kajian tersebut. Data susulan menggunakan soal selidik yang sama telah dikumpul dalam masa dua minggu selepas intervensi tersebut selesai. Dapatan utama ialah pengetahuan, motivasi, kemahiran tingkah laku, aktiviti fizikal, amalan merokok, amalan arak minum, pengambilan makanan, manakala berat, indeks jisim tubuh, dan tekanan darah merupakan dapatan sekunder. Berat, ketinggian dan tekanan darah telah diukur menggunakan peralatan yang standard oleh staf kesihatan terlatih. Analisis niat untuk rawat telah dijalankan selepas menggantikan nilai yang hilang menggunakan kaedah imputasi pelbagai. Model campuran linear umum (GLMM) telah digunakan untuk menguji kesan kumpulan, masa dan interaksi kumpulan-masa selepas pengawalan bagi sembilan perancu berpotensi.

Analisis GLMM menunjukkan intervensi adalah signifikan dalam memperoleh 6.85($p<0.001$), 0.90($p<0.001$), 0.94($p<0.001$), 0.77($p<0.001$), 0.72($p<0.001$), 0.47($p<0.001$), 0.56($p<0.001$), dan 0.39($p=0.045$) lebih tinggi skor keseluruhan pengetahuan, motivasi, kemahiran tingkah laku, aktiviti fizikal, buah-buahan, sayur-sayuran, makanan laut, dan air masing-masing bagi kumpulan intervensi berbanding kumpulan kawalan. Intervensi tersebut juga signifikan dalam pengurangan -0.15($p<0.001$), -0.23($p<0.001$), -0.50($p<0.001$), -0.32($p<0.001$), -0.90($p<0.001$), -0.87($p<0.001$), -0.38($p<0.001$), -0.63($p<0.001$), -1.63($p<0.001$), -0.61($p<0.001$), dan -1.53($p=0.005$) karbohidrat, lemak dan minyak, telur goreng, ayam goreng, minuman berkarbonat, gula, snek manis, ikan masin, berat, BMI, dan tekanan darah diastolik. Faktor ganjil, iaitu berhenti minum alkohol dalam kumpulan intervensi ialah 1.06 kali lebih daripada kumpulan kawalan. Tidak terdapat kesan yang signifikan bagi kumpulan ke atas merokok, tetapi interaksi kumpulan- masa adalah signifikan ($F(1,101) = 5.07, p=0.027$) dan faktor ganjil, iaitu berhenti merokok bagi kumpulan intervensi ialah 6.13 kali lebih tinggi daripada kumpulan kawalan ($t=2.251, p=0.027$). Tidak terdapat kesan yang signifikan bagi intervensi ke atas pengurangan tekanan darah sistolik. Intervensi mempunyai kesan yang positif ke atas peningkatan tahap aktiviti fizikal, penggalakan tabiat pemakanan sihat, pengurangan amalan merokok dan pengambilan alkohol, berat badan, indeks jisim tubuh, tekanan darah diastolik dan peningkatan pengetahuan mengenai penyakit kardiovaskular, motivasi dan kemahiran tingkah laku dalam kalangan pelajar dalam ranah intervensi kajian tetapi tidak berkesan ke atas tekanan darah sistolik. Kajian mengesyorkan supaya dapatan kajian ini diterima pakai sebagai sebahagian daripada kurikula pendidikan di sekolah menengah di Brong Ahafo, Ghana.

ACKNOWLEDGEMENTS

Many people have been exceptionally helpful to me on this PhD journey, technically, financially, emotionally and spiritually; and I deem it fit to mention.

First of all, my sincere gratitude goes to the chairman of the supervisory committee, Dr. Salmiah binti Md. Said, whose guidance and constructive criticism has contributed immensely in making this work what it is. I also appreciate the efforts of the other members of the supervisory committee who are Prof. Datuk Dr. Lekhraj Rampal, Assoc. Prof. Dr. Rosliza Manaf and Assoc. Prof. Dr. Normala Ibrahim. Further, I salute my local supervisor Prof. Seth Owusu-Agyei for his excellent supervision, particularly during the period of data collection in Ghana.

I cannot forget to mention the Director and staff of Kintampo Health Research Centre (Ghana Health Service) who assisted me in diverse ways in my research. I, specifically, wish to acknowledge the Government of Ghana for sponsoring the PhD program.

Many thanks goes to my wife, Dr. Lordina Amoah, for her unrelenting support and encouragement throughout my study. I appreciate her fortitude during the periods of my absence. To my children, John Jnr., Myles, and Jaden, I say thank you for your patience. My gratitude goes to my parents and siblings for the love shown me over the years and support in climbing the educational ladder thus far. Special appreciation goes to Mr. James and Mrs. Paulina Manu for their unflinching support. A big cheers to all my friends for making this journey worthwhile.

A special thank you goes to the Ministry of Education, Ghana for granting permission for the research to be carried out in the sampled schools. I, specifically, recognise the assistance of the Directors of education, headmasters, teachers, and parent teacher association chairmen of the sampled schools.

Finally, I wish to thank the faculty and staff of Universiti Putra Malaysia for the opportunity to do my PhD as well as all those who have contributed in one way or another to make it a success.

Declaration by graduate student

I hereby confirm that:

- this thesis is my original work;
- quotations, illustrations and citations have been duly referenced;
- this thesis has not been submitted previously or concurrently for any other degree at any institutions;
- intellectual property from the thesis and copyright of thesis are fully-owned by Universiti Putra Malaysia, as according to the Universiti Putra Malaysia (Research) Rules 2012;
- written permission must be obtained from supervisor and the office of Deputy Vice-Chancellor (Research and innovation) before thesis is published (in the form of written, printed or in electronic form) including books, journals, modules, proceedings, popular writings, seminar papers, manuscripts, posters, reports, lecture notes, learning modules or any other materials as stated in the Universiti Putra Malaysia (Research) Rules 2012;
- there is no plagiarism or data falsification/fabrication in the thesis, and scholarly integrity is upheld as according to the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) and the Universiti Putra Malaysia (Research) Rules 2012. The thesis has undergone plagiarism detection software

Signature: _____

Date: _____

Name and Matric No: John Amoah, GS43289

Declaration by Members of Supervisory Committee

This is to confirm that:

- the research conducted and the writing of this thesis was under our supervision;
- supervision responsibilities as stated in the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) were adhered to.

Signature: _____
Name of Chairman
of Supervisory
Committee: Dr. Salmiah binti Md Said, MD, M. Comm. Med

Signature: _____
Name of Member
of Supervisory
Committee: Professor
Dr. Lekhraj Rampal, MBBS, MPH, DrPH, FAMM, FAMS

Signature: _____
Name of Member
of Supervisory
Committee: Associate Professor
Dr. Rosliza Manaf, MD, M. Comm. Med

Signature: _____
Name of Member
of Supervisory
Committee: Associate Professor
Dr. Normala Ibrahim, MD, M. Med (Psychiatry)

Signature: _____
Name of Member
of Supervisory
Committee: Professor Seth Owusu-Agyei, MSc

TABLE OF CONTENTS

	Page
ABSTRACT	i
ABSTRAK	iii
ACKNOWLEDGEMENTS	v
APPROVAL	vi
DECLARATION	viii
LIST OF TABLES	xvii
LIST OF FIGURES	xxiii
LIST OF ABBREVIATIONS	xxv
CHAPTER	
1 INTRODUCTION	1
1.1 Background	1
1.2 Problem Statement	5
1.3 Significance of Study	6
1.4 Research Question	6
1.5 Objectives of the Study	7
1.5.1 General Objective	7
1.5.2 Specific Objectives	7
1.6 Research Hypotheses	7
2 LITERATURE REVIEW	9
2.1 Background Information on Literature Search Strategy	9
2.2 Education System in Ghana	9
2.3 Cardiovascular Diseases Definition and Types	10
2.4 Epidemiology of Cardiovascular Diseases	10
2.5 Risk Factors of Cardiovascular Diseases	12
2.6 Previous School Based Intervention Studies on Cardiovascular Disease Risk Factors	12
2.6.1 Physical Inactivity	12
2.6.2 Smoking	16
2.6.3 Alcohol Consumption	18
2.6.3.1 Culture of Alcohol Consumption in Ghana	18
2.6.3.2 Previous School Based Study on Alcohol Consumption	18
2.6.4 Unhealthy Diet	20
2.6.5 Obesity	22
2.6.6 Hypertension	25
2.7 Factors Associated with CVD Risk Factors	27
2.7.1 Age	27
2.7.2 Gender	27
2.7.3 Ethnicity/Race	28
2.7.4 Family History of Cardiovascular Diseases	28
2.8 School-Based Health Intervention Programmes	29

2.9	The Use of the IMB as the Theoretical Framework to Develop the Intervention	29
2.9.1	Assumptions	31
2.9.2	Information	32
2.9.3	Motivation	32
2.9.4	Behavioral skills	32
2.10	Sustainability of the School-Based Intervention Program in Reducing Cardiovascular Risk Factors	33
2.11	Conceptual Framework of the Study	34
3	METHODOLOGY	36
3.1	Study Location	36
3.2	Study Design	37
3.3	Study Duration	38
3.4	Sampling	38
3.4.1	Study Population	38
3.4.2	Sampling Population	38
3.4.2.1	Inclusion Criteria	38
3.4.2.2	Exclusion Criteria	38
3.5	Sampling Technique	39
3.5.1	Sampling Frame	39
3.5.2	Sampling Method	39
3.6	Sample Size Estimation	39
3.7	Randomization	40
3.7.1	Sequence Generation	41
3.7.2	Allocation Concealment Mechanism	41
3.7.3	Implementation	41
3.8	Blinding	41
3.9	Development of the School CVD Risk Factor Reduction Intervention Module for Secondary School Students	41
3.9.1	Validation of the Module	45
3.10	Training	45
3.11	Intervention	45
3.12	Data Collection	46
3.12.1	Study Instruments	46
3.12.2	Questionnaire	46
3.12.3	Anthropometry Measurements	48
3.12.4	Blood Pressure Measurements	48
3.13	Quality Control of Study Instruments	48
3.13.1	Validity of Questionnaire	48
3.13.2	Face Validity	49
3.13.3	Content Validity	51
3.13.4	Validity of the Anthropometric Measurement	51
3.13.5	Reliability of Questionnaire	51
3.14	Implementation of Intervention	52
3.15	Variables	54
3.15.1	Independent Variable	54
3.15.2	Dependent Variables	54
3.15.3	Confounders	54

3.16	Operational Definition of Terms	54
3.16.1	Body Mass Index	54
3.16.2	Hypertension	54
3.16.3	Physical Activity	55
3.16.4	Smoking	55
3.16.5	Alcohol	55
3.16.6	Diet Practices	55
3.16.7	CVD Risk Factor Knowledge	55
3.16.8	Motivation	55
3.16.9	Behavioral Skills	56
3.17	Data Analysis	56
3.17.1	Normality Tests	56
3.17.2	Descriptive Statistics	56
3.17.3	Inferential Statistics	56
3.17.4	Effect Size	57
3.17.5	Sensitivity Analysis	57
3.18	Study Process	57
3.19	Ethical Consideration	58
4	RESULTS	60
4.1	Response Rate in Intervention and Control Groups	60
4.2	Baseline Characteristics of Respondents in Intervention and Control Groups	61
4.2.1	Socio-demographic Characteristics of Respondents at Baseline in Intervention and Control Groups	61
4.2.2	Family History of Obesity and Hypertension at Baseline in Intervention and Control Groups	64
4.2.3	Knowledge, Motivation, and Behavioral Skills Scores at Baseline in Intervention and Control Groups	64
4.2.4	Physical Activity Score, Prevalence of Smoking and Alcohol at Baseline in Intervention and Control Groups	65
4.2.5	Dietary Intake at Baseline in Intervention and Control Groups	67
4.2.6	Body Mass Index, Diastolic and Systolic Blood Pressure Scores at Baseline in Intervention and Control Groups	68
4.3	Follow up Comparison of Between-Groups Total Knowledge Scores at Six Months	68
4.4	Comparison Within-Groups Total Knowledge Scores from Baseline to Six Months	69
4.5	Effect of Group, Time and Interaction on knowledge Scores	69
4.6	Follow up Comparison of Between-Groups Total Motivation Scores at Six Months	70
4.7	Comparison Within-Groups Total Motivation Scores from Baseline to Six Months	71
4.8	Effect of Group, Time and Interaction on Motivation Scores	71
4.9	Follow up Comparison of Between-Groups Total Behavioral Skills Scores at Six Months	73

4.10	Comparison Within-Groups Total Behavioral Skills Scores from Baseline to Six Months	73
4.11	Effect of Group, Time and Interaction on Behavioral Skills Scores	74
4.12	Follow up Comparison of Between-Groups Total Physical Activity Scores at Six Months	75
4.13	Comparison Within-Groups Total Physical Activity Scores from Baseline to Six Months	75
4.14	Effect of Group, Time and Interaction on Physical Activity Scores	76
4.15	Follow-up Comparison of Between-Groups and Within-Groups Smoking	77
4.16	Follow-up Comparison of Between-Groups and Within-Groups Alcohol Consumption	78
4.17	Dietary Intake Among Respondents	79
4.17.1	Comparison of Between-Groups Frequency of Fruits Intake at Six Months	79
4.17.2	Comparison Within-Groups Frequency of Fruits Intake from Baseline to Six Months	79
4.17.3	Effect of Group, Time and Interaction on Fruits Intake	80
4.17.4	Comparison of Between-Groups Frequency of Vegetables Intake at Six Months	81
4.17.5	Comparison Within-Groups Frequency of Vegetables Intake from Baseline to Six Months	81
4.17.6	Effect of Group, Time and Interaction on Vegetables Intake	82
4.17.7	Comparison of Between-Groups Frequency of Seafood Intake	83
4.17.8	Comparison Within-Groups Frequency of Seafood Intake from Baseline to Six Months	83
4.17.9	Effect of Group, Time and Interaction on Seafood Intake	84
4.17.10	Comparison of Between-Groups Frequency of Plain Water Intake Scores at Six Months	85
4.17.11	Comparison Within-Groups Frequency of Plain Water Intake from Baseline to Six Months	85
4.17.12	Effect of Group, Time and Interaction on Plain Water Intake	86
4.17.13	Comparison of Between-Groups Frequency of Carbohydrates Intake at Six Months	87
4.17.14	Comparison Within-Groups Frequency of Carbohydrate Intake from Baseline to Six Months	87
4.17.15	Effect of Group, Time and Interaction on Carbohydrate Intake	88
4.17.16	Comparison of Between-Groups Frequency of Fats and Oils Intake at Six Months	89
4.17.17	Comparison Within-Groups Frequency of Fats and Oils Intake from Baseline to Six Months	89

4.17.18	Effect of Group, Time and Interaction on Fats and Oils Intake	90
4.17.19	Comparison of Between-Groups Frequency of Fried Eggs Intake Scores at Six Months	91
4.17.20	Comparison Within-Groups Frequency of Fried Eggs Intake from Baseline to Six Months	91
4.17.21	Effect of Group, Time and Interaction on Fried Eggs Intake	92
4.17.22	Comparison of Between-Groups Frequency of Fried Chicken Intake at Six Months	93
4.17.23	Comparison Within-Groups Frequency of Fried Chicken Intake from Baseline to Six Months	93
4.17.24	Effect of Group, Time and Interaction on Fried Chicken Intake	94
4.17.25	Comparison of Between-Groups Frequency of Carbonated Drinks Intake at Six Months	95
4.17.26	Comparison Within-Groups Frequency of Carbonated Drinks Intake from Baseline to Six Months	95
4.17.27	Effect of Group, Time and Interaction on Carbonated Drinks Intake	96
4.17.28	Comparison of Between-Groups Frequency of Plain Sugar Intake at Six Months	97
4.17.29	Comparison Within-Groups Frequency of Plain Sugar Intake from Baseline to Six Months	97
4.17.30	Effect of Group, Time and Interaction on Plain Sugar Intake	98
4.17.31	Comparison of Between-Groups Frequency of Sweet Snacks Intake at Six Months	99
4.17.32	Comparison Within-Groups Frequency of Sweet Snack Intake from Baseline to Six Months	99
4.17.33	Effect of Group, Time and Interaction on Sweet Snacks Intake	100
4.17.34	Comparison of Between-Groups Frequency of Salted Fish Intake at Six Months	101
4.17.35	Comparison Within-Groups Frequency of Salted Fish Intake from Baseline to Six Months	101
4.17.36	Effect of Group, Time and Interaction on Salted Fish Intake	102
4.18	Follow up Comparison Between-Groups Total Body Weight Scores at Six Months	103
4.19	Comparison Within-Groups Total Body Weight Scores from Baseline to Six Months	103
4.20	Effect of Group, Time and Interaction on Body Weight Scores	104
4.21	Follow up Comparison Between-Groups Total BMI Scores at Six Months	105
4.22	Comparison Within-Groups Total BMI Scores from Baseline to Six Months	105
4.23	Effect of Group, Time and Interaction on BMI Scores	106

4.24	Comparison Between-Groups Total Diastolic Blood Pressure Scores at Six Months	107
4.25	Comparison Within-Groups Total Diastolic Blood Pressure Scores from Baseline to Six Months	107
4.26	Effect of Group, Time and Interaction on Diastolic Blood Pressure Scores	108
4.27	Comparison Between-Groups Total Systolic Blood Pressure Scores at Six Months	109
4.28	Comparison Within-Groups Total Systolic Blood Pressure Scores from Baseline to Six Months	109
4.29	Effect of Group, Time and Interaction on Systolic Blood Pressure Scores	110
4.30	Main Effects of the Intervention Study	111
4.30.1	Effects of the Intervention on Knowledge, Motivation, and Behavioral Skills	111
4.30.2	Effects of the Intervention on Physical Activity, Smoking, and Alcohol	112
4.30.3	Effects of the Intervention on Dietary Intake	112
4.30.4	Effects of the Intervention on Weight, BMI, Diastolic and Systolic Blood Pressure	114
4.31	Magnitude of the Intervention Effect	114
4.31.1	Magnitude of Intervention Effect for Smoking and Alcohol	116
4.32	Sensitivity Analysis	117
5	DISCUSSION	122
5.1	Response Rate	122
5.2	Socio-demographic Characteristics	122
5.3	Family History of Obesity and Hypertension at Baseline	123
5.4	Knowledge Score at Baseline	123
5.5	Motivation Score at Baseline	124
5.6	Behavioral Skills Score at Baseline	124
5.7	Physical Activity Score, Prevalence of Smoking and Alcohol at Baseline	125
5.8	Dietary Intake at Baseline	125
5.9	Body Mass Index, Diastolic and Systolic Blood Pressure Scores at Baseline	126
5.10	Effects of the Intervention on Knowledge	126
5.11	Effects of the Intervention on Motivation	127
5.12	Effects of the Intervention on Behavioral Skills	128
5.13	Effects of the Intervention on Physical Activity	128
5.14	Effects of the Intervention on Smoking and Alcohol	130
5.15	Effects of the Intervention on Dietary Intake	130
5.16	Effects of the Intervention on Weight and BMI	131
5.17	Effects of the Intervention on Diastolic and Systolic Blood Pressure	132
5.18	The CVD Risk Factor Intervention using IMB	133

6	CONCLUSION AND RECOMMENDATIONS	134
6.1	Conclusion	134
6.2	Strengths	134
6.3	Limitations	135
6.4	Implications and Recommendations	135
	REFERENCES	137
	APPENDICES	165
	BIODATA OF STUDENT	213
	LIST OF PUBLICATIONS	214



LIST OF TABLES

Table		Page
2.1	Leading causes of inpatients deaths in districts and regional hospitals in Ghana, 2003 and 2008	12
2.2	Prevalence of overweight and obesity among students	23
2.3	Prevalence of hypertension among students	26
3.1	Application of the Information-Motivation-Behavioral Skills Model for school based CVD risk factor reduction intervention module	44
3.2	Face validity results	50
3.3	Summary of Cronbach's alpha values	51
3.4	Summary of intervention module	53
4.1	Baseline comparison of socio-demographic characteristics between intervention and control groups	63
4.2	Baseline comparison of family history of obesity and hypertension between intervention and control groups	64
4.3	Baseline comparison of CVD knowledge, motivation, and behavioral skills between intervention and control groups	65
4.4	Baseline comparison of mean physical activity score between intervention and control groups	65
4.5	Baseline comparison of ever and current smoker between intervention and control groups	66
4.6	Baseline comparison of ever and current alcohol consumption between intervention and control groups	66
4.7	Baseline comparison of mean dietary intake scores between intervention and control groups	67
4.8	Baseline comparison of mean BMI, diastolic and systolic BP scores between intervention and control groups	68
4.9	Comparison of mean knowledge scores of intervention and control groups at six months post intervention	69
4.10	Change in the mean knowledge scores from baseline to six months post intervention for both groups	69

4.11	Effects of group, time and interaction on mean knowledge scores	70
4.12	Comparison of mean motivation scores of intervention and control groups at six months post intervention	71
4.13	Change in the mean motivation scores from baseline to six months post intervention for both groups	71
4.14	Effects of group, time and interaction on mean motivation scores	72
4.15	Comparison of mean behavioral skills scores of intervention and control groups at six months post intervention	73
4.16	Change in the mean behavioral skills scores from baseline to six months post intervention for both groups	73
4.17	Effects of group, time and interaction on mean behavioral skills scores	74
4.18	Comparison of mean PA scores of intervention and control groups at six months post intervention	75
4.19	Change in the mean PA scores from baseline to six months post intervention for both groups	75
4.20	Effects of group, time and interaction on mean PA scores	76
4.21	Comparison of smoking status of intervention and control groups at six months post intervention study	77
4.22	Change in the frequency of smoking status from baseline to six months post intervention for both groups	77
4.23	Comparison of alcohol use of intervention and control groups at six months post intervention study	78
4.24	Change in the frequency of alcohol use from baseline to six months post intervention for both groups	78
4.25	Comparison of mean fruits intake scores of intervention and control groups at six months post intervention	79
4.26	Change in the mean fruits intake scores from baseline to six months post intervention for both groups	79
4.27	Effects of group, time and interaction on mean fruits intake scores	80
4.28	Comparison of mean vegetable intake scores of intervention and control groups at six months post intervention	81

4.29	Change in the mean vegetables intake scores from baseline to six months post intervention for both groups	81
4.30	Effects of group, time and interaction on mean vegetables intake scores	82
4.31	Comparison of mean seafood intake scores of intervention and control groups at six months post intervention	83
4.32	Change in the mean seafood intake scores from baseline to six months post intervention for both groups	83
4.33	Effects of group, time and interaction on mean seafood intake scores	84
4.34	Comparison of mean plain water intake scores of intervention and control groups at six months post intervention	85
4.35	Change in the mean plain water intake scores from baseline to six months post intervention for both groups	85
4.36	Effects of group, time and interaction on mean plain water intake scores	86
4.37	Comparison of mean carbohydrate intake scores of intervention and control groups at six months post intervention	87
4.38	Change in the mean carbohydrates intake scores from baseline to six months post intervention for both groups	87
4.39	Effects of group, time and interaction on mean carbohydrate intake scores	88
4.40	Comparison of mean fats and oils intake scores of intervention and control groups at six months post intervention	89
4.41	Change in the mean fats and oil intake scores from baseline to six months post intervention for both groups	89
4.42	Effects of group, time and interaction on mean fats and oils intake scores	90
4.43	Comparison of mean fried eggs intake scores of intervention and control groups at six months post intervention	91
4.44	Change in the mean fried eggs intake scores from baseline to six months post intervention for both groups	91
4.45	Effects of group, time and interaction on mean fried eggs intake scores	92

4.46	Comparison of mean fried chicken intake scores of intervention and control groups at six months post intervention	93
4.47	Change in the mean fried chicken intake scores from baseline to six months post intervention for both groups	93
4.48	Effects of group, time and interaction on fried chicken intake scores	94
4.49	Comparison of mean carbonated drinks intake scores of intervention and control groups at six months post intervention	95
4.50	Change in the mean carbonated drinks intake scores from baseline to six months post intervention for both groups	95
4.51	Effects of group, time and interaction on mean carbonated drinks intake scores	96
4.52	Comparison of mean plain sugar intake scores of intervention and control groups at six months post intervention	97
4.53	Change in the mean plain sugar intake scores from baseline to six months post intervention for both groups	97
4.54	Effects of group, time and interaction on mean plain sugar intake scores	98
4.55	Comparison of mean sweet snacks intake scores of intervention and control groups at six months post intervention	99
4.56	Change in the mean sweet snacks intake scores from baseline to six months post intervention for both groups	99
4.57	Effects of group, time and interaction on mean sweet snacks intake scores	100
4.58	Comparison of mean salted fish intake scores of intervention and control groups at six months post intervention	101
4.59	Change in the mean salted fish intake scores from baseline to six months post intervention for both groups	101
4.60	Effects of group, time and interaction on mean salted fish intake scores	102
4.61	Comparison of mean body weight scores of intervention and control groups at six months post intervention	103
4.62	Change in the mean total body weight scores from baseline to six months post intervention for both groups	103
4.63	Effects of group, time and interaction on mean body weight scores	104

4.64	Comparison of mean BMI scores of intervention and control groups at six months post intervention	105
4.65	Change in the mean BMI scores from baseline to six months post intervention for both groups	105
4.66	Effects of group, time and interaction on mean BMI scores	106
4.67	Comparison of mean diastolic blood pressure scores of intervention and control groups at six months post intervention	107
4.68	Change in the mean diastolic blood pressure scores from baseline to six months post intervention for both groups	107
4.69	Effects of group, time and interaction on mean DBP scores	108
4.70	Comparison of mean systolic blood pressure scores of intervention and control groups at six months post intervention	109
4.71	Change in the mean systolic blood pressure scores from baseline to six months post intervention for both groups	109
4.72	Effects of group, time and interaction on mean systolic blood pressure scores	110
4.73	Fixed effects of group, time, and group-time interaction on total knowledge, motivation, and behavioral skills scores	111
4.74	Fixed effects of group, time, and group-time interaction on total physical activity, smoking, and alcohol	112
4.75	Fixed effects of group, time, and group-time interaction on diet	113
4.76	Fixed effects of group, time, and group-time interaction on total weight, BMI, diastolic and systolic BP scores	114
4.77 a	Fixed coefficient of outcome variables	115
4.77 b	Fixed coefficient of outcome variables	116
4.78	Fixed coefficient of smoking and alcohol	117
4.79 a	Fixed effects of group, time and group-time interactions for all studied variable outcomes	117
4.79 b	Fixed effects of group, time and group-time interactions for all studied variable outcomes	118
4.79 c	Fixed effects of group, time and group-time interactions for all studied variable outcomes	119

4.80 a Comparison of fixed coefficients for group with and without replacement of missing values	120
4.80 b Comparison of fixed coefficients for group with and without replacement of missing values	121



© COPYRIGHT UPM

LIST OF FIGURES

Figure	Page
2.1 The Information-Motivation-Behavioral Skills Model	31
2.2 Conceptual Framework	35
3.1 Map of Ghana showing Brong Ahafo Region	37
3.2 Steps Involved in the Development of the Intervention Module	43
3.3 CONSORT Flow Chart of the Intervention and Control Groups	58
4.1 Flow Chart of Recruitment of Respondents	61
4.2 Trend of Mean Knowledge Score for Intervention and Control Groups	70
4.3 Trend of Mean Motivation Score for Intervention and Control Groups	72
4.4 Trend of Mean Behavioral Skills Score for Intervention and Control Groups	74
4.5 Trend of Mean PA Score for Intervention and Control Groups	76
4.6 Trend of Mean Fruits Intake Score for Intervention and Control Groups	80
4.7 Trend of Mean Vegetable Intake Score for Intervention and Control Groups	82
4.8 Trend of Mean Seafood Intake Score for Intervention and Control Groups	84
4.9 Trend of Mean Plain Water Intake Score for Intervention and Control Groups	86
4.10 Trend of Mean Carbohydrate Intake Score for Intervention and Control Groups	88
4.11 Trend of Mean Fats and Oils Intake Score for Intervention and Control Groups	90
4.12 Trend of Mean Fried Eggs Intake Score for Intervention and Control Groups	92
4.13 Trend of Mean Fried Chicken Intake Score for Intervention and Control Groups	94

4.14	Trend of Mean Carbonated Drinks Intake Score for Intervention and Control Groups	96
4.15	Trend of Mean Plain Sugar Intake Score for Intervention and Control Groups	98
4.16	Trend of Mean Sweet Snacks Intake Scores for Intervention and Control Groups	100
4.17	Trend of Mean Salted Fish Intake for Intervention and Control Groups	102
4.18	Trend of Mean Body Weight Score for Intervention and Control Groups	104
4.19	Trend of Mean BMI Score for Intervention and Control Groups	106
4.20	Trend of Mean DBP Score for Intervention and Control Groups	108
4.21	Trend of Mean SBP Score for Intervention and Control Groups	110

LIST OF ABBREVIATIONS

BMI	Body Mass Index
CDC	Centre for Disease Control and Prevention
CHD	Coronary Heart Disease
CONSORT	Consolidated Standards of Reporting Trials
CVD	Cardiovascular Disease
DALY	Disability Adjusted Life Years
DBP	Diastolic Blood Pressure
GDHS	Ghana Demographic and Health Survey
GHS	Ghana Health Service
GLMM	Generalized Linear Mixed Model
GSS	Ghana Statistical Service
IMB	Information-Motivation-Behavioral Skills
IOM	Institute of Medicine
ITT	Intention-To-Treat
MCAR	Missing Completely At Random
MOE	Ministry of Education
MOH	Ministry of Health
MVPA	Moderate to Vigorous Physical Activity
NCD	Non Communicable Disease
PA	Physical Activity
PACTR	Pan African Clinical Trials Registry
PAQ-A	Physical Activity Questionnaire for Adolescents
PTA	Parent Teacher Association
RCT	Randomized Controlled field Trial

SBP	Systolic Blood Pressure
WHF	World Heart Federation
WHO	World Health Organization



© COPYRIGHT UPM

CHAPTER 1

INTRODUCTION

1.1 Background

Non communicable diseases (NCDs) are the number one public health challenge of the 21st century. There were 56 million worldwide deaths in 2012 where 38 million deaths representing 68% were caused by NCDs. More than 40% (16 million) of NCD deaths occur prematurely, affecting people below 70 years. Almost three quarters of all NCD deaths accounting for 28 million and majority of premature deaths, 82%, occurred in developing countries where most of the world's population lives (WHO, 2011a; 2014). By 2020, NCD deaths are projected to almost equal the combined deaths from communicable, perinatal, maternal, and nutritional diseases in the African continent and to exceed the combined deaths by 2030 (WHO, 2011a). The NCDs are mainly cardiovascular diseases (CVDs), cancers, chronic respiratory diseases and diabetes (Hunter & Reddy, 2013; WHO, 2015a). Cardiovascular deaths accounts for almost half (46.2%) of all NCD deaths, followed by cancer deaths, 21.7%, with respiratory diseases causing 10.7%, and diabetes with 4% deaths (WHO, 2014).

Cardiovascular diseases caused more deaths annually than any other causes (Mozaffarian et al., 2015; WHO, 2015b; World Heart Federation, 2015; Smith et al., 2012). Globally, an estimated 17.5 million people died in 2012 due to CVDs, representing 31% of all global deaths (WHO, 2015b) and affected a third of adult population in the world making it the largest epidemic ever known to mankind (Yusuf, Wood, Ralston, & Reddy, 2015). In Ghana, cardiovascular diseases have been the leading causes of all NCDs and hospital deaths in 2008 accounting for 14.5% of total deaths (Bosu, 2013). According to the Ghana Health Service (GHS, 2015), CVDs are the leading causes of NCD deaths with an estimated 35,000 deaths per year. In a five year review of autopsy cases (19,289) from 2006 to 2010 in one of the teaching hospitals in Ghana (Korle-Bu Teaching Hospital, KBTH) found out that more than one-fifth (22.2%) of the deaths were due to CVDs (Sanuade, Anarfi, Aikins, & Koram, 2014). Also CVDs rose from the seventh and tenth causes of death in the capital (Accra) in 1953 and 1966 respectively to the number one cause of death in 1991 and 2001 and has continued as one of the major causes of death since then (Agyei-Mensah & de-Graft Aikins, 2010). In 2014, stroke and coronary heart disease (CHD) were ranked as the 2nd and 4th leading causes of death in Ghana accounting for 9.75% and 6.48% of all deaths respectively (World Health Rankings, 2014). The WHO (2015c) has reported that NCDs accounted for 34% of total deaths and 31% disability adjusted life years in Ghana with CVDs being the leading cause of NCD deaths.

Risk factors of CVDs are of two types which are modifiable and non-modifiable factors. Non-modifiable risk factors include advancing age, male gender, black race-ethnic background, prior stroke/transient ischemic attack or history of coronary heart disease and family history of stroke. On the other hand, modifiable risk factors of

CVDs include physical inactivity, smoking, alcohol consumption, unhealthy diet, obesity, hypertension, and diabetes mellitus (World Heart Federation, 2017).

Physical inactivity is the fourth leading risk factor for mortality (WHO, 2010). An estimated 3.2 million deaths occur each year due to physical inactivity. In 2010, prevalence levels of physical inactivity in the Eastern Mediterranean region was the highest (88%) followed by both Africa (85%) and Western Pacific regions (85%). In 2010 globally, 23% of adults aged 18 years were physically inactive as explained by doing less than 150 moderate-intensity physical activity per week or its equivalent (WHO, 2014). On the other hand, 81% adolescents between the ages of 11-17 years were physically inactive in 2010 as explained by doing less than 60 minutes of moderate to vigorous daily physical activity, as recommended by the WHO (WHO, 2014). People who are physically inactive have a greater risk for all-cause mortality as compared to those who do at least 30 minutes moderate physical activity on most days in the week. Engaging in 150 minutes of moderate physical activity each week reduces the risk of coronary heart diseases, stroke, hypertension, diabetes, depression, and cancers. Physical activity is a major determinant of energy expenditure and therefore fundamental to balance and weight control (WHO, 2010). A nationwide school based survey among adolescents in Ghana found out that proportion of secondary school students who reported being physically active all days for a total of at least 60 minutes per day during the past seven days were only 18.7% (MOH, 2012).

Tobacco use is one of the main causes of preventable deaths worldwide. Tobacco use is associated with cardiovascular diseases. There are currently about one billion smokers in the world. An estimated six trillion cigarettes are smoked annually by current smokers. Six million people die each year from tobacco use and exposure (WHO, 2011a). The GHS (2017a) reported that the prevalence of tobacco use in Ghana in 2014 was 5.1% among males and 0.4% for females. A research conducted among students of 11-17 years in Ghana revealed that prevalence of smoking among boys was 2.4% while girl smokers was 1.4% (Mamudu & Veeranki, 2013).

Alcohol consumption is associated with the risk of hypertension and hemorrhagic stroke. Globally, an estimated 3.3 million people died (5.9% of all worldwide deaths) in 2012 as a result of alcohol consumption. More than half of these deaths resulted in NCDs of which CVDs and diabetes accounted for 33% of these deaths. Globally, the levels of alcohol consumption in 2010 was estimated at 6.2 liters of pure alcohol per person ≥ 15 years of age (WHO, 2014). In Ghana, the levels of alcohol consumption in 2016 per person ≥ 15 years of age was estimated to be 2.7 liters (WHO, 2018a). In a research among 1,311 adolescents school students in Ghana found that prevalence of alcohol use among students was 42.3% (Hormenu, Hagan, & Schack, 2018).

Unhealthy diet accounts for 1.7 million deaths and 16 million DALYs worldwide as a result of low consumption of fruits and vegetables (WHO, 2014). Adequate fruits and vegetables intake reduces the risk of CVDs (Boeing et al., 2012). Consumption of high energy foods including processed foods like fats and sugars results in obesity (Mendonca et al., 2016). Also, high salt intake increases the risk of hypertension and

CVDs. Globally, the WHO has estimated that people consume between 9-12 g/day of salt which is far above the recommended intake of less than 5g/day. The WHO further indicated that saturated fat predisposes an individual to the risk of coronary heart diseases whereas monounsaturated and polyunsaturated reduces the risk (WHO, 2011a) while the consumption of fish is very low. A study in Ghana among secondary school students revealed the consumption of sweet snacks, sodas, and energy dense foods were high (Amoh & Appiah-Brempong, 2017).

Obesity has been a major problem in recent times. Globally, the prevalence of this risk factor has more than doubled since 1980 and 2014. There were 11% males and 15% females aged 18 years and older who were obese globally in 2014 (WHO, 2014). Thus half a billion adults worldwide are obese. Obesity is a major risk factor of diabetes, hypertension, coronary heart disease and stroke. Overweight and obesity are defined as BMI $\geq 25\text{kg/m}^2$ and $\geq 30\text{kg/m}^2$ respectively accounted for 3.4 million deaths in 2010 and 93.6 million Disability Adjusted Life Years (DALYs) (Cawley, Meyerhoefer, Biener, Hammer, & Wintfeld, 2015; WHO, 2014). The prevalence of childhood obesity is becoming a major challenge especially in low and middle income countries. This is as a result of overindulgence in consumption of high caloric foods, activities such as watching television, playing video games and the internet and other forms of physical inactivity (WHO, 2014). A nationwide study among secondary school students in Ghana reported that 8% of the students were either overweight or obese (MOH, 2012).

Hypertension is a major CVD risk factor (Chioloro, Bovet, & Paradis, 2013; WHO, 2014). The global prevalence of hypertension which is defined as systolic and/or diastolic blood pressure of $\geq 140/90$ mmHg in adults aged ≥ 18 years was around 22% in 2014. The highest prevalence of hypertension across the WHO regions is in Africa, at 30% with the lowest prevalence in the region of the Americas at 18% (WHO, 2014). An estimate of 9.4 million people died worldwide in 2010 as a result of hypertension. The prevalence of hypertension in Ghana is about 48% as reported by the GHS (2017b) and has consistently ranked among the top ten causes of outpatient morbidity, admission, and death. The research was carried out in Ghana among 201 youth from three communities between the ages of 12-24 years found that 32.3% and 4% were pre-hypertensive and hypertensive respectively (Afrifa-Anane, Agyemang, Codjoe, Ogedegbe, & de-Graft Aikins, 2015).

The prevalence of diabetes has been increasing globally especially in low and middle income countries. This increase is largely due to modifiable risk factors such as physical inactivity, overweight, and obesity. The global prevalence of diabetes (defined as a fasting plasma glucose value $\geq 7.0\text{mmol/L}$ (126 mg/dl) or being on medication for raised blood sugar was estimated to be 9% in 2014. In 2012, diabetes killed 1.5 million people and 89 million DALYs (WHO, 2014). The prevalence of adult diabetes in Ghana is about 9% (GHS, 2017b).

Studies have shown that the risk factors for coronary heart disease and stroke begin in childhood that develops in adulthood (Juonala et al., 2010). This means that modifying risks factors and changing behavioral lifestyle for CVD should begin at the youthful age. Therefore, prevention of CVDs should be tackled right from an early age. Unfortunately, many people are not aware of CVD and its risk factors (Lao, Chan, Tong, & Chang, 2015) and because of this the disease burden keeps on rising. Also, merely educating the general public on CVD and its risk factors seems not to have achieved much. Therefore, adding intervention programmes to education especially for the youth on an ongoing process will equip them in protecting themselves from developing CVD disease in adulthood. Educating those who have already developed the disease should be ongoing so that they take the necessary steps in keeping the disease at its lowest levels and educate their families on the dangers of CVDs and its risk factors especially the youth.

School health interventions programmes have been shown to give consistent improvement on the general health status of students (Adab et al., 2015; He et al., 2015) and that they are ideal places for health programmes (Khambalia, Dickinson, Hardey, Gill, & Baur, 2012; Ploeg, Maximova, McGavock, Davis, & Veugelers, 2014). The WHO (2011b) estimated that these modifiable risk factors cause 80% of CVDs mainly physical inactivity, smoking, alcohol use, and unhealthy diet. Although cardiovascular diseases occur in middle and adult ages, the risk factors that cause the disease are mainly lifestyle behaviors that are learned during childhood and carried into adulthood.

Some behavioral studies have shown to result in some improvement in reducing the risk factors of CVDs. A school-based intervention to improve physical activity among secondary school students showed a statistically significant increase among the intervention group than the control group (Wang & Wang, 2018). A randomized control trial study was conducted to lower the intake of salt in students. The study found out that salt intake had decreased significantly in the intervention group and increased in the control group. The mean effect for intervention compared to the control group was -1.9 g/day (95% CI, -2.6 to -1.3 g/day; $p < 0.001$). Further, the systolic blood pressure showed a mean effect of -0.8 mmHg (He et al., 2015). Another lifestyle intervention study reported a significant reduction in BMI of students in the intervention group (-1.76kg/m²) whiles students in the control group showed an increase (1.13kg/m²) (Khumros, Vorayingyong, Suppapitiporn, Rattananupong, & Lohsoonthorn, 2019). A study showed significant reduction of smoking in the intervention arm as compared to the control arm (Gabrhelik et al., 2012). Another study reported that participants in the intervention group significantly increased consumption of fruits and vegetables when compared to the control group (Drapeau, Savard, Gallant, Nadeau, & Gagnon, 2016).

The main aim of this study was to evaluate the effectiveness of a school-based intervention programme on CVD risk factors which was based on the Information-Motivation-Behavioral skills (IMB) model. Physical inactivity, smoking, alcohol, unhealthy diet, obesity, and hypertension were the modifiable risk factors that were

targeted for change among public secondary schools in the Brong Ahafo Region of Ghana.

1.2 Problem Statement

Cardiovascular disease (CVD) is the leading cause of death globally. The burden has been increasing in Ghana and has therefore become a major public health problem. In Ghana it is a leading cause of death since 2001 and has continued as one of the major causes of death since then. In 2008, cardiovascular diseases were responsible for 14.5% of all hospital deaths (Ghana MOH, 2012; GHS, 2015).

Despite all the CVD preventive risk factor measures in place in Ghana, the risk factors among adults have shown increasing trends over the years (MOH, 2012; GHS, 2015). Also, because the risk factors for the development of CVDs begin in childhood and are carried into adulthood, there should be an urgent need to educate students on the risk factors of CVDs right from childhood. Again, CVDs can be prevented if interventions that reduces the risk factors of the diseases are made available to people (Mendis et al., 2011) and that addressing a single modifiable risk factor still leaves one at a higher risk of developing CVDs because of failure in tackling the other coexistent risk factors. Also merely educating students on healthy lifestyles without interventions by reducing CVD risk factors may not be enough.

Therefore to reduce this health and economic burden of the disease in Ghana, the prevalence of the disease and its risk factors among the youth and adults must be reduced drastically. In order to achieve this, preventive measures must start as soon as possible among students in schools in the country. This is because school health programs have shown to result in consistent improvement on the general health status of students. Two districts (Kintampo-North and Nkoranza-North districts) in the region were then selected for this study. This is because the educational levels in the two districts are low and accessibility to health information is poor. In this study, to the best of our knowledge, no behavioral modification intervention studies to reduce CVD risk factors among secondary school students in Ghana has been carried out. Since behavioral change still remains a driving force for reducing CVDs, there is therefore an urgent need for a behavioral change prevention intervention among secondary school students.

The IMB model is one of such psychological conceptualization for understanding and promoting health-related behavior. The IMB conceptualizations was developed (Fisher & Fisher, 1992) to address limitations found in other related theories. This included description of relationship among constructs, predictive validity of key constructs, conceptual parsimony and the inclusion of constructs that are needed for understanding and changing health behaviors. It was also designed to make it easy to be translated into other intervention programs such as addressing obesity-related behaviors, adherence to complex medication regimens, HIV preventive behaviors, and

safety gear utilization behaviors, among others (Fisher & Fisher, 2000; Fisher, Fisher, & Harman, 2003).

1.3 Significance of Study

This study contributed to the body of knowledge on CVD risk factors among the secondary school students in the Brong Ahafo region of Ghana. Again, the intervention module could be adapted and incorporated by the Ghanaian Ministry of Education (MOE) into the school curricula program. Further, it is also recommended that the school health education programme (SHEP) of the Ministry of Health should monitor body weight, BMI, and blood pressure of secondary school students. Furthermore, the intervention study informed, motivated, and gave students the necessary skills that enabled them to practice healthy lifestyle behaviors such as doing at least 60 minutes moderate to vigorous physical activities daily, consumption of healthy foods such as fruits, vegetables, and seafood whilst reducing sugar and salt intake, as well as quitting or not initiating smoking and alcohol.

The IMB is a very powerful behavioral change tool that has been used over the years to improve and to sustain healthy lifestyle behaviors (Chang, Choi, Kim, & Song, 2014). The model had the potential in reducing CVD risk factors because it is composed of critical elements that were needed to adopt and maintain healthy behaviors. The constructs are based on social and health psychology theories that were developed to address limitations in social and health psychology theories such as the description of relationship among constructs, predictive validity of constructs, and the inclusion of constructs that are needed for understanding, changing, and sustaining healthy behaviors.

Also on sustainability of the intervention, students were trained not to only reduce CVD risk factors alone, but to act as peer educators among their friends and in the home. This study involved the participation of teachers and school authorities. Physical Education (PE) teachers were trained by the researchers to implement the physical activity module during PE lessons while the other teachers were trained on the health education module for continuous implementation after the intervention.

1.4 Research Question

The research question of this study was: what are the effects of the behavioral modification intervention program in reducing cardiovascular disease risk factors among secondary school students?

1.5 Objectives of the Study

1.5.1 General Objective

The general objective of this study was to develop, implement and evaluate the effectiveness of a behavioral modification intervention program to reduce cardiovascular disease risk factors among secondary school students in Brong Ahafo, Ghana.

1.5.2 Specific Objectives

The specific objectives of this study were:

1. To determine and compare the socio-demographic characteristics among intervention and control groups at baseline.
2. To determine and compare knowledge, motivation, behavioral skills and CVD risk factors (physical inactivity, smoking, alcohol consumption, unhealthy diet, BMI, diastolic and systolic blood pressures) between intervention and control groups at baseline.
3. To develop and implement a behavioral modification intervention program to reduce CVD risk factors among secondary school students in Brong Ahafo, Ghana.
4. To evaluate the effectiveness of behavioral modification intervention program to increase knowledge, motivation and behavioral skill on CVD risk factors between intervention group as compared to control groups at six months post intervention and also within groups from baseline to six months.
5. To evaluate the effectiveness of behavioral modification intervention program to reduce CVD risk factors in intervention group as compared to control group at six months and also within groups from baseline to six months among secondary school students in Brong Ahafo.

1.6 Research Hypotheses

The research hypotheses of this study were:

1. There is no difference in the socio-demographic characteristics between the intervention and control groups at baseline.
2. The behavioral modification intervention program is effective in improving the knowledge of CVD and its risk factors, motivation, and behavioral skill score among the participants in the intervention group as compared to control group and also within the groups from baseline to six months among secondary school students in Brong Ahafo, Ghana.

3. The behavioral modification intervention program is effective in promoting physical activity levels of participants in the intervention group as compared to control group and also within the groups from baseline to six months among secondary school students in Brong Ahafo, Ghana.
4. The behavioral modification intervention program is effective in reducing the prevalence of smoking among participants in the intervention group as compared to control group and also within the groups from baseline to six months among secondary school students in Brong Ahafo, Ghana.
5. The behavioral modification intervention program is effective in reducing the prevalence of alcohol consumption of participants in the intervention group as compared to control group and also within the groups from baseline to six months among secondary school students in Brong Ahafo, Ghana.
6. The behavioral modification intervention program is effective in promoting fruits and vegetable intake among participants in the intervention group as compared to control group and also within the groups from baseline to six months among secondary school students in Brong Ahafo, Ghana.
7. The behavioral modification intervention program is effective in increasing seafood and water intake and reducing carbohydrates, fats and oils, fried eggs, fried chicken, carbonated drinks, plain sugar, sweet snack, and salted fish intake among participants in the intervention group compared to control group and also within the groups from baseline to six months among secondary school students in Brong Ahafo, Ghana.
8. The behavioral modification intervention program is effective in reducing body weight and BMI of participants in the intervention group as compared to control group and also within the groups from baseline to six months among secondary school students in Brong Ahafo, Ghana.
9. The behavioral modification intervention program is effective in reducing the mean diastolic and systolic blood pressures among participants in the intervention group as compared to control group and also within the groups from baseline to six months among secondary school students in Brong Ahafo, Ghana.

REFERENCES

- Abdulle, A., Al-junaibi, A., & Nagelkerke, N. (2014). High blood pressure and its association with body weight among children and adolescents in the United Arab Emirates. *PloS ONE*, 9(1), 1–5. doi:10.1371/journal.pone.0085129.
- Abraham, S., Noriega, B., & Shin, J. (2018). College students eating habits and knowledge of nutritional requirements. *Journal of Nutrition and Human Health*, 2(1), 12–17. doi:10.35841/nutrition-human-health.2.1.13-17.
- Adab, P., Pallan, M. J., Lancashire, E. R., Hemming, K., Frew, E., Griffin, T., & Cheng, K. K. (2015). 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*, 15(1), 1-10. doi:10.1186/s12889-015-1800-8.
- Aday, L. A., & Cornelius, L. J. (2006). Designing and conducting health surveys: a comprehensive guide, edition (3rd ed.). San Francisco, CA: John Wiley & Sons Ltd. Page 20-51.
- Adhikari, N., Sapakota, K., & Adhikari, S. (2018). Cardiovascular diseases (CVDs) risk attitude and knowledge level of major risk factors for cardiovascular diseases among 15-19 years eleventh and twelfth-grade students of Lekhnath Municipality. *Community Medicine and Health Education*, 8(1), 4–9. doi:10.4172/2161-0711.1000584.
- Afrifa-Anane, E., Agyemang, C., Codjoe, S. N. A., Ogedegbe, G., & de-Graft Aikins, A. (2015). The association of physical activity, body mass index and the blood pressure levels among urban poor youth in Accra, Ghana. *BMC Public Health*, 15(1), 1-9. doi:10.1186/s12889-015-1546-3.
- Agbaje, S., Agu, B. N., Ekpu, F. S., Maduekwe, T. C., & Umoke, P. (2016). Knowledge of risk factors for lifestyle induced chronic diseases among secondary school students in Obio/Akpor LGA, Rivers State. *Public Health and Epidemiology*, 8(8), 136–146. doi:10.5897/JPHE2016.082.
- Agyei-Mensah, S., & de-Graft Aikins, A. (2010). Epidemiological transition and the double burden of disease in Accra, Ghana. *Journal of Urban Health*, 87(5), 879–897. doi:10.1007/s11524-010-9492-y.
- Agyemang, C., Snijder, M., Adjei, D., Van den Born, B., Modesti, P., Peters, R., & Vogt, L. (2016). Ethnic disparities in CKD in the Netherlands: the Healthy Life in an Urban Setting (HELIUS) Study. *American Journal of Kidney Disease*, 67(3), 391–399. doi:10.1053/j.ajkd.2015.07.023.

- Akintunde, A.A., Sade Akintunde, T., & Opadijo, O. G. (2015). Knowledge of heart disease risk factors among workers in a Nigerian University: a call for concern. *Nigeria Medical Journal*, *56*(2), 91–95.
- Alaimo, K., Carlson, J. J., Pfeiffer, K. A., Eisenmann, J. C., Paek, H., Betz, H. H., & Norman, G. J. (2015). Project FIT: a school, community and social marketing intervention improves healthy eating among low-income elementary school children. *Journal of Community Health*, *40*(4), 815–826. doi:10.1007/s10900-015-0005-5.
- Alangea, D. O., Aryeetey, R. N., Gray, H. L., Laar, A. K., & Adanu, R. M. K. (2018). Dietary patterns and associated risk factors among school age children in urban Ghana. *BMC Nutrition*, *4*(22), 1–9. doi:10.1186/s40795-018-0230-2.
- Albarracin, D., Johnson, B., Fishbein, M., & Muellerleile, P. (2001). Theories of reasoned action and planned behavior as models of condom use: a meta-analysis. *Psychological Bulletin*, *127*(1), 142–161. doi:10.1037/0033-2909.127.1.142.
- Aminde, L. N., Takah, N., Ngwasiri, C., Noubiap, J. J., Tindong, M., Dzudie, A., & Veerman, J. L. (2017). Population awareness of cardiovascular disease and its risk factors in Buea, Cameroon. *BMC Pediatrics*, *17*(545), 1–10. doi:10.1186/s12889-017-4477-3.
- Amoh, I., & Appiah-Brempong, E. (2017). Prevalence and risk factors of obesity among senior high school students in the Adansi North district of Ghana. *Journal of Community Medicine and Public Health*, *4*(10), 3762–3769. doi:10.18203/2394-6040.ijcmph20174247.
- Andersen, L., Riddoch, C., Kriemler, S., & Hills, A. (2011). Physical activity and cardiovascular risk factors in children. *British Journal of Sports Medicine*, *45*(11), 871–876. doi:10.1136/bjsports-2011-090333.
- Anderson, A. K. (2017). Prevalence of anemia, overweight/obesity, and undiagnosed hypertension and diabetes among residents of selected communities in Ghana. *International Journal of Chronic Diseases*, *2017*, 1–7. doi:10.1155/2017/7836019.
- Archer, E., & Blair, S. N. (2011). Physical activity and the prevention of cardiovascular disease: from evolution to epidemiology. *Progress in Cardiovascular Diseases*, *53*(6), 387–396. doi:10.1016/j.pcad.2011.02.006.
- Ardic, A., & Erdogan, S. (2016). The effectiveness of the COPE healthy lifestyles TEEN program: a school-based intervention in middle school adolescents with 12-month follow-up. *Advanced Nursing*, *73*(6), 1377–1389. doi:10.1111/jan.13217.
- Aryeetey, R., Lartey, A., Marquis, G., Nti, H., Colecraft, E., & Brown, P. (2017). Prevalence and predictors of overweight and obesity among school-aged children in urban Ghana. *BMC Obesity*, *4*(1), 1–8. doi:10.1186/s40608-017-0174-0.

- Ato, E., Elizabeth, K., Ansong, D., Marie, L., Boakye, I., Marfo, J., & Triston, T. (2013). The burden and correlates of hypertension in rural Ghana: a cross-sectional study. *Journal of Clinical Research & Reviews*, 7(3), 123–128. doi:10.1016/j.dsx.2013.06.015.
- August, K. J., & Sorkin, D. H. (2011). Racial/ethnic disparities in exercise and dietary behaviors of middle-aged and older adults. *Journal of General Internal Medicine*, 26(3), 245–250. doi:10.1007/s11606-010-1514-7.
- Awuah, R. B., Anarfi, J. K., Agyemang, C., Ogedegbe, G., & Aikins, A. de-G. (2014). Prevalence, awareness, treatment and control of hypertension in urban poor communities in Accra, Ghana. *Journal of Hypertension*, 32(6), 1203–1210. doi:10.1097/HJH.0000000000000165.
- Baer, D., Jones, R. M., Mcclish, D., Westerberg, A. L., & Danish, S. (2012). Fruit and vegetable intake among rural youth following a school-based randomized controlled trial. *Journal of Preventive Medicine*, 54(2), 150–156. doi:10.1016/j.yjmed.2011.11.005.
- Balagopal, P., de Ferranti, S. D., Cook, S., Daniels, S. R., Gidding, S. S., Hayman, L. L., & Steinberger, J. (2011). Nontraditional risk factors and biomarkers for cardiovascular disease: mechanistic, research, and clinical considerations for youth: a scientific statement from the American Heart Association. *Journal of Circulation*, 123(23), 2749–2769. doi:10.1161/CIR.0b013e31821c7c64.
- Barlow, S. (2007). Expert committee recommendations regarding the prevention, assessment, and treatment of child and adolescent overweight and obesity: summary report. *Paediatrics*, 120(Suppl 4), s164–s165. doi:10.1542/peds.2007-2329C.
- Barrett-Connor, E. (2013). Menopause, atherosclerosis, and coronary artery disease. *Current Opinion in Pharmacology*, 13(2), 186–191. doi:10.1016/j.coph.2013.01.005.
- Bastien, M., Poirier, P., Lemieux, I., & Després, J. (2014). Overview of epidemiology and contribution of obesity to cardiovascular disease. *Progress in Cardiovascular Diseases*, 56(4), 369–381. doi:10.1016/j.pcad.2013.10.016.
- Battjes-fries, M. C. E., Haveman-nies, A., Renes, R.-J., Meester, H. J., & Veer, P. Van. (2014). Effect of the Dutch school-based education programme ‘Taste Lessons’ on behavioural determinants of taste acceptance and healthy eating: a quasi-experimental study. *Public Health Nutrition*, 18(12), 2231–2241. doi:10.1017/S1368980014003012.
- Bauer, U. E., Briss, P. A., Goodman, R. A., & Bowman, B. A. (2014). Prevention of chronic disease in the 21st century: Elimination of the leading preventable causes of premature death and disability in the USA. *The Lancet*, 384(9937), 45–52. doi:10.1016/S0140-6736(14)60648-6.

- Black, J. A., Park, M., Gregson, J., Falconer, C. L., & White, B. (2015). Child obesity cut-offs as derived from parental perceptions: *British Journal of General Practice*, 65(633), 234–239. doi:10.3399/bjgp15X684385.
- Boateng, D., Wekesah, F., Browne, J. L., Agyemang, C., Agyei-baffour, P., Aikins, A. de-G., & Klipstein-grobusch, K. (2017). Knowledge and awareness of and perception towards cardiovascular disease risk in sub-Saharan Africa: a systematic review. *PLoS ONE*, 12(12), 1–21. doi:10.1371/journal.pone.0189264.
- Boateng, G. O., Luginaah, I. N., & Taabazuing, M. M. (2015). Examining the risk factors associated with hypertension among the elderly in Ghana. *Journal of Aging and Health*, 27(7), 1-23. doi:10.1177/0898264315577588.
- Boeing, H., Bechthold, A., Bub, A., Ellinger, S., Haller, D., Kroke, A., et al. (2012). Critical review: vegetables and fruit in the prevention of chronic diseases. *European Journal of Nutrition*, 51, 637–663. doi:10.1007/s00394-012-0380-y.
- Börjesson, M., Onerup, A., Lundqvist, S., & Dahlöf, B. (2015). Physical activity and exercise lower blood pressure in individuals with hypertension: narrative review of 27 RCTs. *British Journal of Sports Medicine*, 50(6), 356–361. doi:10.1136/bjsports-2015-095786.
- Bosu, W. (2013). Accelerating the control and prevention of non-communicable diseases in Ghana: the key issues. *Postgraduate Medical Journal*, 2(1), 32–40.
- Bosu, W. K. (2010). Epidemic of hypertension in Ghana: a systematic review. *BMC Public Health*, 10(1), 1-14. doi:10.1186/1471-2458-10-418.
- Brady, C. (2016). Decreasing obesity and obesity stigma: socio-demographic differences in beliefs about causes of and responsibility for obesity. *Journal of Social Sciences*, 5(12), 1–10. doi:10.3390/socsci5010012.
- Briasoulis, A., Agarwal, V., & Messerli, F. H. (2012). Alcohol consumption and the risk of hypertension in men and women: a systematic review and meta-analysis. *Journal of Clinical Hypertension*, 14(11), 792–798. doi:10.1111/jch.12008.
- Brown, I. J., Dyer, A. R., Chan, Q., Cogswell, M. E., Ueshima, H., Stamler, J., & Elliott, P. (2013). Estimating 24-hour urinary sodium excretion from casual urinary sodium concentrations in western populations. the INTERSALT Study. *American Journal of Epidemiology*, 177(11), 1180–1192. doi:10.1093/aje/kwt066.
- Browne, S., Minozzi, S., Bellisario, C., Sweeney, M. R., & Susta, D. (2019). Effectiveness of interventions aimed at improving dietary behaviours among people at higher risk of or with chronic non-communicable diseases: an overview of systematic reviews. *European Journal of Clinical Nutrition*, 73(1), 7–23. doi:10.1038/s41430-018-0327-3.

- Brustio, P. R., Moise, P., Marasso, D., Alossa, D., Miglio, F., Mulasso, A., & Boccia, G. (2018). Participation in a school-based walking intervention changes the motivation to undertake physical activity in middle-school students. *PLoS ONE*, *13*(9), 1–13. doi:10.1371/journal.pone.0204098.
- Buxton, C. N. A. (2014). Ghanaian junior high school adolescents dietary practices and food preferences: implications for public health concern. *Journal of Nutrition & Food Sciences*, *4*(5), 1–9. doi:10.4172/2155-9600.1000297.
- Cai, L., Wu, Y., Wilson, R. F., Segal, J. B., Kim, M. T., & Wang, Y. (2014). Effect of childhood obesity prevention programs on blood pressure: a systematic review and meta-analysis. *Journal of Circulation*, *113*, 1–34. doi:10.1161/circulationaha.113.005666.
- Carter, B. D., Abnet, C. C., Feskanich, D., Freedman, N. D., Hartge, P., Lewis, C. E., & Jacobs, E. J. (2015). Smoking and mortality-beyond established causes. *The New England Journal of Medicine*, *372*(7), 631–640. doi:10.1056/nejmsa1407211.
- Cawley, J., Meyerhoefer, C., Biener, A., Hammer, M., & Wintfeld, N. (2015). Savings in medical expenditures associated with reductions in body mass index among us adults with obesity, by diabetes status. *Journal of PharmacoEconomics*, *33*, 707–722. doi:10.1007/s40273-014-0230-2.
- Centers for Disease Control and Prevention (CDC). Global youth tobacco surveillance. surveillance summaries, 2002-2007. (2008). (Vol.57). Atlanta. <http://www.cdc.gov/mmwr> (accessed 21 Nov. 2015).
- Champion, V. (1990). Breast self-examination in women 35 and older: a prospective study. *Journal of Behavioral Science*, *13*(6), 523–538. doi:10.1007/BF00844733.
- Chang, S. J., Choi, S., Kim, S., & Song, M. (2014). Intervention strategies based on information-motivation-behavioral skills model for health behavior change: a systematic review. *Asian Journal of Nursing Research*, *8*(3), 172–181. doi:10.1016/j.anr.2014.08.002.
- Chen, Y., Ma, L., Ma, Y., Wang, H., Luo, J., Zhang, X., & Wang, H. (2015). A national school-based health lifestyles interventions among Chinese children and adolescents against obesity: rationale, design and methodology of a randomized controlled trial in China. *BMC Public Health*, *15*(210), 1–10. doi:10.1186/s12889-015-1516-9.
- Chiolero, A., Bovet, P., & Paradis, G. (2013). Screening for elevated blood pressure in children and adolescents. *JAMA Pediatrics*, *167*(3), 266–273. doi:10.1001/jamapediatrics.2013.438.

- Chomistek, A. K., Manson, J. E., Stefanick, M. L., Lu, B., Sands-Lincoln, M., Goings, S. B., & Eaton, C. B. (2013). Relationship of sedentary behavior and physical activity to incident cardiovascular disease: results from the women's health initiative. *Journal of the American College of Cardiology*, *61*(23), 2346–2354. doi:10.1016/j.jacc.2013.03.031.
- Chrostowska, M., Szyndler, A., Hoffmann, M., & Narkiewicz, K. (2013). Impact of obesity on cardiovascular health. *Best Practice & Research Clinical Endocrinology & Metabolism*, *27*, 147–156. doi:10.1016/j.beem.2013.01.004.
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). New York: Academic Press, Inc. Pages 22-90.
- Colley, R. C., Garriguet, D., Janssen, I., Craig, C. L., Clarke, J., & Tremblay, M. S. (2011). Physical activity of Canadian children and youth: accelerometer results from the 2007-2009 Canadian health measures survey. *Journal of Health Reports*, *22*(1), 15-23.
- Cunha, D. B., de Souza, B. da S. N., Pereira, R. A., & Sichieri, R. (2013). Effectiveness of a randomized school-based intervention involving families and teachers to prevent excessive weight gain among adolescents in Brazil. *PLoS ONE*, *8*(2), 1–8. doi:10.1371/journal.pone.0057498.
- Darfour-Oduro, S. A., Buchner, D. M., Andrade, J. E., & Grigsby-Toussaint, D. S. (2018). A comparative study of fruit and vegetable consumption and physical activity among adolescents in 49 low-and-middle-income countries. *Journal of Scientific Reports*, *8*, 1–12. doi:10.1038/s41598-018-19956-0.
- DeBoer, M. D. (2013). Obesity, systemic inflammation, and increased risk for cardiovascular disease and diabetes among adolescents: a need for screening tools to target interventions. *Journal of Nutrition*, *29*(2), 379–386. doi:10.1016/j.nut.2012.07.003.
- Demetriou, G., Sudeckb Y., G., Thiel, A., & Oliver, H. (2015). The effects of school-based physical activity interventions on students' health-related fitness knowledge: a systematic review. *Educational Research Review*, *16*, 19–40. doi:10.1016/j.edurev.2015.07.002.
- Demirci, H., Nuhoglu, C., Ursavas, I. S., Isildak, S., Basaran, E. O., & Kılıc, M. Y. (2013). Obesity and asymptomatic hypertension among children aged 6–13 years living in Bursa, Turkey. *Family Practice*, *30*, 629–633. doi:10.1093/fampra/cmt048.
- Dhingra, R., & Vasan, R. (2012). Age as a cardiovascular risk factor. *Journal of Medical Clinics in North America*, *96*(1), 87–91. doi:10.1016/j.mcna.2011.11.003.Age.

- Dewar, D. L., Morgan, P. J., Plotnikoff, R. C., Okely, A. D., Batterham, M., & Lubans, D. R. (2014). Exploring changes in physical activity, sedentary behaviors and hypothesized mediators in the NEAT girls group randomized controlled trial. *Journal of Science and Medicine in Sport*, *17*(1), 39–46. doi:10.1016/j.jsams.2013.02.003.
- Doegah, P. T., & Amoateng, A. Y. (2018). Water intake among Ghanaian youth aged 15–34 years: quantitative and qualitative evidence. *Journal of Health, Population and Nutrition*, *37*(3), 1–10. doi:10.1186/s41043-018-0135-3.
- Doku, D. (2012). Substance use and risky sexual behaviours among sexually experienced Ghanaian youth. *BMC Public Health*, *12*(571), 1–7. doi:10.1186/1471-2458-12-571.
- Doku, D., Koivusilta, L., Raisamo, S., & Rimpelä, A. (2013). Socio-economic differences in adolescents' breakfast eating, fruit and vegetable consumption and physical activity in Ghana. *Public Health Nutrition Journal*, *16*(5), 364–372. doi:10.1017/S136898001100276X.
- Domitrovich, C. E., Bradshaw, C. P., Berg, J. K., Pas, E. T., Becker, K. D., Musci, R., & Jalongo, N. (2016). How do school-based prevention programs impact teachers? findings from a randomized trial of an integrated classroom management and social-emotional program. *Journal of Preventive Science*, *17*, 325–337. doi:10.1007/s11121-015-0618-z.
- Drapeau, V., Savard, M., Gallant, A., Nadeau, L., & Gagnon, J. (2016). The effectiveness of a school-based nutrition intervention on children's fruit, vegetables, and dairy product intake. *Journal of School Health*, *86*(5), 353–362. doi: 10.1111/josh.12385.
- Dumith, S. C., Gigante, D. P., Domingues, M. R., & Kohl, H. W. (2011). Physical activity change during adolescence: a systematic review and a pooled analysis. *International Journal of Epidemiology*, *40*(3), 685–698. doi:10.1093/ije/dyq272.
- Eather, N., Morgan, P. J., & Lubans, D. R. (2013). Improving the fitness and physical activity levels of primary school children: results of the Fit-4-Fun group randomized controlled trial. *Journal of Preventive Medicine*, *56*(1), 12–19. doi:10.1016/j.ypmed.2012.10.019.
- Eather, N., Morgan, P. J., & Lubans, D. R. (2016). Improving health-related fitness in adolescents: the CrossFit Teens randomised controlled trial. *Journal of Sports Sciences*, *34*(3), 209–223. doi:10.1080/02640414.2015.1045925.
- Eaton, D. K., Kann, L., Kinchen, S., Shanklin, S., & Ross, J. (2010). Youth risk behavior surveillance-United States, 2009 (Vol. 59). Atlanta. <http://www.cdc.gov/mmwr/pdf/ss/ss5905.pdf> (accessed 20 Dec. 2015).

- Elisau, P., Williams, G., Bourke, M., Clough, G., Harrison, A., & Verma, A. (2015). Factors associated with the prevalence of adolescent binge drinking in the urban areas of Greater Manchester. *European Journal of Public Health*, 28(1), 49–54. doi:10.1093/eurpub/ckv115.
- Engelen, L., Bundy, A. C., Naughton, G., Simpson, J. M., Bauman, A., Ragen, J., & van der Ploeg, H. P. (2013). Increasing physical activity in young primary school children - it's child's play: a cluster randomised controlled trial. *Journal of Preventive Medicine*, 56(5), 319–325. doi:10.1016/j.ypmed.2013.02.007.
- Ennis, C. D. (2017). Educating students for a lifetime of physical activity: enhancing mindfulness, motivation, and meaning. *Journal of Exercise and Sport*, 88(3), 241–250. doi:10.1080/02701367.2017.1342495.
- Falaszchetti, E., Mindell, J., Knott, C., & Poulter, N. (2014). Hypertension management in England: a serial cross-sectional study from 1994 to 2011. *The Lancet*, 383, 1912–1919. doi:10.1016/S0140-6736(14)60688-7.
- Filion, K. B., & Luepker, R. V. (2013). Cigarette smoking and cardiovascular disease: lessons from Framingham. *Journal of Global Health*, 8(1), 35–41. doi:10.1016/j.jgheart.2012.12.005.
- Fisher, J. D., & Fisher, W. A. (1992). Changing AIDS-risk behavior. http://digitalcommons.uconn.edu/chip_docs/2 (accessed 21 Nov. 2015).
- Fisher, J. D., & Fisher, W. A. (2000). Theoretical approaches to individual-level change in HIV risk behavior theoretical approaches to individual level change in HIV risk behavior. http://digitalcommons.uconn.edu/chip_docs/4 (accessed 10 Nov. 2016).
- Fisher, J. D., Fisher, W. A., Amico, K. R., & Herman, J. J. (2006). An information-motivation-behavioral Skills model of adherence to antiretroviral therapy. *Journal of Health Psychology*, 25, 462-473.
- Fisher, W., Fisher, J., & Harman, J. (2003). The information-motivation-behavioral skill model: a general social psychological approach to understanding promoting health behavior. (Blackwell, Malden, Eds.). John Wiley & Sons Ltd. Page 82-100.
- Fisher, W., Sand, M., Lewis, W., & Boroditsky, R. (2000). Canadian menopause study-I: understanding women's intentions to utilise hormone replacement therapy. *The European Menopause Journal*, 37, 1–14. doi:10.1016/S0378-5122(00)00163-8.
- Fonseca, G., Bertolin, M., Gubert, M. B., & Da Silva, E. F. (2019). Effects of a nutritional intervention using pictorial representations for promoting knowledge and practices of healthy eating among Brazilian adolescents. *PLoS ONE*, 14(3), 1–12. doi:10.1371/journal.pone.0213277.

- Fortenberry, K., Ricks, J., & Kovach, F. E. (2013). How much does weight loss affect hypertension? *Journal of Family Practice*, 62(5), 258–259.
- Fortuna, R. J., Nagel, A. K., Rose, E., Mccann, R., Teeters, J. C., Quigley, D. D., & Rocco, T. A. (2015). Effectiveness of a multidisciplinary intervention to improve hypertension control in an urban underserved practice. *Journal of the American Society of Hypertension*, 9(12), 966–974. doi:10.1016/j.jash.2015.10.004.
- Franks, A. L., Kelder, S. H., Dino, G. A., Horn, K. A., Gortmaker, S. L., Wiecha, J. L., & Simoes, E. J. (2015). School nutrition and activity impact on well-being. (A. Hassan, Ed.). Ontario: Apple Academic Press. Page 147-162.
- Gaal, L. F. Van, & Maggioni, A. P. (2013). Overweight, obesity, and outcomes: fat mass and beyond. *The Lancet*, 383(9921), 935–936. doi:10.1016/S0140-6736(13)62076-0.
- Gabrhelik, R., Duncan, A., Miovsy, M., Furr-Holden, C. D. M., Stastna, L., & Jurystova, L. (2012). “Unplugged”: a school-based randomized control trial to prevent and reduce adolescent substance use in the Czech Republic. *Drug and Alcohol Dependence*, 124(1–2), 79–87. doi:10.1016/j.drugalcdep.2011.12.010.
- Gebremariam, M., Henjum, S., Terragni, L., & Torheim, L. (2016). Correlates of fruit, vegetable, soft drink, and snack intake among adolescents: the ESSENS study. *Food & Nutrition Research*, 60, 1–9. doi:10.3402/fnr.v60.32512.
- Gellert, C., Schootker, B., Muller, H., Holleczeck, B., & Brenner, H. (2013). Impact of smoking and quitting on cardiovascular outcomes and risk advancement periods among older adults. *European Journal of Epidemiology*, 28(8), 649–658. doi:10.1007/s10654-013-9776-0.
- George, G. M., Sharma, K. K., Ramakrishnan, S., & Gupta, S. K. (2013). A study of cardiovascular risk factors and its knowledge among school children of Delhi. *Indian Heart Journal*, 66(3), 263–271. doi:10.1016/j.ihj.2014.03.003.
- Ghana Health Service (GHS). (2015). 2014 annual report. Accra. <http://www.ghanahealthservice.org/ghs-category.php.cid=5> (accessed 21 Nov. 2015).
- Ghana Health Service (GHS). (2017b). 2016 annual report. Accra. http://ghanahealthservice.org/downloads/GHS_ANNUAL_REPORT_2016_n.pdf (accessed 21 Nov. 2018).
- Ghana Health Service (GHS) (2017a). The health sector in Ghana: facts and figures 2017. http://ghanahealthservice.org/downloads/FACTS+FIGURES_2017.pdf (accessed 21 Nov. 2018).
- Ghana Statistical Service (GSS) (2009). Ghana demographic and health survey 2008. <https://www.dhsprogram.com/pubs/pdf/FR221/FR221.pdf> (accessed 21 Nov. 2015).

- Ghana Statistical Service (GSS). (2013). 2010 population & housing census: regional analytical report, Brong Ahafo Region. Accra. [http://www.statsghana.gov.gh/docfiles/2010phc/2010_PHC_Regional_Analytical_Reports_Brong_Ahafo_Region .pdf](http://www.statsghana.gov.gh/docfiles/2010phc/2010_PHC_Regional_Analytical_Reports_Brong_Ahafo_Region.pdf) (accessed 21 Nov. 2015).
- Ghana Statistical Service (2012). 2010 population & housing census: summary report of final results. Accra. http://www.statsghana.gov.gh/docfiles/2010phc/Census2010_Summary_report_of_final_results.pdf (accessed 21 Nov. 2015).
- Glanz, K., Rimer, B., & Viswanath, K. (2008). Health behavior and health education: theory, research, and practice (4th ed.). San Francisco: Jossey Bass. Page 11-50.
- Gómez-Pardo, E., Fernández-Alvira, J. M., Vilanova, M., Haro, D., Martínez, R., Carvajal, I., et al. (2016). A comprehensive lifestyle peer group-based intervention on cardiovascular risk factors. *Journal of American College of Cardiology*, 67(5), 479–485. doi:10.1016/j.jacc.2015.10.033
- Gooding, H. C., McGinty, S., Richmond, T. K., Gillman, M. W., & Field, A. E. (2014). Hypertension awareness and control among young adults in the national longitudinal study of adolescent health. *Journal of General Internal Medicine*, 29(8), 1098–1104. doi:10.1007/s11606-014-2809-x.
- Gorini, G., Carreras, G., Bosi, S., Tamelli, M., Monti, C., Storani, S., & Faggiano, F. (2014). Effectiveness of a school-based multi-component smoking prevention intervention: The LdP cluster randomized controlled trial. *Journal of Preventive Medicine*, 61, 6–13. doi:10.1016/j.ypmed.2014.01.004.
- Griebler, U., Rojatz, D., Simovska, V., & Forster, R. (2017). Effects of student participation in school health promotion: a systematic review. *Health Promotion and International*, 32, 195–206. doi:10.1093/heapro/dat090.
- Guerra, P. H., Nobre, M. R. C., Da Silveira, J. A. C., & Taddei, J. A. De A. C. (2013). The effect of school-based physical activity interventions on body mass index: a meta-analysis of randomized trials. *Journal of Clinics*, 68(9), 1263–73. doi:10.6061/clinics/2013(09)14.
- Gunawardena, N., Kurotani, K., Indrawansa, S., Nonaka, D., & Mizoue, T. (2016). School-based intervention to enable school children to act as change agents on weight, physical activity and diet of their mothers: a cluster randomized controlled trial. *International Journal of Behavioral Nutrition and Physical Activity*, 13(45), 1–10. doi:10.1186/s12966-016-0369-7
- Guo, J., Lee, T., Liao, J., & Huang, C.-M. (2015). Prevention of illicit drug use through a school-based program: results of a longitudinal, cluster-randomized controlled trial. *Journal of Adolescent Health*, 56(3), 314–322. doi:10.1016/j.jadohealth.2014.12.003.

- Guthold, R., Cowan, M. J., Autenrieth, C. S., Kann, L., & Riley, L. M. (2010). Physical activity and sedentary behavior among schoolchildren: a 34-country comparison. *Journal of Pediatrics*, *157*(1), 43–49.e1. doi:10.1016/j.jpeds.2010.01.019.
- Haerens, L., Kirk, D., Cardon, G., Bourdeaudhuij, I. De, & Vansteenkiste, M. (2010). Motivational profiles for secondary school physical education and its relationship to the adoption of a physically active lifestyle among university students. *Journal of European Physical Education Review*, *16*(2), 117–139. doi:10.1177/1356336X10381304.
- Hallal, P. C., Andersen, L. B., Bull, F. C., Guthold, R., Haskell, W., & Ekelund, U. (2012). Global physical activity levels: surveillance progress, pitfalls and prospects. *The Lancet*, *380*(9838), 247–257. doi:10.1016/S0140-6736(12)60646-1.
- Hambrick, D. (2007). The field of management's devotion to theory: too much of a good thing? *Academy of Management Journal*, *50*(6), 1346–1352. doi:10.5465/AMJ.2007.28166119
- Hammer, J., Fisher, J., Fitzgerald, P., & Fisher, W. (1996). When two heads aren't better than one: AIDS risk behavior in college-age couples. *Journal of Applied Social Psychology*, *26*(5), 375–397. doi:10.1111/j.1559-1816.1996.tb01855.x.
- Harder-lauridsen, N. M., Birk, N. M., Ried-larsen, M., Juul, A., & Andersen, L. B. (2014). A randomized controlled trial on a multicomponent intervention for overweight. *BMC Journal of Pediatrics*, *24*(273), 1–14.
- He, F. J., Pombo-rodrigues, S., & Macgregor, G. A. (2014). Salt reduction in England from 2003 to 2011: its relationship to blood pressure, stroke and ischaemic heart disease mortality. *British Medical Journal*, *4*, 1–8. doi:10.1136/bmjopen-2013-004549.
- He, F. J., Wu, Y., Feng, X.-X., Ma, J., Ma, Y., Wang, H., & MacGregor, G. A. (2015). School based education programme to reduce salt intake in children and their families (School-EduSalt): cluster randomised controlled trial. *British Medical Journal*, *350*, 1-8. doi:10.1136/bmj.h770.
- Herouvi, D., Karanasios, E., Karayianni, C., & Karavanaki, K. (2013). Cardiovascular disease in childhood: the role of obesity. *European Journal of Pediatrics*, *172*(6), 721–732. doi:10.1007/s00431-013-1932-8.
- Hiemstra, M., Ringlever, L., Otten, R., van Schayck, O. C. P., Jackson, C., & Engels, R. C. M. E. (2014). Long-term effects of a home-based smoking prevention program on smoking initiation: a cluster randomized controlled trial. *Journal of Preventive Medicine*, *60*, 65-70. doi:10.1016/j.jpmed.2013.12.012.

- Hills, A. P., Dengel, D. R., & Lubans, D. R. (2015). Supporting public health priorities: recommendations for physical education and physical activity promotion in schools. *Journal of Progress in Cardiovascular Diseases*, 57(4), 368-374. doi:10.1016/j.pcad.2014.09.010.
- Holmes, M. V., Dale, C. E., Zuccolo, L., Silverwood, R. J., Guo, Y., Ye, Z., & Casas, J. P. (2014). Association between alcohol and cardiovascular disease: mendelian randomisation analysis based on individual participant data. *British Medical Journal*, 349, 1-16. doi:10.1136/bmj.g4164.
- Hormenu, T., Hagan Jnr, J., & Schack, T. (2018). Predictors of alcohol consumption among in- school adolescents in the Central Region of Ghana: a baseline information for developing cognitive-behavioural interventions. *PLoS ONE*, 13(11), 1–16. doi:10.1371/journal.pone.0207093.
- Hout, M. C. V., Foley, M., McCormack, A., & Tardif, E. (2012). Teachers' perspectives on their role in school-based alcohol and cannabis prevention. *International Journal of Health Promotion & Education*, 50(6), 328–341. doi:10.1080/14635240.2012.735388.
- Huang, C., Huang, J., Tian, Y., Yang, X., & Gu, D. (2014). Sugar sweetened beverages consumption and risk of coronary heart disease: a meta-analysis of prospective studies. *Journal of Atherosclerosis*, 234(1), 11–16. doi:10.1016/j.atherosclerosis.2014.01.037.
- Huang, C., Lee, S. O., Chang, E., Pang, H., & Chang, C. (2016). Androgen Receptor (AR) in cardiovascular diseases. *Journal of Endocrinology*, 229(1), 1–35.
- Hung, L., Tidwell, D. K., Hall, M. E., Lee, M. L., Briley, C. A., & Hunt, B. P. (2015). A meta-analysis of school-based obesity prevention programs demonstrates limited efficacy of decreasing childhood obesity. *Journal of Nutrition Research*, 35(3), 229–240. doi:10.1016/j.nutres.2015.01.002.
- Hunter, D. J., & Reddy, K. S. (2013). Noncommunicable diseases. *New England Journal of Medicine*, 369(14), 1336–1343. doi:10.1056/NEJMra1109345.
- Ikehara, S., Iso, H., Yamagishi, K., Kokubo, Y., Saito, I., Yatsuya, H., & Tsugane, S. (2013). Alcohol consumption and risk of stroke and coronary heart disease among Japanese women: the Japan public health center-based prospective study. *Journal of Preventive Medicine*, 57(5), 505–510. doi:10.1016/j.ypmed.2013.07.003.
- Institute of Medicine. (2010). Promoting cardiovascular health in the developing world: a critical challenge to achieve global health. Washington, DC: The national academic press. Page 100-137.

- Isensee, B., Hansen, J., Maruska, K., & Hanewinkel, R. (2014). Effects of a school-based prevention programme on smoking in early adolescence: a 6-month follow-up of the “Eigenständig Werden” cluster randomised trial. *British Medical Journal*, *4*(1), 1-8. doi:/10.1136/bmjopen-2013-004422.
- Iwelunmor, J., Blackstone, S., Veira, D., Nwaozuru, U., Airhihenbuwa, C., Munodawafa, D., et al. (2016). Toward the sustainability of health interventions implemented in sub-Saharan Africa: a systematic review and conceptual framework. *Journal of Implementation Science*, *11*(43), 1–27. doi:10.1186/s13012-016-0392-8.
- Jakovljevic, D. G. (2018). Physical activity and cardiovascular aging: physiological and molecular insights. *Journal of Experimental Gerontology*, *109*, 67–74. doi:10.1016/j.exger.2017.05.016.
- Jamal, A., Homa, D. M., O’Connor, E., Babb, S. D., Caraballo, R. S., Singh, T., & King, B. A. (2015). Current cigarette smoking among adults—United States, 2005–2014 (Vol. 64), 1233–1259. <https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6444a2.htm> (accessed 22 Nov. 2016).
- Juonala, M., Viikari, J. S. A., Kahonen, M., Taittonen, L., Laitinen, T., Hutri-Kahonen, N., & Raitakari, O. T. (2010). Life-time risk factors and progression of carotid atherosclerosis in young adults: the cardiovascular risk in Young Finns study. *European Heart Journal*, *31*(14), 1745–1751. doi:10.1093/eurheartj/ehq141.
- Kähkönen, O., Kankkunen, P., Saaranen, T., Miettinen, H., Kyngäs, H., & Lamidi, M. (2015). Motivation is a crucial factor for adherence to a healthy lifestyle among people with coronary heart disease after percutaneous coronary intervention. *Journal of Clinical Nursing*, *71*(10), 2364–2373. doi:10.1111/jan.12708.
- Kain, J., Concha, F., Moreno, L., & Leyton, B. (2014). School-based obesity prevention intervention in Chilean children: effective in controlling, but not reducing obesity. *Journal of Obesity*, *2014*, 1–8. doi:10.1155/2014/618293.
- Kanjee, Z., Amico, K. R., Li, F., Mbolekwa, K., Moll, A. P., & Friedland, G. (2012). Tuberculosis infection control in a high drug-resistance setting in rural South Africa: information, motivation, and behavioral skills. *Journal of Infection and Public Health*, *5*(1), 67–81. doi:10.1016/j.jiph.2011.10.008.
- Katsiki, N., Papadopoulou, S. K., Fachantidou, A. I., & Mikhailidis, D. P. (2013). Smoking and vascular risk: are all forms of smoking harmful to all types of vascular disease? *Public Health Journal*, *127*(5), 435–441. doi:10.1016/j.puhe.2012.12.021
- Kaya, C., Blake, J., & Chan, F. (2015). Peer-mediated interventions with elementary and secondary school students with emotional and behavioural disorders: a literature review. *Journal of Research and Special Educational Needs*, *15*(2), 120–129. doi:10.1111/1471-3802.12029.

- Kelley, G. A., Kelley, K. S., & Pate, R. R. (2015). Exercise and BMI in overweight and obese children and adolescents: a systematic review and trial sequential meta-analysis. *BioMedical Research International*, 2015, 1–17. doi:10.1155/2015/704539.
- Kelly, A. S., Barlow, S. E., Rao, G., Inge, T. H., Hayman, L. L., Steinberger, J., & Daniels, S. R. (2013). Severe obesity in children and adolescents: identification, associated health risks, and treatment approaches. *Journal of Circulation*, 2013(128), 1689-1712. doi:10.1161/CIR.0b013e3182a5cfb3.
- Kessler, H. S. (2016). Simple interventions to improve healthy eating behaviors in the school cafeteria. *Nutrition Reviews*, 74(3), 198–209. doi:10.1093/nutrit/nuv109.
- Khambalia, A. Z., Dickinson, S., Hardy, L. L., Gill, T., & Baur, L. A. (2012). A synthesis of existing systematic reviews and meta-analyses of school-based behavioural interventions for controlling and preventing obesity. *Obesity Reviews Journal*, 13, 214–233. doi:10.1111/j.1467-789X.2011.00947.x.
- Khumros, W., Vorayingyong, A., Suppakitiporn, S., Rattananupong, T., & Lohsoonthorn, V. (2019). Effectiveness of modified health belief model-based intervention to reduce body mass index for age in overweight junior high school students in Thailand. *Journal of Health Research*, 33(2), 162–172. doi:10.1108/JHR-08-2018-0065.
- Kim, H. (2013). Statistical notes for clinical researchers: assessing normal distribution (2) using skewness and kurtosis. *Journal of Restorative Dentistry & Endodontics*, 38(1), 52–54. doi:10.5395/rde.2013.38.1.52.
- Kim, N., Seo, D., King, M. H., Lederer, A. M., & Sovinski, D. (2014). Long-term predictors of blood pressure among adolescents during an 18-month school-based obesity prevention intervention. *Journal of Adolescent Health*, 55(4), 521–527 doi:10.1016/j.jadohealth.2014.04.011.
- Klutse, C. M. (2015). An investigation into the adolescents nutritional and dietary requirements among secondary schools in the Volta Region of Ghana. *Global Research Journal of Science and Nutrition*, 1(1), 1–5.
- Kolber, M. R. (2014). Family history of cardiovascular disease. *Journal of Canadian Family Physician*, 60(11), 1016.
- Kowalski, K. C., Crocker, P. R. E., & Donen, R. M. (2004). The physical activity questionnaire for older children (PAQ-C) and adolescents (PAQ-A) manual. College of Kinesiology, University of Saskatchewan. <https://www.researchgate.net/publication/228441462> (accessed 21 Nov. 2015).
- Kpodo, F. M., Mensah, C., & Dzah, C. S. (2015). Fruit and vegetable consumption patterns and preferences of students in a ghanaiian polytechnic. *World Journal of Nutrition and Health*, 3(3), 53–59. doi:10.12691/jnh-3-3-2.

- Kuciene, R., & Dulskiene, V. (2014). Associations of short sleep duration with prehypertension and hypertension among Lithuanian children and adolescents: a cross-sectional study. *BMC Public Health*, *14*(255), 1–8. doi:10.1186/1471-2458-14-255.
- Kumah, D. B., Akuffo, K. O., Abaka-Cann, J. E., Affram, D. E., & Osae, E. A. (2015). Prevalence of overweight and obesity among students in the Kumasi Metropolis. *Journal of Nutrition and Metabolism*, *2015*, 1–4. doi:10.1155/2015/613207.
- Labarthe, D. R. (2011). *Epidemiology and prevention of cardiovascular diseases: a global challenge* (2nd ed). Sudbury, Massachusetts: Jones and Bartlett publishers. Page 155-201.
- Lammers, J., Goossens, F., Conrod, P., Engels, R., Wiers, R. W., & Kleinjan, M. (2015). Effectiveness of a selective intervention program targeting personality risk factors for alcohol misuse among young adolescents: results of a cluster randomized controlled trial. *Society for the Study of Addiction*, *110*, 1101–1109. doi:10.1111/add.12952.
- Lao, C., Chan, Y., Tong, H. H., & Chan, A. (2015). Prevalence, awareness and control of cardiovascular risk factors in a low-income population in Macao, China. *Journal of Public Health Research*, *5*(2), 50–57. doi:10.5923/j.phr.20150502.02.
- Larsen, M. N., Nielsen, C. M., Madson, M., Mannich, V., Hansen, L., Bangsbo, J., & Hansen, P. R. (2018). Cardiovascular adaptations after 10 months of intense school-based physical training for 8 to 10 year old children. *Scandinavian Journal of Medicine and Science Sports*, *28*, 33–41. doi:10.1111/sms.13253.
- Laureati, M., Bergamaschi, V., & Pagliarini, E. (2014). School-based intervention with children. Peer-modeling, reward and repeated exposure reduce food neophobia and increase liking of fruits and vegetables. *Journal of Appetite*, *83*, 26–32. doi:10.1016/j.appet.2014.07.031.
- Lavelle, H. V., MacKay, D. F., & Pell, J. P. (2012). Systematic review and meta-analysis of school-based interventions to reduce body mass index. *Journal of Public Health*, *34*(3), 360–369. doi:10.1093/pubmed/fdr116.
- Lemeshow, S., Hosmer, D. W. J., Klar, J., & Lwanga, S. K. (1990). Adequacy of sample size in health studies. John Wiley & Sons Ltd. Page 99-147.
- Llargues, E., Recasens, M. A., Manresa, J.-M., Jensen, B. B., Franco, R., Nadal, A., & Castell, C. (2016). Four-year outcomes of an educational intervention in healthy habits in schoolchildren: the Aall 3 Trial. *European Journal of Public Health*, *27*(1), 42–47. doi:10.1093/eurpub/ckw199.
- Li, J., & Siegrist, J. (2012). Physical activity and risk of cardiovascular disease—a meta-analysis of prospective cohort studies. *International Journal of Environmental Research and Public Health*, *9*(2), 391–407. doi:10.3390/ijerph9020391.

- Li, K., Yao, C., Di, X., Yang, X., Dong, L., Xu, L., & Zheng, M. (2016). Smoking and risk of all-cause deaths in younger and older adults. *Journal of Medicine*, *95*(3), 1-15. doi:10.1097/MD.0000000000002438.
- Lierman, L., Kasprzyk, D., & Benoliel, J. (1991). Understanding adherence of breast self-examination in older women. *Western Journal of Nursing Research*, *13*(1), 46–66. doi:10.1177/019394599101300104.
- Liyanage, L., Lee, N. J., Cook, T., Herrmann, H. C., Jagasia, D., & Han, Y. (2016). The impact of gender on cardiovascular system calcification in very elderly patients with severe aortic stenosis. *International Journal of Cardiovascular Imaging*, *32*, 173–179. doi:10.1007/s10554-015-0752-5.
- Lonsdale, C., Rosenkranz, R. R., Peralta, L. R., Bennie, A., Fahey, P., & Lubans, D. R. (2013a). A systematic review and meta-analysis of interventions designed to increase moderate-to-vigorous physical activity in school physical education lessons. *Journal of Preventive Medicine*, *56*(2), 152–161. doi:10.1016/j.jpmed.2012.12.004.
- Lonsdale, C., Rosenkranz, R. R., Sanders, T., Peralta, L. R., Bennie, A., Jackson, B., & Lubans, D. R. (2013b). 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. *Journal of Preventive Medicine*, *57*(5), 696–702. doi:10.1016/j.jpmed.2013.09.003.
- Lu, Y., Hajifathalian, K., Ezzati, M., Woodland, M., Rimm, E. B., & Danaei, G. (2014). Metabolic mediators of the effects of body-mass index, overweight, and obesity on coronary heart disease and stroke: a pooled analysis of 97 prospective cohorts with 1.8 million participants. *The Lancet*, *383*, 970–983. doi:10.1016/S0140-6736(13)61836-X.
- Maas, A. H. E. M., & Appelman, Y. E. A. (2010). Gender differences in coronary heart disease. *Netherlands Heart Journal*, *18*(12), 598–603. doi:10.1007/s12471-010-0841-y.
- MacArthur, G. J., Harrison, S., Caldwell, D. M., Hickman, M., & Campbell, R. (2015). Peer-led interventions to prevent tobacco, alcohol and/or drug use among young people aged 11–21 years: a systematic review and meta-analysis. *Journal of Addiction*, *111*(3) 391–407. doi:10.1111/add.13224.
- Mahmood, S. S., Levy, D., Vasan, R. S., & Wang, T. J. (2014). The framingham heart study and the epidemiology of cardiovascular disease: a historical perspective. *The Lancet*, *383*(9921), 999–1008. doi:10.1016/S0140-6736(13)61752-3.
- Maksimović, M., Marinković, J., Vlajinac, H., Maksimović, J., Tomanić, M., & Radak, D. (2017). Awareness and knowledge of cardiovascular disease risk factors among medical students. *PubMed*, *129*(13–14), 458–463. doi:10.1007/s00508-017-1192-0.

- Malcon, M. C., MenezesII, A. M. B., Assunção, M. C. F., Neutzling, M. B., & Challal, P. (2011). Effectiveness of an educational intervention on smoking among school adolescents. *Review of Brazillian Epidemiology*, *14*(1), 1–12.
- Mamudu, H., & Veeranki, S. (2013). Tobacco use among school-going adolescents (11–17 years) in Ghana. *Nicotine and Tobacco Research*, *15*(8), 1355–1364. doi:10.1093/ntr/nts269.
- Mayega, R. W., Makumbi, F., Rutebemberwa, E., Peterson, S., Ostensen, C.-G., Tomson, G., & Guwatudde, D. (2012). Modifiable socio-behavioural factors associated with overweight and hypertension among persons aged 35 to 60 years in Eastern Uganda. *PLoS ONE*, *7*(10), 1–9. doi:10.1371/journal.pone.0047632.
- Mcisaac, J. D., Hernandez, K. J., Kirk, S. F. L., & Curran, J. A. (2016). Interventions to support system-level implementation of health promoting schools: a scoping review. *International Journal of Environmental Research and Public Health*, *13*(200), 1–24. doi:10.3390/ijerph13020200.
- Mei, H., Xiong, Y., Xie, S., Guo, S., Li, Y., Guo, B., & Zhang, J. (2016). 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*, *16*(205), 1–12. doi:10.1186/s12889-016-2829-z.
- Mellendick, K., Shanahan, L., Wideman, L., Calkins, S., Keane, S., & Lovelady, C. (2018). Diets rich in fruits and vegetables are associated with lower cardiovascular disease risk in adolescents. *Nutrients*, *10*(136), 1–15. <https://doi.org/10.3390/nu10020136>.
- Melnyk, B. M., Jacobson, D., Kelly, S., Belyea, M., Shaibi, G., Small, L., & Marsiglia, F. F. (2013). Promoting healthy lifestyles in high school adolescents: a randomized controlled trial. *American Journal of Preventive Medicine*, *45*(4), 407–415. doi:10.1016/j.amepre.2013.05.013.
- Mendis, S., Lindholm, L. H., Anderson, S. G., Alwan, A., Koju, R., Onwubere, B. J. C., & Heagerty, A. (2011). Total cardiovascular risk approach to improve efficiency of cardiovascular prevention in resource constrain settings. *Journal of Clinical Epidemiology*, *64*(12), 1451–1462. doi:10.1016/j.jclinepi.2011.02.001.
- Mendonca, R. D. D., Marc, A., Gea, A., Fuente-arrillaga, C. De, Martinez-gonzalez, M. A., Cristine, A., & Bes-rastrollo, M. (2016). Ultraprocessed food consumption and risk of overweight and obesity: the University of Navarra Follow-Up (SUN) cohort study. *American Journal of Clinical Nutrition*, *104*(5), 1433–1440. doi:10.3945/ajcn.116.135004.
- Menyanu, E., Charlton, K. E., Ware, L. J., Russel, J., Biritwum, R., & Kowal, P. (2017). Salt use behaviours of ghanaians and south africans: a comparative study of knowledge, attitudes and practices. *Journal of Nutrients*, *9*(939), 1–13. doi:10.3390/nu9090939.

- Midford, R., Mitchell, J., Lester, L., Cahill, H., Foxcroft, D., Ramsden, R., & Pose, M. (2014). Preventing alcohol harm: early results from a cluster randomised, controlled trial in Victoria, Australia of comprehensive harm minimisation school drug education. *International Journal of Drug Policy*, 25(1), 142–150. doi:10.1016/j.drugpo.2013.05.012.
- Ministry of Education Ghana (MOE). (2019). Education system in Ghana. <http://moe.gov.gh/index.php/about-us/> (accessed 9 Aug. 2019).
- Ministry of Health Ghana (MOH). (2012). Strategy for the management, prevention and control of chronic non-communicable diseases in Ghana 2012-2016. Accra. <https://www.mindbank.info/item/1933> (accessed 21 Nov. 2015).
- Misovich, S., Fisher, J., & Fisher, W. (1996). The perceived AIDS-preventive utility of knowing one's partner well: a public health dictum and individual's risky sexual behavior. *Canadian Journal of Human Sexuality*, 5(2), 83–90.
- Misovich, S., Martinez, T., Fisher, J., Bryan, A., & Catapano, N. (2003). Predicting breast self-examination: a test of the Information-Motivation-Behavioral Skills model. *Journal of Applied Social Psychology*, 33(4), 775–790. doi:10.1111/j.1559-1816.2003.tb01924.x.
- Mogre, V., Aneyire, E. S., & Gyamfi, E. K. (2013). Physical activity and BMI status of school-age children in Tamale, Northern Ghana. *Pakistan Journal of Nutrition*, 12(5), 484–490.
- Mohammed, M., Matthijs, S., Alotaiby, F. F., de Vries, N., & de Vries, H. (2016). Effects of a randomized controlled trial to assess the six-months effects of a school based smoking prevention program in Saudi Arabia. *Journal of Preventive Medicine*, 90, 100–106. doi:10.1016/j.ypmed.2016.06.032.
- Moher, D., Hopewell, S., Schulz, K. F., Montori, V., Gøtzsche, P. C., Devereaux, P. J., & Altman, D. G. (2010). CONSORT 2010 explanation and elaboration: updated guidelines for reporting parallel group randomised trials. *British Medical Journal*, 10(1), 1-14. doi: 10.1136/bmj.c869.
- Moore, G. F., Littlecott, H. J., Fletcher, A., Hewitt, G., & Murphy, S. (2016). Variations in schools' commitment to health and implementation of health improvement activities: a cross-sectional study of secondary schools in Wales. *BMC Public Health*, 16(138), 1–11. doi:10.1186/s12889-016-2763-0.
- Moran, A. E., Roth, G. A., Narula, J., & Mensah, G. A. (2014). 1990-2010 global cardiovascular disease atlas. *Global Heart*, 9(1), 3–16. doi:10.1016/j.ghheart.2014.03.1220.
- Morano, M., Rutigliano, I., Rago, A., Pettoello-Mantovani, M., & Campanozzi, A. (2016). A multi-component school-initiated obesity intervention to promote healthy lifestyles in children. *Nutrition*, 32(10), 1075–80. doi:10.1016/j.nut.2016.03.007.

- Movva, R., & Figueredo, V. M. (2013). Alcohol and the heart: To abstain or not to abstain? *International Journal of Cardiology*, *164*(3), 267–276. doi:10.1016/j.ijcard.2012.01.030.
- Mozaffarian, D., Benjamin, E. J., Go, A. S., Roger, V. L., Berry, J. D., Borden, W. B., & Turner, M. B. (2015). Executive summary: heart disease and stroke statistics-2015 update: a report from the American Heart Association. <http://circ.ahajournals.org/cgi/doi/10.1161/CIR.0b013e318282ab8f> (accessed 21 Nov. 2016).
- Muka, T., Oliver-Williams, C., Kunutsor, S., Laven, J. S. E., Fauser, B. C. J. M., Chowdhury, R., & Franco, O. H. (2016). Association of age at onset of menopause and time since onset of menopause with cardiovascular outcomes, intermediate vascular traits, and all-cause mortality: a systematic review and meta-analysis. *JAMA Cardiology*, *1*(7), 767–776. doi:10.1001/jamacardio.2016.2415.
- Mukamana, O., & Johri, M. (2016). What is known about school-based interventions for health promotion and their impact in developing countries? a scoping review of the literature. *Health Education Research*, *31*(5), 587–602. doi:10.1093/her/cyw040.
- Muncan, B. (2018). Cardiovascular disease in racial/ethnic minority populations: illness burden and overview of community-based interventions. *Public Health Reviews*, *39*(32), 1–11. doi:10.1186/s40985-018-0109-4.
- Myers, J., McAuley, P., Lavie, C. J., Despres, J. P., Arena, R., & Kokkinos, P. (2015). Physical activity and cardiorespiratory fitness as major markers of cardiovascular risk: their independent and interwoven importance to health status. *Progress in Cardiovascular Diseases Journal*, *57*(4), 306–314. doi:10.1016/j.pcad.2014.09.011.
- Nakamura, K., Fuster, J. J., & Walsh, K. (2014). Adipokines: a link between obesity and cardiovascular disease. *Journal of Cardiology*, *63*(4), 250–259. doi:10.1016/j.jjcc.2013.11.006.
- National Health Service. (2015). Cardiovascular disease overview. <http://www.nhs.uk/Conditions/cardiovascular-disease/Pages/Introduction.aspx> (accessed 18 Dec. 2015).
- National Institute of Health. (2005). Fourth report on diagnosis, evaluation, and treatment of high blood pressure in children and adolescents. <http://www.nhlbi.nih.gov>. (accessed 21 Nov. 2015).
- Nielsen, M., Andersson, C., Gerds, T. A., Andersen, P. K., Jensen, T. B., Køber, L., & Torp-pedersen, C. (2013). Familial clustering of myocardial infarction in first-degree relatives: a nationwide study. *European Heart Journal*, *34*, 1198–1203. doi:10.1093/eurheartj/ehs475.

- Nti, C. A. (2008). Household dietary practices and family nutritional status in rural Ghana. *Journal of Nutrition Research and Practice*, 2(1), 35–40. doi:10.4162/nrp.2008.2.1.35.
- Nti, C. A., Brown, A., & Danquah, A. (2012). Adolescents' knowledge of diet-related chronic diseases and dietary practices in Ghana. *Journal of Food and Nutrition Sciences*, 2, 1527–1532. doi:10.4236/fns.2012.311199.
- Nyawornota, V. K., Aryeetey, R., Bosomprah, S., & Aikins, M. (2013). An exploratory study of physical activity and over-weight in two senior high schools in the Accra Metropolis. *Ghana Medical Journal*, 47(4), 197–203.
- Obirikorang, Y., Obirikorang, C., Anto, E. O., Acheampong, E., Dzah, N., Akosah, C. N., & Nsenbah, E. B. (2016). 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. *Journal of Diabetes Research*, 2016, 1–10. doi:10.1155/2016/9759241.
- Ofori-Asenso, R., Agyeman, A. A., Laar, A., & Boateng, D. (2016). Overweight and obesity epidemic in Ghana—a systematic review and meta-analysis. *BMC Public Health*, 16, 1–18. doi:10.1186/s12889-016-3901-4.
- Ofori-Asenso, R., & Garcia, D. (2015). Cardiovascular diseases in Ghana within the context of globalization. *Journal of Cardiovascular Diagnosis and Therapy*, 6(1), 67–77. doi:10.3978/j.issn.2223-3652.2015.09.02.
- Okubo, Y., Sairenchi, T., Irie, F., & Yamagishi, K. (2014). Association of alcohol consumption with incident hypertension among middle-aged and older Japanese population: the Ibarakai Prefectural Health Study (IPHS). *Journal of American Heart Association*, 63, 41–47. doi:10.1161/hypertensionaha.113.01585.
- Olawole-Isaac, A., Ogundipe, O., Amoo, E. O., & Adeloye, D. (2018). Substance use among adolescents in sub-Saharan Africa: a systematic review and meta-analysis. *South African Journal of Child Health*, 12(2 Suppl 1), S79–S84. doi:10.7196/sajch.2018.v12i2.1524.
- Oppong Asante, K., Meyer-Weitz, A., & Petersen, I. (2014). Substance use and risky sexual behaviours among street connected children and youth in Accra, Ghana. *Substance Abuse Treatment, Prevention, and Policy*, 9(1), 1-9. doi:10.1186/1747-597x-9-45.
- Oppong Asante, K., & Kugbey, N. (2019). Alcohol use by school-going adolescents in Ghana: prevalence and correlates. *Journal of Mental Health & Prevention*, 13, 75–81. doi:10.1016/j.mhp.2019.01.009.

- Owen, N., Healy, G. N., Matthews, C. E., & Dunstan, D. W. (2012). Too much sitting: the population-health science of sedentary behaviour. *Exercise and Sport Sciences Reviews Journal*, 38(3), 105–113. doi:10.1097/JES.0b013e3181e373a2.
- Owusu, A. A., Ankrah, M. Y., Boateng, G. P., & Anteh, G. (1995). Food weight/handy measures tables (Ghana). The DREYFUS Health Foundation "problem-solving for better health" program, Accra, Ghana. Page 1-31 <http://www.dreyfusfoundation-Ghana.com>.
- Patnode, C. D., Connor, E. O., Whitlock, E. P., Perdue, L. A., Soh, C., & Hollis, J. (2013). Primary care-relevant interventions for tobacco use prevention and cessation in children and adolescents: a systematic evidence review for the US preventive services task force. *Annals of Internal Medicine Journal*, 158(4), 253–260. doi: 10.7326/0003-4819-158-4-201302190-00580.
- Pearson, N., & Biddle, S. J. H. (2011). Sedentary behavior and dietary intake in children, adolescents, and adults: a systematic review. *American Journal of Preventive Medicine*, 41(2), 178–188. doi:10.1016/j.amepre.2011.05.002.
- Pérez-López, F., Larrad-Mur, L., Kallen, A., Chedraui, P., & Taylor, H. (2011). Gender differences in cardiovascular disease: hormonal and biochemical influences. *Reproductive Science*, 17(6), 511–531. doi:10.1177/1933719110367829.
- Perk, J., Helmut, G., Graham, I., Reiner, Z., & Verschuren, W. M. M. (2012). European guidelines on cardiovascular disease prevention in clinical practice. *European Heart Journal*, 33, 1635–1701. doi:10.1093/eurheartj/ehs092.
- Philippi, S. T., & Leme, A. B. C. (2015). Dietary intake and meal frequency of Brazilian girls attending a school-based randomized controlled trial. *Journal of Nutrition and Food Science*, 45(6), 954–968. doi:10.1108/NFS-06-2015-0072.
- Phillips, J., & Figaji, T. (2010). Effect of an intervention programme on the physical activity participation patterns among school going children in South Africa. *British Journal of Sports Medicine*, 44(14), 871–876. doi:10.1136/bjism.2010.078972.28.
- Pickering, T. G., Hall, J. E., Appel, L. J., Falkner, B. E., Graves, J., Hill, M. N., & Roccella, E. J. (2005). Recommendations for blood pressure measurement in humans and experimental animals. part 1: blood pressure measurement in humans. *Hypertension Journal*, 45, 142–161. doi:10.1161/01.HYP.0000150859.47929.8e.
- Ploeg, K. A.V., Maximova, K., MCGavock, J., Davis, W., & Veugelers, P. (2014). Do school-based physical activity interventions increase or reduce inequalities in health? *Social Science & Medicine*, 112, 80–87. doi:10.1016/j.socscimed.2014.04.032.

- Popkin, B. M., & Slining, M. M. (2013). New dynamics in global obesity facing low- and middle-income countries. *Obesity Reviews Journal*, *14*, 11–20. doi:10.1111/obr.12102.
- Quaresma, A., Palmeira, A., Martins, S., Minderico, C., & Sardinha, L. (2015). Psychosocial predictors of change in physical activity and quality of life in the PESSOA program: a school-based intervention study. *Archives of Exercise Health and Disease*, *5*(1), 366–376. doi:10.5628/aeht.v5i1-2.170.
- Rampal, L., Rampal, S., Azhar, M. Z., & Rahman, A. R. (2008). Prevalence, awareness, treatment and control of hypertension in Malaysia: a national study of 16,440 subjects. *Journal of Public Health*, *122*(1), 11–18. doi:10.1016/j.puhe.2007.05.008.
- Rampal, S., Rampal, L., Rahmat, R., Azhar Md Zain, Yee Guan Yap, Mohamed, M., & Taha, M. (2009). Variation in the prevalence, awareness, and control of diabetes in a multiethnic population: a nationwide population study in Malaysia. *Asia-Pacific Journal of Public Health*, *22*(2), 194–202. doi:10.1177/1010539509334816.
- Rapsomaniki, E., Timmis, A., George, J., Pujades-rodriguez, M., Shah, A. D., Denaxas, S., & Caulfi, M. J. (2014). Blood pressure and incidence of twelve cardiovascular diseases: lifetime risks, healthy life-years lost, and age-specific associations in 1.25 million people. *The Lancet*, *383*, 1899–1911. doi:10.1016/S0140-6736(14)60685-1.
- Reremoana F. T., Jonathan B. D., Ambler, A., Hogan, S., Sandhya W. C., Michael J.A. et al. (2015). Childhood to early-midlife systolic blood pressure trajectories early-life predictors, effect modifiers, and adult cardiovascular outcomes. *Epidemiology and Population Journal*, *66*(6), 1108–1115. doi:10.1161/Hypertensionaha.115.05831.
- Rezapour, B., Mostafavi, F., & Khalkhali, H. R. (2016). School-based and precede-proceed-model intervention to promote physical activity in the high school students: case study of Iran. *Global Journal of Health Science*, *8*(9), 271–280. doi:10.5539/gjhs.v8n9p271.
- Robertson, W., Murphy, M., & Johnson, R. (2016). Evidence base for the prevention and management of child obesity. *Journal of Paediatrics and Child Health*, *12*, 1–7. doi:10.1016/j.paed.2015.12.009.
- Ruijter, H. M. Den, & Pasterkamp, G. (2015). Gender and cardiovascular disease. *PanVascular Medicine Journal*, *10*, 1939–1951. doi:10.1007/978-3-642-37078-6_244.
- Sanuade, O., Anarfi, J., Aikins, A., & Koram, K. (2014). Patterns of cardiovascular disease mortality in Ghana: a 5-year review of autopsy cases at Korle-Bu Teaching Hospital. *European PMC Journal*, *24*(1), 55–59.

- Sanuade, O., Boatemaa, S., & Kushitor, M. (2018). Hypertension prevalence, awareness, treatment and control in Ghanaian population: evidence from the Ghana demographic and health survey. *PLoS ONE*, *13*(11), 1–18. doi:10.1371/journal.pone.0205985.
- Saraf, D. S., Gupta, S. K., Pandav, C. S., Nongkinrih, B., Kapoor, S. K., Pradhan, S. K., & Krishnan, A. (2015). Effectiveness of a school based intervention for prevention of non-communicable diseases in middle school children of rural north india: a randomized controlled trial. *Indian Journal of Pediatrics*, *82*(4), 354–362. doi:10.1007/s12098-014-1562.
- Sawyer, S. M., Afi, R. A., Bearinger, L. H., Blakemore, S., Dick, B., Ezeh, A. C., & Patton, G. C. (2012). Adolescence: a foundation for future health. *The Lancet*, *379*, 1630–1640. doi:10.1016/S0140-6736(12)60072-5.
- Scaglioni, S., De Cosmi, V., Ciappolino, V., Parazzini, F., Brambilla, P., & Agostoni, C. (2018). Factors influencing children’s eating behaviours. *Journal of Nutrients*, *10*, 1–17. doi:10.3390/nu10060706.
- Schutter, A., Lavie, C. J., & Milani, R. V. (2014). The impact of obesity on risk factors and prevalence and prognosis of coronary heart disease—the obesity paradox. *Journal of Progress in Cardiovascular Diseases*, *56*(4), 401–408. doi:10.1016/j.pcad.2013.08.003.
- Shahid, S. M., & Bishop, K. S. (2019). Comprehensive approaches to improving nutrition: future prospects. *Journal of Nutrients*, *11*(8), 1–19. doi:10.3390/nu11081760.
- Shakeshaft, A., Doran, C., Petrie, D., Breen, C., Havard, A., Abudeen, A., & Sanson-Fisher, R. (2014). The effectiveness of community action in reducing risky alcohol consumption and harm: a cluster randomised controlled trial. *PLoS ONE*, *11*(3), 1-14 doi:10.1371/journal.pmed.1001617.
- Sharma, B., Kim, H. Y., & Nam, E. W. (2018). Effects of school-based health promotion intervention on health behaviors among school adolescents in north Lima and Callao, Peru. *Journal of Lifestyle Medicine*, *8*(2), 60–71. doi:10.15280/jlm.2018.8.2.60.
- Shrestha, R., & Copenhaver, M. (2015). Long-term effects of childhood risk factors on cardiovascular health during adulthood. *Clinical Medicine Review of Vascular Health*, *7*, 1–5. doi:10.4137/CMRVH.S29964.
- Shrivastava, U., & Misra, A. (2015). Need for ethnic-specific guidelines for prevention, diagnosis, and management of type 2 diabetes in South asians. *Diabetes Technology Therapy*, *17*(6), 435–439. doi:10.1089/dia.2014.0213.
- Simane, B., & Zaitchik, B. F. (2014). The sustainability of community-based adaptation projects in the blue Nile highlands of Ethiopia. *Journal of Sustainability*, *6*, 4308–4325. doi:10.3390/su6074308.

- Singh, G. K., Siahpush, M., Azuine, R. E., & Williams, S. D. (2015). Widening socioeconomic and racial disparities in cardiovascular disease mortality in the United States, 1969-2013. *International Journal of MCH and AIDS*, 3(2), 106–118.
- Skinner, A. C., & Skelton, J. A. (2014). Prevalence and trends in obesity and severe obesity among children in the United States, 1999-2012. *JAMA*, 168(6), 561–566. doi:10.1001/jamapediatrics.2014.21.
- Smith, S. C., Collins, A., Ferrari, R., Holmes, D. R., Logstrup, S., McGhie, D. V., & Zoghbi, W. A. (2012). Our time: a call to save preventable death from cardiovascular disease (heart disease and stroke). *European Heart Journal*, 33(23), 2910–2916. doi:10.1093/eurheartj/ehs313.
- Snijder, M. B., Agyemang, C., Peters, R. J., Stronks, K., Ujcic-voortman, J. K., & Valkengoed, I. G. M. Van. (2017). Case finding and medical treatment of type 2 diabetes among different ethnic minority groups: the HELIUS Study. *Journal of Diabetes Research*, 2017, 1–8. doi:10.1155/2017/9896849.
- Soler, E. P., & Ruiz, V. C. (2010). Epidemiology and risk factors of cerebral ischemia and ischemic heart diseases: similarities and differences. *Current Cardiology Reviews*, 6(3), 138–149. doi:10.2174/157340310791658785.
- Solomon, I., Adjuik, M., Takramah, W., Axame, W., Owusu, R., Parbey, P., & Kweku, M. (2017). Prevalence and awareness of hypertension among urban and rural adults in Hohoe Municipality, Ghana. *Journal of Medical Research*, 3(3), 136–145.
- Sonnino, R. (2016). Health care leadership development and training: progress and pitfalls. *Journal of Healthcare Leadership*, 8, 19–29.
- Spagnolo, A., Giussani, M., Ambrozzi, A. M., Bianchetti, M., Maringhini, S., Matteucci, M. C., & Strambi, M. (2013). Focus on prevention, diagnosis and treatment of hypertension in children and adolescents. *Italian Journal of Pediatrics*, 39(20), 1–18. doi:10.1186/1824-7288-39-20.
- Strøm, H. K., Adolfsen, F., Fossum, S., Kaiser, S., & Martinussen, M. (2014). Effectiveness of school-based preventive interventions on adolescent alcohol use: a meta-analysis of randomized controlled trials. *Substance Abuse Treatment, Prevention, and Policy*, 9(48) 1–11. doi: 0.1186/1747-597x-9-48.
- Suchert, V., Isensee, B., Sargent, J., Weisser, B., & Hanewinkel, R. (2015). Prospective effects of pedometer use and class competitions on physical activity in youth: a cluster-randomized controlled trial. *Preventive Medicine*, 81, 399–404. doi:10.1016/j.ypmed.2015.10.002.
- Sultana, N. (2017). Nutritional awareness among the parents of primary school going children. *Saudi Journal of Humanities and Social Sciences*, 2, 708–725. doi.org/10.21276/sjhss.

- Sung, M. M. Y., & Dyck, J. R. B. (2012). Age-related cardiovascular disease and the beneficial effects of calorie restriction. *Heart Failure Reviews*, *17*, 707–719. doi:10.1007/s10741-011-9293-8.
- Sutherland, R., Campbell, E., Lubans, D. R., Morgan, P. J., Okely, A. D., Nathan, N., & Wiggers, J. (2015). ‘Physical Activity 4 Everyone’ school-based intervention to prevent decline in adolescent physical activity levels: 12 month (mid-intervention) report on a cluster randomised trial. *British Journal of Sports Medicine*, *50* (8), 1–10. doi:10.1136/bjsports-2014-094523.
- Tabachnick, B. G., & Fidell, L. S. (2007). Using multivariate statistics. (S. Hartman & T. Felser, Eds.) (5th ed.). Boston, USA: Pearson Education, Inc. Page 33-61.
- Tabei, S. M. B., Senemar, S., Saffari, B., Ahmadi, Z., & Haqparast, S. (2014). Non-modifiable factors of coronary artery stenosis in late onset patients with coronary artery disease in southern Iranian population. *Journal of Cardiovascular and Thoracic Research*, *6*(1), 51–55. doi:10.5681/jcvtr.2014.010.
- Tarp, J., Jespersen, E., Møller, N. C., Klakk, H., Wessner, B., Wedderkopp, N., & Bugge, A. (2018). Long-term follow-up on biological risk factors, adiposity, and cardiorespiratory fitness development in a physical education intervention: a natural experiment (CHAMPS-study DK). *BMC Public Health*, *18*(605), 1–14. doi:10.1186/s12889-018-5524-4 research.
- Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach’s alpha. *International Journal of Medical Education*, *2*, 53–55. doi:10.5116/ijme.4dfb.8dfd.
- Thapa, S., Martinez, P., & Clausen, T. (2014). Depression and its correlates in South Africa and Ghana among people aged 50 and above: findings from the WHO study on global ageing and adult health. *Journal of Psychiatry*, *17*(6), 10–15. doi:10.4172/1994-8220.1000167.
- The LifeWindows Team. (2006). The LifeWindows motivation-information-behavioral skills adherence questionnaire (LW-IMB-AAQ). Centre for health, intervention, and prevention. university of Connecticut. http://chipcontent.chip.uconn.edu/chipweb/documents/Research/F_LWIMBARTQuestionnaire.pdf (accessed 21 Nov. 2015).
- The tobacco atlas country fact sheet, Ghana. (2015). <http://www.tobaccoatlas.org/country-data/ghana/> (accessed 21 Nov. 2016).
- Thomas, R. E., Baker, P., & Thomas, B. C. (2016). Family-based interventions in preventing children and adolescents from using tobacco: a systematic review and meta-analysis. *Journal of Academic Pediatrics*, *16*(5), 419-426. doi:10.1016/j.acap.2015.12.006.

- Thompson, M., Dana, T., Bougatsos, C., Blazina, I., & Norris, S. L. (2013). Screening for hypertension in children and adolescents to prevent cardiovascular disease. *American Academy of Pediatrics*, *131*(3), 490–525. doi:10.1542/peds.2012-3523.
- Tripodi, S. J., Bender, K., Litschge, C., & Vaughn, M. G. (2010). Interventions for reducing adolescent alcohol abuse. *Journal of American Medical Association*, *164*(1), 85–91. doi:10.1001/archpediatrics.2009.235.
- Verschuren, W. M. M. (2012). Diet and cardiovascular disease. *Journal of Current Cardiology Reports*, *14*(6), 701–708. doi:10.1007/s11886-012-0318-2.
- Vuvor, F., & Harrison, O. (2017). Knowledge, practice and perception of taking soft drinks with food and the metabolic effects on high school students in Ghana. *Journal of Endocrinology and Metabolism*, *1*(13), 1–7.
- Walugembe, D. R., Sibbald, S., Ber, M. J. L., & Kothari, A. (2019). Sustainability of public health interventions: where are the gaps? *Health Research Policy and Systems Journal*, *17*(8), 1–7. doi:10.1186/s12961-018-0405-y.
- Wang, M., & Wang, L. (2018). Teaching games for understanding intervention to promote physical activity among secondary school students. *BioMed Research International*, *2018*, 1–11. doi:10.1155/2018/3737595.
- Wenger, N. K., Ouyang, P., Miller, V. M., & Merz, N. B. (2016). Strategies and methods for clinical scientists to study sex-specific cardiovascular health and disease in women. *Journal of American College of Cardiology*, *67*(18), 18–20. doi:10.1016/j.jacc.2016.03.504.
- Whelton, P. K. (2015). The elusiveness of population-wide high blood pressure control. *Annual Review of Public Health Journal*, *36*, 109–130. doi:10.1146/annurev-publhealth-031914-122949.
- Whetten, D. (1989). What constitutes a theoretical contribution? *Academy of Management Review*, *14*(4), 490–495. doi:10.5465/AMR.1989.4308371.
- Williams, S., Kimble, D., Covell, N., Weiss, L., Newton, K., Fisher, J., & Fisher, W. (1992). College students use implicit personality theory instead of safer sex. *Journal of Applied Social Psychology*, *22*(12), 921–933.
- Woodgate, R. L., & Sigurdson, C. M. (2015). Building school-based cardiovascular health promotion capacity in youth: a mixed methods study. *BMC Public Health*, *15*(421), 1–11. doi:10.1186/s12889-015-1759-5.
- World Health Organization. (2007). BMI-for-Age (15-19years). http://www.who.int/growthref/who2007_bmi_for_age/en/ (accessed 20 Nov. 2016).

- World Health Organization. (2010). Global recommendations on physical activity for health. http://apps.who.int/iris/bitstream/10665/44399/1/9789241599979_eng.pdf (accessed 21 Nov. 2015).
- World Health Organization. (2011b). A prioritized research agenda for prevention and control of noncommunicable diseases, World Health Organization, Geneva. http://apps.who.int/iris/bitstream/10665/44569/1/9789241564205_eng.pdf (accessed 21 Nov. 2015).
- World Health Organization. (2011a). Global status report on noncommunicable diseases 2010, Geneva. http://whqlibdoc.who.int/publications/2011/9789240686458_eng.pdf (accessed 21 Nov. 2015).
- World Health Organization. (2014). Global status report on noncommunicable diseases 2014 “Attaining the nine global noncommunicable diseases targets; a shared responsibility.” Geneva. Retrieved from www.who.int (accessed 21 Nov. 2015).
- World Health Organization. (2015b). Health topics: cardiovascular diseases. http://www.who.int/topics/cardiovascular_diseases/en/ (accessed 21 Nov. 2015).
- World Health Organization. (2015d). Media centre: cardiovascular (CVDs) key facts. <http://www.who.int/mediacentre/factsheets/fs317/en/> (accessed 21 Nov. 2015).
- World Health Organization. (2015c). NCDs Ghana statistic. http://www.who.int/nmh/countries/gha_en.pdf?ua=1 (accessed 21 Nov. 2015).
- World Health Organization. (2015a). Noncommunicable diseases. <http://www.who.int/mediacentre/factsheets/fs355/en/> (accessed 21 Nov. 2015).
- World Health Organization. (2016). School health and youth health promotion. http://www.who.int/school_youth_health/en/ (accessed 19 Apr. 2016).
- World Health Rankings: Health Profile Ghana. (2014). <http://www.worldlifeexpectancy.com/country-health-profile/ghana> (accessed 26 Jan. 2016).
- World Health Organization. (2018a). Global Health Observatory (GHO) Data. World Health Statistics 2018. http://www.who.int/gho/publications/world_health_statistics/2018/EN_WHS2018_AnnexA.pdf?ua=1 (accessed 26 Nov. 2018).
- World Health Organization. (2018b). Global status report on alcohol and health. https://www.who.int/substance_abuse/publications/global_alcohol_report/en/ (accessed 1 Aug. 2019).

- World Heart Federation (WHF). (2017). Cardiovascular disease risk factors. <https://www.world-heart-federation.org/resources/risk-factors/> (accessed 1 Aug. 2019).
- World Heart Federation (WHF). (2015). Heart fact sheet on cardiovascular diseases. <http://www.world-heart-federation.org/heart-facts/fact-sheets/cardiovascular-disease-terms>. (accessed 21 Nov. 2015).
- Xu, F., Ware, R. S., Leslie, E., Tse, L. A., Wang, Z., Li, J., & Wang, Y. (2015b). Effectiveness of a randomized controlled lifestyle intervention to prevent obesity among Chinese primary school students: Click-obesity study. *PLoS ONE*, *10*(10), 1–12. doi:10.1371/journal.pone.0141421.
- Xu, X. L., Zhu, R., Sharma, M., Deng, S., Liu, S., Liu, D.-Y., & Zhao, Y. (2015a). 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. *The Lancet*, *386*, S78. doi:10.1016/S0140-6736(15)00659-5.
- Yang, Q., Zhang, Z., Gregg, E. W., Flanders, W. D., Merritt, R., & Hu, F. B. (2014). Added sugar intake and cardiovascular diseases mortality among US adults. *Jama Internal Medicine*, *174*(4), 516–524. doi:10.1001/jamainternmed.2013.13563.
- Yang, Q., Zhang, Z., Kuklina, E. V., Fang, J., Ayala, C., Hong, Y., & Merritt, R. (2012). Sodium intake and blood pressure among US children and adolescents. *Paediatrics*, *130*(4), 611–619. doi:10.1542/peds.2011-3870.
- Yang, Y., Kang, B., Lee, E., Yang, H., Kim, H.-S., Lim, S.-Y., Yoon, & K.-H. (2017). Effect of an obesity prevention program focused on motivating environments in childhood: a school-based prospective study. *International Journal of Obesity*, *41*, 1027–1034. doi:10.1038/ijo.2017.47.
- Ylimaki, E. L., Kanste, O., Heikkinen, H., Bloigu, R., & Kyngas, H. (2015). The effects of a counselling intervention on lifestyle change in people at risk of cardiovascular disease. *European Journal of Cardiovascular Nursing*, *14*(2), 153–161. doi:10.1177/1474515114521725.
- Yu, S. S. K., Castillo, D. C., Courville, A. B., & Sumner, A. E. (2012). The triglyceride paradox in people of African descent. *Metabolic Syndrome and Related Disorders*, *10*(2), 77–82. doi:10.1089/met.2011.0108.
- Yusuf, S., Wood, D., Ralston, J., & Reddy, K. S. (2015). The world heart federation's vision for worldwide cardiovascular disease prevention. *The Lancet*, *386*(9991), 399–402. doi:10.1016/S0140-6736(15)60265-3.
- Zaborskis, A., Lagunaite, R., Busha, R., & Lubiene, J. (2012). Trend in eating habits among Lithuanian school-aged children in context of social inequality: three cross-sectional surveys 2002, 2006 and 2010. *BMC Public Health*, *19*, 1–12. doi:10.1186/1471-2458-12-52.

BIODATA OF STUDENT

John Amoah hails from the Ashanti Region in Ghana, West Africa. He attended Forces Primary School at Uaddara Barracks, and had his Secondary School education at Opoku Ware Secondary School, all in the Ashanti Region of Ghana. He obtained his Bachelor of Science degree at the University for Development Studies, Tamale. He later obtained his Master Degree program in Health Service Administration at the University of Ghana Business School. He worked as an intern from 2008 to 2009 at Princess Marie Louise Childrens' Hospital in Accra and progressed to a Health Service Administrator in 2010. He currently works at the Kintampo Health Research Centre (KHRC), in Brong Ahafo Region as a Research Fellow. He has also worked in the Administration department as the Human Resource Manager of the Research Centre. He has won awards as the best senior staff on two occasions at the KHRC and other awards for meritorious services at University for Development Studies and University of Ghana Business School.

LIST OF PUBLICATIONS

Published Papers

- Amoah, J, Salmiah, M. S., Rampal, L., Manaf, R. A., & Ibrahim, N. (2019). The effectiveness of a behavioral modification intervention to reduce cardiovascular disease risk factors amongst public secondary school students in Brong Ahafo Region, Ghana: a study design. *International Journal of Health Sciences and Research*, 9(6), 234–245.
- Amoah, J, Salmiah, M. S., Rampal, L., Manaf, R. A., & Ibrahim, N. (2019). Prevalence of elevated and hypertension among secondary school students in Ghana. *International Journal of Innovative Research and Development*, 8(6), 110–115.
- Amoah, J, Salmiah, M. S., Rampal, L., Manaf, R. A., Ibrahim, N., & Amoah, L. (2019). Cardiovascular disease risk factors among secondary school students: a review. *International Journal of Health Sciences and Research*, 9(8), 473–483

Submitted Papers

- Amoah, J, Salmiah, M. S., Rampal, L., Manaf, R. A., Ibrahim, N., & Owusu-Agyei, S. Effects of a school-based intervention to reduce cardiovascular disease risk factors among secondary school students: a cluster randomized controlled trial. *BMC Public Health* (PUBH-D-19-02538).
- Amoah, J, Salmiah, M. S., Rampal, L., Manaf, R. A., Ibrahim, N., & Amoah, L. Effects of a health educational intervention on cardiovascular disease knowledge, motivation and behavioral skills: a cluster randomized controlled trial. *BMC Public Health* (PUBH-D-19-02816)
- Amoah, J, Salmiah, M. S., Rampal, L., Manaf, R. A., & Ibrahim, N. Prevalence of Overweight and Obesity among Secondary School Adolescents in Ghana. *Hindawi Journal of Nutrition and Metabolism* (3453842).
- Amoah, J, Salmiah, M. S., Rampal, L., Manaf, R. A., & Ibrahim, N. Prevalence and predictors of alcohol use among senior high school students in Ghana. *Philippine Journal of Health Research and Development* (PJHRD2019-0177)



UNIVERSITI PUTRA MALAYSIA

STATUS CONFIRMATION FOR THESIS / PROJECT REPORT AND COPYRIGHT

ACADEMIC SESSION : First Semester 2019/2020

TITLE OF THESIS / PROJECT REPORT :

EFFECTIVENESS OF BEHAVIORAL MODIFICATION INTERVENTION TO REDUCE
CARDIOVASCULAR DISEASE RISK FACTORS AMONG PUBLIC SECONDARY SCHOOL
STUDENTS IN BRONG AHAFO, GHANA

NAME OF STUDENT: JOHN AMOAH

I acknowledge that the copyright and other intellectual property in the thesis/project report belonged to Universiti Putra Malaysia and I agree to allow this thesis/project report to be placed at the library under the following terms:

1. This thesis/project report is the property of Universiti Putra Malaysia.
2. The library of Universiti Putra Malaysia has the right to make copies for educational purposes only.
3. The library of Universiti Putra Malaysia is allowed to make copies of this thesis for academic exchange.

I declare that this thesis is classified as :

*Please tick (v)

CONFIDENTIAL

(Contain confidential information under Official Secret Act 1972).

RESTRICTED

(Contains restricted information as specified by the organization/institution where research was done).

OPEN ACCESS

I agree that my thesis/project report to be published as hard copy or online open access.

This thesis is submitted for :

PATENT

Embargo from _____ until _____
(date) (date)

Approved by:

(Signature of Student)
New IC No/ Passport No.:

Date :

(Signature of Chairman of Supervisory Committee)
Name:

Date :

[Note : If the thesis is CONFIDENTIAL or RESTRICTED, please attach with the letter from the organization/institution with period and reasons for confidentially or restricted.]