Effects of a health educational intervention on cardiovascular disease knowledge, motivation and behavioral skills: A cluster randomized controlled trial

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Abstract

Background

Cardiovascular diseases (CVD) are the number one public health challenge of the 21st century. Globally, the disease causes more deaths than any other cause. Unfortunately, many people are not aware of CVDs and its risk factors and because of this the disease burden keeps on rising. Objective of this study was to develop, implement and evaluate the effects of a health education program to improve CVD knowledge, motivation, and behavioral skills among secondary school students in Ghana.

Methods

A parallel single-blind cluster randomized controlled trial was carried out for a period of six-months with baseline and post intervention evaluations. Participants (n=848) were secondary school students of ages of 14-19 years from four schools (clusters) in Brong Ahafo, Ghana. Students in the intervention group received health education intervention whereas those of the control group received no intervention. The intervention included information on cardiovascular diseases and its risk factors, motivation, and behavioral skills modules. At six months, a follow-up data using same questionnaire were collected after the intervention was completed. The generalized linear mixed model (GLMM) was used to assess the overall effects of the intervention.

Results

Of the 848 students, 836 completed the follow-up assessment immediately after six-month. The GLMM showed the intervention was significant in improving 6.85(p<0.001), 0.90(p<0.001), 0.94(p<0.001) higher total CVD knowledge, motivation, and behavioral skills scores respectively for the intervention group when compared to the control group.

Conclusions

The intervention was effective in increasing CVD knowledge, motivation, and behavioral skills of students in the intervention arm of the study. It is recommended that the health education module be implemented into secondary schools education curricula in Ghana to improve CVD knowledge, motivation, and behavioral skills. Equipping students with the IMB will reduce CVD risk factors and
prevent the onset of CVDs in future.

Background

Non communicable diseases (NCDs), mainly cardiovascular diseases (CVD) are the number one public health challenge of the 21st century. Globally, cardiovascular disease causes more deaths than any other cause (1). CVDs alone has been estimated to cause more deaths than nutritional diseases, maternal and perinatal conditions, and infectious diseases combined by 2030 (2). Aside being the leading cause of deaths worldwide (3,4) CVD is also the leading cause of disability in the form of disability adjusted life years (DALYs). In the year 1990, there were total loss of 85 million DALYs and is projected to reach approximately 150 million in 2020 (5). Studies in Ghana have shown that CVDs are the leading causes of death (6–8).

Risk factors (physical inactivity, unhealthy diet, smoking, and alcohol) for the development of CVDs are not only peculiar to adults but these behaviors begin as early as in childhood and adolescents(9,10). The Ghanaian ministry of health (11) has reported that risk factors of CVDs among children and adolescents have been increasing. Unfortunately, Many people are not aware of CVDs and its risk factors and because of this the (12) the disease burden keeps on rising. For instance in a cross sectional study among secondary school students in China revealed that 81% had never been taught about smoking and tobacco prevention in school (13), an indication that knowledge is low. The other aspect is that motivation and behavioral skills of CVDs and its risk factors are low. According to Fisher and Fisher (14), health-related information, motivation, and behavioral skills are necessary to adopt health behaviors. Individuals who are well informed, motivated to act, and have the fundamental skills to perform a behavior, are very likely to adopt healthy behaviors and obtain beneficial health outcomes (15). On the other hand, individuals who are not well informed, are not motivated to act, and do not possess the skills needed to perform a behavior, are very likely to engage in risky behaviors and thus experience unfavorable health outcomes.

The adolescents phase presents opportunities for health and this pattern determines the future health status of the individual (16). Also schools can play a major role in improving health status of students and adolescents and the adults they will become. Students are in school throughout the academic
year and spend generally five days a week in school. This is because at this crucial adolescent age, students learn certain habits that influence behaviors such as physical activities, tobacco smoking, eating habits and alcohol use that could lead to chronic diseases like cardiovascular diseases, cancers, and diabetes which are now the leading causes of global death (17). The aim of this study was to evaluate the effects of a health education programme on CVD knowledge, motivation, and behavioral skills among students in Ghana.

Methods

Study design and settings

The study protocol has been published elsewhere (18). The study reporting was according to the Consort statement. It was a single blind parallel cluster randomized controlled trial with participants being public secondary schools and recruited from two districts in Brong Ahafo, Ghana. The unit of randomization, intervention, and analysis were schools (clusters). There were four clusters in this study and each arm of the study was made of two clusters which was carried out for a period of six months. The University Putra Malaysia and the Kintampo Health Research Centre Ethics Committees approved this study protocol. The trial was also registered with the Pan African Clinical Trial Registry (PACTR201709002540178). The study team sought permissions from the Ministry of Education Ghana, headmasters, and parent teacher association chairpersons of selected schools. All students had equal chance of being selected into this study. A student was not included in this study if he/she was suffering from serious medical conditions including heart diseases, asthma, or respiratory conditions or was advised by a medical professional not to engage in physical activities/exercise. Written and signed informed consent were obtained from all participating students and their parents/guardians because they were minors.

Respondents in the intervention group received a CVD health education intervention on CVD knowledge and its risk factors, motivation, and behavioral skills while those in the control group were not exposed to the intervention. Baseline measurements of CVD knowledge, motivation, and behavioral skills were taken for the intervention and control groups. Immediately after six months a post intervention assessment was carried out to evaluate the effectiveness of the intervention.
Sample size

The study required a >80% power to detect an effect of 0.8 standard deviation at the 5% significance level with 0.8 and 0.9 estimated response and eligibility rates respectively. We also expected a 0.01 yielding a cluster design effect of 1.085. The target sample size for each group was then calculated to be 424 students for each cluster or 848 students in total. To achieve this sample size, students from form one to three were recruited from four public secondary schools in two districts.

Selection of schools and Randomization

Two districts were randomly selected for this study by a biostatistician who was not involved in this study. Each of the selected district had two public secondary schools and all were included in this study. Randomization technique in the ratio 1:1 for intervention and control groups respectively were carried out. Secondary schools (clusters) were the unit of randomization. Allocation concealment was achieved with sequentially numbered opaque sealed envelopes by an education officer containing treatment allocation cards (intervention and control). The envelopes were then serially numbered from the outside. Schools were randomly assigned to either the intervention or control group of the study on the same day participants were selected for this study. It was however performed after baseline data had been collected.

Sequence Generation and Blinding

A biostatistician who was not involved in the trial generated the allocation sequence. Using a block randomization (1:1 ratio) of two digit blocks A and B (each containing one intervention and one control, to ensure equal distributions in the two groups), two schools each were allocated to intervention and control groups. Health staff who took anthropometry and blood pressure measurements were blinded to participants’ groups and were not allowed to take anthropometry and blood pressure measurements at the post intervention. The research team that facilitated the health education intervention module could not be blinded as such. Contamination of the study was minimized since there were intervention and control schools and the schools were far apart each other.
Intervention

The CVD risk factor health education intervention module was sub-divided into three sections. These were the section on CVD knowledge and its risks factors, motivation, and behavioral skills. The interactive health education sections, the researchers did the education in the intervention schools on knowledge (including CVDs, its risk factors, causes, development and prevention, amongst others), motivation (which included encouraging students to perform exercises, not to initiate smoking and alcohol amongst others), and behavioral skills which included the ability to select fruits and perform some form of simple physical activities without the use of equipments). The intervention schools were visited three times in a week for a period of six months. Each section of the health education lasted for about an hour with a break followed by questions, answers and discussions in Table 1.

Outcome variables

This study had only primary outcomes which were CVD knowledge and its risk factors, motivation, and behavioral skills.

Outcome measurements

In the assessment of outcomes in both groups, a baseline survey was conducted before the schools were randomly allocated to either intervention or control groups of the study. A follow-up assessment was conducted within two weeks after six months intervention. The assessment was self-administered in English by students. The questionnaire took about 25 minutes to complete. Students were given code numbers and were asked not to write their names or sign on the questionnaires to ensure confidentiality.

Section one was the modified CVD knowledge assessment questionnaire which comprised of meaning of CVDs, risk factors and preventive strategies of CVDs to assess CVD knowledge score among respondents. The school-based instrument was developed (19) to assess CVD knowledge levels among students. The scoring of the instrument was in the form of true or false questions and unsure (don’t know) response for each question. Respondents were to choose either true, false or “don’t know’ by circling in the provided box. Each correct answer was awarded one score. The maximum
score was 26 and the minimum score was 0.

Sections two and three were the Motivation and Behavior skills respectively, which were the modified versions of the LifeWindows Information-Motivation-Behavioral skills questionnaires (20) which constructs were originally developed by (21). Motivation constructs assessed questions on personal and social motivation relating to how motivated or encouraged participants were to perform a CVD risk factor reduction lifestyle. Scoring of responses were based on the Likert scale from ‘I strongly disagree to I strongly agree’. Each of the items was scored based on the responses from 0 to 3; with strongly disagree as 0 to strongly agree as 3.

Behavioral skills questionnaire tested students’ ability to reduce CVD risk factors. The questions assessed their behavior skills including how hard or how easy it was to apply their behavioral skills. The responses were ‘very hard to very easy’ with a scale from 0 to 3. Very hard was awarded a score of 0 while very easy had a score of 3. Then the mean scores were then determined.

**Statistical analysis**

Data collected were cleaned and analyzed using IBM Statistical Package for Social Sciences (SPSS) version 22. The data analysis was grouped into descriptive and inferential statistics. The level of significance for all the statistical tests was set at 0.05. For mean estimations, 95% confidence intervals (CI) was computed. For descriptive statistics, means and standard deviations (SD) were used as a measure of central and dispersion to summarize the variables. Frequencies and percentages were used to summarize categorical variables. The Chi-square and independent t-tests were performed to compare baseline characteristics of groups by their socio-demographic and CVD knowledge, motivation, and behavioral skills respectively. At six months, the independent t-tests were performed to determine the between groups differences of CVD knowledge and its risk factors, motivation, and behavioral skills. Paired sample t-tests were performed to determine the within group differences of the variables. Intention-to-treat (ITT) analysis was the method that was used to handle missing data in the analysis. Replacement of data was then conducted for each missing variable using the multiple imputation method, following which Generalized Linear Mixed Model (GLMM) analysis was performed to determine the overall effectiveness of the intervention study. The magnitude, also
referred to as coefficient of fixed effects were used in the GLMM analysis to determine the overall effectiveness of the intervention study.

Results
The study design in Figure 1 was according to the CONSORT statement. There were 950 students that were assessed from four schools for inclusion into the study. Fifty four students did not meet the inclusion criteria while 48 declined to participate. Then 848 were randomly assigned to either the intervention (424) or control group (424). At the end of the study at six months five students had drop out of the study in the intervention group while the control group was seven. The ITT was used to maintain the initial randomization process.

Fig 1 Study design adapted from CONSORT

Table 2 compares baseline socio-demographic characteristics and CVD knowledge, motivation, and behavioral skills risk between intervention and control groups. The ages of respondents in both group ranged from 14–19 years. Mean (SD) age in the intervention group was 17.05 (1.4) and that of the control group was 16.94 (1.4). There were 208 (49.1%) males in the intervention group where the control group was 203 (47.9%). Females 216 (50.9%) in the intervention group was slightly lower than females 221(52.1%) in the control group. The dominant ethnic group in the study was Akan ethnic group. There were 230 (54.2%) Akans in the intervention compared to 221 (52.1%) in the control group. Further, there were 14.38 (4.78), 1.80 (0.73), and 1.65 (0.64) in the intervention group when compared to the control group of 13.77 (4.79), 1.70 (0.79), and 1.58 (0.72) of CVD knowledge, motivation, and behavioral skills respectively.

Table 3 shows the differences in the outcome variables at six months follow-up between the intervention and control groups. The intervention group had a significantly higher mean difference for CVD knowledge 7.36 (6.85–7.87), motivation 0.97 (0.90–1.05), and behavioral skills 1.00 (0.93–1.07) than in the control group.

Figures 2, 3, and 4 showed a continuous rise from baseline to post-intervention at six months of knowledge (14.38 to 20.46), motivation (1.80 to 2.51), and behavioral skills (1.65 to 2.40) scores among the intervention group while there was a drop among participants in the control group in
terms of knowledge (13.77 to 13.10), motivation (1.70 to 1.54), and behavioral skills (1.58 to 1.40) respectively. The intervention successfully improved knowledge motivation, and behavioral skills scores among students in the intervention group.

Fig. 2 Trend of Mean Knowledge Score for Intervention and Control Group

Fig. 3 Trend of Mean Motivation Score for Intervention and Control Group

Fig 4 Trend of Mean Behavioral Skills Score for Intervention and Control Group

Table 4 presents the fixed coefficients of the outcome variable that were studied. The results showed that a student attending the intervention group of the study is expected to lead to an increase in CVD knowledge by 6.85, motivation by 0.90, and behavioral skills by 0.94 times when compared to an individual in the control group.

Discussions

In this cluster randomized controlled trial, the students in the intervention group showed statistically significant increase in CVD knowledge, motivation, and behavioral skills. The present study is unique in that the intervention was directed at secondary school students to improve CVD knowledge, motivation, and behavioral skills. This is among a few cluster randomized controlled trials that examined the impact of school-based health education intervention on CVD knowledge, motivation, and behavioral skills.

Some health educational intervention studies among secondary school students have shown improvements in improving CVD knowledge, motivation, and behavioral skills. An intervention to evaluate the effectiveness of health education intervention among students showed significant improvement in CVD knowledge among participants in the intervention group than in the control group (22). A systematic review on school-based interventions led to an increase in knowledge among the intervention schools (23). A school-based cluster randomized controlled trial study on physical activity showed that motivation among students was positively associated to physical activity (24). Another school-based study showed that motivation was a major factor in influencing students to healthy lifestyles (25,26). This suggest that motivated students practiced healthy lifestyles that led to positive health outcomes among the intervention group. An intervention study among school
adolescents reported of significant improvements in behavioral skills in the intervention group when compared to the control arm of the study (27). These achievements are very critical as respondents who are well informed, motivated with the necessary behavior skills adopted healthy behaviors (14,15).

The strengths of this study includes; the cluster randomized controlled design used in this study prevented the possibility of cross contamination between the two groups. The module that was developed was distinct because of the combined expertise. Attrition rate in this study was minimal. The robust nature of the GLMM analysis used in this study allowed for representation of true effect of the intervention. Limitation in this study was that the questionnaire as a tool of data collection, a lot depended on the truthfulness of responses that were given by the participants.

Conclusion
A six-month school health education intervention on cardiovascular disease and its risk factors was effective in improving CVD knowledge, motivation, and behavioral skills of secondary school students in Brong Ahafo, Ghana. It is recommended that the health education intervention program be implemented in all secondary schools in Ghana. Integrating the intervention in schools will allow for longer and consistent impact. It is also recommended that the Ghanaian Ministry of health incorporate this into their programs and policies.

List Of Abbreviations
CI: confidence interval
CVD: cardiovascular disease
GLMM: generalized linear mixed model
IMB: information-motivation-behavioral skills
ITT: intention-to-treat analysis
SD: standard deviation

Declarations

Ethics approval and consent to participate
University Putra Malaysia (UPM/TNCPI/RMC/1.4.18.2) and the Kintampo Health Research Centre (KHRCIEC/2017–16) Ethics committees approved the study. Consent were sought from parents/guardians and participating student.
Consent for publication

Consent for publication were sought from all students and their parents/guardians.

Availability of data and material

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interest

The authors declare that they have no competing interests.

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Authors’ contributions

JA conceived the study, wrote the study protocol, designed the intervention module, managed the field work, data entry, performed the statistical analysis and drafted the manuscript. SMS participated in the study design, helped performed the statistical analysis and helped drafted the manuscript. LR participated in the study design and helped designed the intervention module and the statistical analysis. RAM participated in the study design and helped draft and revised the manuscript. NI helped draft the health education intervention module and revised the manuscript. LA helped performed the statistical analysis and helped drafted and revised the manuscript. All authors read and approved the final manuscript.

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Tables
Table 1 Summary of intervention module

| components                  | Secondary school information, motivation, and behavioral skills module |
|-----------------------------|-------------------------------------------------------------------------|
| **Information**             | Knowledge of cardiovascular disease and its risk factors:              |
|                             | - Students were informed how modifiable risk factors                   |
|                             | translated into intermediary risk factors and into CVDs.             |
|                             | Prevention of CVDs through modifiable risk factors:                   |
|                             | Students were taught on reduction of modifiable risk factors of CVDs.|
|                             | These included:                                                       |
|                             | Physical Activity: Doing at least 60 minutes moderate                  |
|                             | to vigorous physical activity daily.                                  |
|                             | Diet: Consumption of healthy diet devoid of too much salt, too much   |
|                             | sugar, too much fat, too much fried foods, and red meat. Consumption   |
|                             | of fruits and vegetables, drinking enough plain water instead of      |
|                             | coloured (sugar) water, fish, whole grains instead of polished grains. |
|                             | Smoking: Information on tobacco, stopping smoking (for student        |
|                             | smokers) and not initiating smoking for non-smokers                  |
|                             | Alcohol: Same with alcohol consumption as with smoking.               |
| **Motivation**              | Students were encouraged that if they performed the required physical  |
|                             | activity on daily basis and eat healthy foods they would become smart |
|                             | and healthy and would be free from overweight, obesity, diabetes,     |
|                             | and being hypertensive. They would also be free from other diseases.  |
|                             | They were further encouraged and taught that not initiating or        |
|                             | stopping smoking and alcohol would make their lungs and heart        |
|                             | function properly, strong, and free from heart diseases.             |
|                             | Peer groups to educate fellow students to serve as a source of       |
|                             | motivation.                                                           |
|                             | Poster, Sport and dancing competitions, group work and interactions,  |
|                             | and role plays to motivate students.                                  |
| **Behavioral Skills**       | Students were taught to demonstrate the ability to select their foods,|
|                             | to choose drinks with reduced sugar content, to reduce salt intake,   |
|                             | to choose the appropriate fruits and vegetables, to know the skill to |
|                             | perform the various forms of physical activities, stop/not initiate   |
|                             | smoking and alcohol consumption.                                      |

Table 2 Baseline comparison between intervention and control groups

Due to technical limitations, Table 2 is only available as a download in the supplemental files section.

Table 3 Changes from baseline to six months and comparison between groups post intervention
| Outcome variables | n  | Mean (SD) | Mean change from baseline (95%CI) | n  | Mean (SD) | Mean change from baseline (95%CI) | Mean difference (95CI) | p-value |
|-------------------|----|-----------|-----------------------------------|----|-----------|-----------------------------------|------------------------|---------|
| CVD knowledge     | 419| 20.46 (2.84) | 6.10 (5.79-6.41) | 417| 13.10 (4.51) | -0.69 (-0.80, -0.58) | 7.36 (6.85-7.87) | <0.001 |
| Motivation        | 2.51 (0.38) | 0.72 (0.67-0.77) | 1.54 (0.68) | 417| 1.54 (0.68) | -0.16 (-0.20, -0.13) | 0.97 (0.90-1.05) | <0.001 |
| Behavioral skills | 419| 2.40 (0.32) | 0.75 (0.70-0.80) | 417| 1.40 (0.65) | -0.18 (-0.20, -0.15) | 1.00 (0.93-1.07) | <0.001 |

Table 4 Magnitude of the Intervention Effect

| Variable          | Coefficient | Std Error | t-value | Sig.     | Lower | Upper    |
|-------------------|-------------|-----------|---------|----------|-------|----------|
| Knowledge         |             |           |         |          |       |          |
| Intervention      | 6.85        | 0.106     | 64.461  | <0.001   | 6.64  | 7.06     |
| Control           | 1           |           |         |          |       |          |
| Motivation        |             |           |         |          |       |          |
| Intervention      | 0.90        | 0.024     | 37.452  | <0.001   | 0.85  | 0.95     |
| Control           | 1           |           |         |          |       |          |
| Behavioral Skills |             |           |         |          |       |          |
| Intervention      | 0.94        | 0.091     | 10.230  | <0.001   | 0.76  | 1.13     |
| Control           | 1           |           |         |          |       |          |

Figures
Figure 1

Study design adapted from CONSORT
Figure 1 Trend of Mean Knowledge Score for Intervention and Control Group
Fig. 2 Trend of Mean Motivation Score for Intervention and Control Group
Figure 4

Fig 3 Trend of Mean Behavioral Skills Score for Intervention and Control Group

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

Table 2.jpg
CONSORT 2010 Checklist.doc