



## Perceived Cardiovascular Disease Risk Factors among Adolescents in Riyadh, Saudi Arabia

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### Authors' contributions

This work was carried out in collaboration between both authors. Author AB designed the study, performed the statistical analysis and wrote the draft of the manuscript. Author SOAR wrote the protocol, collected the data, and managed the literature searches of the study. Both authors read and approved the final manuscript.

### Article Information

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### ABSTRACT

**Objectives:** The aim of this study is to assess the level of knowledge and perception of cardiovascular risk factors among male adolescent students and the practiced healthy lifestyle.

**Methods:** A cross-sectional multistage study targeted adolescent male students from public secondary schools in Riyadh, Saudi Arabia. They were surveyed by using a self-administered questionnaire. The participants were categorized as knowledgeable and perceiving the cardiovascular risk factors risk or not.

**Results:** A significant association with four factors were likely found to act as CVD predictors among adolescents like limited knowledge on prevention (AOR = 0.519, 95% CI = 0.358-0.752); inadequate information on diseases severity (AOR = 0.444, 95% CI = 0.284-0.696); low ability to promote health (AOR = 0.447, 95% CI = 0.295-0.677); and, non-confidence in practicing a healthy lifestyle (AOR = 0.584, 95% CI = 0.407-0.839).

**Conclusion:** Curriculum school inclusion of positive health practice might help much in improving the perceiveness on cardiovascular disease and better awareness in the coming generation.

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## 1. INTRODUCTION

According to the World Health Organization (WHO) report in the year 2017, cardiovascular diseases (CVDs) are considered the cause number one of all deaths worldwide with an estimate of 17.8 million deaths [1]. More than three-quarters of CVD deaths take place in low- and middle-income countries [2].

Adequate public knowledge of risk factors are important in increasing or decreasing the chances of developing disease conditions or having existing diseases worsen (i.e. consumption of an unhealthy diet or junk foods and being physically inactive result in poor blood cholesterol, obesity, and high blood pressure that turn into CVDs and diabetes mellitus) [3-5].

Many studies illustrated clearly that getting cardiovascular disease in adulthood are likely to begin with the acquired risk factors during childhood and adolescent age such as obesity and hypertension [6,7]. Moreover, a recent study has suggested that cardiovascular risk factors may be correlated between children and their parents including hypertension, metabolic syndrome, and high body mass index (BMI) [7].

Worldwide, few studies were conducted to assess the perception of adolescents on risk factors for CVDs. Similarly in Saudi Arabia, some studies have been conducted among Saudi adolescents seeking their actual knowledge on risk factors for some major chronic diseases such as physical inactivity or for type 2 diabetes risk factors and related preventive measures [8,9].

The aim of this study is to assess the level of knowledge on risk factors regarding CVDs, and the levels of preventive attitudes among male adolescent students in public-sector secondary schools in Riyadh, Saudi Arabia. Consequently, the findings will enable the stockholder to address an effective model in the road of empowering this generation to change their daily practices geared toward reducing the burden of these diseases in the country.

## 2. METHODS

### 2.1 Participants and Study Design

A cross-sectional multistage study targeted adolescent male students in public schools in

Riyadh city which is the capital of Saudi Arabia. Male adolescent students who attend secondary public schools were included in this study, therefore male student with previous history of cardiac diseases or being study in private secondary schools and all female adolescent students were excluded.

A total calculated sample size of 1151 adolescent students was used with the assumption of confidence level of 95%,  $\pm 5\%$  precision, proportions of 50% as it gives maximum sample size and design effect of 3. According to the Statistics from the Ministry of Education, there are 129 schools in Riyadh [10]. A multistage, stratified, random sample method was used where stratification was performed based on the distribution of the schools in each of the five areas of Riyadh and then by class level in each selected school. A proportionate number of schools from each area and classes from each school were randomly selected. All the participants provide informed consent and description of the purpose and nature of the study before they enrolled in the study.

### 2.2 Data Collection Methods, Instruments Used, Measurements

Data were collected by the investigator and a team of three trained health professionals.

After the basic information provided to eligible students in their class and agreed to participate, interviewer administered an anonymous structured close-ended questionnaire of English version previously validated by Reena Patel in 2011 [11,12] was used to collect data for this study.

### 2.3 Outcome Variable

The outcome variable was a student with good perceived susceptibility of risk factors for CVDs: measured with binary outcome of "Yes" or "No".

### 2.4 Explanatory Variables

The demographic characteristics of the participants was the first part of the questionnaire. The component of the survey also comprises components in three major constructs: a) Knowledge on Cardiovascular Diseases (CVD); b) Knowledge of risk factors of CVD; c) Knowledge on how to prevent CVDs. The author

followed the constructs used in the health belief model (HBM), where some questions measures the knowledge (6 questions), risk factors (4 questions), health beliefs (4 questions) including perceived susceptibility, health-promoting behaviors (7 questions), as well as cues to action and perceived barriers (10 questions) [13].

In total, 31 questions (5 sections) answered as yes=1 and no=0 type questions, true/false (0 and 1, respectively), a 5-point Likert scale (strongly disagree =1, disagree=2, neutral=3, agree=4, strongly agree=5) taking neutral, disagree and strongly disagree as a negative score. Therefore, an overall score was calculated by computing the sum of the scales for each construct a cut-off point, where the 75<sup>th</sup> percentile, was used to assess the overall construct accordingly. The 5 constructs were categorized as of less scores if the calculated findings was less than or equal to 75% and otherwise supportive outcome. The reason the 75<sup>th</sup> percentile was chosen as a marker for good/poor levels was that it can statistically predict not only good levels, but truer and stronger levels of a certain parameter, assuming normal distribution [14].

The tool of the study was translated to Arabic and backward to English by bilingual experts and then piloted testing 20 participants (not included in the study count) to ensure the consistency, persistence, and validation of the contents of the Arabic version (Cronbach's alpha was 0.825), which was not far from the original English version.

## 2.5 Statistical Analyses

Collected data were checked for incompleteness and then entered for analysis using IBM SPSS software (version 21.0; IBM Corporation, Armonk, NY), and differences were considered statistically significant at 2-sided P values of <.05. The participants were categorized as knowledgeable, positive perceived risk factors, and with less barriers for the different analyses. Results were expressed as number of participants (percentage) or mean  $\pm$  standard deviation. Intergroup differences were evaluated using the  $\chi^2$  test for categorical variables and analysis of variance for continuous variables. Regression and logistic regression analyses were performed to evaluate the associations of good knowledge (vs poor knowledgeable) with different school levels. Analysis was done using multilevel logistic regression which performed and adjusted in a stepwise manner for variables

that might affect perceived risk factors for CVDs among adolescents. This model was adjusted for class level, diseases severity, ability to promote health, barriers, confidant, and practicing healthy life style. The crude odds ratio of 95% confidence interval was tested with Pearson chi square p-value < 0.05 in the cross tabulation as significant and used in the multilevel multivariable logistic regression.

## 3. RESULTS

From the total enrolled students, 1135 respondents were included for the completeness of the answers (1135/1151=98.6% respondent rate). The main areas of the enrolled participants and their distribution by class levels (see Table 1 in Supplemental Material; available online).

The overall incorrect knowledge on the causes, risk factors, and the way to prevent CVDs was strongly significant between the first year secondary school respondents to those in the second and third level (P value <0.01), which was consistent with the overall incorrect knowledge in the same cohorts. Student of the first level were less knowledgeable of the causes and risk factors of cardiovascular disease such as being smoker, diabetic, or those with low physical exercise (P value <0.01). Moreover, similar significant statistical differences in preventive knowledge of CVDs were reported between first year student and their counterpart in second or third level secondary school (P value <0.01).

Mainly three questions were asked on when is expected to get CVD using different period scales as in the next 10-15 years, next 20-30 years, or never get CVDs. Table 2 shows overall high rate of the students' false perceptions (60.4%) for developing CVDs in the future mainly among the students of the first year secondary school (p value <0.05).

The students were asked to identify the severity level of some diseases such as HIV, high blood pressure, cancer, asthma, flu, and CVDs (as shown in Table 3). Although a very low rate of incorrect answers were found in the overall level of knowledge (8.6%), differences in responses varied between questions (range, 6.1% to 61.0%). However, there were no significant differences between the different class levels and the level of answers except in responses related to CVD severity where around 25% of the students belongs to the first and second level of

secondary school classes in comparison to those of the third level classes (18.3%) and *P* value = 0.025.

The majority of students showed a high rate of barriers in taking good action toward the

prevention of CVDs, as expressed by their responses in particular for those related to fast food enjoyment (third level classes =83.6%)(as shown in Table 4). Variations in answers for the faced barriers for performing exercise,

**Table 1. Adolescent incorrect information on cardiovascular disease**

| Variables  | First      |             | Second    |             | Third     |             | P value      |
|--|------------|-------------|-----------|-------------|-----------|-------------|--------------|
|  | n          | %           | n         | %           | n         | %           |              |
| <b>Nature of Cardiovascular disease is:</b>            |            |             |           |             |           |             |              |
| 1 Infectious diseases                                  | 120        | 30.3        | 88        | 23.5        | 71        | 19.6        | 0.002        |
| 2 Non avoidable disease                                | 111        | 28.0        | 107       | 28.8        | 87        | 24.0        | 0.303        |
| 3 Chronic disease                                      | 260        | 66.0        | 245       | 66.0        | 226       | 63.3        | 0.675        |
| 4 A curable disease                                    | 339        | 85.6        | 317       | 84.8        | 301       | 83.1        | 0.640        |
| 5 Caused by obesity                                    | 115        | 29.0        | 106       | 28.4        | 88        | 24.3        | 0.298        |
| 6 The most leading cause of death                      | 166        | 41.9        | 146       | 39.1        | 152       | 42.0        | 0.665        |
| Overall knowledge on the causes CVDs                   | 139        | 44.8        | 109       | 35.2        | 62        | 20.0        | <0.0001      |
| <b>Risk factors for cardiovascular disease include</b> |            |             |           |             |           |             |              |
| 7 Smoking  | 85         | 21.4        | 86        | 23.0        | 51        | 14.1        | 0.005        |
| 8 Lack of physical exercise                            | 148        | 37.3        | 131       | 35.0        | 77        | 21.3        | 0.000        |
| 9 Eating high fat food                                 | 127        | 32.0        | 103       | 27.5        | 97        | 26.9        | 0.229        |
| 10 Being diabetes                                      | 260        | 65.8        | 231       | 61.9        | 202       | 55.8        | 0.018        |
| Overall knowledge on risk factors CVDs                 | 73         | 43.2        | 56        | 33.1        | 40        | 23.7        | 0.018        |
| <b>Cardiovascular disease is prevented by</b>          |            |             |           |             |           |             |              |
| 11 Eating healthy diets and low fat                    | 206        | 51.9        | 168       | 44.8        | 133       | 36.8        | 0.000        |
| 12 Regularly exercise                                  | 94         | 23.7        | 63        | 16.9        | 50        | 13.9        | 0.002        |
| 13 Reducing excess body weight                         | 72         | 18.1        | 56        | 14.9        | 46        | 12.8        | 0.119        |
| 14 Quitting smoking                                    | 105        | 26.5        | 83        | 22.2        | 59        | 16.3        | 0.003        |
| 15 High blood cholesterol                              | 76         | 19.1        | 67        | 17.9        | 45        | 12.4        | 0.033        |
| Overall Knowledge on prevention of CVDs                | 87         | 39.9        | 81        | 37.2        | 50        | 22.9        | 0.007        |
| <b>Overall level of Knowledge three dimentions</b>     | <b>106</b> | <b>26.7</b> | <b>83</b> | <b>22.1</b> | <b>56</b> | <b>15.5</b> | <b>0.001</b> |

**Table 2. Student’s attitude to prevent CVDs risk factors and the unpracticed healthy life style**

| Variables   | Class level       |                   |                  |                   | P value      |
|---|-------------------|-------------------|------------------|-------------------|--------------|
|   | Total<br>n (%)    | one<br>n (%)      | two<br>n (%)     | three<br>n (%)    |              |
| <b>Attitude to prevent CVDs risk factors</b>          |                   |                   |                  |                   |              |
| Eat meals of low calories                             | 961 (84.8)        | 331 (83.6)        | 325 (86.7)       | 305 (84.3)        | 0.460        |
| Quite smoking   | 628 (55.6)        | 218 (54.9)        | 223 (59.9)       | 187 (51.9)        | <b>0.088</b> |
| Practicing daily exercise                             | 854 (75.4)        | 286 (72.2)        | 301 (80.3)       | 267 (73.8)        | <b>0.024</b> |
| Eat low fat snacks                                    | 869 (76.6)        | 295 (74.3)        | 296 (78.9)       | 278 (76.8)        | 0.315        |
| Overall attitude of prevention                        | 818 (72.1)        | 269 (67.8)        | 290 (77.3)       | 259 (71.5)        | 0.012        |
| <b>Unpracticed healthy life style to prevent CVDs</b> |                   |                   |                  |                   |              |
| Walking   | 472 (41.6)        | 183 (46.1)        | 142 (37.9)       | 147 (40.6)        | 0.061        |
| Football  | 805 (71.1)        | 302 (76.1)        | 273 (73.0)       | 230 (63.5)        | <b>0.001</b> |
| Swimming  | 1038 (91.5)       | 365 (91.9)        | 341 (90.9)       | 332 (91.7)        | 0.872        |
| Running   | 860 (75.8)        | 317(79.8)         | 285 (76.0)       | 258 (71.3)        | <b>0.022</b> |
| Other   | 962 (85.7)        | 334 (85.0)        | 320 (86.0)       | 308 (86.0)        | 0.894        |
| Overall unpracticing exercise                         | 994 (87.7)        | 353 (88.9)        | 333 (88.8)       | 308 (85.1)        | 0.197        |
| <b>Unpracticed Excercise &amp; unhealth diet</b>      |                   |                   |                  |                   |              |
| Do you eat fast food                                  | 1043 (92.0)       | 363 (91.4)        | 339 (90.4)       | 341 (94.2)        | 0.146        |
| Do you eat fruits and vegetables?                     | 602 (53.1)        | 202 (50.9)        | 201 (53.6)       | 199 (55.0)        | 0.514        |
| Are you trying to lose excess weight?                 | 636 (56.2)        | 217 (54.8)        | 224 (60.1)       | 195 (53.9)        | 0.186        |
| Overall unhealthy lifestyle                           | 827 (72.9)        | 283 (71.3)        | 276 (73.6)       | 268 (74.0)        | 0.653        |
| <b>Overall for Excerc&amp;diet practice</b>           | <b>916 (80.8)</b> | <b>325 (81.9)</b> | <b>301(80.3)</b> | <b>290 (80.1)</b> | <b>0.791</b> |

adherence to healthy foods, and getting enough time for exercise ( $P$  value  $< 0.05$ ).

The overall attitude of preventing CVDs risk factors was 72.1% among all the participants, however differences were observed between younger students of the first grade (67.8%) which was lower than those in higher grades of second and third year secondary school (77.3% and 71.5%, respectively), which is statistically significant ( $p=0.012$ ). In general, younger students showed that they were less likely to change their behavioral attitude toward the prevention of CVDs such as for lowering the calories of diet, quitting smoking, using physical exercise, and the use of low fat diet than the older groups in second and third level of secondary school. Likewise, in general, students of secondary school showed a very high percentage (87.7%) of unpracticed healthy life style to prevent CVDs which include rarely walking, very little playing football, unlikely to practice swimming, running or other exercises, however, no statistical differences was found between class levels. Similarly, the percentages of unpracticed healthy life style to prevent CVDs either for exercise or controlling the diet was around 72.9%. This include activities such as the ability to control eat fast food, eat more fruits and vegetables, and trying to lose excess weight. The rate of unpracticing these activities was in range between 71.3% in first grade students to 74.0% among the last grade students, however it was not statistically significant difference, as seen in Table 2.

Both bivariate and multivariate backward logistic regression model was used to measure the relationship between the overall level of knowledge and perceived risk factors for CVDs as categorical dependent variable and 6 independent variables by estimating probabilities using a logistic function. The included variables were: student class level, knowledge on disease severity, ability of the student to promote health activities, the level of barrier that prevent them to act healthy, to what extent they are confident to implement the healthy life style, how much they are currently implemented healthy life style in their daily life. All the significant unadjusted Odds Ratio (OR) with  $P$  value  $< 0.05$ , reflected in the adjusted Odds Ratio (AORs) values, however, all of the values were reversible within the 95% confidence interval below 1, as seen in Table 3. On the other hand, four main variables were likely to act as CVD predictors among

adolescents in secondary schools for the such as limited knowledge of and practices toward preventive approaches pertained primarily to class level (AOR = 0.519, 95% CI = 0.358-0.752,  $P$  value = 0.001); inadequate information regarding the severity of some diseases (AOR = 0.444, 95% CI = 0.284-0.696,  $P$  value = 0.000); students' ability to promote health (AOR = 0.447, 95% CI = 0.295-0.677,  $P$  value = 0.000); and finally, non-confidence in practicing a healthy lifestyle (AOR = 0.584, 95% CI = 0.407-0.839,  $P$  value = 0.004).

## 4. DISCUSSION

### 4.1 Perceived Risk Factor on CVDs

In this study, different domains such as risk factors, healthy lifestyle practices, and others were used to assess the overall knowledge and practices among adolescents.

Our study aimed to answer 3 main questions: 1) Do male adolescent students in public-sector secondary schools of Riyadh have good levels of knowledge regarding CVDs and associated risk factors? 2) Are the study cohort aware of CVD risk factors? And 3) to what extent those male adolescent are positive in relation to basic recommendations for healthy lifestyle and physical activity? To reach for certain conclusions, the aforementioned questions focused directly to assessment of knowledge, the existent risk factors, their self-perceived beliefs on getting CVDs in the future, and their health-promoting behaviors related to CVDs. Therefore, the main finding from this study has responded to the first given question related to the level of knowledge and illustrated a good levels of knowledge regarding CVDs and associated risk factors among the studied groups, however, the level of knowledge has influenced by the level of class education. So those younger students showed low level of knowledge in comparison to the older students. The overall level of knowledge was 84.5% among the third-level class which is higher than those in the second-level class and the first-level class (77.9%, 73.3%, respectively). This findings are consistent with similar study elsewhere correlating an increase in knowledge with increased education levels [15]. Other study revealed that good knowledge regarding CVD risk factors among the adolescent students was directly associated with their family history and educational status [16]. It is important that adolescents and young people

to know the risk factors of CVD, its complications, and adequate management measures, and to know the protection methods that they have to use to avoid the burden of the disease in the future and its poor outcomes. It is largely presumed by society that CVD is an expensive disease due to its expenditures on and instructions by health care personnel. It may reduce life expectancy and quality of living. The direct association of knowledge of CVD risk factors may affect the facts needed to understand the problem's severity. CVD can be controlled through informative programs and skills, such as one's awareness that healthy behaviors can impact CVD risk-factor levels. Worth wise, the participants demonstrated better knowledge and attitude about the severity of CVD than risk factors of CVDs despite the variations between younger students and older. A previous study has been conducted in Saudi Arabia among secondary school students has revealed poor ability to recognize type 2 diabetes risk factors and to adopt healthy lifestyle behaviors.

In our study, the perceived threat of developing CVDs in the future was low among the study sample. Less than one third of the students believed that they might develop CVDs in the future which indicate a poor perception about CVD risk factors. On the other hand, around two-thirds of them expect that they will not develop CVDs in the next 20-30 years or more (65.7%). This could be due to the low level of knowledge related to CVDs and its complications among this group of adolescents. Notably, not viewing oneself as being at risk for heart disease was a top barrier to engaging in preventive health behaviors for adolescents [17]. School curriculum and family members might be work as an important source of information for the students in this age group.

The current study offers perspective on the relationship between aspects of disease knowledge and health behaviors among adolescents. Theoretical frameworks, such as the Health Belief Model, outline a complex interplay of factors that result in health behavior engagement, including understanding personal susceptibility to future occurrence of the disease. While awareness of future health risks may contribute to health behavior engagement, it is not sufficient to solely drive behavior change in all circumstances.

## **4.2 Knowledge Related to Disease Severity**

Our study demonstrate the fact that any increase in general knowledge regarding CVDs will highly correlated with the knowledge of disease severity and disease prevention. However, most of the students were unaware of the CVDs as severe in relation to other diseases ( $P$  value = 0.025). This findings was similar to other study on the knowledge and perception of cardiovascular risk factors among university students elsewhere [18].

## **4.3 Student Ability versus Barriers to Promote a Healthy Lifestyle**

Students' ability to promote a healthy lifestyle depends on many factors and requires cooperation from family, school, community, and government. In this study, the responses illustrated high level of barrier to reduce the risk factors, meanwhile their answers showed adequate attitude to combat the risks of getting CVDs (85.2% vs. 72.1%). The most common behaviour with difficult to change was those related to quitting smoking (22.3%), avoiding high-fat meals (21.3%), or not consuming high-calorie foods (17.1%). Despite the average responses of good knowledge regarding CVDs causes, the majority of the participating adolescents did not perceive themselves to be at risk for future CVDs and even those who perceived themselves to be at risk showed poor dietary practices. One of the probable explanations might be that adolescents considered CVDs to be old age-related problems and underestimated their future risks. Similar findings were also reported from Nepal and in the United States, specifically Michigan [6,16].

The Center of Disease Control and Prevention in the United State has implemented strategies to promote healthy lifestyles for school health [19]. Promotion of school-based cardiovascular health programs might be crucial in dispelling myths and misconceptions and eventually preventing early onset atherosclerosis [20].

Risk for serious health problems exist, and indeed such problems are silently present. Although adolescents in Kingdom of Saudi Arabia, similar to those in other parts of the world, engage in health-risk behaviors, there are some behaviors or states that particularly stand

**Table 3. Univariate and multivariate regression analysis of level of perceived CVD risk factors among adolescents (n=1135)**

|                               |       | <b>OR</b> | <b>95% C.I</b> | <b>P value</b> | <b>AOR</b> | <b>95% C.I</b> | <b>P value</b> |
|-------------------------------|-------|-----------|----------------|----------------|------------|----------------|----------------|
| Class level                   | Three | †         | -              | -              | †          | -              | -              |
|                               | one   | 0.519     | 0.357-0.755    | 0.001          | 0.519      | 0.358-0.752    | 0.001          |
|                               | Two   | 0.702     | 0.477-1.031    | 0.071          | 0.698      | 0.476-1.025    | 0.066          |
| Diseases Severity             | less  | 0.438     | 0.278-0.689    | 0.000          | 0.444      | 0.284-0.696    | 0.000          |
|                               | High  | †         | -              | -              | †          | -              | -              |
| Ability to promote health     | No    | 0.431     | 0.283-0.656    | 0.000          | 0.447      | 0.295-0.677    | 0.000          |
|                               | Yes   | †         | -              | -              | †          | -              | -              |
| Barriers                      | high  | 0.911     | 0.643-1.289    | 0.598          | -          | -              | -              |
|                               | Less  | †         | -              | -              | -          | -              | -              |
| Confidante                    | Less  | 0.609     | 0.416-0.893    | 0.011          | 0.584      | 0.407-0.839    | 0.004          |
|                               | high  | †         | -              | -              | †          | -              | -              |
| Practicing healthy life style | No    | 0.863     | 0.580-1.282    | 0.465          | -          | -              | -              |
|                               | Yes   | †         | -              | -              | -          | -              | -              |

† Reference; OR= Odds ratio, AOR= Adjusted odds ratio

**Table 4. Percentages of barriers for CVD risk reduction**

| <b>Variables</b>                 | <b>Class level</b> |          |            |          |            |          |              |          |                |
|----------------------------------|--------------------|----------|------------|----------|------------|----------|--------------|----------|----------------|
|                                  | <b>Total</b>       |          | <b>One</b> |          | <b>Two</b> |          | <b>Three</b> |          | <b>P value</b> |
|                                  | <b>No.</b>         | <b>%</b> | <b>No.</b> | <b>%</b> | <b>No.</b> | <b>%</b> | <b>No.</b>   | <b>%</b> |                |
| Difficult to chang eating habits | 642                | 82.5     | 283        | 71.3     | 270        | 72.4     | 241          | 66.8     | 0.210          |
| like fast food                   | 684                | 88.1     | 320        | 80.6     | 326        | 87.2     | 300          | 83.3     | 0.047          |
| Fast food is testy               | 726                | 93.6     | 276        | 69.7     | 273        | 73.0     | 240          | 66.7     | 0.175          |
| Unavailability of healthy food   | 649                | 83.7     | 230        | 57.9     | 229        | 61.4     | 217          | 59.9     | 0.616          |
| no time for exercise             | 606                | 78.0     | 271        | 68.3     | 249        | 66.6     | 216          | 59.7     | 0.034          |
| Heating weather prevent exersise | 663                | 85.4     | 291        | 73.5     | 249        | 66.8     | 227          | 62.7     | 0.006          |
| Overallbarrier                   | 662                | 85.2     | 278        | 70.0     | 266        | 70.9     | 235          | 64.9     | 0.165          |

out, including poor dietary habits, inadequate physical activity, overweight/obesity, lack of traffic safety, bullying and violence, and tobacco and alcohol/substance use [21-23].

## 5. CONCLUSIONS

Significant associations was found between class level in secondary school students and their knowledge, perceived risk factors for CVDs. Therefore, supportive program might be established from the first level secondary school to engage their students through education and motivation in health-promotion activities based on self-engagement to address the burden of CVDs in Saudi Arabia as well as to provide full support to those who wish to modify their lifestyle. In addition, this process need to ensure a strong collaboration among nutritionists, health educators, and school health personnel to better meet students' needs.

## 6. LIMITATIONS

As this study was cross-sectional, it had some limitations, such as self-expressed information provided by students. Thus, some potential bias reporting could have occurred when the participants interpreted questions according to their emotions. Inadequate information on CVDs also led them to show a lack of ability to promote healthy lifestyles, and they expressed many barriers to taking good action toward CVD prevention. Strong evidence of this study was that similar previous studies in Saudi Arabia have not been conducted in this age group using the tool implemented in our study.

## CONSENT

All the participants provide informed consent and description of the purpose and nature of the study before they enrolled in the study.

## ETHICAL APPROVAL

The study was approved by the scientific committee at the level of College of Public Health and Health Informatics and then by the IRB at King Abdulla International Medical Research Center with reference number IRBC/SP17/087/R. A memo was obtained from the Ministry of Education instructing all school

administration in Riyadh to facilitate the conduction of this study project and to cooperate positively.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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