Patterns of lifestyle risk behaviors among Saudi Arabian school students

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ABSTRACT

Background: Lifestyle risk behaviours initiated at a young age tend to remain in adulthood. Clustering of lifestyle risk behaviours has negative cumulative effects on health. The aim of this study was to examine patterns of clustering lifestyle risk behaviours (smoking, physical inactivity, high sugars intake, low fruits and vegetables intake, and infrequent tooth brushing) among younger and older Saudi male adolescents.

Methods: A stratified cluster random sample of 1213 Saudi Arabian male school students living in Riyadh city answered adapted WHO health behaviour in school-aged children (HBSC) questionnaire on health-related behaviours. The patterns of clustering lifestyle risk behaviours were assessed using an observed to expected ratio (O/E) method.

Results: The results showed that 10 (in older adolescents) and 09 (in younger adolescents) out of 27 combinations of lifestyle risk behaviors clustered. The combination of three risk behaviors (smoking, physical inactivity and high sugars intake) clustered with the highest O/E ratio of 3.16 among younger adolescents, while the combination of (smoking, high sugars intake and low fruits/vegetables intake) was among older adolescents with O/E: of 1.67.

Conclusions: The current study identifies patterns of clustering lifestyle risk behaviours among younger and older Saudi male adolescents. Identification of these patterns is important for health promotion interventions.

Keywords: Patterns, Clustering, Lifestyle, Health-related behaviours, Adolescents

INTRODUCTION

Many of lifestyle risk behaviours such as smoking, unhealthy diet, and physical inactivity are common to major non-communicable diseases particularly in low and middle-income countries.1 The non-communicable diseases are the leading cause of death globally and effect social and economic development.2 The multi-dimensional associations between health-related behaviours mean that certain health behaviours tend to cluster in defined patterns.3,4 The clustering of health-related behaviours may increase negative cumulative and synergistic effects on health.5 For example, it was found that lifestyle risk behaviours such as, smoking, less intake of fruit and vegetable, physical inactivity and alcohol intake predict a four times difference in mortality from non-communicable diseases.6

Adolescence has been recognized by health promoters as an important stage of life for determining a range of behaviours. Research shows that many lifestyle behaviours initiated at a young age, such as physical activity, food preference and smoking tend to remain in adulthood.7 The majority of the research on clustering patterns of behaviours focus mainly on the adult population with some studies focusing on adolescents in developed countries.8,9 Such research is scarce in low and middle-income countries, particularly in Saudi Arabia where nearly 20% of its population are adolescents.10 Most studies on the health behaviours in Saudi Arabia examine risk behaviours in isolation.11 For example,
results from of the National school health survey “Jeeluna” in Saudi Arabia show prevalence for single risk behaviours at a time.\textsuperscript{10}

By exploring the patterns of clustering lifestyle behaviours, we gain insight into how lifestyle risk behaviours relate to one another in adolescents and is critical for designing tailored health promotion interventions. Therefore, the aim of this study was to examine the patterns of clustering five lifestyle risk behaviours (smoking, physical inactivity, high intake of sugars, low fruits and vegetables intake, and infrequent tooth brushing) among younger and older Saudi male adolescents.

\textbf{METHODS}

\textbf{Sample}

The target population was Saudi male students aged 13-14-year-old in 8\textsuperscript{th} grade and 17-18-year-old in 12\textsuperscript{th} grade. The two age groups selected were considered to represent the ages of onset of physical and emotional changes in early adolescence, and in the older group, when they are about to choose their future careers.\textsuperscript{12} The sample of the study was selected by stratified cluster random sampling in order to produce more precision and better representatives of the study population. The sampling frame was the list of all schools in Riyadh city. The list was divided into four strata: public intermediate schools, public secondary schools, private intermediate schools, and private secondary schools. Schools were selected from each stratum by simple random sampling. This procedure is efficient administratively and can be almost as precise as random sampling if the sample size is increased.\textsuperscript{13} All grade 8 and 12 classes in the selected schools were recruited. And all students attending the selected classes on the day of the survey were invited to participate. Schools for special needs children were excluded. Non-Saudi students and students not in the study age groups were excluded.

The sample size was computed according to mean number of aggregated lifestyle behaviours by age group variable at significance level of 5\% and power of 80\%. After adjusting the design factor 1.2 for cluster sampling and 20\% over-sampling for non-response the minimum final sample size was calculated as 900 students. A self-administered classroom-based questionnaire used in the WHO health behaviour in school-aged children (HBSC) was adapted for use in this study. The adapted questionnaire had questions on characteristics of demographic, lifestyle behaviours, family structure, parent’s education, and peer groups. Ethical permission was obtained from the administration general of education at Riyadh region, Saudi Arabia. Informed consent and information sheet were distributed through schools to parents and guardians.

\textbf{Measures}

The five lifestyle risk behaviours were defined based on public health recommendations (Table 1).\textsuperscript{14} Smoking was measured by “How often do you smoke tobacco at present?” Response options ranged from: “Every day, to I do not smoke”. The 60-minute moderate-to-vigorous physical activity (MVPA) is brief enough to be used as a general research instrument.\textsuperscript{15} It consists of two questions: “Physical activity is any activity that increases your heart rate and makes you get out of breath some of the time. Physical activity can be done in sports, school activities, playing with friends, or walking to school. Some examples of physical activity are running, brisk walking, rollerblading, biking, swimming, basketball, and football”. 1“Over the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day?” 2“Over a typical or usual week, on how many days were you physically active for a total of at least 60 minutes per day?” Response options: “0 days, to 7 days”. Dietary behaviours questions included in the study were on frequency of eating fruits/vegetables and eating sweets/drinking soft drinks. Questions were asked separately: “How many times a week do you usually eat or drink fruits/vegetables/sweets/soft drinks?” Response options: “never, less than once a week, once a week, 2-4 days a week, 5-6 days a week, once a day every day, more than once every day”. Tooth brushing behaviour was measured by: “How often do you brush your teeth?” Response options: “More than once a day, once a day, at least once a week but not daily, less than once a week, never”.

\begin{table}[h]
\centering
\begin{tabular}{|c|c|}
\hline
\textbf{Lifestyle risk behaviors} & \textbf{Definition applied} \\
\hline
Smoking & At least once or more per week\textsuperscript{23} \\
\hline
Physical inactivity & less than 5 days per week of 60-minute moderate-to-vigorous physical activity per day\textsuperscript{15} \\
\hline
High sugars intake & Once or more daily\textsuperscript{24} \\
\hline
Low fruits and vegetables intake & Less than once daily\textsuperscript{25} \\
\hline
Infrequent tooth brushing & Less than twice daily\textsuperscript{26} \\
\hline
\end{tabular}
\caption{Indicator of lifestyle risk behaviors.}
\end{table}

\textbf{Statistical analysis}

For statistical analysis purposes, the five lifestyle risk behaviours were coded into binary variables (presence of risk behaviours=1; or absence of risk behaviours=0). All the binary lifestyle risk behaviours were summed to yield the count of accumulated risk behaviours ranging from 0 to 5. Based on multiple combinations between two or more of the five lifestyle binary behaviours, the possible number of combinations was 27. The clustering was
examined for each combination of lifestyle risk behaviours by comparing between the observed (O) and expected (E) prevalence. Clustering was considered to exist when the observed prevalence exceeded the expected prevalence in each combination. The expected prevalence for each combination was calculated by multiplying together the individual proportion of individual behaviours assuming mutual independence of the behaviours in the study population. The ratio of observed to expected proportion (O/E) was considered to be 0% of younger adolescents. For three or more lifestyle risk behaviours, clustering was considered to exist; the higher the value is an indication of stronger clustering of a particular combination of lifestyle risk behaviours, and is presented with 95% confidence interval (CI). An O/E ratio above one for a particular combination of lifestyle risk behaviours indicates that clustering exist; the higher the value is an indication of stronger clustering of a particular combination of lifestyle risk behaviours.

**RESULTS**

Of 1213 school students, 612 were 13-14 years and 601 were 17-18 years old. Fifty-three % of students attended public and 47% private schools. With regard to parents’ education, about 32% had high degree for their fathers and 11% had high degree for their mothers (Table 2).

The most frequent lifestyle risk behaviours among the Saudi male students were infrequent tooth brushing (74.3%), followed by low fruits and vegetables intake (70.7%), high sugars intake (66.5%), physical inactivity (62.2%) and smoking (21.2%). In general, the prevalence of lifestyle risk behaviours was more among older compared to younger adolescents. For the accumulation of lifestyle risk behaviors, 6% of older adolescents had all five lifestyle risk behaviors compared to younger 1%. And 14% of older had four lifestyle risk behaviors compared to 10% of younger adolescents. For three or less lifestyle risk behaviors, younger adolescents had high prevalence compared to older adolescents (Table 3).

**Table 2: Sociodemographic characteristics of Saudi male adolescent, (n=1213).**

| Variables                        | All    | Younger | Older |
|----------------------------------|--------|---------|-------|
| N                                | 1213   | 612     | 601   |
| **School type**                  |        |         |       |
| Public                           | 644    | 53.1    | 323   | 26.6 | 321   | 26.5 |
| Private                          | 569    | 46.9    | 289   | 23.8 | 280   | 23.1 |
| **Father’s education level**     |        |         |       |
| Higher education (Master, PhD)   | 382    | 31.5    | 236   | 19.5 | 146   | 12.0 |
| University education (BA or Diploma) | 388    | 32.0    | 188   | 15.5 | 200   | 16.5 |
| Secondary school or low          | 443    | 36.5    | 188   | 15.5 | 255   | 21.0 |
| **Mother’s education level**     |        |         |       |
| Higher education (Master, PhD)   | 134    | 11.0    | 84    | 6.9  | 50    | 4.1  |
| University education (BA or Diploma) | 411    | 33.9    | 221   | 18.2 | 190   | 15.7 |
| Secondary school or low          | 668    | 55.1    | 307   | 25.3 | 361   | 29.8 |

**Table 3: Prevalence of single and clustering count of lifestyle risk behaviors, (n=1213).**

| Variables                        | All    | Younger 13-14 years | Older 17-18 years |
|----------------------------------|--------|---------------------|------------------|
| N                                | 1213   | 612                 | 601              |
| **Single lifestyle risk behaviors** |        |                     |                  |
| Smoking                          | 257    | 21.2                | 58               | 9.5  | 199   | 33.1 |
| Physical inactivity              | 755    | 62.2                | 329              | 53.8 | 426   | 70.9 |
| High sugars intake               | 806    | 66.5                | 402              | 65.7 | 404   | 67.2 |
| Low fruit and vegetable intake   | 857    | 70.7                | 410              | 67.0 | 447   | 74.4 |
| Infrequent tooth brushing        | 901    | 74.3                | 439              | 71.7 | 462   | 77.0 |
| **Clustering count of lifestyle behaviors** |        |                     |                  |
| 5                                | 86     | 7.1                 | 13               | 1.1  | 73    | 6.0  |
| 4                                | 290    | 23.9                | 115              | 9.5  | 175   | 14.4 |
| 3                                | 442    | 36.4                | 241              | 19.9 | 201   | 16.6 |
| 2                                | 284    | 23.4                | 163              | 13.4 | 121   | 10.0 |
| 1                                | 92     | 7.6                 | 64               | 5.3  | 28    | 2.3  |
| 0                                | 19     | 1.6                 | 16               | 1.3  | 3     | 0.3  |
Table 4: Clustering patterns of lifestyle risk behaviors in Saudi male adolescents, (n=1213).

| No. of behaviors | Smoking | Physical inactivity | High sugar intake | Low fruits/vegetable intake | Infrequent toothbrush |
|------------------|---------|---------------------|-------------------|----------------------------|-----------------------|
|                  | +       | +                   | +                 | +                          | 13-14 years           |
|                  | +       | -                   | -                 | -                          | O%        | O/E | 95% CI       | 17-18 years |
|                  | +       | +                   | +                 | +                          | O%        | O/E | 95% CI       |
| 5                | +       | +                   | +                 | +                          | 2.12 1.30 (0.69-2.22) | 12.15 1.36 (1.06-1.71) |
|                  | -       | +                   | +                 | +                          | 0.65 0.81 (0.22-2.08) | 3.83 1.22 (0.77-1.83) |
|                  | +       | -                   | +                 | +                          | 0.33 0.39 (0.05-1.40) | 3.00 0.68 (0.40-1.08) |
|                  | -       | +                   | +                 | +                          | 15.19 0.98 (0.79-1.20) | 17.64 0.97 (0.79-1.17) |
|                  | +       | +                   | +                 | -                          | 0.49 0.77 (0.16-2.25) | 2.33 0.86 (0.48-1.45) |
|                  | +       | -                   | +                 | +                          | 2.12 1.53 (0.01-2.61) | 2.33 0.63 (0.34-1.05) |
|                  | +       | +                   | -                 | +                          | 0.33 0.79 (0.09-2.84) | 0.83 0.54 (0.18-1.25) |
|                  | -       | +                   | -                 | +                          | 6.86 0.90 (0.65-1.22) | 5.16 0.81 (0.55-1.15) |
|                  | -       | -                   | +                 | +                          | 11.00 1.38 (1.06-1.74) | 10.82 1.21 (0.93-1.54) |
|                  | +       | +                   | +                 | -                          | 0.98 3.16 (1.15-6.84) | 1.16 1.25 (0.50-2.58) |
|                  | +       | +                   | -                 | +                          | 0.20 0.50 (0.01-2.79) | 1.16 0.88 (0.36-1.83) |
|                  | -       | -                   | +                 | +                          | 5.90 0.98 (0.69-1.35) | 3.16 0.58 (0.35-0.91) |
|                  | -       | -                   | -                 | +                          | 1.14 1.67 (0.67-3.44) | 0.50 0.39 (0.08-1.14) |
|                  | +       | -                   | -                 | +                          | 0.33 0.46 (0.06-1.65) | 1.50 0.83 (0.38-1.58) |
|                  | -       | -                   | +                 | +                          | 12.80 0.97 (0.76-1.21) | 7.32 0.99 (0.72-1.32) |
|                  | +       | -                   | +                 | -                          | -       | -       | 1.83 1.67 (0.83-2.98) |
| 3                | -       | -                   | +                 | +                          | 2.12 0.54 (0.28-0.93) | 2.16 0.69 (0.37-1.18) |
|                  | +       | +                   | -                 | -                          | 0.16 1.01 (0.03-5.63) | 0.17 0.36 (0.01-1.99) |
|                  | -       | +                   | +                 | -                          | 2.94 0.99 (0.59-1.57) | 1.83 0.96 (0.48-1.71) |
|                  | -       | +                   | -                 | +                          | 2.45 0.79 (0.44-1.30) | 4.49 1.68 (1.11-2.44) |
|                  | +       | -                   | -                 | +                          | 0.16 0.46 (0.01-2.58) | 1.00 1.58 (0.58-3.44) |
|                  | -       | -                   | +                 | -                          | 6.86 1.06 (0.76-1.43) | 4.16 1.59 (1.03-2.35) |
|                  | -       | -                   | +                 | +                          | 6.86 1.01 (0.73-1.37) | 3.83 1.05 (0.66-1.57) |
|                  | +       | -                   | +                 | -                          | 0.49 1.84 (0.38-5.38) | 0.50 1.30 (0.27-3.01) |
|                  | +       | -                   | +                 | -                          | -       | -       | 0.17 0.31 (0.01-1.74) |
|                  | -       | -                   | +                 | -                          | 4.57 0.89 (0.59-1.29) | 1.83 0.82 (0.41-1.48) |

O: observed; E: expected; CI: confidence interval; +: presence; -: absence
As shown in Table 4, the clustering, which is when the observed prevalence of a particular combination of risk behaviors was higher than the expected prevalence based on the random co-occurrence of the individual risk behaviors, was identified in 10 and 09 out of 27 possible combinations of lifestyle risk behaviors in older and younger adolescents, respectively. Among the younger adolescents, the combination of three risk behaviors (smoking, physical inactivity and high sugars intake) clustered with highest O/E ratio of 3.16 across all the combinations, indicating that this cluster is 3-fold higher than the expected if these behaviors were independent. The highest O/E ratio observed in older adolescents was 1.68, where (physical inactivity, low fruits/vegetables intake) were clustered.

The all five lifestyle risk behaviours clustered among both age groups with slightly high ratio among older adolescents (O/E ratio: 1.36 and 1.30 for older and younger adolescents respectively). For the combinations of four lifestyle behaviours, only one combination clustered among younger and older adolescents. Among younger adolescents, the combination was all lifestyle risk behaviours except physical inactivity (O/E: 1.53), while for the older adolescents the combination was all lifestyle risk behaviours except low fruits/vegetables intake (O/E: 1.22) (Table 4).

The combination of (smoking, high sugars intake and low fruits/vegetables intake) co-occurred in older adolescents (O/E: 1.67), while this combination was not existing among younger adolescents. On the other hand, the combination of (smoking, high sugars and infrequent tooth brushing) clustered only in younger adolescent (O/E: 1.67). The combination of (physical inactivity, low fruits/vegetables intake and infrequent tooth brushing) clustered in both younger and older adolescents (O/E: 1.38 and 1.21, respectively) (Table 4).

Among the two lifestyle risk behaviours, the combination of (smoking, high sugars intake) clustered among both younger and older adolescent with high O/E ratio in younger (O/E: 1.84) compared to older adolescent (O/E: 1.30). The combination of (physical inactivity + low fruits and vegetables intake) resulted in high ratio among older adolescents (O/E: 1.68), while this combination was not clustered in younger adolescents (O/E: 0.79) (Table 4).

**DISCUSSION**

The aim of the current study was to assess the patterns of lifestyle risk behaviours among younger and older adolescents. This is the first study examines multiple patterns of major lifestyle risk behaviours (smoking, physical inactivity, high intake of sugars, low fruits and vegetables intake, and infrequent tooth brushing) among school-going adolescents aged 13-14 years and 17-18 years in Saudi Arabia.

Previous studies used different analytical methods to assess clustering of multiple behaviours. Moreover, these studies included a wide range and types of investigated behaviours, and different study population. Then, comparisons of results between this study and previous studies should be done with caution.

The results of this study confirm co-occurrence of lifestyle risk behaviours among younger and older adolescents’ population. And about one third of Saudi male adolescents had three lifestyle risk behaviours (36%). These findings are comparable to adolescents in middle-income countries. For example, in Malaysia, the clustering of five lifestyle risk behaviours among adolescents aged 16-17 years was assessed using O/E ratio. It was found that one third of adolescents had of three risk behaviours (37%), From the 27 possible combinations of lifestyle risk behaviours 10 and 09 were identified in older and younger adolescents, respectively, indicating that these patterns of lifestyle risk behaviours more prevalent than expected.

The current study found that older adolescents had more prevalent of four or more lifestyle risk behaviours, while younger adolescents had more prevalent of three or less lifestyle risk behaviours. This emphasized that the accumulation of health-related behaviours varies throughout the adolescence. And adolescents at older age had a greater chance of consuming smoking compared to younger adolescents.

The combination of three risk behaviours (smoking, physical inactivity and high sugars intake) clustered among both age groups with highest O/E ratio in younger adolescents. For two lifestyle risk behaviours, smoking and high sugars intake clustered in both younger and older adolescents. Comparable findings were found among Brazilian adolescents. One explanation might be that smoking in adolescence may stimulate intake of more sweets and soft drinks. Moreover, smoking has been considered as “gateway behaviours” to cluster other risky behaviours.

The present study showed that the combination of (physical inactivity + low fruits and vegetables intake) clustered only among older adolescents. This pattern of clustering was found in a study among Brazilian adolescents.

These results suggest that health promotion interventions using multiple health-related behaviours approach should be advocated among adolescents instead of an isolated individual health behaviours approach.

This study included a representative sample of Saudi male adolescents enrolled in the grade 8 and 12 in Riyadh, the capital city of Saudi Arabia. Therefore, the results of this study may be applicable to Saudi male adolescents’ population in the studied age groups. In addition, the high response rate due to a good collaboration from schools and adolescents may reduce selection bias.
The current study was based on self-reported questionnaire, therefore might be subject to recall and social desirability biases. However, studies showed that confidentiality and anonymity of self-reported questionnaire reduces bias and provides reliable and valid data. Dichotomization of lifestyle behaviours based on public health recommendations was required for the analysis of patterns of multiple lifestyle risk behaviours, which may lead to loss of some information. Female adolescents were not included in this study as the education system in Saudi Arabia separates schools for girls and boys. Girls have their own schools and female staff; males are not allowed to enter schools for girls. This limits the generalizability of the study findings among Saudi female adolescents.

The current study provides more insights into the interrelationship between these lifestyle risk behaviours. Consequently, it has important implication for public health and future research. The patterns of lifestyle found in this study may indicate some forms of health promotion interventions that targeting multiple lifestyle behaviours simultaneously. For example, the combination of (physical inactivity and low fruits and vegetables intake) may suggest that the intervention related to these behaviours could occur simultaneously. Tailored health promotion interventions among adults on multiple health-related behaviours (fruit consumption, vegetable consumption, fat consumption and physical activity) have shown significant effects on dietary behaviours and physical activity. More research is needed on the effectiveness of pattern-based health promotion interventions in adolescents.

CONCLUSION

The current study identifies patterns of clustering lifestyle risk behaviours among younger and older Saudi male adolescents. Identification of these patterns is important for health promotion interventions.

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