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Patterns of Unhealthy Behaviors among School-Aged Students in Riyadh City, Saudi Arabia

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ABSTRACT

Unhealthy behaviors initiated at a young age tend to remain in adulthood. Accumulation of unhealthy behaviors has cumulative negative effects on health status. The aim of this study was to examine patterns of co-occurrence of unhealthy behaviors (smoking, physical inactivity, high sugar intake, low fruit and vegetable intake, and infrequent tooth brushing) among younger and older Saudi male adolescents. A stratified cluster random sample of 1213 Saudi Arabian male school students living in Riyadh city answered the adapted WHO Health Behavior in School-Aged Children (HBSC) questionnaire on health-related behaviors. The co-occurrence patterns of unhealthy behaviors were assessed using an observed-to-expected ratio (O/E) method. The results showed that the pattern of three unhealthy behaviors (smoking + high sugar intake + physical inactivity) co-occurred with the highest O/E ratio of 3.16 among younger adolescents. In comparison, the pattern of (smoking + high sugar intake + low fruit/vegetables intake) was high among older adolescents with O/E: 1.67. The current study identifies patterns of unhealthy behaviors among younger and older Saudi male adolescents. Identification of these patterns is important for health promotion interventions.

Key words: *Patterns, Co-occurrence, Clustering, Health-related behaviors, Adolescents*

INTRODUCTION

Many unhealthy behaviors, 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 affect social and economic development [2]. The multi-dimensional associations between health-related behaviors mean that certain health behaviors tend to co-occur in defined patterns [3, 4]. The co-occurrence of health-related behaviors may increase negative cumulative and synergistic effects on health [5]. For example, it was found that unhealthy behaviors such as smoking, less fruit and vegetable intake, physical inactivity, and alcohol intake predict a four times difference in mortality from non-communicable diseases [6].

Health promoters have recognized adolescence as an important stage of life for determining a range of behaviors. Research shows that many unhealthy behaviors 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 patterns of co-occurrence behaviors focuses mainly on the adult population [8], with some studies focusing on adolescents in developed countries [9]. Such research is scarce in low and middle-income countries, particularly Saudi Arabia, where nearly 20 % of its population are adolescents [10]. Most studies on health behaviors in Saudi Arabia examine behaviors in isolation [11]. For example, results from the National School Health Survey “Jeeluna” in Saudi Arabia show the prevalence of single-risk behaviors at a time [10].

By exploring the co-occurrence patterns of unhealthy behaviors, we gain insight into how health-related behaviors relate to one another in adolescents and are critical for designing tailored health promotion interventions [12]. Therefore, this study aimed to examine the co-occurrence patterns of five unhealthy behaviors (smoking, physical inactivity, high intake of sugars, low fruit and vegetable intake, and infrequent tooth brushing) among younger and older Saudi male adolescents in Riyadh city, Saudi Arabia.

MATERIALS AND METHODS

Sample

The target population was Saudi boys students aged 13-14 in 8th grade and 17-18 in 12th grade. The two age groups selected were considered to represent the ages of onset of physical and emotional changes in early adolescence and the older group when they are about to choose their future careers [13]. The study sample was selected by stratified cluster random sampling 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 [14]. All Grade 8 and 12 classes in the selected schools were recruited. In addition, 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 the mean number of aggregated unhealthy behaviors by age group variable at the 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 Behavior in School-Aged Children (HBSC) was adapted for use in this study. The adapted questionnaire had questions on characteristics of demographic, unhealthy behaviors, family structure, parents' education, and peer groups.

Measures

The five unhealthy behaviors were defined based on public health recommendations (**Table 1**) [15]. Smoking was measured by "How often do you currently smoke tobacco?" Response options were: "Every day, so I do not smoke." The 60-minute Moderate-to-Vigorous Physical Activity (MVPA) is brief enough to be used as a general research instrument [16]. It consists of two questions: "Physical activity is any activity that increases your heart rate and sometimes makes you get out of breath. Physical activity includes 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, how many days were you physically active for at least 60 minutes per day?" Response options: "0 days, to 7 days". Dietary behaviors questions included in the study were on the frequency of eating fruits/vegetables and 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". Toothbrushing behavior 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."

Table 1. Indicators of unhealthy behaviors

Unhealthy behaviors	Definition applied
Smoking	At least once or more per week [17]
Physical inactivity	less than 5 days per week of 60 minutes Moderate-to-Vigorous Physical Activity per day [16]
High sugars intake	Once or more daily [18]
Low fruit and vegetable intake	Less than once daily [19]
Infrequent toothbrushing	Less than twice daily [20]

Statistical analysis

For statistical analysis purposes, the five unhealthy behaviors were coded into binary variables (presence of risk behavior =1; or absence of risk behavior =0). All the binary behaviors were summed to yield the count of accumulated unhealthy behaviors ranging from 0 to 5. Based on multiple combinations between two or more of the five binary behaviors, the possible number of combinations was 27. Co-occurrence was examined for each combination of unhealthy behaviors by comparing the observed (O) and expected (E) prevalence. Co-occurrence was considered to exist when the observed prevalence exceeded the anticipated prevalence of each combination. The expected prevalence for each combination was calculated by multiplying the individual proportion of individual behaviors, assuming mutual independence of the behaviors in the study population. The ratio of observed to expected proportion (O/E) was considered to measure the existence of co-occurrence of a particular combination of unhealthy behaviors [8]. An O/E ratio above one for a particular combination of behaviors indicates that co-occurrence exists and is presented with 95% confidence interval (CI) [21]. Confidence intervals for O/E ratios were obtained by a computer program (CIA version 1.1, 1989, BMA Publishers, London, UK). The analyses were conducted using STATA version 12.0 (STATA Corp, College Station, Texas, USA).

RESULTS AND DISCUSSION

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

Table 2. Sociodemographic characteristics of Saudi male adolescents (n=1213)

Variable	All		Younger		Older	
	N	%	N	%	N	%
	1213		612	50.5	601	49.5
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, Ph.D.)	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, Ph.D.)	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

As depicted in **Table 3**, The most frequent unhealthy behaviors among the Saudi male students were infrequent tooth brushing (74.3%), followed by low fruit and vegetable intake (70.7%), high sugars intake (66.5%), physical inactivity (62.2%) and smoking (21.2%). In general, the prevalence of unhealthy behaviors increased among older than younger adolescents. For the accumulation of unhealthy behaviors, 6% of older adolescents had all five unhealthy behaviors compared to younger 1%. And 14% of older had four unhealthy behaviors compared to 10% of younger adolescents. For three or fewer unhealthy behaviors, younger adolescents had a higher prevalence than older adolescents.

Table 3. Prevalence of single and co-occurrence count of unhealthy behaviors (n=1213)

Variable	All		Younger 13-14		Older 17-18	
	N	%	N	%	N	%
	1213		612	50.5	601	49.5
Single unhealthy 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

Co-occurrence count of unhealthy 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

As shown in **Table 4**, o-occurrence, which is when the observed prevalence of a particular combination of unhealthy 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 unhealthy behaviors in older and younger adolescents, respectively. Among the younger adolescents, the combination of three risk behaviors (smoking + physical inactivity + high sugar intake) co-occurred with the highest O/E ratio of 3.16 across all the combinations, indicating that this pattern is 3-fold higher than expected if these behaviors were independent. The highest O/E ratio observed in older adolescents was 1.68, where (physical inactivity + low fruit and vegetable intake) were co-occurred.

All five unhealthy behaviors co-occurred among both age groups, with a 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 unhealthy behaviors, only one combination co-occurred among younger and older adolescents. Among younger adolescents, the combination was all unhealthy behaviors except physical inactivity (O/E: 1.53), while for the older adolescents, the combination was all unhealthy behaviors except low fruit and vegetable intake (O/E: 1.22) (**Table 4**).

The combination of (smoking + high sugar intake + low fruit and vegetable intake) co-occurred in older adolescents (O/E: 1.67), while this combination has not existed among younger adolescents. On the other hand, the combination of (smoking + high sugars + infrequent toothbrushing) co-occurred only in younger adolescents (O/E: 1.67). The combination of (physical inactivity + low fruit and vegetable intake + infrequent toothbrushing) co-occurred in both younger and older adolescents (O/E: 1.38 and 1.21, respectively) (**Table 4**).

Table 4. Patterns of unhealthy behaviors in Saudi male adolescents (n=1213)

Number of behaviors	smoking	Physical inactivity	High sugar intake	Low fruit and vegetable intake	Infrequent toothbrush	13-14			17-18		
						O%	O/E	95% CI	O%	O/E	95% CI
5	+	+	+	+	+	2.12	1.30	(0.69-2.22)	12.15	1.36	(1.06-1.71)
4	+	+	+	-	+	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)
3	+	+	-	-	+	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)
2	-	+	-	-	+	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

Among the unhealthy behaviors, the combination of (smoking + high sugars intake) co-occurred among both younger and older adolescents, with a high O/E ratio in younger (O/E: 1.84) compared to older adolescents (O/E: 1.30). The combination of (physical inactivity + low fruit and vegetable intake) resulted in high ratio among older adolescents (O/E: 1.68), while this combination was not co-occurred in younger adolescents (O/E: 0.79) (**Table 4**).

The current study aimed to assess the patterns of co-occurrence behaviors among younger and older adolescents. This is the first study that examines multiple patterns of major unhealthy behaviors (smoking, physical inactivity, high intake of sugars, low fruit and vegetable 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 the co-occurrence of multiple behaviors. Moreover, these studies included a wide range and types of investigated behaviors and different study populations. Then, comparisons of results between this study and previous studies should be made with caution.

The results of this study confirm the co-occurrence of unhealthy behaviors among younger and older adolescents population. And about one-third of Saudi boys adolescents had three unhealthy behaviors (36%). These findings are comparable to adolescents in middle-income countries. For example, in Malaysia, It was found that one-third of adolescents had three risk behaviors (37%) [22]. From the 27 possible combinations of unhealthy behaviors, 10 and 09 were identified in older and younger adolescents, respectively, indicating that these patterns of behaviors were more prevalent than expected.

The current study found that older adolescents had more prevalence of four or more unhealthy behaviors, while younger adolescents had a more prevalence of three or fewer unhealthy behaviors [23]. This emphasized that the accumulation of health-related behaviors varies throughout adolescence [24]. And adolescents at an older age had a greater chance of consuming smoking compared to younger adolescents.

The combination of three risk behaviors (smoking + physical inactivity + high sugar intake) co-occurred among both age groups, with the highest O/E ratio in younger adolescents. Two unhealthy behaviors, smoking, and high sugar intake, co-occurred in both younger and older adolescents. Comparable findings were found among Brazilian adolescents [25]. One explanation might be that smoking in adolescence may stimulate the intake of more sweets and soft drinks. Moreover, smoking has been considered a "gateway behavior" to accumulate other risky behaviors [26].

The present study showed that the combination of (physical inactivity + low fruit and vegetable intake) co-occurred only among older adolescents. This pattern was found in a study among Brazilian adolescents [27]. These results suggest that health promotion interventions using multiple health-related behavior approaches should be advocated among adolescents instead of an isolated individual health-related behavior approach.

This study included a representative sample of Saudi male adolescents enrolled in grades 8 and 12 in Riyadh, the capital of Saudi Arabia. Therefore, this study's results may apply to the Saudi male adolescent population in the

studied age groups. In addition, the high response rate due to good collaboration between schools and adolescents may reduce selection bias.

The current study was based on the self-reported questionnaire. Therefore, it might be subject to recall and social desirability biases. However, studies showed that confidentiality and anonymity of self-reported questionnaire reduce bias and provides reliable and valid data [28]. The dichotomization of unhealthy behaviors based on public health recommendations was required to analyze patterns of multiple unhealthy behaviors, which may lead to the 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 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.

CONCLUSION

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

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