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The key determinants of low back pain among lifestyle behaviors in adolescents

A cross-sectional study from Saudi Arabia

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Abstract

Establishing preventive measures and treatment strategies for adolescents with low back pain (LBP) may be greatly enhanced by fully grasping the complex interaction between LBP and lifestyle behaviors. The key objective of this study was to explore the possible associations between lifestyle behaviors and LBP among adolescents in Saudi Arabia. A cross-sectional study was conducted among high school students from 5 major regions in Saudi Arabia. Participants were enlisted for the research project between May and November 2021. To evaluate the presence/severity of LBP, physical activity, sedentary duration, sleep quality, nutrition, health responsibility, interpersonal relationships, spiritual growth, and stress management, a well-established web-based survey was employed. A total of 2000 students participated, with 57.9% reporting LBP. Students with LBP had lower scores on overall health-promoting lifestyle behaviors and all subscales, including physical activity, compared to those without LBP. Linear regression analysis revealed significant associations between sedentary duration and global sleep quality with pain severity among students with LBP. This study highlights the association between lifestyle behaviors and LBP among adolescents in Saudi Arabia. Promoting physical activity, reducing sedentary behavior, and improving sleep quality may be crucial in preventing and managing LBP in this population. Comprehensive strategies targeting lifestyle behaviors should be implemented to improve the well-being of adolescents and reduce the burden of LBP. Further research is needed to better understand the underlying mechanisms and develop effective preventive and treatment strategies for LBP among adolescents.

Abbreviations: BMI = body mass index, CI = confidence interval, HPLP-II = Health-Promoting Lifestyle Profile-II, LBP = low back pain.

Keywords: low back pain, nutrition, physical activity level, sedentary behavior, sleep quality, teenagers

1. Introduction

Low back pain (LBP) is a complex condition that can be influenced by a number of personal characteristics, occupational factors (both physical and psychological), and environmental factors.[1] The lifetime prevalence of LBP is estimated to range between 60% and 80% globally.[2] Several studies found that up to 41.2% of students had a high point prevalence of LBP.[3–8] Long periods of sitting while studying or using computers can cause LBP in many students.[3,4] Physical inactivity, sedentary lifestyles, obesity, income, and inadequate self-care practices are some of the variables that might account for these relationships.[9–12] LBP is linked to multifaceted lifestyle problems in students that have not yet been studied, given that 80% of people may generally get LBP at a certain stage of their lifetime.[13] A recent study conducted on Saudi Arabian teens revealed that 57.8% of the participants had suffered LBP over 12 months.[14]

For young adults, physical exercise and LBP have both direct and indirect impacts.[14] One of the most crucial aspects of health for individuals with LBP is physical activity, which may have an impact on how active they are on a daily basis.[14] Adolescents are more likely than adults to participate in inappropriate behaviors that are detrimental to their health like sedentary lifestyles, physical inactivity, and psychosocial stress.[15] Keating research indicates that between 40% to 50% of students are physically inactive.[16] A recent poll found that

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around 9% of students in Czech completed the 10,000 steps/day criterion.[17]

While physically inactive lifestyles were associated with a considerably higher prevalence of recurring LBP, physical activity levels were positively correlated with a lower incidence of chronic LBP.[18] Students engaged in sedentary activities including studying, watching television, playing video games, using computers, and sitting for 8 hours a day, according to another study done in the UK.[19] There is not much information available on how to decrease students' sedentary behavior.[20] Students who spend long periods engaged in sedentary activities, such as sitting for extended periods, may often experience stress and a sense of overload while studying.[21] A study conducted in Saudi Arabia revealed that a considerable proportion (61.5%) of students who engaged in sitting for extended periods—more than 4 hours a day—frequently suffered from LBP.[22] There is, however, little proof linking specific lifestyle variables and LBP.

Inadequate sleep quality has been found to be closely associated with an unhealthy lifestyle characterized by inadequate exercise, irregular eating habits, and poor overall health, underscoring how important a healthy lifestyle is to maintaining optimal sleep patterns.[23] In Poland, 48.7% of students stated that they typically get between 5 and 7 hours of sleep.[24] Studies have revealed a significant connection between sleep problems and pain intensity, with a notable percentage (50–60%) of individuals who experience sleep problems also reporting LBP.[25] Furthermore, studies have indicated that individuals with LBP who have trouble sleeping and experience more intense pain face a heightened risk of requiring hospitalization due to their healthcare needs, in contrast to individuals with good sleep quality.[26] These results imply that the onset of LBP may be linked to low-quality sleep. Among patients with LBP, a 58.7% estimated prevalence of sleep disturbance was reported.[27] It was shown that pain intensity and sleep disruption were independently correlated, with each point increase on the pain scale (11-point numerical scale scored from 0 to 10) translating into a 10% higher chance of perceiving inadequate quality of sleep.[27]

The exploration of lifestyle behaviors in adolescents with LBP is of utmost importance, considering the potential health consequences linked to LBP during the critical young adult years. As adolescents undergo significant physical and psychological transformations, the adoption of a healthy lifestyle plays a vital role in managing these changes and maintaining overall physical and psychological stability. Investigating the complex interplay between LBP and lifestyle behaviors can provide valuable insights for future research, enabling the formulation of targeted preventive measures and effective treatment strategies for students affected by LBP. Thus, the key objective of this research was to determine the associations between lifestyle outcomes and LBP among adolescents.

2. Methods

2.1. Design

A cross-sectional study of adolescents (high school students) in 5 distinct areas of Saudi Arabia (Riyadh, Jeddah, Medina, Asir, and Arar) was carried out, which together make up around 70% of the nation's population. A simple random sampling approach was used in the study to examine the association between lifestyle behaviors and LBP in both male and female students. A comprehensive sectional questionnaire was used to electronically gather data between November 2021 and April 2022.

A priori power analysis was performed using a statistical formula designed for the cross-sectional investigations to determine the appropriate sample size,.[28] To maintain a cautious approach, we assumed a prevalence rate of around 50% for LBP, along with a 95% confidence interval (CI) and a precision level of 5% for a single population proportion. Considering that there were 2 sex groups (male and female), we multiplied the minimal sample size (i.e., 768 participants) by the number of domains, resulting in a total sample size of 1536.

This study was reviewed and authorized by Prince Sattam Bin Abdulaziz University's Ethical Committee of Applied Medical Sciences in Al Kharj, Kingdom of Saudi Arabia (Protocol No.: RHPT/021/014). Before their participation, the researchers obtained consent from all individuals involved in the study, ensuring their informed agreement to complete the questionnaire.

To gather data, a self-reported Arabic questionnaire with closed-ended questions was utilized in this study. All participating students needed to respond to every question. To ensure the questionnaire's clarity, relevance, and comprehensibility, a panel of 10 volunteers within a similar age group evaluated the questionnaire items. The survey was broken up into 5 sections as follows:

- Demographics: The sociodemographic and anthropometric characteristics of the participants, including name, age, sex, height, weight, and marital status.
- LBP: Participants were asked a binary question (yes/no) to ascertain whether or not they experienced LBP.
- Severity of LBP: A numerical 0 to 10 rating scale was employed to evaluate the pain severity experienced by participants with LBP over the previous 7 days.
- Lifestyle behaviors: Participants' lifestyle behaviors were assessed using the 52-item Health-Promoting Lifestyle Profile-II (HPLP-II).[29] The HPLP-II encompasses 6 distinct subscales, namely stress management, physical activity, nutrition, health responsibility, interpersonal relationships, and spiritual growth. Each subscale employs a 4-point Likert scale for response evaluation of items. An increased HPLP-II score denotes a greater level of engagement in behaviors that promote health. To derive the overall assessment of lifestyle behavior, it is recommended to calculate the average across the 6 subscales.[29]
- Sedentary duration: Participants were asked to provide the number of hours (hrs.) per day spent in a sedentary state without engaging in any physical activity over the course of the previous week.
- Sleep quality: The evaluation of sleep quality was carried out using a globally recognized Sleep Quality Questionnaire.

The study participants consisted of adolescents from different regions across Saudi Arabia. The researchers, who possessed a degree in physiotherapy, personally visited the high schools in these regions and handed out the questionnaires to those who expressed their willingness to take part. Additionally, students from other regions were invited to join the study through an electronic survey disseminated via popular social media platforms such as WhatsApp, Telegram, and Twitter.

2.2. Statistical analysis

The data collected through Google Forms was imported into Microsoft Excel 2019 for cleaning and organization. Descriptive statistics, including measures such as mean, standard deviation, frequency, and percentage, were computed using statistical package for the social sciences version 25 to summarize the variables of interest for the entire sample. Continuous variables were presented as mean ± standard deviation, while categorical variables were reported as frequencies. To explore potential demographic and lifestyle behavior differences between adolescent groups with and without LBP, the data was stratified based on LBP presence. Statistical tests were employed to assess these differences, specifically the Mann–Whitney U test for non-normally distributed data with unequal sample sizes, and the chi-squared test for frequencies and percentages. A Linear Generalized Regression Model was utilized to examine how LBP pain severity and lifestyle behaviors are associated. This analysis was conducted while controlling for relevant covariates. Three models were constructed: Model 1 without any covariates, Model 2 incorporating age as a covariate, and Model 3 including age, body mass index (BMI), and sex as covariates. In all statistical analyses performed, a significance level of $P < .05$ was employed.

3. Results

A total of 2000 adolescent participants (63.9% male, 36.1% female) completed and submitted the survey. The average age was 16.67 ± 1.158 years old, and the average BMI was 32.03 ± 0.14. Approximately 57.9% of participants were with LBP. The average total HPLP-II was 21.65 (2.5 ± 0.59). Among the sex HPLP-II subscales, the highest average score was for spiritual growth (2.86 ± 0.67) and the lowest average score was for physical activity (2.26 ± 0.76). The participants' overall demographics and clinical characteristics are shown in Table 1.

Table 2 demonstrates the overall characteristics of participants, grouped by LBP (Yes/No). Adolescents with LBP, in comparison with those without LBP, had a lower BMI, higher sleep duration, higher sedentary duration, and higher scores on global sleep quality. Moreover, adolescents with LBP, in comparison with those without LBP, had lower scores on the overall HPLP scale (20.94 vs 22.64) and all HPLP-II subscales. Among the 6 HPLP-II subscales, both students with LBP and those without had the highest scores on spiritual growth (25.11 and 26.64, respectively) and the lowest scores on physical activity (17.12 and 19.36, respectively).

A binary logistic regression was run to analyze the relationship between lifestyle behaviors on the probability of having low back pain among adolescents (Table 3). It was found that holding all other predictor variables constant, the odds of low back pain occurrence increase by 75% (95% CI: 50–104%) for each unit reduction in the HPLP-II score. Also, the odds of low back pain occurrence decreased by 42% (95% CI: 48–35%) for each additional unit in the global sleep quality score. Further, the analysis demonstrated that the odds of low back pain occurrence increased by 80% (95% CI: 20–170%) for each additional hour/day spent sitting without being active.

Linear regression analysis of the HPLP-II subscales, sedentary duration, and global sleep quality with pain severity was conducted to detect which independent variables were predictors of pain severity in students with LBP (Table 4). The analyses demonstrated significant associations between all HPLP-II subscales, global sleep quality, sedentary duration, and pain severity in model 1 (unadjusted). However, when we adjusted for age (model 2), the only predictors that showed significant associations with pain severity were spiritual growth, interpersonal relations, global sleep quality, and sedentary duration. Furthermore, in model 3 (adjusted for age, BMI, and sex), the results showed that only the sedentary duration and global sleep quality were significantly associated with pain severity. However, there were no significant associations between HPLP-II subscales and pain severity demonstrated in model 3.

4. Discussion

The study aimed to identify the predictors of pain severity in students with LBP using various factors such as sedentary behavior, sleep quality, and Health Promoting Lifestyle Profile II (HPLP-II) subscales. The results of the study indicated that when age was adjusted for, only global sleep quality and sedentary duration were significant contributors to pain severity.

The study's findings suggest that global sleep quality and sedentary duration are strong predictors of pain severity in adolescents with LBP. These findings are consistent with previous studies that have highlighted the importance of sleep and sedentary behavior in chronic pain conditions. Poor sleep quality is associated with increased pain sensitivity, changes in pain modulation, and altered response to pain medication.[30] Sedentary behavior, on the other hand, is associated with metabolic dysfunction, inflammation, and musculoskeletal abnormalities, contributing to the development and progression of LBP.[31]

The lack of significant association between the HPLP-II subscales and pain severity is an interesting finding. The HPLP-II measures health-promoting behaviors in 6 domains, including health responsibility, physical activity, nutrition, spiritual growth, interpersonal relations, and stress management. The lack of association suggests that these subscales may not be the primary determinants of pain severity in students with LBP. Other lifestyle factors, such as sedentary behavior and sleep quality, may have a more direct influence on pain severity.

The results of the current study found that sleep quality and sedentary behavior were associated with low back pain severity among adolescents with back pain. These findings were adjusted for age, sex, and BMI. However, after full adjustment, this study indicated that HPLP-II subscales were not associated with back pain severity in this population. The results were in contrast to previous research.[32,33] A recent systematic review found moderate evidence for the association between physical activity and low back pain severity among children and adolescents including 9 studies (n = 75,233 participants).[33] One of the major

Table 1

Demographics and clinical characteristics.

Variables	Mean ± SD; N (%)
Age (N = 2000)	16.67 ± 1.158
BMI (N = 1979)	23.53 ± 6.9
Sex, male, female	1278 (63.9), 722 (36.1)
Back pain, yes (N = 2000)	1158 (57.9)
HPLP total (N = 2000)	21.65 or 2.5 ± 0.59
Health responsibility (N = 2000)	19.53 or 2.17 ± 0.73
Physical activity (N = 2000)	18.08 or 2.26 ± 0.76
Nutrition (N = 2000)	20.61 or 2.29 ± 0.65
Spiritual growth (N = 2000)	25.74 or 2.86 ± 0.67
Interpersonal relations (N = 2000)	24.66 or 2.74 ± 0.61
Stress management (N = 2000)	21.28 or 2.66 ± 0.66
Sleep duration (N = 2000)	13.15 ± 6.63
Global sleep quality (N = 2000)	1.9 ± 0.92
Sedentary duration, hrs (N = 2000)	1.98 ± 1.04

BMI = body mass index, HPLP = Health-Promoting Lifestyle Profile, N = number, SD = standard deviation.

Table 2

The differences between students with and without back pain.

Variables	Adolescents with LBP (N = 1158)	Adolescents without LBP (N = 842)	*P*-value
Age	16.82 ± 1.15	16.48 ± 1.14	<.001
BMI (n = 1979)	23.87 ± 7.4	23.05 ± 6.2	.40
Sex, male, female	624 (53,8),534 (46.11)	654 (77.67),188 (22.32)	<.001
Pain severity	4.61 ± 2.48	0.00 ± 0.06	<.001
HPLP-II total score	20.94 or 2.41 ± 0.55	22.64 or 2.61 ± 0.64	<.001
Health responsibility	18.54 or 2.06 ± 0.68	20.88 or 2.32 ± 0.76	<.001
Physical activity	17.12 or 2.14 ± 0.72	19.36 or 2.42 ± 0.79	<.001
Nutrition	19.8 or 2.20 ± 0.61	21.69 or 2.41 ± 0.68	<.001
Spiritual growth	25.11 or 2.79 ± 0.64	26.64 or 2.96 ± 0.70	<.001
Interpersonal relations	24.39 or 2.71 ± 0.58	25.2 or 2.80 ± 0.65	<.001
Stress management	20.72 or 2.59 ± 0.62	22,08 or 2.76 ± 0.69	<.001
Sleep duration, hrs	13.59 ± 6.71	12.54 ± 6.48	.060
Global sleep quality	2.07 ± 0.93	1.66 ± 0.84	<.001
Sedentary duration, hrs	2.17 ± 1.05	1.7 ± 0.97	<.001

BMI = body mass index, HPLP = Health-Promoting Lifestyle Profile, hrs = hours, LBP = low back pain, N = number.

Table 3

Binary logistic regression for low back pain against variables.

Variables	OR (95% CI)	*P*-value
HPLP-II total score	1.75 (1.5, 2.04)	<.001
Health responsibility	1.62 (1.43, 1.83)	<.001
Physical activity	1.61 (1.43, 1.82)	<.001
Nutrition	1.64 (1.43, 189)	<.001
Spiritual growth	1.45 (1.27, 1.66)	<.001
Interpersonal relations	1.27 (1.1, 1.47)	.001
Stress management	1.49 (1.29, 1.7)	<.001
Sleep duration	.97 (.96,.98)	<.001
Global sleep quality	.58 (.52,.65)	<.001
Sedentary duration, hrs	1.8 (1.2, 2.7)	.002

CI = confidence interval, HPLP = Health-Promoting Lifestyle Profile, hrs = hours, OR = odds ratio.

differences between this report and our study is the inclusion of age range. Our study included only high school (>15 years) while the previous study included 9 to 19 years old. Consistent with our results, previous studies found an association between sedentary behavior and back pain severity.[32–34] Poor sleep and sedentary behavior were linked with low back pain severity in our study which was similar to a previous report.[35] Future research should examine this association using a longitudinal design to better understand this association.

Several plausible explanations have been put forth to elucidate the association between LBP, sedentary behavior, and poor sleep quality. These explanations encompass biomechanical, biological, and psychosocial factors that collectively contribute to the development and exacerbation of LBP symptoms among adolescents. Biomechanically, sedentary behaviors can lead to increased loading on the intervertebral discs, reduced spinal stability, and compromised postural control. Furthermore, prolonged sitting can result in muscular imbalances, specifically weakened core and back muscles, which play a crucial role in providing support and stability to the lumbar spine. These biomechanical changes might have contributed to the development and/or persistence of low back pain among adolescents.[36] Biologically, poor sleep quality can disrupt the normal functioning of the pain modulation system, leading to increased pain sensitivity and altered pain perception. Additionally, inadequate sleep has been shown to impair tissue repair processes and compromise the body's ability to recover from musculoskeletal injuries, potentially exacerbating low back pain symptoms. Psychologically, poor sleep quality is often associated with increased levels of stress, anxiety, and depression, which can contribute to the development and persistence of pain.[37–39] Furthermore, the bidirectional relationship between sleep and pain suggests that the presence of low back pain itself may further disrupt sleep patterns, creating a vicious cycle of sleep disturbance and pain.[40]

This study has some strengths and limitations. One of the strengths is including a large number of adolescents representative of this population across multiple regions of Saudi Arabia. Another strength is using validated outcome measures such as HPLP-II and sleep quality. However, some limitations should be considered in the current study. The lack of a longitudinal study limits data interpretation and there is no cause-and-effect relationship. Another limitation is the unequal number of males to females that might affect the results interpretation especially when we adjusted for sex, the results have changed in terms of HPLP-II subscales that were not significant with back pain severity. Finally, although lifestyle behavior and sleep outcomes were measured using validated outcomes, objective measures such as Actigraph might have better estimates and variables across multiple days without the impact of recall bias. Therefore, future research should examine the association between lifestyle behavior and back pain using objective tools in this population.

Table 4

The associations between lifestyle behaviors and pain severity in people with LBP.

Predictors	ß	SE	CI (95%)	*P* value
Model 1				
HPLP-II total score	1.00	.15	.705 to 1.29	<.001
Health responsibility	.912	.17	.56 to 1.26	<.001
Physical activity	.96	.14	.67 to 1.24	<.001
Nutrition	.97	.17	.62 to 1.32	<.001
Spiritual growth	.95	.12	.72 to 1.19	<.001
Interpersonal relations	1.04	.16	.73 to 1.36	<.001
Stress management	.80	.13	.54 to 1.06	<.001
Global sleep quality	1.73	.07	1.5 to 1.8	<.001
Sedentary duration, hrs	1.7	.07	1.58 to 1.87	<.001
Model 2				
HPLP-II total score	2.5	.16	–.07 to.57	.13
Health responsibility	.23	.19	–.13 to.61	.21
Physical activity	.31	.16	–.005 to.63	.054
Nutrition	.33	.19	–.038 to.71	.078
Spiritual growth	.39	.14	.11 to.67	.005
Interpersonal relations	.4	.17	.05 to.75	.023
Stress management	.19	.14	–.103 to.48	.204
Global sleep quality	1.18	.10	.98 to 1.39	<.001
Sedentary duration, hrs	1.13	.104	.93 to 1.3	<.001
Model 3				
HPLP-II total score	–.14	.16	–.48 to.18	.38
Health responsibility	–.20	.19	–.59 to.17	.28
Physical activity	–.09	.16	–.42 to.23	.58
Nutrition	–.098	.19	–.47to.28	.61
Spiritual growth	–.064	.14	–.35 to.22	.66
Interpersonal relations	–.08	.18	–.43 to.27	.65
Stress management	–.25	.15	–.56 to.04	.09
Global sleep quality	.67	.11	.43 to.9	<.001
Sedentary duration, hrs	.63	.12	.39 to.87	<.001

Dependent variable: pain severity; model 1: no covariates; model 2: age; model 3: age, BMI, sex. CI = confidence Interval, HPLP = Health-Promoting Lifestyle Profile, hrs = hours, SE = standard error.

5. Conclusion

The findings indicate that LBP is prevalent among adolescents. Moreover, LBP adolescents had lower scores on the overall health-promoting lifestyle, and sedentary behavior and poor sleep quality were also more prevalent among adolescents with LBP. Global sleep quality and sedentary duration were significant predictors of pain severity among adolescents with LBP. This study emphasizes the significance of considering lifestyle factors in the management of LBP and underscores the need for multidimensional approaches to explore how adolescents' lifestyle practices and LBP are intricately related. By adopting a holistic approach, healthcare professionals, educators, and policymakers can contribute to improving the well-being of adolescents and reducing the burden of LBP in this population.

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