Original Article

Socio-Demographic Determinants of Non-Communicable Disease Risk Factors Among Adolescents in Rawalpindi, Pakistan: A School-Based Cross-Sectional Study

Bushra Ameer Saeed Awan, Syed Fawad Mashhadi, Aarij Sohail Iqbal, Ramsha Habib, Saad Waseem Butt, Ahmed Rashid

ABSTRACT

Objective: To determine the frequency of major non-communicable disease (NCD) risk factors among adolescents aged 13–17 years in public and private schools of Rawalpindi, and to assess the association of socio-demographic factors with these risk factors.

Methodology: A cross-sectional study among 400 adolescents aged 13–17 years from one public and one private secondary school in Rawalpindi was conducted. Two-stage stratified random sampling was used with equal numbers from grades VII to X. Data was collected using WHO Global School-Based Student Health Survey (GSHS). Categorical variables were presented as frequencies and percentages. Associations were measured using chi-square test, followed by logistic regression.

Results: Of 400 participants (mean age 14.9 ± 1.4 years), 49.8% were male. Dietary risk (364, 91.0%), physical inactivity (351, 87.8%), and sedentary behavior (215, 53.7%) were the most prevalent NCD risk factors. Older age (AOR 14.67; 95% CI 3.88–55.47) and private school attendance (AOR 12.56; 95% CI 3.60–43.84) were the strongest predictors of dietary and physical inactivity risk ($p < 0.001$ for both). Higher grade level was independently associated with increased sedentary behavior (AOR 1.44; 95% CI 1.17–1.79; $p = 0.001$).

Conclusion: School type and older age predicted dietary risk and physical inactivity, while sedentary behavior rose with grade level. Interventions should target screen time, affordable nutrition, and physical activity promotion.

KEYWORDS: Adolescent, Cross-Sectional Study, Dietary Risk, Logistic Regression, Noncommunicable Diseases, Risk Factors, Sedentary Behavior

INTRODUCTION

Non-communicable diseases are the leading cause of mortality globally, accounting for approximately 41 million deaths annually, with over 85% occurring in low- and middle-income countries.[1] Evidence from around the world has demonstrated a rising prevalence of non-communicable disease (NCD) risk factors, which are seen to be common in all age categories, among both poor and affluent people, as well as across genders.[2] Eighty-five percent of the 15 million NCD-related premature deaths each year occur in low- and middle-income countries.[3] Similar to the global trend, NCDs account for over 67% of all deaths in Pakistan, with a notable increase in recent decades.[4] Non-communicable diseases (NCDs) are increasingly common among children and adolescents, and health-related behaviors established during these life stages account for a large percentage of

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premature adult fatalities.[5]

The growing public health issue of NCDs among teenagers has prompted a warning from the World Health Organization (WHO).[6] Adolescence, a crucial developmental period characterized by social, psychological, and physical changes, provides a chance to build good habits that avert health issues in adulthood. In addition to characteristics like being overweight or obese, risk behaviors including substance abuse, poor nutrition, and physical inactivity can contribute to the development of diseases and unfavorable health outcomes later in life.[7] The majority of NCDs are caused by these behavioral and metabolic risk factors. For instance, being overweight increases the risk of diabetes by 44%, ischemic heart disease by 23%, and several types of cancer by 7%–41% worldwide.[8] Adolescents in low- and middle-income countries (LMICs) have a significant prevalence of NCD risk factors, with approximately 8.5% being obese, 80% engaging in reduced physical activity, 13.6% of adolescents currently smoking, 25% engaging in episodic drinking.[9] In Pakistan, the burden of non-communicable diseases among adolescents is further compounded by suboptimal dietary practices, with available evidence indicating low dietary diversity and inadequate intake of nutrient-rich foods, alongside a high reliance on energy-dense, nutrient-poor diets among adolescents in low- and middle-income settings.[10] High consumption of fried snacks, carbonated drinks, and processed foods along with low intake of fruits, vegetables, and dairy has been linked to the early onset of obesity, diabetes, and cardiovascular risks. The prevalence of physical inactivity is also concerning, as many adolescents adopt sedentary lifestyles, spend long hours on screens, and lack physical activity in their daily routines. These behaviors are influenced by socio-demographic determinants such as age, gender, parental education, and school type.[11]

A key gap in the existing evidence is that most Pakistani NCD risk data come from adult surveys and do not break results down by school type. This study aims to examine the risk factors for non-communicable diseases (NCDs) among adolescents in Pakistan using individual data. This effort will contribute to international literature and offer insights regarding preventable risk factors for NCDs among adolescents, given the importance of preserving good health in younger age groups. This will serve as a foundation for future studies and interventions aimed at preventing NCDs in adolescents.

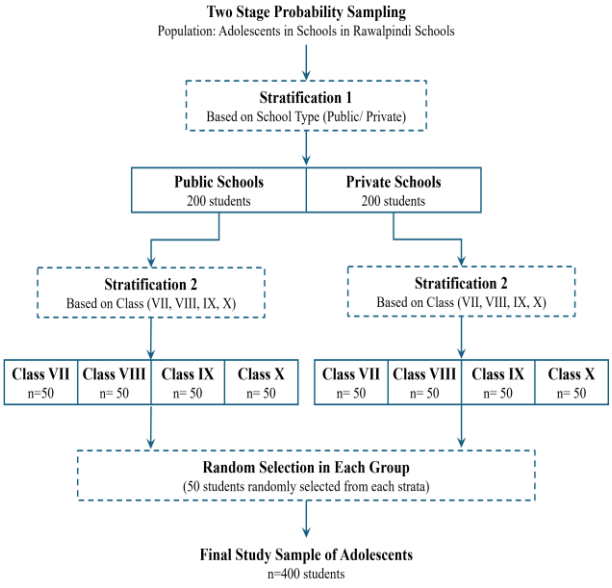
METHODOLOGY

This cross-sectional analytical study was conducted in public and private schools in Rawalpindi, Pakistan from June to October 2025, after obtaining ethical approval from the Ethical Review Committee and Institutional Review Board of Army Medical College, NUMS (ERC/ID: 05/2025/499). The sample size was calculated using the WHO sample size estimation approach, with a 95% confidence level, an anticipated population proportion of 50%, and an absolute precision of 5%. A prevalence of 50% was adopted as a conservative estimate to yield the maximum sample size, given the high and variable burden of clustered NCD risk factors reported in adolescent populations globally.[12] This yielded a minimum required sample size of 384 students, which was rounded up to 400 to allow equal allocation of 50 students from each of the eight classes. Students were enrolled in the study using a two-stage probability sampling technique. A list of schools was obtained from the Directorate of Federal Government Education Institutes (FGEI) for public schools and from the Private Education Provider Registration and Information System (PEPRIS) for private schools. In the first stage, schools were stratified into public and private categories, and one school from each stratum was selected using simple random sampling. The second stage employed stratified random sampling as well where children in both schools were stratified based on the class in which they were studying (VII, VIII, IX and X).

Using simple random sampling, 50 students were chosen from each stratum (equal allocation employed). In total, 200 students were selected from each school, completing a final sample size of 400 as shown in Figure 1.

Written informed consent was obtained from parents or guardians, and verbal assents were obtained from all participating students. Adolescents aged 13–17 years, enrolled in classes VII to X of the selected public and private schools, and present on the day of data collection were eligible for inclusion.

Figure I: **Sampling Technique**



Students with any diagnosed chronic illness or physical disability that could independently influence dietary habits, physical activity, or sedentary behavior, those who declined to participate, and those absent on the day of data collection were excluded. The study was conducted in accordance with the principles of the Declaration of Helsinki. All collected questionnaires were complete, and no missing data were observed for the variables included in the analysis. Data collection was supervised by the researchers, and any queries raised by students were clarified at the time of completion to ensure completeness. Data was collected using the WHO Global School-Based Student Health Survey (GSHS) questionnaire, a standardized and internationally validated self-report instrument. Dietary, physical activity, and sedentary behavior variables were derived from the GSHS items. Dietary risk was defined by the authors as low fruit and vegetable intake and frequent consumption of unhealthy foods, using thresholds adapted from previous studies. Physical inactivity was defined as <60 min moderate-to-vigorous activity per day and sedentary behavior as recreational screen time >3 hours per day. Participants were classified as early adolescents (13–15 years) or late adolescents (16–17 years) per WHO developmental classification. [11,13]

Qualitative data (such as gender, school type, class of student, parental education and occupation) was presented as percentage and frequencies. Quantitative data (such as age) was presented as mean and standard deviation. Chi-Square test was applied to find out association between socio-demographic factors and NCD risk factors. Binary logistic regression was applied separately for dietary risk, physical inactivity, and sedentary behavior to assess the independent effect of socio-demographic variables on each outcome. Results were presented as adjusted odds ratios with 95% confidence intervals, and a p-value of less than 0.05 was taken as statistically significant. Both unadjusted and adjusted odds ratios are presented with 95% confidence intervals. Goodness of fit was assessed using the Hosmer–Lemeshow test, and multicollinearity was evaluated using variance inflation factor. All models showed adequate fit and no evidence of problematic multicollinearity.

RESULTS

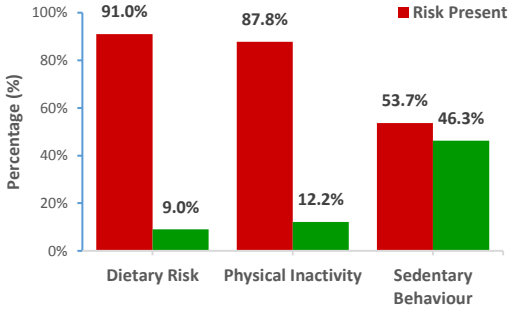
A total of 400 adolescents were enrolled in the study, with a mean age of 14.9 ± 1.4 years. The sample was nearly equally distributed by gender, school type, and grade. The majority were early adolescents (13–15 years) and reported living with both parents. Detailed sociodemographic characteristics are presented in Table I

Table I: Socio-Demographic Characteristics of Study Participants (n = 400)

Variable	Category	n (%)
Age group	Early adolescents (13–15 years)	263 (65.8)
	Late adolescents (16–17 years)	137 (34.2)
Mean age ± SD	14.9 ± 1.4 years	-
Gender	Male	199 (49.8)
	Female	201 (50.2)
Grade	VII	100 (25.0)
	VIII	100 (25.0)
	IX	100 (25.0)
	X	100 (25.0)
School type	Public	200 (50.0)
	Private	200 (50.0)
Living arrangement	Both parents	317 (79.3)
	Single parent	72 (18.0)
	Another guardian	11 (2.7)
Father's education	No formal / Primary	72 (18.0)
	Secondary	115 (28.8)
	University	213 (53.2)
Mother's education	No formal / Primary	104 (26.0)
	Secondary	116 (29.0)
	University	180 (45.0)
Father's occupation	Government servant	117 (29.2)
	Business / Private sector	178 (44.5)
	Other	105 (26.3)
Mother's occupation	Housewife	223 (55.8)
	Employed (any type)	177 (44.2)

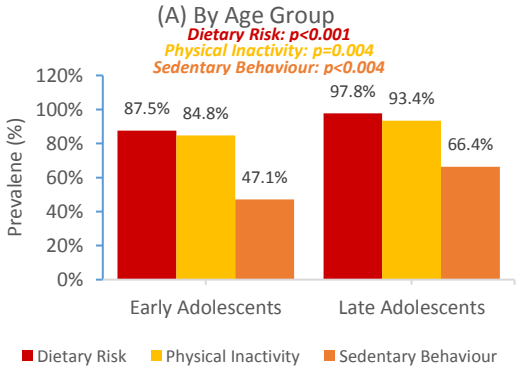
Dietary risk was the most prevalent (91.0%) NCD risk factor, followed by physical inactivity (87.8%) and sedentary behavior (53.7%) as shown in Figure 2.

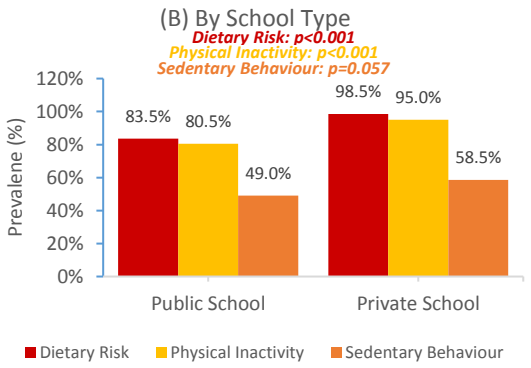
Figure 2: Prevalence of NCD risk factors among study participants



Late adolescents had higher prevalence of dietary risk (97.8% vs 87.5%), physical inactivity (93.4% vs 84.8%), and sedentary behavior (66.4% vs 47.1%) compared with early adolescents. Similarly, private school students showed higher prevalence of dietary risk (98.5% vs 83.5%), physical inactivity (95.0% vs 80.5%), and sedentary behavior (58.5% vs 49.0%) than public school students. Significant associations were observed for dietary risk and physical inactivity with both age group and school type (all $p \leq 0.004$), while sedentary behavior was significantly associated with age group ($p < 0.001$) but not school type ($p = 0.057$). The distribution of dietary risk, physical inactivity, and sedentary behavior by age group and school type shown in Figure 3.

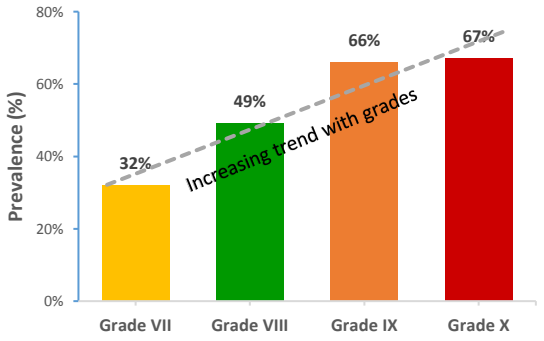
Figure 3: Distribution of dietary risk, physical inactivity, and sedentary behavior by age group (A) and school type (B)





Grade level was strongly associated with sedentary behavior (p value < 0.001). More sedentary risk was observed with higher grades. Students in grade VII had the lowest risk (32.0%), while those in grade X had the highest risk (67.0%). This grade-wise trend is depicted in Figure 4.

Figure 4: Sedentary behavior risk (screen time >3 h/day) by grade level



Binary logistic regression was conducted for dietary risk, physical inactivity, and sedentary behavior. In univariate analysis, age, grade, school type, and parental education were associated with dietary risk and physical inactivity; however, after adjustment, only age, grade, and school type remained significant. Late adolescents and private school students had higher odds of dietary risk (AOR = 14.67 and 12.56) and physical inactivity (AOR = 5.09 and 3.74; all $p \leq 0.001$), while higher grade was protective. For sedentary behavior, only grade remained significant (AOR = 1.44, p = 0.001). All models showed adequate fit on the Hosmer–Lemeshow test, with detailed results presented in Table II.

Table II: Multivariable Logistic Regression - Independent Predictors of Three NCD Risk Outcomes (n = 400)

Predictor	OR	95% CI	*p* value	AOR	95% CI	p value
DIETARY RISK: 364 (91.0%) with risk						
Age: late (16–17 years) vs early adolescent	6.41	1.93–21.30	< 0.001	14.67	3.88–55.47	< 0.001
School type: private vs public	12.98	3.91–43.07	< 0.001	12.56	3.60–43.84	< 0.001
Grade (per unit increase – protective)	0.56	0.40–0.79	0.001	0.44	0.28–0.67	< 0.001
Father's education	0.50	0.30–0.86	0.012	0.58	0.29–1.18	0.131
Mother's education	0.51	0.32–0.82	0.005	0.56	0.32–1.00	0.050
Living status	2.98	0.95–9.39	0.062	1.28	0.42–3.91	0.663
PHYSICAL INACTIVITY: 351 (87.8%) with risk						
Age: late (16–17 years) vs early adolescent	2.98	1.35–6.55	0.007	5.09	2.09–12.42	< 0.001
School type: private vs public	4.03	2.00–8.14	< 0.001	3.74	1.77–7.91	0.001
Grade (per unit increase – protective)	0.65	0.49–0.86	0.003	0.54	0.39–0.75	< 0.001
Living status	3.13	1.15–8.52	0.026	1.71	0.64–4.58	0.285
Father's education	0.56	0.36–0.87	0.009	0.71	0.41–1.23	0.218
Mother's education	0.57	0.39–0.84	0.004	0.64	0.41–1.01	0.057
Father's occupation	1.02	0.81–1.29	0.870	—	—	—
SEDENTARY BEHAVIOR: 215 (53.7%) with risk						
Grade (per unit increase – risk factor)	1.55	1.29–1.86	< 0.001	1.44	1.17–1.79	0.001
Age: late (16–17 years) vs early adolescent	2.22	1.44–3.41	< 0.001	1.46	0.89–2.38	0.132
Gender	0.59	0.40–0.88	0.009	0.70	0.46–1.06	0.092
School type: private vs public	1.47	0.99–2.18	0.057	1.51	0.99–2.30	0.055
Father's occupation	0.98	0.84–1.14	0.777	—	—	—
Mother's occupation	0.94	0.84–1.04	0.235	—	—	—

DISCUSSION

Findings of this study indicated that NCD risk behaviors, particularly poor diet and physical inactivity, were prevalent among secondary school adolescents in Rawalpindi. Private school enrolment and late adolescent age were the strongest independent predictors of dietary risk and physical inactivity, whereas sedentary behavior increased with the advancing grade. These findings are in line with evidence from Pakistan and suggest that unhealthy habits are quite common among urban school-going adolescents.[14,15] The true predictive value of socio-demographic factors only emerges when confounders are controlled, similar to study conducted in India.[16] After adjusting for confounders, private school enrolment remained the strongest independent predictor of both dietary risk and physical inactivity, contrary to evidence from Colombia.[17] However a systematic review of Pakistani school-age children reported a higher prevalence of overnutrition among students attending private schools, attributed to increased access to energy-dense foods and sedentary lifestyles.[18] One might expect private school students to be healthier given their socioeconomic advantage, but this study found the opposite**.** Research from Turkey has shown a similar trend: having more money makes it easier to purchase fast food and processed foods rather than healthier alternatives.[19] An Egyptian study also pointed to this real problem with the similar effect of food environment in and around private schools. [20]Age showed a stronger effect after adjustment. Although late adolescents already had higher dietary risk on bivariate analysis (97.8% vs 87.5%), this difference increased further after controlling for grade (AOR 14.67). This increase suggests that grade level was masking the true association in the crude analysis, indicating a suppression effect. In practical terms, within the same grade, older students were more likely to have dietary risk behaviors. A similar pattern was observed for physical inactivity, where the effect of age also strengthened after adjustment (AOR = 5.09 vs crude OR = 2.98). These findings are largely consistent with the available literature.[21]

High physical inactivity prevalence, particularly among private school students, aligns with global patterns and may partly reflect the strong academic focus in schools, where time for physical activity is often reduced in higher grades.[22] Higher grade appeared protective against physical inactivity (AOR 0.54) after adjustment, possibly reflecting more structured daily routines in senior classes. In contrast, sedentary behavior increased with grade level, likely driven by rising academic demands and digital engagement rather than individual demographics, as age and gender both lost significance after adjustment.[4] This aligns with evidence that sedentary behavior has a stronger negative impact during adolescence, particularly when linked to screen time, and that lower sedentary time combined with higher physical activity is associated with better outcomes.[23] In bivariate analysis, parental education was associated with dietary risk and physical inactivity, but this effect disappeared after adjusting for school type, suggesting that its influence may operate through the school environment. This is partly consistent with previous research showing better outcomes among children of more educated parents, although our findings indicate that this effect may not be independent of environmental factors. [24]

The study benefits from using a WHO-validated instrument (GSHS), equal representation of public and private schools (200 each), and uniform sampling across all four grade levels, which strengthens the comparability of subgroup analyses. Using separate multivariable models for each NCD risk behavior allowed clearer identification of independent predictors for each outcome, rather than assuming that all behaviors share the same underlying factors.

Being cross-sectional study, it cannot establish causation. In addition, the use of self-reported data may have introduced recall bias and social desirability bias. Household income was not

measured; therefore, some residual confounding of the association between school type and the studied outcomes may be possible. Future studies with larger samples should also examine the socio-demographic predictors of substance use behaviors such as tobacco and vaping, which represent important but distinct components of the adolescent NCD risk profile.

CONCLUSION

NCD risk behaviors were common among secondary school students in Rawalpindi and differed between public and private schools. Sedentary behavior increased with grade level, while dietary risk and physical inactivity were mainly associated with school type and older age. Factors like parental education and living status did not show an independent effect after adjustment.

Recommendations: Schools should incorporate dedicated physical education hours in daily routine to address high physical inactivity. School canteens should promote low-cost healthy snacks options while limiting ultra-processed and high-sugar items. Particularly for upper grades, structured screen time awareness sessions should be conducted.

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