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Overweight And Its Associated Risk Factors Among Urban School Adolescents In Nepal

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Overweight And Its Associated Risk Factors Among Urban School Adolescents In Nepal

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1 # ABSTRACT

2 **Objectives**

3 The prevalence of non-communicable diseases is increasing in Nepal. Overweight and

4 obesity are the major risk factors of many non-communicable diseases. Adolescence is a

5 critical phase for development of overweight and obesity. Risk factors associated with

6 overweight are not well understood in Nepal. The objective of the study was to identify the

7 factors associated with overweight and obesity among adolescent students.

8

9 **Setting**

10 A cross-sectional descriptive study was carried out in the Lalitpur sub-metropolitan city,

11 Nepal among higher secondary school students.

12

13 **Participants**

14 A random sample of 360 students of the age–group 16 to 19 years from eight schools were

15 included in the study.

16

17 **Results**

18 The prevalence of overweight among adolescent students was 12.2% (CI: 8.9-15.5). Being

19 male (AOR=2.64, 95% CI: 1.18-4.88), studying in private school (AOR=2.10, 95% CI: 1.03-

20 4.28), high socio-economic status family (AOR=4.77, 95%CI: 1.36-16.72), watching TV for

21 more than 2 hours/day (AOR=8.86, 95% CI: 3.90-20.11), consuming fruits ≤ 4 times/week

22 (AOR=3.13, 95%CI: 1.39-7.01) were more likely to be overweight. There was no statistically

23 significant association between adolescence overweight and age, ethnicity, mother's

24 education level, mother's occupation, number of siblings or family type.

25

3

1

2 **Conclusions**

3 Socioeconomic status, watching TV for longer time, and consuming less fruits are major risk

4 factors of overweight among adolescents in Nepal. Interventions are needed to increase the

5 awareness about the risk factors of adolescence overweight and obesity to decrease

6 prevalence of overweight-associated non-communicable diseases.

7

8 **Keywords**

9 Adolescent, overweight, risk factors, cross-sectional study, Nepal

10

11 **Strengths and limitations of this study**

12 Strength: This is among a few studies conducted in Nepal, which analyzed risk factors

13 associated with overweight among urban adolescent students.

14 Limitation: This is not a nationally representative study, therefore not generalized specially

15 for rural adolescents.

16

17

1 **Introduction**

2 Today overweight and obesity are the major public health problems worldwide. Although

3 once considered a major problem in affluent countries, overweight and obesity are now on

4 the rise even in low and middle-income nations like Nepal (1). This is primarily due to rapid

5 unplanned urbanization, along with the transition of Nepal's economy from subsistence to

6 market economy, which consequently led to changes in occupation, which requires different

7 change in lifestyle, and more importantly change in food habits. Prevalence and risk of

8 overweight and obesity during childhood and adolescence are increasing at greater pace in

9 developing nations rather than in developed ones (1). Overweight and obesity are the major

10 risk factors of non-communicable diseases (NCDs) such as diabetes, osteoarthritis and

11 cardiovascular diseases. WHO estimates that, NCDs cause 68% of deaths globally and nearly

12 three quarters of all NCDs deaths occur in low and middle-income countries (2).

13

14 Adolescence is a critical phase for the development of obesity due to various biological,

15 psychological, social and environmental changes (3, 4). Adolescence overweight and obesity

16 may persist into adulthood and increases the risk for development of non-communicable

17 diseases at a younger age and consequently a premature death. In addition to future health

18 risks, overweight and obese adolescent also suffer from short-term health consequences (1).

19 In addition, their participation in school and other daily activities also limit depending on the

20 degree of obesity.

21

22 In Nepal, nearly one-quarter of the population (24%) comprise of adolescents (5). NCDs

23 account 60% of all deaths in Nepal and 23% caused by cardiovascular diseases (6). A survey

24 conducted in Nepal in 2013 reported the prevalence of overweight among Nepalese people

25 (15-69 years age) to be 17.7% (7). Limited research has been done as yet on the prevalence

1   and factors associated with overweight among Nepalese adolescents (8). This study was an

2   attempt to fill the information and knowledge gap in this area and potential use of it will be

3   policy and program design to appropriately address problem in timely manner.

4

5   # Methods

6   ### *Study area*

7   This study was conducted in Lalitpur sub-metropolitan city, one of the major cities in Nepal.

8   It is adjacent to the capital city Kathmandu and is located in the southeast part of Kathmandu

9   valley. It is growing at faster pace and density of schools in Kathmandu valley is the highest

10 in this city.

11

12 ### *Study design and Selection of participants*

13 A cross sectional study was conducted during October to November 2014. Multistage random

14 sampling method was used to select the participants. The study area was purposively

15 selected. Out of fifty-two higher secondary schools, eight schools (4 government and 4

16 private) were randomly chosen and out of the included schools either one of the grades 11 or

17 12 was randomly selected. All students of the selected grade were included in the study. A

18 total of 381 students filled the self-administered questionnaire, 21 questionnaires were

19 discarded during data analysis (eight questionnaire incompletely filled, two students were

20 physically disabled and 11 students found to be above 19 years age) therefore only 360

21 students' response and anthropometric measurements were included in the study.

22

23 ### *Data collection and statistical analysis*

24 Data were collected using self-administered, pre-tested and structured questionnaire.

25 Anthropometric measurements (height and weight) were obtained as per WHO guidelines

6

1 using SECA digital weighing scale and stadiometer (9). Accuracy of weighing scale and

2 stadiometer were checked using standard weight and height at the beginning of every data

3 collection session and after every five students' measurements. Data were entered in Epi-data

4 3.1. Anthropometric calculation was done using WHO Anthro Plus software version 1.0.4

5 (10). The statistical analysis was done using Statistical Package for Social Science (SPSS)

6 software version 21. Bivariate and multivariate binary logistic regression analyses were done

7 to find out the association between dependent (overweight) and independent (risk-factors)

8 variables. Initially in bivariate analysis, single variable at a time was entered; unadjusted odds

9 ratio (OR) and 95 percent confidence interval (CI) were computed for all independent

10 variables. Multicollinearity was checked among the variables and there was no significant

11 collinearity (VIF 1-2). Then in multivariate analysis all independent variable were entered at

12 same time to adjust the effect of confounding, and adjusted OR and 95% CI were computed.

13 Hosmer and Lemeshow test was done to test the goodness-of-fit for multivariate logistic

14 regression model and model was found to be good/fit (p-value > 0.05).

15

16 *Variables*

17 Adolescent whose BMI-for-age was above plus one standard deviations (+1SD) from the

18 median of the WHO reference population were classified as overweight (11). Age was

19 calculated by subtracting the date of birth, which was mentioned by the students, from date of

20 data collection. Ethnicities of students were dichotomies into advantaged group (includes

21 advantaged janajatis and upper caste) and relatively disadvantaged group (includes dalits,

22 disadvantaged janajatis, disadvantaged non-dalit terai people and religious minorities). For

23 socio-economic status, wealth index was computed using Principal Component Analysis

24 (PCA) considering the assets holdings of the participants; and tertiles were generated namely

25 low (poor), middle and high (rich). The components included in wealth index were ownership

1   of house, vehicles, animals, electronic goods (refrigerator, radio, TV, computer, fan),

2   furniture (sofa, bed, cupboard, table, chair), mobile phone, telephone, housing characteristics

3   and type of fuel for cooking.

4

5   **Ethical consideration**

6   The study was approved by the Institutional Review Board of Institute of Medicine,

7   Tribhuvan University, Kathmandu, Nepal. Informed written consent was obtained from the

8   sampled school authorities and participants. Confidentiality of information was assured and

9   insured throughout the study. Information about nutritional problems (underweight,

10   overweight and micronutrients deficiency) focusing the causes, health consequences, and

11   prevention was given to the students.

12

13   # Results

14   The prevalence of overweight was 12.2% (95%CI: 8.9-15.5). Table 1 shows the general

15   characteristics of adolescent students. The mean age, weight, height and BMI of the

16   participants were 16.98 years (95%CI: 16.88-17.08), 52.53 Kg (95%CI: 51.57-53.50), 159.90

17   cm (95%CI: 158.99-160.80), and 20.52 Kg/m^2 (95%CI: 20.20-20.83) respectively. Bivariate

18   analysis showed that six factors were independently associated with overweight in adolescent

19   (Table 2). In multivariate analysis being male, studying in private school, high socio-

20   economic status, watching TV more than 2hours/day, and consuming fruits ≤4 times per

21   week were significantly statistically associated with overweight. Whilst age, ethnicity,

22   mother's educational level, mother's occupation, family type and number of siblings were not

23   significantly statistically associated with overweight (Table 2).

24

1   Male students were nearly three times more likely to be overweight than females (AOR=2.64,

2   95% CI: 1.18-4.88). Likewise, students studying in private schools were nearly two times

3   more likely to be overweight than the students studying in government schools (AOR=2.10,

4   95% CI: 1.03-4.28). Similarly, the students from rich families were five times more likely to

5   be overweight than students from poor families (AOR=4.77, 95%CI: 1.36-16.72). Students

6   who spent more than 2hours per day in watching TV were nearly nine times more likely to be

7   overweight than the students who spent less than 2hours per day (AOR=8.86, 95% CI: 3.90-

8   20.11). Students who consumed fruits ≤4 times a week were three times more likely to be

9   overweight than student who consumed >4 times/week (AOR=3.13, CI: 1.39-7.01). (Table 2)

10

11   ## Discussion

12   The study data suggests that being male, studying in a private school, belonging to high

13   socio-economic status family, watching TV for more than 2 hours/day, consuming fruits ≤4

14   times per week were potential risk factors of overweight among Nepalese adolescent

15   students. In this study, prevalence of overweight among adolescents was found to be 12.2%,

16   which is lower than the reported by studies from Pakistan, India and China (12-15). This

17   finding is higher than the study conducted in Kaski district of Nepal (8). The males were

18   nearly three times more likely to be overweight than females. The finding is consistent with

19   the studies from Pakistan, India and China, which reported high prevalence in males than

20   females (12-19).

21

22   This study showed adolescents studying in private schools were twice more likely to be

23   overweight than adolescents studying in government schools. The finding is consistent with

24   the studies conducted in India (14, 17). In this study, overweight among adolescents was

25   found to be significantly associated with the socio-economic status. The students from higher

1 socio-economic background families were nearly five times more likely to be overweight

2 than students from poor families. The finding is compatible with the findings of studies done

3 in India (13, 16-18, 20). The students from higher socio-economic background families have

4 more purchasing power for calorie dense fast foods.

5

6 This study found that students who spent more than 2hours per day in watching TV were

7 nearly nine times more likely to be overweight than the students who spent less than

8 2hours/day. Watching TV could be contributing to overweight in many ways like (a) increase

9 sedentary behavior and decrease physically activity (b) increase snacking while watching (c)

10 disturb normal sleeping pattern (d) cause unhealthy eating pattern from advertisements of

11 junk/fast foods (4, 21-23). A study conducted in Nepal showed that $1/4^{th}$ advertisements

12 appeared on selected Nepali and Indian TV channels were related to junk foods and most

13 these of advertisements were targeted the children (24). A study conducted among adolescent

14 girls in Sri-Lanka showed that risk of overweight was three times higher among those who

15 had screen time >2 hours/day (25). Another study done in India among adolescent reported

16 the risk of overweight was seven times higher who had screen time >4hours/day (20).

17

18 Fruits and vegetables are important part of a healthy diet, their adequate daily consumption

19 could help loose weight and prevent many non-communicable diseases (26). In this study,

20 students who consumed fruits ≤4 times a week were three times more likely to be overweight

21 than student who consumed >4 times/week. A study among Pakistani adolescents showed

22 that students who consumed fruits ≥4 a week were less likely to be obese than those who

23 consumed <4 times a week (12). Another study conducted among adolescent girls in Sri-

24 Lanka showed that risk of overweight was two times higher among those who consumed

25 fruits <4 days per week (25).

10

1

Conclusion

3   The study provides evidence of high prevalence of overweight among adolescents living in

4   the urban area of Nepal. Socioeconomic status, watching TV for a long period of time, and

5   consuming less fruits are major risk factors of overweight among adolescents in Nepal.

6   Policies and programs not limited to Ministry of Health and Population but also Ministry of

7   Education and Ministry of Youth and Sports are needed to address the fast growing problem

8   appropriately and timely manner. An enabling environment is paramount important to

9   increase the awareness about the risk factors of adolescence overweight to decrease

10   prevalence of overweight-associated non-communicable diseases for coming generation of

11   Nepal.

12

11

1　　**Abbreviations**

2　　AOR　　　　　Adjusted Odd's Ratio

3　　BMI　　　　　Body Mass Index

4　　CI　　　　　　Confidence Interval

5　　NCDs　　　　Non-Communicable Diseases

6　　OR　　　　　Odd's Ratio

7　　PCA　　　　　Principal Component Analysis

8　　SD　　　　　Standard Deviation

9　　SPSS　　　　Statistical Package for Social Science

10　TV　　　　　Television

11　VIF　　　　　Variance inflation factor

12　WHO　　　　World Health Organization

13

1 **Competing interests**

2 The authors declare that they have no competing interests.

3 **Authors' contributions**

4 SP was involved in conceptualizing the study, reviewing the literature, designing protocol,

5 developing questionnaire, data collection, analysis and preparing the manuscript. AKP

6 supported in statistical analyses, interpretation of data and critically reviewed the manuscript.

7 KPB, BP, RMP helped in conceptualizing the study and critically reviewed the manuscript.

8 All authors read and approved the final manuscript.

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11 their help in data collection. We would to like to thank all schools authorities and students

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24 **Data sharing statement:** No additional data are available.

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1 **Table 1: General characteristics of sampled adolescent students**

Characteristics	Frequency	Percentage
Age		0.408
16-17 years	268	74.4
18-19 years	92	25.6
Mean (±SD)	16.98 (±0.98)	
Sex		
Female	190	52.8
Male	170	47.2
Ethnicity		
Advantaged	235	65.3
Relatively disadvantaged	125	34.7
School type		
Private	180	50
Government	180	50
Mother's educational level		
Formal education	226	62.8
No formal education	134	37.2
Mother's occupation		
Working outside home also/ Employed/non-housewife	185	51.4
Unemployed/housewife	175	48.6
Family type		
Nuclear	244	67.8
Extended/joint	116	32.2
No. of siblings		
Up to 2	264	73.3
More than 2	96	26.7
Socio-economic status		
Rich	120	33.3
Middle class	120	33.3
Poor	120	33.3
Watching TV		
≤ 2 hours/day	281	78.1
> 2 hours/day	79	21.9
Fruits consumption		
≤ 4 times/week	184	51.1
> 4times/week	176	48.9

2

16

Table 2. Determinants of overweight among adolescent students, Nepal

Characteristics	Overweight (n=44) No. (%)	No Overweight (n=316) No. (%)	Unadjusted OR (95%CI)	p-value	Adjusted OR (95%CI)	p-value
Age						
16-17 years	35 (13.1)	233 (86.9)	1.38 (0.64-3.00)	0.409	1.05 (0.37-2.94)	0.927
18-19 years	09 (09.8)	83 (90.2)	1		1	
Sex						
Male	27 (15.9)	143 (84.1)	1.92 (1.00-3.67)	**0.048***	2.64 (1.18-4.88)	**0.018***
Female	17 (08.9)	173 (91.1)	1		1	
Ethnicity						
Advantaged	32 (13.6)	203 (86.4)	1.48 (0.74-3.00)	0.270	1.38 (0.57-3.31)	0.476
Relatively disadvantaged	12 (09.6)	113 (90.4)	1		1	
School type						
Private	29 (16.1)	151 (83.9)	2.11 (1.09-4.09)	**0.027***	2.10 (1.03-4.28)	**0.042***
Government	15 (08.3)	165 (91.7)	1		1	
Mother's educational level						
Formal education	32 (14.2)	194 (85.8)	0.60 (0.30-1.20)	0.148	0.85 (0.32-2.22)	0.732
No formal education	12 (09.0)	122 (91.0)	1		1	
Mother's occupation						
Working outside home also/ Employed/ non-housewife	27 (14.6)	158 (85.4)	1.18 (0.54-2.60)	0.673	1.18 (0.54-2.60)	0.673
Unemployed/housewife	17 (09.7)	158 (90.3)	1		1	
Family type						
Nuclear	34 (13.9)	210 (86.1)	1.72 (0.82-3.61)	0.154	1.41 (0.59-3.39)	0.445
Extended/joint	10 (08.6)	106 (91.4)	1		1	
No. of siblings						
Up to 2	39 (14.8)	225 (85.2)	3.15 (1.20-8.26)	**0.019***	1.85 (0.61-5.61)	0.097
More than 2	05 (05.2)	91 (94.8)	1		1	
Socio-economic status						
High (Rich)	28 (23.3)	92 (76.7)	4.26 (1.85-9.80)	**0.001***	4.77 (1.36-16.72)	**0.018***

Middle	08 (06.7)	112 (93.3)	1.00 (0.36-2.76)	1.000	0.93 (0.27-3.18)	0.912
Low (Poor)	08 (06.7)	112 (93.3)	1		1	
Watching TV						
> 2 hours/day	26 (32.9)	53 (67.1)	7.17 (3.67-14.00)	**0.000***	8.86 (3.90-20.11)	**0.000***
≤ 2 hours/day	18 (06.4)	263 (93.6)	1		1	
Fruits consumption						
≤ 4 times/week	31 (16.8)	153 (83.2)	2.54 (1.28-5.04)	**0.008***	3.13 (1.39-7.01)	**0.006***
> 4times/week	13 (07.4)	163 (92.6)	1		1	

Note: Adjusted for age, sex, ethnicity, type of school, mother's educational level, mother's occupation, family type, number of siblings, socio-economic status, watching TV and fruits consumption.

*p-value <0.05

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1 # ABSTRACT

2 **Objectives**

3 The prevalence of non-communicable diseases is increasing in Nepal. Overweight and

4 obesity are the major risk factors of many non-communicable diseases. Adolescence is a

5 critical phase for development of overweight and obesity. Risk factors associated with

6 overweight and obesity are not well understood in Nepal. The objective of the study was to

7 identify the factors associated with overweight and obesity among adolescent students.

8

9 **Setting**

10 A cross-sectional descriptive study was carried out in the Lalitpur sub-metropolitan city,

11 Nepal among higher secondary school students.

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13 **Participants**

14 A random sample of 360 students of the age–group 16 to 19 years from eight schools were

15 included in the study.

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17 **Results**

18 The prevalence of overweight among adolescent students was 12.2% (CI: 8.9-15.5). Being

19 male (AOR=2.64, 95% CI: 1.18-4.88), studying in private school (AOR=2.10, 95% CI: 1.03-

20 4.28), high socio-economic status family (AOR=4.77, 95% CI: 1.36-16.72), watching TV for

21 more than 2 hours/day (AOR=8.86, 95% CI: 3.90-20.11), consuming fruits ≤ 4 times/week

22 (AOR=3.13, 95%CI: 1.39-7.01) were more likely to be overweight. There was no statistically

23 significant association between adolescence overweight and age, ethnicity, mother's

24 education level, mother's occupation, number of siblings or family type.

25

Conclusions

Socioeconomic status, watching TV for longer time, and consuming less fruits are major risk factors of overweight among adolescents in Nepal. Interventions are needed to increase the awareness about the risk factors of adolescence overweight and obesity to decrease prevalence of overweight-associated non-communicable diseases.

Keywords

Adolescent, overweight, risk factors, cross-sectional study, Nepal

Strengths and limitations of the study

- This study is among a few studies conducted in Nepal, which analyzed risk factors associated with overweight among urban adolescent students.

- Schools and participants of the study have been selected randomly, which increases the strength of the study.

- This study was conducted in eight schools in Lalitpur sub metropolitan city. So, the risk factors that identified may not be representative of every urban city in Nepal.

- The study findings are based on self-report of the students because of which findings are likely to suffer from over-reporting and recall bias.

- Cross-sectional nature of the study limits drawing inferences about causation.

4

1 **Introduction**

2 Today overweight and obesity are the major public health problems worldwide. Although

3 once considered a major problem in affluent countries, overweight and obesity are now on

4 the rise even in low and middle-income nations like Nepal (1). This may be due to ongoing

5 urbanization and economic transitions (subsistence to market) in Nepal. Nepal is urbanizing

6 at faster pace, its urban population has increased to 17% of the total population in 2011 from

7 13.9% in 2001 (2). The inercensal urban population growth rate is 3.38% where rural and

8 total population growth rates are 1.03 and 1.4 in 2011(2). Economic transition and

9 urbanization process precipitates greatly increased levels of lifestyle-related risk factors like

10 low physical activities and dietary habits changes (3). Prevalence and risk of overweight and

11 obesity during childhood and adolescence are increasing at greater pace in developing nations

12 rather than in developed ones (1). Overweight and obesity are the major risk factors of non-

13 communicable diseases (NCDs) such as diabetes, osteoarthritis and cardiovascular diseases.

14 WHO estimates that, NCDs cause 68% of deaths globally and nearly three quarters of all

15 NCDs deaths occur in low and middle-income countries (4).

16

17 Adolescence is a critical phase for the development of obesity due to various biological,

18 psychological, social and environmental changes (5, 6). Adolescence overweight and obesity

19 may persist into adulthood. A prospective longitudinal study showed that the 56% males and

20 42% females who were overweight in adolescence remained overweight in adulthood

21 whereas 47% males and 55% females who were obese in adolescence remained obese in

22 adulthood (7). Adolescence overweight and obesity may increase the risk for development of

23 non-communicable diseases at a younger age and consequently a premature death. In addition

24 to future health risks, overweight and obese adolescent also suffer from short-term health

5

1   consequences (1). In addition, their participation in school and other daily activities also limit

2   depending on the degree of obesity.

3

4   In Nepal, nearly one-quarter of the population (24%) comprise of adolescents (8). NCDs

5   account 60% of all deaths in Nepal and 23% caused by cardiovascular diseases (9). A

6   national survey conducted in Nepal in 2013 reported the prevalence of overweight among

7   Nepalese people (15-69 years age) to be 17.7% (10). Limited research has been done as yet

8   on the prevalence and factors associated with overweight among Nepalese adolescents (11).

9   This study was an attempt to fill the information and knowledge gap in this area and potential

10   use of it will be for designing policy and program to appropriately address problem in timely

11   manner.

12

13   **Methods**

14   ***Study area***

15   This study was conducted in Lalitpur sub-metropolitan city, one of the major cities in Nepal.

16   It is adjacent to the capital city Kathmandu and is located in the southeast part of Kathmandu

17   valley. It is growing at faster pace and density of schools in Kathmandu valley is the highest

18   in this city.

19

20   ***Study design and Selection of participants***

21   A cross sectional study was conducted during October to November 2014. Multistage random

22   sampling method was used to select the participants. The study area Lalitpur sub-

23   metropolitan city was purposively selected. A list of affiliated Higher Secondary Schools

24   (HSS) to Higher Secondary Education Board (HSEB) of Nepal was downloaded from HSEB

25   website. There were 52 schools in the sampling frame (13 government and 39 privates) in

1 this study. Two separate lists of private and government schools were prepared. Out of 52

2 schools, eight schools (4 government and 4 private) were randomly were chosen through

3 lottery method. And from each selected school one of the grades 11 or 12 was randomly

4 selected. All students of the selected grade were included in the study. A total of 381 students

5 filled the self-administered questionnaire, 21 questionnaires were discarded during data

6 analysis (eight questionnaires were incompletely filled, two students were physically disabled

7 and 11 students found to be above 19 years age), therefore only 360 students' response and

8 anthropometric measurements were included in the study.

9

10 ***Data collection and statistical analysis***

11 Data were collected using self-administered, pre-tested and structured questionnaire.

12 Anthropometric measurements (height and weight) were obtained as per WHO guidelines

13 using SECA digital weighing scale and stadiometer (12). Accuracy of weighing scale and

14 stadiometer were checked using standard weight and height at the beginning of every data

15 collection session and after every five students' measurements. Data were entered in Epi-data

16 3.1. Anthropometric calculation was done using WHO Anthro Plus software version 1.0.4

17 (13). The statistical analysis was done using Statistical Package for Social Science (SPSS)

18 software version 21. Bivariate and multivariate binary logistic regression analyses were done

19 to find out the association between dependent (overweight) and independent (risk-factors)

20 variables. Initially in bivariate analysis, single variable at a time was entered; unadjusted odds

21 ratio (OR) and 95 percent confidence interval (CI) were computed for all independent

22 variables. Multicollinearity was checked among the variables and there was no significant

23 collinearity (VIF 1-2). Then in multivariate analysis all independent variable were entered at

24 same time to adjust the effect of confounding, and adjusted OR and 95% CI were computed.

1 Hosmer and Lemeshow test was done to test the goodness-of-fit for multivariate logistic

2 regression model and model was found to be good/fit (p-value > 0.05).

3

4 ***Variables***

5 Adolescent whose BMI-for-age was above plus one standard deviations (+1SD) from the

6 median of the WHO reference population were classified as overweight (14). Age was

7 calculated by subtracting the date of birth, which was mentioned by the students, from date of

8 data collection. Ethnicities of students were dichotomies into advantaged group (includes

9 advantaged janajatis and upper caste) and relatively disadvantaged group (includes dalits,

10 disadvantaged janajatis, disadvantaged non-dalit terai people and religious minorities). For

11 socio-economic status, a wealth index was computed using Principal Component Analysis

12 (PCA) considering the assets holdings of the participants; and tertiles were generated namely

13 low (poor), middle and high (rich). The components included in wealth index were ownership

14 of house, vehicles, animals, electronic goods (refrigerator, radio, TV, computer, fan),

15 furniture (sofa, bed, cupboard, table, chair), mobile phone, telephone, housing characteristics

16 and type of fuel for cooking. Number of times fruits consumed by the students during last one

17 week were dichotomies into ≤ 4 times/week and > 4times/week. On an average numbers of

18 hours per day students watched TV were dichotomies into > 2 hours/day and ≤ 2 hours/day.

19

20 ***Questionnaire***

21 A structured questionnaire was developed based on study objectives. For wealth index, a

22 validated Nepal demographic and health survey 2011 (NDHS) questionnaire measure was

23 used (15). For fruits consumptions, a list of locally available (market and locally grown)

24 fruits in the study season was developed and students were asked to tick number of times

25 they had consumed the particular fruit during last one week. For watching TV, students were

1   asked to tick the average numbers of hours per day they watched the TV during last one

2   week. For validity of the questionnaire, a piloting study was done in one non-sampled school.

3

4   **Ethical consideration**

5   The study was approved by the Institutional Review Board of Institute of Medicine,

6   Tribhuvan University, Kathmandu, Nepal. Informed written consent was obtained from the

7   sampled school authorities and participants. Confidentiality of information was assured and

8   insured throughout the study. Information about nutritional problems (underweight,

9   overweight and micronutrients deficiency) focusing the causes, health consequences, and

10 prevention was given to the students.

11

12 # Results

13 The prevalence of overweight was 12.2% (95%CI: 8.9-15.5). Table 1 shows the general

14 characteristics of adolescent students. The mean age, weight, height and BMI of the

15 participants were 16.98 years (95%CI: 16.88-17.08), 52.5 Kg (95%CI: 51.5-53.5), 159.9 cm

16 (95%CI: 159.0-160.8), and 20.5 Kg/m^2 (95%CI: 20.2-20.8) respectively. Bivariate analysis

17 showed that six factors were independently associated with overweight in adolescent (Table

18 2). In multivariate analysis being male, studying in private school, high socio-economic

19 status, watching TV more than 2hours/day, and consuming fruits ≤4 times per week were

20 significantly statistically associated with overweight. Whilst age, ethnicity, mother's

21 educational level, mother's occupation, family type and number of siblings were not

22 significantly statistically associated with overweight (Table 2). Separate analyses in males

23 and females were performed. In males, school type, socio-economic status, watching TV

24 more than 2hours/day and consuming fruits ≤4 times per week were significantly statistically

25 associated with overweight (see supplementary Table 1 & Table 2). In females, socio-

1 economic status, watching TV more than 2hours/day and consuming fruits ≤4 times per week

2 were significantly statistically associated with overweight (see supplementary Table 1 &

3 Table 2).

4

5 Male students were 2.64 times more likely to be overweight than females (AOR=2.64, 95%

6 CI: 1.18-4.88). Likewise, students studying in private schools were 2.1 times more likely to

7 be overweight than the students studying in government schools (AOR=2.10, 95% CI: 1.03-

8 4.28). Similarly, the students from rich families were 4.77 times more likely to be overweight

9 than students from poor families (AOR=4.77, 95%CI: 1.36-16.72). Students who spent more

10 than 2hours per day in watching TV were 8.86 times more likely to be overweight than the

11 students who spent less than 2hours per day (AOR=8.86, 95% CI: 3.90-20.11). Students who

12 consumed fruits ≤4 times a week were 3.13 times more likely to be overweight than student

13 who consumed >4 times/week (AOR=3.13, CI: 1.39-7.01). (Table 2)

14

Discussion

16 The study data suggests that being male, studying in a private school, belonging to high

17 socio-economic status family, watching TV for more than 2 hours/day, consuming fruits ≤4

18 times per week were potential risk factors of overweight among Nepalese adolescent

19 students. In this study, prevalence of overweight among adolescents was found to be 12.2%,

20 which is lower than the reported by studies from Pakistan, India and China (16-19). This

21 finding is higher than the study conducted in Kaski district of Nepal (11). The males were

22 nearly three times more likely to be overweight than females. The finding is consistent with

23 the studies from Pakistan, India and China, which reported high prevalence in males than

24 females (16-23).

25

1 This study showed adolescents studying in private schools were twice more likely to be

2 overweight than adolescents studying in government schools. The finding is consistent with

3 the studies conducted in India (18, 21). In this study, overweight among adolescents was

4 found to be significantly associated with the socio-economic status. The students from higher

5 socio-economic background families were nearly five times more likely to be overweight

6 than students from poor families. The finding is compatible with the findings of studies done

7 in India (17, 20-22, 24). The students from higher socio-economic background families have

8 more purchasing power for calorie dense fast foods.

9

10 This study found that students who spent more than 2hours per day in watching TV were

11 nearly nine times more likely to be overweight than the students who spent less than

12 2hours/day. Watching TV could be contributing to overweight in many ways like (a) increase

13 sedentary behavior and decrease physically activity (b) increase snacking while watching (c)

14 disturb normal sleeping pattern (d) cause unhealthy eating pattern from advertisements of

15 junk/fast foods (6, 25-27). A study conducted in Nepal showed that $1/4^{th}$ advertisements

16 appeared on selected Nepali and Indian TV channels were related to junk foods and most

17 these of advertisements were targeted the children (28). A study conducted among adolescent

18 girls in Sri-Lanka showed that risk of overweight was three times higher among those who

19 had screen time >2 hours/day (29). Another study done in India among adolescent reported

20 the risk of overweight was seven times higher who had screen time >4hours/day (24).

21

22 Fruits and vegetables are important part of a healthy diet, their adequate daily consumption

23 could help lose weight and prevent many non-communicable diseases (30). In this study,

24 students who consumed fruits ≤4 times a week were three times more likely to be overweight

25 than student who consumed >4 times/week. A study among Pakistani adolescents showed

1   that students who consumed fruits ≥4 a week were less likely to be obese than those who

2   consumed <4 times a week (16). Another study conducted among adolescent girls in Sri-

3   Lanka showed that risk of overweight was two times higher among those who consumed

4   fruits <4 days per week (29).

5

6

Strengths and limitations of the study

8   • This study is among a few studies conducted in Nepal, which analyzed risk factors

9   associated with overweight among urban adolescent students.

10 • Schools and participants of the study have been selected randomly, which increases the

11   strength of the study.

12 • This study was conducted in eight schools in Lalitpur sub metropolitan city. So, the risk

13   factors that identified may not be representative of every urban city in Nepal.

14 • The study findings are based on self-report of the students because of which findings are

15   likely to suffer from over-reporting and recall bias.

16 • Cross-sectional nature of the study limits drawing inferences about causation.

17

Conclusion

19 The study provides evidence of high prevalence of overweight among adolescents living in

20 the urban area of Nepal. Socioeconomic status, watching TV for a long period of time, and

21 consuming less fruits are major risk factors of overweight among adolescents in Nepal.

22 Policies and programs not limited to Ministry of Health and Population but also Ministry of

23 Education and Ministry of Youth and Sports are needed to address the fast growing problem

24 appropriately and timely manner. An enabling environment is paramount important to

12

1 increase the awareness about the risk factors of adolescence overweight to decrease

2 prevalence of overweight-associated non-communicable diseases for coming generation of

3 Nepal.

4

13

1 **Abbreviations**

2 AOR 　　　　Adjusted Odd's Ratio

3 BMI 　　　　Body Mass Index

4 CI 　　　　　Confidence Interval

5 NCDs 　　　Non-Communicable Diseases

6 OR 　　　　Odd's Ratio

7 PCA 　　　　Principal Component Analysis

8 SD 　　　　　Standard Deviation

9 SPSS 　　　Statistical Package for Social Science

10 TV 　　　　　Television

11 VIF 　　　　Variance inflation factor

12 WHO 　　　World Health Organization

13

1 **Competing interests**

2 The authors declare that they have no competing interests.

3 **Authors' contributions**

4 SP was involved in conceptualizing the study, reviewing the literature, designing protocol,

5 developing questionnaire, data collection, analysis and preparing the manuscript. AKP

6 supported in statistical analyses, interpretation of data and critically reviewed the manuscript.

7 KPB, BP, RMP helped in conceptualizing the study and critically reviewed the manuscript.

8 All authors read and approved the final manuscript.

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24 **Data sharing statement:** No additional data are available.

25

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1 **Table 1: General characteristics of sampled adolescent students**

Characteristics	Frequency	Percentage
Age		
16-17 years	268	74.4
18-19 years	92	25.6
Mean (±SD)	16.98 (±0.98)	
Sex		
Female	190	52.8
Male	170	47.2
Ethnicity		
Advantaged	235	65.3
Relatively disadvantaged	125	34.7
School type		
Private	180	50
Government	180	50
Mother's educational level		
Formal education	226	62.8
No formal education	134	37.2
Mother's occupation		
Working outside home also/ Employed/non-housewife	185	51.4
Unemployed/housewife	175	48.6
Family type		
Nuclear	244	67.8
Extended/joint	116	32.2
No. of siblings		
Up to 2	264	73.3
More than 2	96	26.7
Socio-economic status[*]		
Rich	120	33.3
Middle class	120	33.3
Poor	120	33.3
Watching TV		
≤ 2 hours/day	281	78.1
> 2 hours/day	79	21.9
Fruits consumption		
≤ 4 times/week	184	51.1
> 4times/week	176	48.9

2 [*] Wealth index was computed using PCA, and the components included in wealth index were
3 ownership of house, vehicles, animals, electronic goods (refrigerator, radio, TV, computer,
4 fan), furniture (sofa, bed, cupboard, table, chair), mobile phone, telephone, housing
5 characteristics and type of fuel for cooking.
6

18

Table 2. Risk factors of the overweight among adolescent students, Nepal

Characteristics	Overweight (n=44) No. (%)	No Overweight (n=316) No. (%)	Unadjusted OR (95%CI)	p-value	Adjusted OR (95%CI)	p-value
Age						
16-17 years	35 (13.1)	233 (86.9)	1.38 (0.64-3.00)	0.409	1.05 (0.37-2.94)	0.927
18-19 years	9 (9.8)	83 (90.2)	1		1	
Sex						
Male	27 (15.9)	143 (84.1)	1.92 (1.00-3.67)	**0.048***	2.64 (1.18-4.88)	**0.018***
Female	17 (8.9)	173 (91.1)	1		1	
Ethnicity						
Advantaged	32 (13.6)	203 (86.4)	1.48 (0.74-3.00)	0.271	1.38 (0.57-3.31)	0.476
Relatively disadvantaged	12 (9.6)	113 (90.4)	1		1	
School type						
Private	29 (16.1)	151 (83.9)	2.11 (1.09-4.09)	**0.027***	2.10 (1.03-4.28)	**0.042***
Government	15 (8.3)	165 (91.7)	1		1	
Mother's educational level						
Formal education	32 (14.2)	194 (85.8)	1.67 (0.30-1.20)	0.148	0.85 (0.32-2.22)	0.732
No formal education	12 (9.0)	122 (91.0)	1		1	
Mother's occupation						
Working outside home also/ Employed/ non-housewife	27 (14.6)	158 (85.4)	1.59 (0.83-3.03)	0.673	1.18 (0.54-2.60)	0.673
Unemployed/housewife	17 (9.7)	158 (90.3)	1		1	
Family type						
Nuclear	34 (13.9)	210 (86.1)	1.72 (0.82-3.61)	0.154	1.41 (0.59-3.39)	0.445
Extended/joint	10 (8.6)	106 (91.4)	1		1	
No. of siblings						
Up to 2	39 (14.8)	225 (85.2)	3.15 (1.20-8.26)	**0.019***	1.85 (0.61-5.61)	0.097
More than 2	5 (5.2)	91 (94.8)	1		1	
Socio-economic status						
High (Rich)	28 (23.3)	92 (76.7)	4.26 (1.85-9.80)	**<0.001***	4.77 (1.36-16.72)	**0.018***

19

Middle	8 (6.7)	112 (93.3)	1.00 (0.36-2.76)	1.00	0.93 (0.27-3.18)	0.912
Low (Poor)	8 (6.7)	112 (93.3)	1		1	
Watching TV						
> 2 hours/day	26 (32.9)	53 (67.1)	7.17 (3.67-14.00)	**<0.001***	8.86 (3.90-20.11)	**<0.001***
≤ 2 hours/day	18 (6.4)	263 (93.6)	1		1	
Fruits consumption						
≤ 4 times/week	31 (16.8)	153 (83.2)	2.54 (1.28-5.04)	**0.008***	3.13 (1.39-7.01)	**0.006***
> 4times/week	13 (7.4)	163 (92.6)	1		1	

Note: Adjusted for age, sex, ethnicity, type of school, mother's educational level, mother's occupation, family type, number of siblings, socio-economic status, watching TV and fruits consumption.

*p-value <0.05

Separate analysis in male and female

Supplement Table 1: General characteristics of sampled adolescent students

Characteristics	Both Sexes		Male (n=170)		Female (n=190)	
	Overweight (n=44) No. (%)	No Overweight (n=316) No. (%)	Overweight (n=27) No. (%)	No Overweight (n=143) No. (%)	Overweight (n=17) No. (%)	No Overweight (173) No. (%)
Age						
16-17 years	35 (13.1)	233 (86.9)	24 (18.2)	108 (81.8)	11 (8.1)	125 (91.9)
18-19 years	9 (9.8)	83 (90.2)	3 (7.9)	35 (92.1)	6 (11.1)	48 (88.9)
Ethnicity						
Advantaged	32 (13.6)	203 (86.4)	22 (19.6)	90 (80.4)	10 (8.1)	113 (91.9)
Relatively disadvantaged	12 (9.6)	113 (90.4)	5 (8.6)	53 (91.4)	7 (10.4)	60 (89.6)
School type						
Private	29 (16.1)	151 (83.9)	21 (20.2)	83 (79.8)	8 (10.5)	68 (89.5)
Government	15 (8.3)	165 (91.7)	6 (9.1)	60 (90.9)	9 (7.9)	105 (92.1)
Mother's educational level						
Formal education	32 (14.2)	194 (85.8)	21 (18.4)	93 (81.6)	11 (9.8)	101 (90.2)
No formal education	12 (9.0)	122 (91.0)	6 (10.7)	50 (89.3)	6 (7.7)	72 (92.3)
Mother's occupation						
Working outside home also/ Employed/ non-housewife	27 (14.6)	158 (85.4)	19 (18.8)	82 (81.2)	8 (9.5)	76 (90.5)
Unemployed/housewife	17 (9.7)	158 (90.3)	8 (11.6)	61 (88.4)	9 (8.5)	97 (91.5)
Family type						
Nuclear	34 (13.9)	210 (86.1)	21 (19.3)	88 (80.7)	17 (8.9)	173 (91.1)
Extended/joint	10 (8.6)	106 (91.4)	6 (9.8)	55 (90.2)	4 (7.3)	51 (92.7)
No. of siblings						
Up to 2	39 (14.8)	225 (85.2)	24 (19.5)	99 (80.5)	15 (10.6)	126 (89.4)
More than 2	5 (5.2)	91 (94.8)	3 (6.4)	44 (93.6)	2 (4.1)	47 (95.9)
Socio-economic status						
High (Rich)	28 (23.3)	92 (76.7)	18 (32.1)	38 (67.9)	10 (15.6)	54 (84.4)

Middle	8 (6.7)	112 (93.3)	5 (8.3)	55 (91.7)	3 (5.0)	57 (95.0)
Low (Poor)	8 (6.7)	112 (93.3)	4 (7.4)	50 (90.6)	4 (6.1)	62 (93.9)
Watching TV						
> 2 hours/day	26 (32.9)	53 (67.1)	14 (41.2)	20 (58.8)	12 (26.7)	33 (73.3)
≤ 2 hours/day	18 (6.4)	263 (93.6)	13 (9.6)	123 (90.4)	5 (3.4)	140 (96.6)
Fruits consumption						
≤ 4 times/week	31 (16.8)	153 (83.2)	20 (20.6)	77 (79.4)	11 (12.6)	76 (87.4)
> 4times/week	13 (7.4)	163 (92.6)	7 (9.6)	66 (90.4)	6 (5.8)	97 (94.2)

SES: wealth index was computed using PCA, and the components included in wealth index were ownership of house, vehicles, animals, electronic goods (refrigerator, radio, TV, computer, fan), furniture (sofa, bed, cupboard, table, chair), mobile phone, telephone, housing characteristics and type of fuel for cooking.

Supplement Table 2. Risk factors of overweight among adolescent students, Nepal

Characteristics	Both sexes				Male				Female			
	Unadjusted OR (95%CI)	p-value	Adjusted OR (95%CI)	p-value	Unadjusted OR (95%CI)	p-value	Adjusted OR (95%CI)	p-value	Unadjusted OR (95%CI)	p-value	Adjusted OR (95%CI)	p-value
Age												
16-17 years	1.4 (0.6-3.0)	0.409	1.1 (0.4-2.9)	0.927	2.6 (0.7-9.1)	0.14	1.8 (0.4-8.7)	0.47	0.7 (0.3-2.0)	0.51	0.9 (0.2-3.8)	0.86
18-19 years	1		1		1		1		1		1	
Sex												
Male	1.9 (1.0-3.7)	**0.048***	2.6 (1.2-4.9)	**0.018***	NA		**NA**		NA		**NA**	
Female	1		1									
Ethnicity												
Advantaged	1.5 (0.7-3.0)	0.271	1.4 (0.6-3.3)	0.476	2.6 (0.9-7.2)	0.07	3.0 (0.8-11.0)	0.10	0.8 (0.3-2.1)	0.59	0.5 (0.1-2.1)	0.37
Relatively disadvantaged	1		1		1		1		1		1	
School type												
Private	2.1 (1.1-4.1)	**0.027***	2.1 (1.0-4.3)	**0.042***	2.5 (0.96-6.64)	0.06	2.1 (1.0-4.6)	**0.046**	1.4 (0.5-3.7)	0.54	0.7 (0.1-4.0)	0.69
Government	1		1		1		1		1		1	
Mother's Education												
Formal education	1.7 (0.3-1.2)	0.148	0.9 (0.3-2.2)	0.732	1.9 (0.7-5.0)	0.20	1.4 (0.4-5.2)	0.64	1.3 (0.5-3.7)	0.61	0.7 (0.1-3.1)	0.62
No formal education	1		1		1				1		1	
Mother's occupation												
Working outside home also/ Employed/ non-housewife	1.6 (0.8-3.0)	0.673	1.2 (0.5-2.6)	0.673	1.8 (0.7-4.3)	0.21	2.1 (0.7-6.1)	0.18	1.1 (0.4-3.1)	0.80	0.7 (0.2-2.5)	0.63
Unemployed/housewife	1		1		1		1		1		1	
Family type												

Nuclear	1.7 (0.8-3.6)	0.154	1.4 (0.6-3.4)	0.445	2.2 (0.8-5.8)	0.11	2.8 (0.9-8.5)	0.069	1.4 (0.4-4.4)	0.61	1.1 (0.3-4.7)	0.86
Extended/joint	1		1		1		1		1		1	
No. of siblings												
Up to 2	3.2 (1.2-8.3)	**0.019***	1.8 (0.6-5.6)	0.097	3.5 (1.01-12.4)	**0.047**	1.7 (0.4-7.3)	0.47	2.8 (0.6-12.7)	0.18	2.0 (0.3-11.7)	0.43
More than 2	1		1		1		1		1		1	
Socio-economic status												
High (Rich)	4.3 (1.9-9.8)	**<0.001***	4.8 (1.4-16.7)	**0.018***	5.9 (1.8-18.9)	**0.003**	6.0 (1.7-21.6)	**.006**	2.9 (0.8-9.7)	0.09	4.3 (1.1-16.7)	**0.036**
Middle	1.0 (0.4-2.8)	1.00	0.9 (0.3-3.2)	0.912	1.1 (0.3-4.5)	0.855	1.2 (0.3-5.2)	0.76	0.8 (0.2-3.8)	0.79	1.2 (0.2-6.4)	0.797
Low (Poor)	1		1		1		1		1		1	
Watching TV												
> 2 hours/day	7.17 (3.7-14.0)	**<0.001***	8.9 (3.9-20.1)	**<0.001***	6.6 (2.7-16.1)	**<0.001**	4.3 (1.6-11.6)	**0.004**	10.2 (3.3-30.9)	**<0.001**	11.5 (3.6-37.2)	**<0.001**
≤ 2 hours/day	1		1		1		1		1		1	
Fruits consumption												
≤ 4 times/week	2.5 (1.3-5.0)	**0.008***	3.13 (1.4-7.0)	**0.006***	2.5 (0.97-6.1)	**.057**	3.5 (1.2-10.0)	**0.022**	2.3 (0.8-6.6)	0.11	3.7 (1.1-12.0)	**0.031**
> 4times/week	1		1		1		1		1		1	

Note: Adjusted for age, sex, ethnicity, school type, mother's educational level, mother's occupation, family type, number of siblings, socio-economic status, watching TV and fruits consumption

*p-value <0.05

STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies*

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6
Bias	9	Describe any efforts to address potential sources of bias	*6*
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	6
		(*c*) Explain how missing data were addressed	6
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	6
		(*e*) Describe any sensitivity analyses	Not applicable
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	5
		(b) Give reasons for non-participation at each stage	5
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	16
		(b) Indicate number of participants with missing data for each variable of interest	No missing data
Outcome data	15*	Report numbers of outcome events or summary measures	8
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	17
		(*b*) Report category boundaries when continuous variables were categorized	-
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	12
Discussion			
Key results	18	Summarise key results with reference to study objectives	9
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9
Generalisability	21	Discuss the generalisability (external validity) of the study results	11
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Not applicable

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Overweight And Its Associated Risk Factors Among Urban School Adolescents In Nepal: A Cross Sectional Study

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1   **Overweight And Its Associated Risk Factors Among Urban**

2   **School Adolescents In Nepal: A Cross Sectional Study**

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30

1 # ABSTRACT

2 **Objectives**

3 The prevalence of non-communicable diseases is increasing in Nepal. Overweight and

4 obesity are the major risk factors of many non-communicable diseases. Adolescence is a

5 critical phase for development of overweight and obesity. Risk factors associated with

6 overweight and obesity are not well understood in Nepal. The objective of the study was to

7 identify the factors associated with overweight and obesity among adolescent students.

8

9 **Setting**

10 A cross-sectional descriptive study was carried out among higher secondary school students

11 in the Lalitpur sub-metropolitan city, Nepal.

12

13 **Participants**

14 A random sample of 360 students aged 16 to 19 years from eight schools were included in the

15 study.

16

17 **Results**

18 The prevalence of overweight among adolescent students was 12.2% (CI: 8.9-15.5). Factors

19 associated with being overweight included being male (AOR=2.64, 95% CI: 1.18-4.88),

20 studying in private school (AOR=2.10, 95% CI: 1.03-4.28), high socio-economic status

21 family (AOR=4.77, 95% CI: 1.36-16.72), watching television for more than two hours per

22 day (AOR=8.86, 95% CI: 3.90-20.11), and consuming fruits four times or less per week

23 (AOR=3.13, 95%CI: 1.39-7.01). There was no statistically significant association between

24 adolescent overweight and age, ethnicity, mother's education level, mother's occupation,

25 number of siblings or family type.

1

2 **Conclusions**

3 Socioeconomic status, watching television for longer time, and consuming less fruits are

4 major risk factors of overweight among adolescents in Nepal. Interventions are needed to

5 increase the awareness about the risk factors of adolescent overweight and obesity to

6 decrease prevalence of overweight-associated non-communicable diseases.

7

8 **Keywords**

9 Adolescent, overweight, risk factors, cross-sectional study, Nepal

10

11 # Strengths and limitations of the study

12 • This study is among a few studies conducted in Nepal, which analyzed risk factors

13 associated with overweight among urban adolescent students.

14 • Schools and participants of the study have been selected randomly, which increases the

15 strength of the study.

16 • This study was conducted in eight schools in Lalitpur sub metropolitan city. So, the risk

17 factors that identified may not be representative of every urban city in Nepal.

18 • The study findings are based on self-reporting by the students and such findings are likely

19 to suffer from over - or under - reporting and recall bias.

20 • Cross-sectional nature of the study limits drawing inferences about causation.

21

1 ## Introduction

2 Today overweight and obesity contribute to the major public health problems worldwide.

3 Although once considered a major problem in affluent countries, overweight and obesity are

4 now on the rise even in low and middle-income nations like Nepal (1). This may be due to

5 ongoing urbanization and economic transitions (subsistence to market) in Nepal. Nepal is

6 urbanizing at faster pace, its urban population has increased to 17% of the total population in

7 2011 from 13.9% in 2001 (2). The urban population growth rate is 3.38% where rural and

8 total population growth rates are 1.03 and 1.4 in 2011 (2). Economic transition and the

9 urbanization process precipitates greatly increased levels of lifestyle-related risk factors like

10 low physical activities and changes in dietary habits (3). Prevalence and risk of overweight

11 and obesity during childhood and adolescence are increasing at greater pace in developing

12 nations rather than in developed ones (1). Overweight and obesity are the major risk factors

13 of non-communicable diseases (NCDs) such as diabetes, osteoarthritis and cardiovascular

14 diseases. World Health Organization (WHO) estimates that NCDs cause 68% of deaths

15 globally and nearly three quarters of all NCD deaths occur in low and middle-income

16 countries (4).

17

18 Adolescence is a critical phase for the development of obesity due to various biological,

19 psychological, social and environmental changes (5, 6). Adolescence overweight and obesity

20 may persist into adulthood. A prospective longitudinal study showed that the 56% males and

21 42% females who were overweight in adolescence remained overweight in adulthood

22 whereas 47% males and 55% females who were obese in adolescence remained obese in

23 adulthood (7). Adolescence overweight and obesity may increase the risk for development of

24 non-communicable diseases at a younger age and consequently a premature death. In addition

25 to future health risks, overweight and obese adolescent also suffer from short-term health

5

1 consequences (1). In addition, their participation in school and other daily activities also limit

2 depending on the degree of obesity.

3

4 In Nepal, nearly one-quarter of the population (24%) comprise of adolescents (8). NCDs

5 account 60% of all deaths in Nepal and 23% caused by cardiovascular diseases (9). A

6 national survey conducted in Nepal in 2013 reported the prevalence of overweight among

7 Nepalese people (15-69 years age) to be 17.7% (10). Limited research has been done as yet

8 on the prevalence and factors associated with overweight among Nepalese adolescents (11).

9 This study is an attempt to fill the information and knowledge gap in this area and potential

10 use of it will be for designing policy and program to appropriately address this problem in

11 timely manner.

12

13 **Methods**

14 *Study area*

15 This study was conducted in Lalitpur sub-metropolitan city, one of the major cities in Nepal.

16 It is adjacent to the capital city Kathmandu and is located in the southeast part of Kathmandu

17 valley. It is a fast growing area and has the highest density of schools in the Kathmandu

18 valley.

19

20 *Study design and Selection of participants*

21 A cross sectional study was conducted during October to November 2014. A multistage

22 random sampling method was used to select the participants. The study area Lalitpur sub-

23 metropolitan city was purposively selected. A list of affiliated Higher Secondary Schools

24 (HSS) to Higher Secondary Education Board (HSEB) of Nepal was downloaded from HSEB

25 website. There were 52 schools in the sampling frame (13 government and 39 private) in this

6

1 study. Two separate lists of private and government schools were prepared. Out of 52

2 schools, eight schools (four government and four private) were randomly chosen through a

3 lottery method and from each selected school one of the grades 11 or 12 was randomly

4 selected. All students of the selected grade were included in the study. A total of 381 students

5 filled out the self-administered questionnaire, and 21 questionnaires were discarded during

6 data analysis (eight questionnaires were incompletely filled, 11 students were over 19 years

7 age and two physically disabled students did not provide informed consent for measuring

8 their weight). A total of 360 students' responses and anthropometric measurements were

9 included in the study.

10

11 ***Data collection and statistical analysis***

12 Data were collected using self-administered, pre-tested and structured questionnaire.

13 Anthropometric measurements (height and weight) were obtained as per WHO guidelines

14 using SECA digital weighing scale and stadiometer (12). The accuracy of the weighing scale

15 and stadiometer were checked using standard weight and height at the beginning of every

16 data collection session and after every five students measurement. Data were entered in Epi-

17 data 3.1. Anthropometric calculation was done using WHO Anthro Plus software version

18 1.0.4 (13). The statistical analysis was done using Statistical Package for Social Science

19 (SPSS) software version 21. Bivariate and multivariate binary logistic regression analyses

20 were done to find out the association between dependent (overweight) and independent (risk-

21 factors) variables. Initially in bivariate analysis, a single variable at a time was entered;

22 unadjusted odds ratio (OR) and 95 percent confidence interval (CI) were computed for all

23 independent variables. Multicollinearity was checked among the variables and there was no

24 significant collinearity (VIF 1-2). Multivariate analysis with all independent variable entered

25 at same time was completed to adjust the effect of confounding, and adjusted OR and 95

1 percent CI were computed. Hosmer and Lemeshow test was done to test the goodness-of-fit

2 for multivariate logistic regression model and the model was found to be a good/fit (p-value >

3 0.05).

4

5 *Variables*

6 Adolescents whose BMI-for-age was above plus one standard deviations (+1SD) from the

7 median of the WHO reference population were classified as overweight (14). Age was

8 calculated by subtracting the date of birth, which was mentioned by the students, from date of

9 data collection. Ethnicities of students were organized into advantaged group (includes

10 advantaged Janajatis and upper caste) and relatively disadvantaged group (includes Dalits,

11 disadvantaged Janajatis, disadvantaged non-dalit Terai people and religious minorities).

12 Socio-economic status was computed by wealth index using Principal Component Analysis

13 (PCA), considering the assets holdings of the participants. Tertiles were generated data and

14 organized in low (poor), middle and high (rich) categories. The components included in the

15 wealth index were ownership of house, vehicles, animals, electronic goods (refrigerator,

16 radio, TV, computer, fan), furniture (sofa, bed, cupboard, table, chair), mobile phone,

17 telephone, housing characteristics and type of fuel for cooking. Fruit consumption by the

18 students during the past one week was grouped as four or less servings a week and more than

19 four servings a week. Similarly, the average number of hours of television watched was

20 grouped as two hours or less per day and more than two hours per day.

21

22 *Questionnaire*

23 A structured questionnaire was developed based on study objectives. For wealth index, a

24 validated Nepal demographic and health survey 2011 (NDHS) questionnaire measure was

25 adapted (15). For fruit consumptions, a list of locally available (market and locally grown)

1   fruits in the study season was developed and students were asked to tick number of times

2   they had consumed the particular fruit during the past one week. Students were asked to tick

3   the average numbers of hours per day they watched the television during last one week. A

4   pilot study of the questionnaire was done in one non-sampled school. The questionnaire

5   (consisting of socio-demographic, watching television and fruits consumption) was

6   administered to 20 students. The questionnaires were found to be apt.

7

8   **Ethical consideration**

9   The study was approved by the Institutional Review Board of Institute of Medicine,

10   Tribhuvan University, Kathmandu, Nepal. Informed written consent was obtained from the

11   sampled school authorities and participants. Confidentiality of information was assured and

12   insured throughout the study. Information about the causes, health consequences, and

13   prevention of nutritional problems such as underweight, overweight and micronutrients

14   deficiency, was given to the students.

15

16   # Results

17   The prevalence of overweight was 12.2% (95%CI: 8.9-15.5). Table 1 shows the general

18   characteristics of adolescent student participants. The mean age, weight, height and BMI of

19   the participants were 16.98 years (95% CI: 16.88-17.08), 52.5 Kg (95% CI: 51.5-53.5), 159.9

20   cm (95% CI: 159.0-160.8), and 20.5 Kg/m^2 (95% CI: 20.2-20.8) respectively. Bivariate

21   analysis showed that six factors were independently associated with overweight in

22   adolescents (Table 2). In multivariate analysis being male, studying in private school, having

23   high socio-economic status, watching television more than two hours per day, and consuming

24   fruits four times or less per week were significantly statistically associated with overweight.

25   However, age, ethnicity, mother's educational level, mother's occupation, family type and

1 number of siblings did not show a statistically significant association with being overweight

2 (Table 2). Separate analyses in males and females were performed (see supplementary Table

3 1 and Table 2). In males, school type, socio-economic status, watching television more than

4 two hours per day and consuming fruits four times or less per week show a statistically

5 significant association with being overweight (see supplementary Table 1 and Table 2). In

6 females, socio-economic status, watching TV more than two hours per day and consuming

7 fruits four times or less per week show a statistically significant association with being

8 overweight (see supplementary Table 1 and Table 2).

9

10 Male students were 2.64 times more likely to be overweight than females (AOR=2.64, 95%

11 CI: 1.18-4.88). Likewise, students studying in private schools were 2.1 times more likely to

12 be overweight than the students studying in government schools (AOR=2.10, 95% CI: 1.03-

13 4.28). Similarly, the students from rich families were 4.77 times more likely to be overweight

14 than students from poor families (AOR=4.77, 95%CI: 1.36-16.72). Students who spent more

15 than two hours per day in watching television were 8.86 times more likely to be overweight

16 than the students who spent less than two hours per day (AOR=8.86, 95% CI: 3.90-20.11).

17 Students who consumed fruits four times or less a week were 3.13 times more likely to be

18 overweight than student who consumed fruits more than four times per week (AOR=3.13, CI:

19 1.39-7.01). (Table 2)

20

21 ## Discussion

22 The study data suggests that being male, studying in a private school, belonging to high

23 socio-economic status family, watching television for more than two hours per day,

24 consuming fruits four times or less per week were potential risk factors of overweight among

25 Nepalese adolescent students. In this study, prevalence of overweight among adolescents in

1   Nepal was found to be 12.2%, which is lower than the reported by studies from Pakistan,

2   India and China (16-19). However, this finding is higher than the study conducted in the

3   Kaski district of Nepal (11). The males were nearly three times more likely to be overweight

4   than females. The finding is consistent with the studies from Pakistan, India and China,

5   which reported high prevalence in males than females (16-23).

6

7   This study showed adolescents studying in private schools were twice more likely to be

8   overweight than adolescents studying in government schools. The finding is consistent with

9   the studies conducted in India (18, 21). In this study, overweight among adolescents was

10 found to be significantly associated with the socio-economic status. The students from higher

11 socio-economic background families were nearly five times more likely to be overweight

12 than students from poor families. The finding is compatible with the findings of studies done

13 in India (17, 20-22, 24). The students from higher socio-economic background families have

14 more purchasing power for calorie dense and nutrient poor fast foods.

15

16 This study found that students who spent more than two hours per day in watching television

17 were nearly nine times more likely to be overweight than the students who spent less than

18 two hours per day. Watching television could be contributing to increasing incidence of

19 overweight among adolescents in many ways including (a) increased sedentary behavior and

20 decrease physically activity (b) increase snacking while watching television (c) disturbance in

21 normal sleeping pattern (d) increasing trends towards unhealthy eating pattern influenced by

22 advertisements of junk/fast foods (6, 25-27). A study conducted in Nepal showed that 1/4th

23 advertisements appeared on selected Nepali and Indian television channels were related to

24 junk foods and most these of advertisements were targeted the children (28). A study

25 conducted among adolescent girls in Sri-Lanka showed that risk of overweight was three

1   times higher among those who had screen time of more than two hours per day (29). Another

2   study done in India among adolescents reported the risk of overweight seven times higher

3   among those who had screen time of more than four hours per day (24).

4

5   Fruits and vegetables are important part of a healthy diet, their adequate daily consumption

6   could help lose weight and prevent many non-communicable diseases (30). In this study,

7   students who consumed fruits four times or less in a week were three times more likely to be

8   overweight than student who consumed fruits more than four times per week. A study among

9   Pakistani adolescents showed the same association with students who consumed fruits four or

10   more times per week being less likely to be obese than those who consumed fruits less than

11   four times per week (16). Another study conducted among adolescent girls in Sri-Lanka

12   showed that risk of overweight was two times higher among those who consumed fruits less

13   than four days per week (29).

14

15

Strengths and limitations of the study

17   • This study is among a few studies conducted in Nepal, which analyzed risk factors

18   associated with overweight among urban adolescent students.

19   • Schools and participants of the study have been selected randomly, which increases the

20   strength of the study.

21   • This study was conducted in eight schools in Lalitpur sub metropolitan city. So, the risk

22   factors that identified may not be representative of every urban city in Nepal.

23   • The study findings are based on self-reporting by the students and such findings are likely

24   to suffer from over-or under-reporting and recall bias.

25   • Cross-sectional nature of the study limits drawing inferences about causation.

12

1

Conclusion

The study provides evidence of the high prevalence of overweight among adolescents living in one urban area of Nepal. Socioeconomic status, watching television for a long period of time, and consuming less fruits are major risk factors of overweight among adolescents in Nepal. Policies and programs not limited to Ministry of Health and Population but also Ministry of Education and Ministry of Youth and Sports are needed to address the fast growing problem appropriately and timely manner. An enabling environment is paramount important to increase the awareness about the risk factors of adolescence overweight to decrease prevalence of overweight-associated non-communicable diseases for coming generation of Nepal.

13

1   **Abbreviations**

2   AOR   Adjusted Odd's Ratio

3   BMI   Body Mass Index

4   CI   Confidence Interval

5   NCDs   Non-Communicable Diseases

6   OR   Odd's Ratio

7   PCA   Principal Component Analysis

8   SD   Standard Deviation

9   SPSS   Statistical Package for Social Science

10   TV   Television

11   VIF   Variance inflation factor

12   WHO   World Health Organization

13

1 **Competing interests**

2 The authors declare that they have no competing interests.

3 **Authors' contributions**

4 SP was involved in conceptualizing the study, reviewing the literature, designing protocol,

5 developing questionnaire, data collection, analysis and preparing the manuscript. AKP

6 supported in statistical analyses, interpretation of data and critically reviewed the manuscript.

7 KPB, BP, RMP helped in conceptualizing the study and critically reviewed the manuscript.

8 All authors read and approved the final manuscript.

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24 **Data sharing statement:** No additional data are available.

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1 **Table 1: General characteristics of sampled adolescent students**

Characteristics	Frequency	Percentage
Age		
16-17 years	268	74.4
18-19 years	92	25.6
Mean (±SD)	16.98 (±0.98)	
Sex		
Female	190	52.8
Male	170	47.2
Ethnicity		
Advantaged	235	65.3
Relatively disadvantaged	125	34.7
School type		
Private	180	50
Government	180	50
Mother's educational level		
Formal education	226	62.8
No formal education	134	37.2
Mother's occupation		
Working outside home also/ Employed/non-housewife	185	51.4
Unemployed/housewife	175	48.6
Family type		
Nuclear	244	67.8
Extended/joint	116	32.2
No. of siblings		
Up to 2	264	73.3
More than 2	96	26.7
Socio-economic status[*]		
Rich	120	33.3
Middle class	120	33.3
Poor	120	33.3
Watching TV		
≤ 2 hours/day	281	78.1
> 2 hours/day	79	21.9
Fruits consumption		
≤ 4 times/week	184	51.1
> 4times/week	176	48.9

2 [*] Wealth index was computed using PCA, and the components included in wealth index were
3 ownership of house, vehicles, animals, electronic goods (refrigerator, radio, TV, computer,
4 fan), furniture (sofa, bed, cupboard, table, chair), mobile phone, telephone, housing
5 characteristics and type of fuel for cooking.
6

18

Table 2. Risk factors of the overweight among adolescent students, Nepal

Characteristics	Overweight (n=44) No. (%)	No Overweight (n=316) No. (%)	Unadjusted OR (95%CI)	p-value	Adjusted OR (95%CI)	p-value
Age						
16-17 years	35 (13.1)	233 (86.9)	1.38 (0.64-3.00)	0.409	1.05 (0.37-2.94)	0.927
18-19 years	9 (9.8)	83 (90.2)	1		1	
Sex						
Male	27 (15.9)	143 (84.1)	1.92 (1.00-3.67)	**0.048***	2.64 (1.18-4.88)	**0.018***
Female	17 (8.9)	173 (91.1)	1		1	
Ethnicity						
Advantaged	32 (13.6)	203 (86.4)	1.48 (0.74-3.00)	0.271	1.38 (0.57-3.31)	0.476
Relatively disadvantaged	12 (9.6)	113 (90.4)	1		1	
School type						
Private	29 (16.1)	151 (83.9)	2.11 (1.09-4.09)	**0.027***	2.10 (1.03-4.28)	**0.042***
Government	15 (8.3)	165 (91.7)	1		1	
Mother's educational level						
Formal education	32 (14.2)	194 (85.8)	1.67 (0.30-1.20)	0.148	0.85 (0.32-2.22)	0.732
No formal education	12 (9.0)	122 (91.0)	1		1	
Mother's occupation						
Working outside home also/ Employed/ non-housewife	27 (14.6)	158 (85.4)	1.59 (0.83-3.03)	0.673	1.18 (0.54-2.60)	0.673
Unemployed/housewife	17 (9.7)	158 (90.3)	1		1	
Family type						
Nuclear	34 (13.9)	210 (86.1)	1.72 (0.82-3.61)	0.154	1.41 (0.59-3.39)	0.445
Extended/joint	10 (8.6)	106 (91.4)	1		1	
No. of siblings						
Up to 2	39 (14.8)	225 (85.2)	3.15 (1.20-8.26)	**0.019***	1.85 (0.61-5.61)	0.097
More than 2	5 (5.2)	91 (94.8)	1		1	
Socio-economic status						
High (Rich)	28 (23.3)	92 (76.7)	4.26 (1.85-9.80)	**<0.001***	4.77 (1.36-16.72)	**0.018***

Middle	8 (6.7)	112 (93.3)	1.00 (0.36-2.76)	1.00	0.93 (0.27-3.18)	0.912
Low (Poor)	8 (6.7)	112 (93.3)	1		1	
Watching TV						
> 2 hours/day	26 (32.9)	53 (67.1)	7.17 (3.67-14.00)	**<0.001***	8.86 (3.90-20.11)	**<0.001***
≤ 2 hours/day	18 (6.4)	263 (93.6)	1		1	
Fruits consumption						
≤ 4 times/week	31 (16.8)	153 (83.2)	2.54 (1.28-5.04)	**0.008***	3.13 (1.39-7.01)	**0.006***
> 4times/week	13 (7.4)	163 (92.6)	1		1	

Note: Adjusted for age, sex, ethnicity, type of school, mother's educational level, mother's occupation, family type, number of siblings, socio-economic status, watching TV and fruits consumption.

*p-value <0.05

Separate analysis in male and female

Supplement Table 1: General characteristics of sampled adolescent students

Characteristics	Both Sexes		Male (n=170)		Female (n=190)	
	Overweight (n=44) No. (%)	No Overweight (n=316) No. (%)	Overweight (n=27) No. (%)	No Overweight (n=143) No. (%)	Overweight (n=17) No. (%)	No Overweight (173) No. (%)
Age						
16-17 years	35 (13.1)	233 (86.9)	24 (18.2)	108 (81.8)	11 (8.1)	125 (91.9)
18-19 years	9 (9.8)	83 (90.2)	3 (7.9)	35 (92.1)	6 (11.1)	48 (88.9)
Ethnicity						
Advantaged	32 (13.6)	203 (86.4)	22 (19.6)	90 (80.4)	10 (8.1)	113 (91.9)
Relatively disadvantaged	12 (9.6)	113 (90.4)	5 (8.6)	53 (91.4)	7 (10.4)	60 (89.6)
School type						
Private	29 (16.1)	151 (83.9)	21 (20.2)	83 (79.8)	8 (10.5)	68 (89.5)
Government	15 (8.3)	165 (91.7)	6 (9.1)	60 (90.9)	9 (7.9)	105 (92.1)
Mother's educational level						
Formal education	32 (14.2)	194 (85.8)	21 (18.4)	93 (81.6)	11 (9.8)	101 (90.2)
No formal education	12 (9.0)	122 (91.0)	6 (10.7)	50 (89.3)	6 (7.7)	72 (92.3)
Mother's occupation						
Working outside home also/ Employed/ non-housewife	27 (14.6)	158 (85.4)	19 (18.8)	82 (81.2)	8 (9.5)	76 (90.5)
Unemployed/housewife	17 (9.7)	158 (90.3)	8 (11.6)	61 (88.4)	9 (8.5)	97 (91.5)
Family type						
Nuclear	34 (13.9)	210 (86.1)	21 (19.3)	88 (80.7)	17 (8.9)	173 (91.1)
Extended/joint	10 (8.6)	106 (91.4)	6 (9.8)	55 (90.2)	4 (7.3)	51 (92.7)
No. of siblings						
Up to 2	39 (14.8)	225 (85.2)	24 (19.5)	99 (80.5)	15 (10.6)	126 (89.4)
More than 2	5 (5.2)	91 (94.8)	3 (6.4)	44 (93.6)	2 (4.1)	47 (95.9)
Socio-economic status						
High (Rich)	28 (23.3)	92 (76.7)	18 (32.1)	38 (67.9)	10 (15.6)	54 (84.4)

Middle	8 (6.7)	112 (93.3)	5 (8.3)	55 (91.7)	3 (5.0)	57 (95.0)
Low (Poor)	8 (6.7)	112 (93.3)	4 (7.4)	50 (90.6)	4 (6.1)	62 (93.9)
Watching TV						
> 2 hours/day	26 (32.9)	53 (67.1)	14 (41.2)	20 (58.8)	12 (26.7)	33 (73.3)
≤ 2 hours/day	18 (6.4)	263 (93.6)	13 (9.6)	123 (90.4)	5 (3.4)	140 (96.6)
Fruits consumption						
≤ 4 times/week	31 (16.8)	153 (83.2)	20 (20.6)	77 (79.4)	11 (12.6)	76 (87.4)
> 4times/week	13 (7.4)	163 (92.6)	7 (9.6)	66 (90.4)	6 (5.8)	97 (94.2)

SES: wealth index was computed using PCA, and the components included in wealth index were ownership of house, vehicles, animals, electronic goods (refrigerator, radio, TV, computer, fan), furniture (sofa, bed, cupboard, table, chair) mobile phone, telephone, housing characteristics and type of fuel for cooking.

Supplement Table 2. Risk factors of overweight among adolescent students, Nepal

Characteristics	Both sexes				Male				Female			
	Unadjusted OR (95%CI)	p-value	Adjusted OR (95%CI)	p-value	Unadjusted OR (95%CI)	p-value	Adjusted OR (95%CI)	p-value	Unadjusted OR (95%CI)	p-value	Adjusted OR (95%CI)	p-value
Age												
16-17 years	1.4 (0.6-3.0)	0.409	1.1 (0.4-2.9)	0.927	2.6 (0.7-9.1)	0.14	1.8 (0.4-8.7)	0.47	0.7 (0.3-2.0)	0.51	0.9 (0.2-3.8)	0.86
18-19 years	1		1		1		1		1		1	
Sex												
Male	1.9 (1.0-3.7)	**0.048***	2.6 (1.2-4.9)	**0.018***	NA		**NA**		NA		**NA**	
Female	1		1									
Ethnicity												
Advantaged	1.5 (0.7-3.0)	0.271	1.4 (0.6-3.3)	0.476	2.6 (0.9-7.2)	0.07	3.0 (0.8-11.0)	0.10	0.8 (0.3-2.1)	0.59	0.5 (0.1-2.1)	0.37
Relatively disadvantaged	1		1		1		1		1		1	
School type												
Private	2.1 (1.1-4.1)	**0.027***	2.1 (1.0-4.3)	**0.042***	2.5 (0.96-6.64)	0.06	2.1 (1.0-4.6)	**0.046**	1.4 (0.5-3.7)	0.54	0.7 (0.1-4.0)	0.69
Government	1		1		1		1		1		1	
Mother's Education												
Formal education	1.7 (0.3-1.2)	0.148	0.9 (0.3-2.2)	0.732	1.9 (0.7-5.0)	0.20	1.4 (0.4-5.2)	0.64	1.3 (0.5-3.7)	0.61	0.7 (0.1-3.1)	0.62
No formal education	1		1		1				1		1	
Mother's occupation												
Working outside home also/ Employed/ non-housewife	1.6 (0.8-3.0)	0.673	1.2 (0.5-2.6)	0.673	1.8 (0.7-4.3)	0.21	2.1 (0.7-6.1)	0.18	1.1 (0.4-3.1)	0.80	0.7 (0.2-2.5)	0.63
Unemployed/housewife	1		1		1		1		1		1	
Family type												

Nuclear	1.7 (0.8-3.6)	0.154	1.4 (0.6-3.4)	0.445	2.2 (0.8-5.8)	0.11	2.8 (0.9-8.5)	0.069	1.4 (0.4-4.4)	0.61	1.1 (0.3-4.7)	0.86
Extended/joint	1		1		1		1		1		1	
No. of siblings												
Up to 2	3.2 (1.2-8.3)	**0.019***	1.8 (0.6-5.6)	0.097	3.5 (1.01-12.4)	**0.047**	1.7 (0.4-7.3)	0.47	2.8 (0.6-12.7)	0.18	2.0 (0.3-11.7)	0.43
More than 2	1		1		1		1		1		1	
Socio-economic status												
High (Rich)	4.3 (1.9-9.8)	**<0.001***	4.8 (1.4-16.7)	**0.018***	5.9 (1.8-18.9)	**0.003**	6.0 (1.7-21.6)	**.006**	2.9 (0.8-9.7)	0.09	4.3 (1.1-16.7)	**0.036**
Middle	1.0 (0.4-2.8)	1.00	0.9 (0.3-3.2)	0.912	1.1 (0.3-4.5)	0.855	1.2 (0.3-5.2)	0.76	0.8 (0.2-3.8)	0.79	1.2 (0.2-6.4)	0.797
Low (Poor)	1		1		1		1		1		1	
Watching TV												
> 2 hours/day	7.17 (3.7-14.0)	**<0.001***	8.9 (3.9-20.1)	**<0.001***	6.6 (2.7-16.1)	**<0.001**	4.3 (1.6-11.6)	**0.004**	10.2 (3.3-30.9)	**<0.001**	11.5 (3.6-37.2)	**<0.001**
≤ 2 hours/day	1		1		1		1		1		1	
Fruits consumption												
≤ 4 times/week	2.5 (1.3-5.0)	**0.008***	3.13 (1.4-7.0)	**0.006***	2.5 (0.97-6.1)	**.057**	3.5 (1.2-10.0)	**0.022**	2.3 (0.8-6.6)	0.11	3.7 (1.1-12.0)	**0.031**
> 4times/week	1		1		1		1		1		1	

Note: Adjusted for age, sex, ethnicity, school type, mother's educational level, mother's occupation, family type, number of siblings, socio-economic status, watching TV and fruits consumption

*p-value <0.05

OVERWEIGHT AND ITS ASSOCIATED RISK FACTORS AMONG URBAN SCHOOL ADOLESCENTS IN NEPAL

Instruction:
Please
- read each question carefully and respond appropriately
- feel free to ask if you don't understand/confuse about any question
- tick☐ (✔) or write answer in the box accordingly

Form No.		Date of data collection	
Weight of the student		…………. Kg	

Q. No.	Questions	Response and Code
1	What is your name? (Optional)	
2	What is your school's name?	
3	What is the type of your school?	☐1. Government ☐2. Private
4	What is your date of birth?	Day ……… Month ……… Year ……… (AD)
5	Are you a male or female?	☐1.Male ☐2.female
6	What is your ethnicity?	☐1. Dalits ☐2. Disadvantaged Janajatis ☐3. Disadvantaged Non Dalit Terai People ☐4. Religious Minorities ☐5. Advantaged Janajatis ☐6. Upper Caste ☐7. Others specify..........
7	What is the educational level of your mother?	☐1. Illiterate ☐2. Literate ☐3. Primary (1-5) ☐4. Lower Secondary (6-8) ☐5. Secondary (9-10) ☐6. Higher Secondary (11-12) ☐7. Bachelor and above ☐8. Don't know
8	What is the major occupation of your mother?	☐1. Housewife ☐2. Agriculture ☐3. Labor ☐4. Business ☐5. Government service ☐6. Non-government service ☐7. Foreign employee ☐8. Student ☐9. Unemployed ☐10. Others (specify) ☐1. Don't know
9	How many brothers and sisters you have?	……… Brothers ……… Sisters
10	What is type of your family?	☐1. Nuclear ☐2. Joint ☐3. Extended ☐4. Others specify..........
11	During last one week, how many hours you had watched TV per day?	☐< 1hour/day ☐1-2 hours/day

1

		☐> 2hours

12. How many numbers of times you had consumed the following fruits in last one week?

Fruits Name	Not consumed	Once per week	2-4 times per week	5-6 times per week	> 6 times per week
Apple	☐	☐	☐	☐	☐
Banana	☐	☐	☐	☐	☐
Guava	☐	☐	☐	☐	☐
Orange	☐	☐	☐	☐	☐
Pomegranate	☐	☐	☐	☐	☐
Grapes	☐	☐	☐	☐	☐
Others, specify					

SOCIOECONOMIC STATUS

Q. No	Questions	Response and code
13	Do you have your own home?	☐1. Yes ☐0. No
14	Are you living in your own home or rented house?	☐1. Own ☐2. Rented ☐3. Others specify……….
15	Tick the items which you have at your home/house	• Electricity ☐1. Yes ☐0. No • Radio ☐1. Yes ☐0. No • Television ☐1. Yes ☐0. No • Mobile phone ☐1. Yes ☐0. No • Telephone ☐1. Yes ☐0. No • Refrigerator ☐1. Yes ☐0. No • Bed ☐1. Yes ☐0. No • Sofa ☐1. Yes ☐0. No • Cupboard ☐1. Yes ☐0. No • Computer ☐1. Yes ☐0. No • Table ☐1. Yes ☐0. No • Chair ☐1. Yes ☐0. No • Clock ☐1. Yes ☐0. No • Fan ☐1. Yes ☐0. No • Dhiki/Janto ☐1. Yes ☐0. No
21	What type of fuel is used mainly for cooking at your home/house?	☐1. Electricity ☐2. LPG ☐3. Biogas ☐4. Kerosene ☐5. Wood ☐6. Animal dung ☐7. Other (specify)………….
22	What is your house's roof mainly made of?	☐1. Thatched roof ☐2. Galvanized sheet ☐3. Ceramic stiles ☐4. Cement ☐5. Others, specify ………
23	Does any member of the family own any agricultural land?	☐1. Yes ☐0. No
24	How many bigha/katha of agricultural land your family own?	…………… Bigha …………… Ropani ☐Don't know

25	Do you have any livestock, herds, other farm animals or poultry?	☐. Yes ☐. No
26	If yes, please specify which animal/s and how many.	Buffalo …………… Milk cows or bulls ……… Goats …………… Chickens ………… Ducks …………… Pigs …………… Others specify …………
27	Does anyone in the family own Bicycle/rickshaw, Motorcycle/ scooter, three-wheeler, Car, Bus or truck?	• Bicycle/rickshaw ☐. Yes ☐0. No • Motorcycle/ scooter ☐. Yes ☐0. No • Three wheeler ☐. Yes ☐0. No • Car ☐. Yes ☐0. No • Bus or truck ☐. Yes ☐0. No

Your responses are greatly appreciated. If you have any other comments, please mention below.

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Thank you!!!

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4   **STROBE 2007 (v4) Statement—Checklist of items that should be included in reports of *cross-sectional studies***
5

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6
Bias	9	Describe any efforts to address potential sources of bias	*6*
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	6
		(*b*) Describe any methods used to examine subgroups and interactions	6
		(*c*) Explain how missing data were addressed	6
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	6
		(*e*) Describe any sensitivity analyses	Not applicable
Results			

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	5
		(b) Give reasons for non-participation at each stage	5
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	16
		(b) Indicate number of participants with missing data for each variable of interest	No missing data
Outcome data	15*	Report numbers of outcome events or summary measures	8
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	17
		(*b*) Report category boundaries when continuous variables were categorized	-
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	12
Discussion			
Key results	18	Summarise key results with reference to study objectives	9
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9
Generalisability	21	Discuss the generalisability (external validity) of the study results	11
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Not applicable

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.