Demographic, Lifestyle and Mental Health Factors Associated with Physical Activity Among School-Going Adolescents in Timor-Leste

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Abstract. It is widely accepted that physical activity has beneficial impacts on health outcomes. However, a large proportion of adolescents are physically inactive. The objective of the present study is to examine factors associated with physical activity among school-going adolescents in Timor-Leste. Nationally representative data with a sample size of 3455 students were used. An ordered probit model was utilized to assess the effects of various demographic, lifestyle and mental health factors on different levels of physical activity (0, 1–2, 3–4, 5–6 and 7 days/week). Small numbers of adolescents engaged in physical activity 7 days/week (9.2%). Older male adolescents were more likely to spend 3–4, 5–6 and 7 days/week on physical activity than younger female adolescents. Consumption of vegetables, soft drinks and alcohol was associated with a decreased likelihood of not participating in physical activity. Adolescents were more likely to spend 7 days/week on physical activity if they had severe loneliness feelings and mild sleep difficulties. Demographic, lifestyle and mental health factors play an important role in determining physical activity levels among school-going adolescents. The findings of the present study are crucial to policymakers interested in the lifestyles of the adolescent population.

Keywords: Adolescent · Demographic factors · Lifestyles · Physical activity · Mental health

1 Introduction

The beneficial effects of physical activity on adolescent health are well-documented. Physically active adolescents tend to have better cardiovascular health, bone density, lipid profiles, muscular fitness, and healthier body weight compared to their physically inactive counterparts [1]. Furthermore, studies show physical activity to be able to improve insulin sensitivity and blood glucose regulation among adolescents with type-1 diabetes [1]. There is also strong evidence suggesting that the health benefits of physical activity in adolescents can be carried forward to adulthood [2]. Moreover, physical activity appears to have desirable impacts on non-physical health. Cognitive development, self-esteem, emotions, mental health, academic performance, and positive

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social behaviours, for instance, are found to be better among adolescents who adopt a physically active lifestyle than physically inactive adolescents [3, 4].

In light of the known physical and non-physical health benefits of regular physical activity, the World Health Organization (WHO) recommends adolescents spend at least 60 min on physical activity daily [5]. However, based on 298 school surveys from 146 countries across the globe, a very large proportion of adolescents aged 11–17 years in 2016 were found to be physically inactive, with 81% did not meet the WHO's physical activity recommendation [6]. It seems that the benefits of physical activity are often ignored as adolescents often live a physically inactive lifestyle in many countries. In Southeast Asia, Timor-Leste is one of the top countries with a large number of physically inactive adolescents. Reference [6] estimated that 85.5% and 93.4% of male and female adolescents in Timor-Leste, respectively, did not spend at least 5 days/week on physical activity. Considering this high prevalence of adolescent physical inactivity, it is important to implement a better population-based physical activity policy in Timor-Leste. To support this policy planning, the present study examines various factors that are hypothesised to be associated with participation in physical activity among adolescents in Timor-Leste.

The contributions of the present study to the empirical literature are numerous. First, the country of interest in the present study, Timor-Leste, is a developing country where physical inactivity is prevalent and empirical studies related to physical activity among adolescents are lacking. While the studies by [6, 7] were remarkable for their examination of adolescent physical activity patterns across the globe, including Timor-Leste, they only focused on the prevalence of physical activity. Factors affecting the probability of participating in physical activity were, however, not explored. Second, the present study uses a large, nationally representative population sample to generate important findings. Since Timor-Leste has a low-income economy and encounters a serious issue regarding poor access to health care [8], outcomes from the present study would be of great research interest and beneficial to stakeholders. Knowledge of factors influencing physical activity participation and its frequency gained in this study is crucial to public health policymakers in Timor-Leste interested in the health outcomes of the population.

Third, different from past studies which often treated physical activity as a binary variable (active vs. inactive), the present study categorizes physical activity into several levels and uses an ordinal regression to examine factors influencing the probabilities of engaging in these levels of physical activity. Thereby, which cohorts of the adolescent population are more or less likely to be physically active can be well-identified. Fourth, in addition to demographic and lifestyle factors, the present study includes two new mental health variables, i.e., loneliness and sleep difficulties, in an attempt to explore their impacts on physical activity participation. As pointed out by [9], who conducted a systematic review of studies regarding mental health and physical activity, stress is a risk factor for physical inactivity. This suggests that poor mental health is negatively associated with physical activity levels because individuals who suffer from stress are less ready to engage in physical activity and are more likely to indulge in unhealthy behaviours when compared to individuals with a good mental health conditions [9]. It is therefore worth one's while to further understand the role of mental health in physical

activity by shedding light on the relationships between physical activity and loneliness, and sleep difficulties.

2 Methodology

2.1 Data

The present study is a cross-sectional, correlational study. Secondary analyses of data from the Global School-Based Student Health Survey (GSHS) Timor-Leste were conducted to provide empirical findings. The WHO collaborated with the Ministry of Health of Timor-Leste on the survey. The purpose of the survey was to collect information on school-going adolescents' health behaviours and their protective, and risk factors. This information would be used by policymakers to formulate population-based public health measures. While the survey may not be recent, it is the largest and most comprehensive nationwide adolescent health survey in Timor-Leste.

The focus population was school-going adolescents in lower- and upper-secondary schools (13–17 years old). To ensure that the sample was representative, a two-stage cluster sampling was employed to collect the data. Firstly, a total of 38 schools across the nation were selected based on the probability proportional to schools' enrolment size. Secondly, classes in each school were selected using systematic equal probability sampling. All students in the selected classes were eligible for the survey, except those who did not give consent. A total of 4691 students were invited but only 3704 completed the questionnaires. This was equivalent to a response rate of 79%. Respondents self-administrated the piloted, structured questionnaires, which were prepared in both Tetum and English languages. The questionnaires comprised numerous questions surrounding school-going adolescent demographics, lifestyles, substance use and mental health. Processing and screening for questionnaire data were done by the United States Centers for Disease Control and Prevention (CDC). Respondents were requested to provide written consent before answering the questionnaires. Ethical approval was obtained from the Ministries of Health and Education in Timor-Leste as well as the WHO's Ethical Committee. Further information on the methodology of the GSHS can be obtained elsewhere [10].

2.2 Dependent Variable

Physical activity refers to any bodily movement generated by skeletal muscles which result in energy expenditure. The level of physical activity was used as the dependent variable. It was formatted as an ordinal variable with five ordered levels: 0, 1–2, 3–4, 5–6 and 7 days/week of physical activity. The variable was formed based on a question asked in the questionnaires: 'During the past 7 days, how many days were you physically active for a total of at least 60 min per day?' Respondents responded with '0', '1–2', '3–4', '5–6' or '7' days. According to the WHO recommendations, adolescents should spend at least 60 min on physical activity daily. Therefore, adolescents who allocated 7 days/week to physical activity were considered to be physically active.

2.3 Independent Variables

The independent variables used in the present study consisted of demographic (age, gender), lifestyle (fruit and vegetables [FV] intake, soft drinks consumption, smoking, alcohol drinking, use of illicit drugs) and mental health factors (loneliness, sleep difficulties). These variables are selected based on findings from previous empirical studies [11–20], as well as the availability of data.

To obtain respondents' demographic profiles, respondents were requested to report their age (11–12, 13–14, 15–16, 17–18 years) and gender (male, female). In terms of fruit consumption, respondents were asked 'During the past 30 days, how many times per day did you usually eat fresh fruit?' Respondents' responses were grouped into four categories: '<1', '1–2', '3–4' and '≥5 times'. A similar question surrounding respondents' consumption of vegetables was asked. The question related to soft drinks consumption was designed as 'During the past 30 days, how many times per day did you usually drink carbonated soft drinks?' Four categories were formed based on the possible answers: '<1', '1–2', '3–4' and '≥5 times'.

The following three questions were used to determine whether respondents were smokers, alcohol drinkers, or illicit drug users: 'During the past 30 days, on how many days did you smoke cigarettes?', 'During the past 30 days, how many days did you have at least one drink containing alcohol?' and 'During the past 30 days, how many times have you used illicit drugs, such as marijuana?' Concerning sleep difficulties, respondents were asked 'During the past 12 months, how often have you been so worried about something that you could not sleep at night?' The responses were 'never', 'rarely', 'sometimes', 'most of the time' and 'always'. To facilitate assessment, 'rarely' was combined with 'sometimes' to form 'moderate', while 'most of the time' was combined with 'always' to form 'severe'. Information about loneliness was obtained from a somewhat similar question: 'During the past 12 months, how often have you felt lonely?'.

2.4 Statistical Analyses

Before conducting any statistical tests, the prevalence of physical activity and descriptive statistics of variables were calculated and presented. Pearson's Chi-squared tests were then used to assess demographic, lifestyle and mental health variations in levels of physical activity (0, 1–2, 3–4, 5–6 and 7 days/week). In terms of multivariate analyses, an ordered probit regression model was utilized to examine the independent effects of demographic, lifestyle and mental health variables on levels of physical activity. Marginal effects of independent variables were computed. To identify whether loneliness and sleep difficulties were relevant variables, two models were estimated. Model 1 consisted of only demographic and lifestyle variables, while Model 2 included loneliness and sleep difficulties variables. Pseudo R-squared and Akaike's information criterion (AIC) of these two models were then compared. Additionally, to diagnose a possible multicollinearity issue in the regression, variance inflation factors (VIFs) of all independent variables were calculated. After deleting 6.7% of respondents who reported incomplete information, only 3455 observations were retained for the analyses. Given that the data have a large sample size, the deletion of a small number of respondents is unlikely to yield biased results [21]. A significance level of $p < 0.05$ was selected for hypothesis testing. Stata statistical software was used to perform all the analyses [22].

3 Results

Of the total respondents, about 29.8% did not spend time on physical activity (0 days/week), while only a small proportion spent 3–4 (8.2%), 5–6 (3.5%) and 7 days/week (9.2%) on physical activity. A large percentage of adolescents aged 15–16 (34.4%) and 17–18 years (34.1%). Females outweighed males by 7.6%. About half of the adolescents did not consume fruit (55%), vegetables (43%) and soft drinks (58%). The majority of adolescents did not smoke (80.2%), consume alcohol (85.4%) and use

Table 1. Summary statistics of variables (n = 3455)

Variables	Count	Per cent
Physical activity		
0	1030	29.81
1–2	1702	49.26
3–4	284	8.22
5–6	120	3.47
7	319	9.23
Age		
11–12	228	6.60
13–14	860	24.89
15–16	1188	34.38
17–18	1179	34.12
Gender		
Male	1597	46.22
Female	1858	53.78
Fruit		
<1	1900	54.99
1–2	1163	33.66
3–4	190	5.50
≥5	202	5.85
Vegetables		
<1	1474	42.66
1–2	1361	39.39
3–4	390	11.29
≥5	230	6.66
Soft drinks		
<1	2020	58.47

(*continued*)

Table 1. (*continued*)

Variables	Count	Per cent
1–2	1080	31.26
3–4	180	5.21
≥5	175	5.07
Smoking		
Yes	684	19.80
No	2771	80.20
Alcohol		
Yes	505	14.62
No	2950	85.38
Illicit drugs		
Yes	178	5.15
No	3277	94.85
Loneliness		
No	1390	40.23
Moderate	1599	46.28
Severe	466	13.49
Sleep difficulties		
No	1671	48.36
Moderate	1392	40.29
Severe	392	11.35

Source: GSHS 2015

illicit drugs (94.9%). Only a small number of adolescents suffered from severe loneliness (13.5%) and profound sleep difficulties (11.4%) (Table 1).

Significantly older male adolescents than younger female adolescents reported participating in physical activity 1–2, 3–4, 5–6 and 7 days/week. Physical inactivity (0 days/week) was more prevalent among adolescents who consumed a very small amount of FV than those who consumed a large amount. About 9% and 14.3% of adolescents who consumed ≥5 and <1 serving of soft drinks, respectively, reported being physically active 7 days/week. More than 10% of adolescents who smoked and consumed alcohol allocated 7 days/week to physical activity compared to only 8% of those who did not smoke and consume alcohol. The proportions of being physically inactive among illicit drug users and non-users were rather similar. There were differences in the number of adolescents with severe loneliness compared to those without loneliness in participating in physical activity 1–2 (46.3 vs. 48%), 3–4 (10.5 vs. 7.1%), 5–6 (4.3 vs. 2.7%) and 7 days/week (10.3 vs. 8%). Compared to adolescents without sleep difficulties, those who suffered from moderate and severe sleep difficulties tended to report

spending more time on physical activity. Taken together, these significant differences in the prevalence of physical activity supported the use of an ordered probit to shed light on the independent effects of demographic, lifestyle, and mental health variables on the probabilities of engaging in different levels of physical activity (Table 2).

Model 2 had a higher value of Pseudo R-squared and a lower value of AIC compared to Model 1. This indicated that Model 2 should be used to obtain statistical inferences and that loneliness and sleep difficulties were relevant variables and should not be omitted from the regression. Both models did not have multicollinearity given that their maximum VIFs were less than ten [23] (Table 3).

Table 2. Cross-tabulations of demographic, lifestyle, mental health variables and physical activity (n = 3455)

Variables	0	1–2	3–4	5–6	7
Age					
11–12	91	106	11	8	12
	(39.91)	(46.49)	(4.82)	(3.51)	(5.26)
13–14	256	416	76	30	82
	(29.77)	(48.37)	(8.84)	(3.49)	(9.53)
15–16	382	579	92	38	97
	(32.15)	(48.74)	(7.74)	(3.20)	(8.16)
17–18	301	601	105	44	128
	(25.53)	(50.98)	(8.91)	(3.73)	(10.86)
$\chi^2(12)$	32.399				
p-value	0.001				
Gender					
Male	423	740	158	61	215
	(26.49)	(46.34)	(9.89)	(3.82)	(13.46)
Female	607	962	126	59	104
	(32.67)	(51.78)	(6.78)	(3.18)	(5.60)
$\chi^2(4)$	84.857				
p-value	<0.001				
Fruit					
<1	593	921	148	64	174
	(31.21)	(48.47)	(7.79)	(3.37)	(9.16)
1–2	333	603	94	38	95
	(28.63)	(51.85)	(8.08)	(3.27)	(8.17)
3–4	49	88	27	6	20

(*continued*)

Table 2. (*continued*)

Variables	0	1–2	3–4	5–6	7
	(25.79)	(46.32)	(14.21)	(3.16)	(10.53)
≥5	55	90	15	12	30
	(27.23)	(44.55)	(7.43)	(5.94)	(14.85)
$\chi^2(12)$	27.727				
p-value	0.006				
Vegetables					
<1	475	727	102	49	121
	(32.23)	(49.32)	(6.92)	(3.32)	(8.21)
1–2	393	693	113	45	117
	(28.88)	(50.92)	(8.30)	(3.31)	(8.60)
3–4	93	192	45	9	51
	(23.85)	(49.23)	(11.54)	(2.31)	(13.08)
≥5	69	90	24	17	30
	(30.00)	(39.13)	(10.43)	(7.39)	(13.04)
$\chi^2(12)$	47.153				
p-value	<0.001				
Soft drinks					
<1	633	981	154	70	182
	(31.34)	(48.56)	(7.62)	(3.47)	(9.01)
1–2	297	575	87	29	92
	(27.50)	(53.24)	(8.06)	(2.69)	(8.52)
3–4	54	83	18	5	20
	(30.00)	(46.11)	(10.00)	(2.78)	(11.11)
≥5	46	63	25	16	25
	(26.29)	(36.00)	(14.29)	(9.14)	(14.29)
$\chi^2(12)$	48.571				
p-value	<0.001				
Smoking					
Yes	165	330	75	28	86
	(24.12)	(48.25)	(10.96)	(4.09)	(12.57)

(*continued*)

Table 2. (*continued*)

Variables	0	1–2	3–4	5–6	7
No	865	1372	209	92	233
	(31.22)	(49.51)	(7.54)	(3.32)	(8.41)
$\chi^2(4)$	28.505				
p-value	<0.001				
Alcohol					
Yes	118	243	59	23	62
	(23.37)	(48.12)	(11.68)	(4.55)	(12.28)
No	912	1459	225	97	257
	(30.92)	(49.46)	(7.63)	(3.29)	(8.71)
$\chi^2(4)$	24.956				
p-value	<0.001				
Illicit drugs					
Yes	53	82	26	6	11
	(29.78)	(46.07)	(14.61)	(3.37)	(6.18)
No	977	1620	258	114	308
	(29.81)	(49.44)	(7.87)	(3.48)	(9.40)
$\chi^2(4)$	11.602				
p-value	0.021				
Loneliness					
No	476	667	99	37	111
	(34.24)	(47.99)	(7.12)	(2.66)	(7.99)
Moderate	421	819	136	63	160
	(26.33)	(51.22)	(8.51)	(3.94)	(10.01)
Severe	133	216	49	20	48
	(28.54)	(46.35)	(10.52)	(4.29)	(10.30)
$\chi^2(8)$	32.097				
p-value	<0.001				
Sleep difficulties					
No	560	796	113	60	142

(*continued*)

Table 2. (*continued*)

Variables	0	1–2	3–4	5–6	7
	(33.51)	(47.64)	(6.76)	(3.59)	(8.50)
Moderate	360	718	126	48	140
	(25.86)	(51.58)	(9.05)	(3.45)	(10.06)
Severe	110	188	45	12	37
	(28.06)	(47.96)	(11.48)	(3.06)	(9.44)
$\chi^2(8)$	30.754				
p-value	<0.001				

Source: GSHS 2015
Note: The entries refer to counts and row percentages (in parentheses). *p*-values for Pearson's Chi-squared (χ^2) tests. The significance level is $p < 0.05$.

Table 3. Results for ordered probit regression models (n = 3455)

Variables	Model 1	Model 2
Age		
11–12	Ref.	Ref.
13–14	0.276*	0.269*
	(0.086)	(0.086)
15–16	0.183*	0.158*
	(0.083)	(0.084)
17–18	0.320*	0.283*
	(0.083)	(0.084)
Gender		
Male	0.245*	0.251*
	(0.041)	(0.041)
Female	Ref.	Ref.
Fruit		
<1	Ref.	Ref.

(*continued*)

Table 3. (*continued*)

Variables	Model 1	Model 2
1–2	-0.002	-0.003
	(0.043)	(0.043)
3–4	0.075	0.082
	(0.086)	(0.086)
≥5	0.080	0.067
	(0.092)	(0.091)
Vegetables		
<1	Ref.	Ref.
1–2	0.052	0.052
	(0.043)	(0.043)
3–4	0.226*	0.219*
	(0.064)	(0.064)
≥5	0.186*	0.184*
	(0.085)	(0.086)
Soft drinks		
<1	Ref.	Ref.
1–2	0.025	0.021
	(0.043)	(0.043)
3–4	0.001	-0.004
	(0.091)	(0.091)
≥5	0.232*	0.235*
	(0.096)	(0.095)
Smoking		
Yes	0.078	0.065
	(0.054)	(0.054)
No	Ref.	Ref.
Alcohol		
Yes	0.146*	0.134*
	(0.057)	(0.056)
No	Ref.	Ref.
Illicit drugs		
Yes	-0.070	-0.079
	(0.085)	(0.085)

(*continued*)

Table 3. (*continued*)

Variables	Model 1	Model 2
No	Ref.	Ref.
Loneliness		
No	–	Ref.
Moderate	–	0.170*
	–	(0.041)
Severe	–	0.143*
	–	(0.062)
Sleep difficulties		
No	–	Ref.
Moderate	–	0.098*
	–	(0.041)
Severe	–	0.046
	–	(0.065)
Wald test	124.540	151.220
p-value	<0.001	<0.001
Pseudo-R2	0.015	0.018
AIC	8558.341	8538.275
Maximum VIF	4.140	4.180

Source: GSHS 2015

Note: The entries refer to estimated coefficients from ordered probit regression and robust standard errors (in parentheses). The significance level is $p < 0.05$. * $p < 0.05$. Ref. refers to reference groups.

Adolescents aged 17–18, 15–16 and 13–14 years were 4.7, 2.6 and 4.6% more likely to engage in physical activity 7 days/week, respectively, than those aged 11–12 years. They were also 5.4–9.5% less likely to be physically inactive. Males were 1.1–4% more likely to spend 1–2, 3–4, 5–6 and 7 days/week on physical activity than females. The probability of not participating in physical activity was reduced by 6–7.2% if adolescents consumed ≥3 servings of vegetables daily. Adolescents who consumed ≥5 servings of soft drinks daily were 7.6% less likely to be physically inactive than those who did not consume. The probabilities of allocating 1–2, 3–4, 5–6 and 7 days/week to physical activity were 0.5, 1.1, 0.6 and 2.2% higher, respectively, among alcohol drinkers than non-drinkers. Being suffering from moderate or severe loneliness increased the probabilities of engaging in physical activity 1–2, 3–4, 5–6 and 7 days/week by 0.6–1%, 1.2–1.4%, 0.6–0.7% and 2.4–2.7%, respectively. Moderate sleep difficulties were associated with 0.6, 0.8, 0.4 and 1.6% higher probabilities of participating in physical activity 1–2, 3–4, 5–6 and 7 days/week, respectively (Table 4).

Table 4. Correlates demographic, lifestyle, and mental health variables to physical activity (n = 3455)

Variables	0	1–2	3–4	5–6	7
Age					
11–12	Ref.	Ref.	Ref.	Ref.	Ref.
13–14	-0.089*	0.009*	0.022*	0.012*	0.046*
	(0.027)	(0.002)	(0.007)	(0.004)	(0.016)
15–16	-0.054*	0.008*	0.013*	0.007*	0.026*
	(0.028)	(0.004)	(0.007)	(0.004)	(0.014)
17–18	-0.095*	0.012*	0.023*	0.012*	0.047*
	(0.027)	(0.003)	(0.007)	(0.004)	(0.015)
Gender					
Male	-0.086*	0.014*	0.021*	0.011*	0.040*
	(0.014)	(0.003)	(0.004)	(0.002)	(0.007)
Female	Ref.	Ref.	Ref.	Ref.	Ref.
Fruit					
<1	Ref.	Ref.	Ref.	Ref.	Ref.
1–2	0.001	-0.001	-0.001	-0.001	-0.001
	(0.015)	(0.003)	(0.004)	(0.002)	(0.007)
3–4	-0.027	0.004	0.007	0.004	0.013
	(0.028)	(0.003)	(0.007)	(0.004)	(0.015)
≥5	-0.023	0.003	0.006	0.003	0.011
	(0.030)	(0.003)	(0.007)	(0.002)	(0.015)
Vegetables					
<1	Ref.	Ref.	Ref.	Ref.	Ref.
1–2	-0.018	0.003	0.004	0.002	0.008
	(0.015)	(0.002)	(0.004)	(0.002)	(0.007)
3–4	-0.072*	0.005*	0.018*	0.010*	0.039*
	(0.020)	(0.002)	(0.005)	(0.003)	(0.013)
≥5	-0.060*	0.005*	0.015*	0.008*	0.032*
	(0.027)	(0.002)	(0.007)	(0.004)	(0.017)
Soft drinks					
<1	Ref.	Ref.	Ref.	Ref.	Ref.
1–2	-0.007	0.001	0.002	0.001	0.003
	(0.015)	(0.003)	(0.004)	(0.002)	(0.007)

(*continued*)

Table 4. (*continued*)

Variables	0	1–2	3–4	5–6	7
3–4	0.001	-0.001	-0.001	-0.001	-0.001
	(0.031)	(0.006)	(0.008)	(0.004)	(0.014)
≥5	-0.076*	0.004	0.019*	0.011*	0.042*
	(0.028)	(0.003)	(0.008)	(0.005)	(0.019)
Smoking					
Yes	-0.022	0.003	0.005	0.003	0.010
	(0.018)	(0.002)	(0.004)	(0.002)	(0.009)
No	Ref.	Ref.	Ref.	Ref.	Ref.
Alcohol					
Yes	-0.045*	0.005*	0.011*	0.006*	0.022*
	(0.018)	(0.002)	(0.005)	(0.003)	(0.010)
No	Ref.	Ref.	Ref.	Ref.	Ref.
Illicit drugs					
Yes	0.028	-0.006	-0.006	-0.003	-0.012
	(0.030)	(0.008)	(0.007)	(0.004)	(0.012)
No	Ref.	Ref.	Ref.	Ref.	Ref.
Loneliness					
No	Ref.	Ref.	Ref.	Ref.	Ref.
Moderate	-0.058*	0.010*	0.014*	0.007*	0.027*
	(0.014)	(0.003)	(0.003)	(0.002)	(0.007)
Severe	-0.048*	0.006*	0.012*	0.006*	0.024*
	(0.020)	(0.002)	(0.005)	(0.003)	(0.011)
Sleep difficulties					
No	Ref.	Ref.	Ref.	Ref.	Ref.
Moderate	-0.034*	0.006*	0.008*	0.004*	0.016*
	(0.014)	(0.002)	(0.003)	(0.002)	(0.007)
Severe	-0.016	0.002	0.004	0.002	0.007
	(0.022)	(0.003)	(0.005)	(0.003)	(0.011)
Wald $\chi 2$	151.220				
p-value	<0.001				
Maximum VIF	4.180				

Source: GSHS 2015

Note: The entries refer to marginal effects from ordered probit regression and robust standard errors (in parentheses). The significance level is $p < 0.05$. * $p < 0.05$. Ref. refers to reference groups.

4 Discussion

The present study is the first comprehensive study, using nationally representative data that contain a large sample size, to explore demographic, lifestyle and mental health factors associated with levels of physical activity among school-going adolescents in Timor-Leste. The findings of the present study showed that nearly half of the adolescents had a low physical activity level (1–2 days/week) (49.3%) and almost one-third were inactive (0 days/week) (30%). This high prevalence of physical inactivity was comparable to those evidenced in other countries, such as Malaysia, Saudi Arabia, Spain, Switzerland and the US, ranging from 28 to 88.7% [11–13, 24, 25]. Policymakers and stakeholders are therefore suggested to make a concerted effort to promote physically active lifestyles among adolescents throughout the country with a specific focus on students in secondary schools. Urgent action needs to be taken to design a better nationwide student-focused physical activity policy. Public health administrators can collaborate with school authorities on numerous effective nationwide public policies.

The correlation between age and physical activity received extensive attention in past studies. On one hand, [11, 26] using survey data from Switzerland and Malaysia, respectively, found that older adolescents were less likely to indulge in physical activity than their younger peers. Similar conclusions were made by [18], who conducted a scoping review of studies related to adolescent physical activity, and [19], who based their study on Spain. On the other hand, [13] pointed out that older students were more physically active than younger students. A systematic review study by [27] agreed with [13] and emphasized a positive relationship between age and levels of physical activity. Findings from the present study that older adolescents were more likely to be physically active and less likely to be physically inactive than younger adolescents corroborated evidence of [13, 27]. Perhaps this could be due to the fact older adolescents have attended more physical education classes when compared to younger adolescents and consequently are more aware of the benefits of physical activity. A further examination by [28, 29] suggested frequency of attending physical education classes was positively associated with time spent on physical activity as the advantages of being physically active were often highlighted in the classes. An interesting policy implication arises in light of the present study's findings. It is recommended that public health administrators work together with school authorities to introduce a physical activity programme to promote physically active lifestyles among young school-going adolescents, especially those aged below 17 years. Efforts could be made to introduce more sports activities and events in secondary schools.

Previous studies pointed to a significant relationship between gender and physical activity. As evidenced by [12], who based their study on Saudi Arabia, male students in secondary schools generally spent more time on vigorous physical activity compared with females. Drawing from South African data, [30] found similar results. Specifically, male students in rural areas were more physically active when compared to female students. In addition, using Brazil, Spanish and North Carolina data, [16, 19, 20] found females to be less likely to participate in physical activity than males. These findings were reaffirmed by two Malaysian studies that physical activity was more frequent among males than females [31, 32]. The reason cited by [32] was that females tended to be afraid of injuries caused by sports and receive less support from their peers and adults

for physical activity. Time constraints and misperception were another two explanations provided by [29]. It was reasoned that females often allocated more time to household activities than males and thought that physical activity led to a masculine look. Thereby, they were less devoted to physical activity. In the present study, male students were found to be more likely to indulge in a physically active lifestyle than female students, which corroborated the findings of previous studies [12, 30, 32]. This finding implies the possible accomplishment of programmes aimed at improving physical activity levels among school-going female adolescents because the amount of time allocated by this population to physical activity tends to be low. Among the suggested policies included sharing information on how physical activity improves women's health with all female students in secondary schools. For instance, school-based health awareness campaigns aimed at advertising the beneficial effects of physical activity on health outcomes could be held frequently.

The role of diet in physical activity was examined in several past studies. Reference [12], using school-based cross-sectional data, found physical activity to be more regular among male students who had a high intake of FV than those with low intake. Reference [13] studied lifestyle factors associated with physical activity and also suggested a positive relationship between FV consumption and physical activity. Reference [14] used Brazilian data to examine the associations between behavioural factors and physical activity among students in primary schools. They found that diet scores calculated based on the consumption of healthy (e.g., raw vegetables and fresh fruits) and unhealthy foods (e.g., soft drinks and cookies) were positively associated with physical activity. More specifically, adolescents who often consumed FV and avoided soft drinks were likely to be physically active. Reference [15], focusing on school-going adolescents in Malaysia, lent support to previous studies and found that low intake of FV and high consumption of soft drinks were risk factors for physical inactivity. Their finding was rationalised by poor health awareness. Additionally, [17] found that the probability of being physically inactive was higher among students who did not take supplements and breakfast. Surprisingly, however, the present study found that adolescents who often consumed vegetables and soft drinks were more likely to be highly physically active than those with low consumption of vegetables and soft drinks, which was not fully consistent with the evidence from previous studies. It is uncertain why soft drink consumption is positively associated with physical activity, but it can be explored further in an experimental study. Concerning policy implications, it may be worthwhile to put efforts into educating school-going adolescents who have low consumption of vegetables about the advantages of being physically active. Such an intervention focusing on adolescents is suggested to be implemented even from the elementary-school level, especially given the current rise in the prevalence of physical inactivity in adolescents. School authorities are suggested to incorporate in diet-related health programmes several measures that can improve physical activity.

While the relationships between risk behaviours (e.g., smoking, drinking and use of illicit drugs) and physical activity were well-evidenced in previous studies, they were inconclusive. Using a sample from a Spanish university, [13] uncovered that smokers and alcohol drinkers were less likely to live a physically active lifestyle compared to non-smokers and non-alcohol drinkers. In contrast, [14] drawing from Brazilian data

observed that adolescents who consumed cigarettes, alcohol and illicit drugs had higher odds of engaging in physical activity when compared with their peers who did not smoke, drink or use illegal substances. In Malaysia, a study by [15] found a positive relationship between the frequency of smoking and time spent on physical activity, even though it evidenced that alcohol drinkers allocate less time to physical activity than non-drinkers. The interrelations between physical activity and smoking, and alcohol drinking were also observed by [25], who based their study on Peninsular Malaysia. Results of the current analysis that adolescents who consumed alcohol were more likely to be physically active and less likely to be physically inactive compared with their peers who did not consume alcohol were consistent with the findings of [14]. However, the present study's findings did not identify any differences in levels of physical activity between smokers and non-smokers, and between illicit drug users and non-users. Therefore, it seems to be fruitful for public health policymakers and researchers to obtain a better understanding of why non-alcohol drinkers tend to be less active than alcohol drinkers so that a more effective measure directed towards improving physical activity levels among school-going adolescents can be formulated. Nevertheless, public health specialists can devote their attention to promoting a physically active lifestyle among adolescents who do not consume alcohol. Using popular social media, such as Facebook and Instagram to publicize the advantages of being physically active can be given consideration.

To our knowledge, the present study is the first study to examine the effects of loneliness and sleep difficulties on physical activity among school-going adolescents, with findings showing that adolescents who felt moderately or severely lonely were more likely to be physically active than those without loneliness feelings, and adolescents who suffered from mild sleep difficulties had a higher likelihood of practising a physically active lifestyle when compared to their peers who did not encounter any sleep problems. These findings somewhat contradicted those of [9] that stress reduced physical activity. Contradictory findings were also observed by [24], who focused on adolescents in the US, that low self-esteem and depression were risk factors for physical inactivity. The authors further suggested that self-esteem and depression mediated the relationships between parental factors and physical activity in adolescents. A plausible but unverified explanation for our finding is that adolescents who suffer from loneliness and sleep difficulties may use exercise as an additive method to cope with stress, and consequently have a high physical activity level. This suggests that while overcoming adolescent loneliness and sleep deprivation issues remains the main scope of policymakers in Timor-Leste, additional attempts can be made to promote a physically active lifestyle in school-going adolescents without loneliness and sleep difficulties. Physical activity promotion messages could consider emphasising the long-term health benefits of living a physically active lifestyle even without the pre-existence of mental health conditions. These messages can be delivered through mass media which are widely accessed by adolescents. These include television, films and video games. A better understanding of the relationships between physical activity and loneliness, and sleep difficulties can be supplemented by an in-depth qualitative study.

Several limitations of the present study are noteworthy. First, although the dataset used in the present study had comprehensive information about adolescent demographic, lifestyle and mental health profiles, it was collected a few years ago and thus could

not reflect the most recent scenario in Timor-Leste. Second, because of cross-sectional data, the causal impacts of lifestyle and mental health factors on physical activity could not be identified. Third, parental income and education variables were unable to be included in the analyses due to data limitations. Despite these drawbacks, the present study has numerous strengths: (1) The novelty of population. Timor-Leste is a developing country, where the prevalence of adolescent physical inactivity is high and there are only a few studies that examine physical activity among school-going adolescents. (2) Use of nationally representative data with a large sample size to generate important findings which are useful for policy planning and research. (3) Utilization of a strong analytical approach to explore factors associated with different levels of physical activity. (4) Inclusion of several new mental health variables, that are loneliness and sleep difficulties, in the analyses. Therefore, a better understanding of the correlation between mental health and physical activity can be obtained.

5 Conclusion

The findings of the present study provide important information about demographic, lifestyle and mental health factors associated with participation in physical activity among secondary school students in Timor-Leste, which could assist policymakers in formulating a more effective intervention measure directed towards improving school-going adolescent physical activity levels. In the present study, age, gender, vegetable intake, consumption of soft drinks, alcohol drinking, loneliness and sleep difficulties are associated with physical activity. More specifically, adolescents are more likely to be physically active if they are older, males and alcohol drinkers. Physical activity is more frequent among adolescents who consume vegetables and soft drinks than those who do not. Furthermore, adolescents who suffer from loneliness and sleep difficulties tend to have a higher level of physical activity when compared to their peers with good mental health conditions. It can therefore be concluded that demographic, lifestyle and mental health factors are important determinants of physical activity in school-going adolescents. The findings of the present study appear to have significant implications for the Ministry of Health of Timor-Leste. While the present study's findings indicate that intervention measures are essential to generate desirable health outcomes, numerous policy implications are apparent concerning demographic, lifestyle and mental health factors associated with adolescent physical activity patterns in Timor-Leste.

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