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**The relationship between physical activity and mental health among adolescents in six middle-income countries: A cross-sectional study**

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**Abstract**

Both physical inactivity and poor mental health appear to be emerging worldwide youth problems. These two are closely related but the understanding of the relationship between them in middle-income countries is very limited. This secondary data analysis study examined the link between physical activity and adolescent mental health among 23,372 11-17 year-old adolescents in six middle-income countries using the Global School-based Health Survey. Physical activity was assessed by participation in (1) exercise for 60 minutes and (2) walking/biking in any day of a week in the past seven days. Mental health was assessed by the presence of (1) loneliness, (2) anxiety, (3) depression, (4) suicidal ideation, and (5) suicide attempts in the past 12 months. It was found that there was a low prevalence of physical activity among the participants. Only 7.5% and 15.9% of the participants in the Philippines and in Indonesia walked or biked at least once in the past seven days, respectively. Only 16.3% and 34.5% of the participants in China and in Pakistan exercised for more than 60 minutes at least once in a week, respectively. In general, there was a low prevalence of 12-month mental health problems among adolescents (e.g., 7.9% in Thailand reported loneliness, 4.9% in Sri Lanka reported anxiety). The binomial regression analysis showed that the strength and direction of the link between the presence of physical

activity and 12-month mental health issues varied across diverse countries. Further research may incorporate physical activity to promote positive youth mental health for possible cost-effective interventions.

**Keywords**

adolescent, mental health, physical activity, middle income countries

The onset of many mental problems appears before 14 years of age (Jacka *et al.*, 2013; Williams *et al.*, 2002). Early prevention of mental health problems may help develop and sustain good mental health in adulthood. Previous studies have identified that positive mental health in adolescence is associated with high levels of parental monitoring (Lipps *et al.*, 2012), high levels of peer support (Vaughan *et al.*, 2010), positive school climate (Suldo *et al.*, 2012), strong religious beliefs (Bullock *et al.*, 2012), healthy dietary patterns (O'Neil *et al.*, 2014), low levels of drug use and low levels of sexual risk behaviors (Hallfors *et al.*, 2004), low levels of alcohol use (Balogun *et al.*, 2014), low levels of bullying (Borowsky *et al.*, 2013), and high levels of neighborhood collectivity (Browning *et al.*, 2013). Despite these tremendous efforts targeting to mitigate mental health problems, prevalence of poor mental health in adolescence still increases. For instance, suicide and depression are being considered the leading mental health problems in young individuals aged 15-29 (World Health Organization, 2014).

To articulate positive mental health in young people, relatively less-studied factors such as physical activity may be taken into account in research. Physical activity is likely to be one of the prevention strategies which seems to be promising to reduce the likelihood of mental health problems such as depression, anxiety (Callaghan, 2004). Based on the World Health Organization's (2015) recommendations, young people aged 5–17 should exercise at least 60 minutes daily. Most of the daily physical activity should also include indoor or outdoor sports such as aerobic, walking, biking at least 3 times per week which will help demonstrate better health. Concordantly, growing evidence has indicated that greater physical activity may reduce the likelihood of depression and anxiety (Biddle and Asare, 2011; DeMoor *et al.*, 2008; Hallal *et al.*, 2006) and decrease the risk for displaying suicidality in young people (Cho, 2014) in high-

income countries (Camero *et al.*, 2012). For example, a qualitative study suggested that physical activity can contribute to the recovery of adolescent mental health problems in Denmark (Staal and Jespersen, 2015). In contrast to the aforementioned existing empirical evidence in high-income countries, the relationship between mental health and physical activity is a relatively new field with little known in middle-income countries (Patton *et al.*, 2012). There remains a need to extend this work to school-going adolescents in a range of middle-income countries to investigate the physical activity as a possible protective factor against the development of mental health problems in adolescents.

## METHODS

### *Data source and sample*

The Global School-based Health Survey (GSHS), a cross-sectional study, was developed by the World Health Organization (2014) between 2003-2012. This survey aims to measure and assess self-reported student health and risk behaviors, and potential protective factors such as dietary behaviors and mental health, among 11-17 year-old students solely in low- and middle-income countries, a total of 52 countries from Africa (13 countries), the Americas (19 countries), the Eastern Mediterranean region (11 countries), the Western Pacific regions (2 countries), the South-East Asia region (6 countries), and Europe (1 country). Approval for research was granted by the WHO in which ethical approval had been provided by the ministries of education and/or health in each participating country (World Health Organization, 2013).

The GSHS data were sampled in a two-stage framework, first at the school level in each country to select a representative sample of school-going adolescents. Next, at the school level, classes were selected within each school. The students in the chosen classes were invited to

participate in the survey and answered the questions in a pen-and-paper format. The computer scannable answer sheets were collected by survey administrators and coordinators in each country and then sent to the Centers for Disease Control and Prevention in the States. The center then scanned and processed the answer sheets to ensure comparability across participating countries. The school response rate was multiplied by the student response rate producing overall response rate of participating countries (Centers for Disease Control and Prevention, 2013). The sample size was representative of school-going adolescents in participating countries and large enough to further conduct for statistical analyses. The reliability of survey items were also generally accepted as well-established (e.g., Randall, Doku, Wilson, & Peltzer, 2014). However, we should be aware of the fact that the reliability and validity of the GSHS items may vary from one country to another due to the possible cultural and other differences. Additionally, GSHS is utilized and continuously being used in many empirical studies (e.g. Pengpid and Peltzer, 2013; Randall *et al.*, 2014), and yielded good test-retest reliability in many settings and diverse ethnicities such as ethnic Fijian girls (Becker *et al.*, 2010) and Iranian adolescents (Ziaei *et al.*, 2014). All data used in this study are available for public use which can be accessed at <http://www.who.int/chp/gshs/methodology/en/index.html>.

### *Measures*

Based on the existing studies, GSHS can be considered beneficial to measure youth mental health and its associated protective factors such as healthy dietary patterns (Arat 2016), parental/caregiver involvement (e.g., Arat & Wong, 2016; Hasumi, Ahsan, Couper, Aguayo, & Jacobsen, 2012) in low- and middle-income countries. Yet poor youth health, including mental

health problems still continues to rise resulting in higher chances of adolescent mortality in these settings (Viner et al., 2011). Nagata, Ferguson, and Ross (2016) pointed that more research is needed to explore the potential factors (e.g., physical activity) which can ameliorate mental health problems in young people residing in low- and middle-income countries. To fill this gap, we chose the survey items on GSHS, one of the existing reliable empirical assessment tools to measure the association between mental health status and physical activity among young individuals. The variables used in this study are presented as follows:

*The mental health status of the study participants* were assessed with five questions based on students' perceptions: about loneliness ("During the past 12 months, how often have you felt lonely?"), anxiety ("During the past 12 months, how often have you been so worried about something that you could not sleep at night?"), and depression ("During the past 12 months, did you ever feel so sad or hopeless almost every day for 2 weeks or more in a row that you stopped doing your usual activities?"), and suicidal ideation ("During the past 12 months, did you ever seriously consider attempting suicide?"), and suicide attempts ("During the past 12 months, how many times did you actually attempt suicide?"). With respect to loneliness and anxiety, the answers consisted of never, rarely, sometimes, most of the time, or always. In terms of depression, suicidal ideation, and suicide plan, the answers were composed of yes or no. Regarding suicide attempts, the answers were comprised of 0 times, 1 time, 2 or 3 times, 4 or 5 times, or 6 or more times. For overall factors, all categories were dichotomized based on yes (most of the time/always)/no (never, rarely, sometimes, 0 time).

*Physical activity* was measured by two questions, namely, exercising for 60 minutes per day within a week ("During the past 7 days, on how many days were you physically active for a

total of at least 60 minutes per day?), and walking/biking ("During the past 7 days, on how many days did you walk or ride a bicycle to or from school?"). The answers consisted of 0 days, 1 day, 2 days, 3 days, 4 days, 5 days, 6 days, or 7 days. For overall factors, all categories were dichotomized based on yes (1 to 7 days)/no (0 days).

Lastly, the current analysis included other factors which, although theoretically related to mental health and/or physical activity, are not of primary interest and are instead included as control variables. The selection of control variables was also limited to the factors included in the GSHS. These variables were chosen based on the previous studies on secondary data relative to adolescent mental health. These variables consisted of participants' age and gender (Ram, Strohschein, & Gaur, 2014), parental monitoring, close friends, and bullying (Abdirahman, Bah, Shrestha, & Jacobsen, 2012) and insufficient nutrition, in other words, hunger as an indicator of socioeconomic status (Powell, Slater, Chaloupka, & Harper, 2006) independently associated with youth mental health and physical activity.

#### *Data analysis*

Binomial logistic regression analyses were conducted to examine the relationship between physical activity and adolescent mental health. Prior to the logistic regression analyses, a weighting factor was utilized in overall analysis to reflect the likelihood of sampling each participant in each country or city, and, further to reduce bias on differing patterns of non-response (World Health Organization, 2013). The following formula was used to calculate the weighting factor in each country survey where GSHS has been implemented (Rudatsikira *et al.*, 2007) as follows:



$$W = W1 * W2 * f1 * f2 * f3.$$

W1 = the inverse of the probability of selecting the school; W2 = the inverse of the probability of selecting the classroom within the school; f1 = a school-level non response adjustment factor calculated by school size category (small, medium, large). The factor was calculated in terms of school enrollment instead of number of schools; f2 = a school-level non response adjustment factor calculated by class; and f3 = a post stratification adjustment factor calculated by grade.

All variables were re-coded on a dichotomous scale based on the previous studies on the GSHS database (Page, 2009). A multiple imputation method was utilized for variables where the amount of missing data exceed 5 percent to overcome the weakness in analyzing, or preventing any bias, or misinterpretation, and to secure representativeness (Sterne et al., 2009). To prevent estimation bias resulting from the exclusion of these subjects, missing values were replaced with imputed values, using the multiple imputation by the Expectation-Maximization means to employ efficient and unbiased analysis (Graham, 2012). The results of the multiple imputation analysis suggested that the analysis for factors associated with adolescent mental health outcomes did not demonstrate serious bias. According to the multiple imputation analyses, the variables having p-values that were close to or above 0.05 among 43 countries excluded from the current study such as the Philippines  $p=.063$ . On the contrary, the p-values of the aforementioned variables across countries were included such as Guyana  $p=.009$  which was still below 0.05. As a result, only six countries were included which met the Expectation-Maximization criteria. Data analysis was performed using IBM SPSS software.

## RESULTS

This secondary data analysis included and examined 23,372 school-going young people in six middle income countries between the years of 2003 and 2009. The response rates varied from 76% to 99%. Table 1 presents sample size, survey year, and response rates of the participants from the six chosen middle-income countries. The average age of male adolescents was 14.95 (SD=1.12) in China, 15.99 (SD=1.07) in the Philippines, 14.85 (SD=.91) in Indonesia, 14.83 (SD=.97) in Sri Lanka, 14.67 (SD=1.06) in Thailand, and 14.25 (SD=.82) in Pakistan. The average age of female adolescents was 14.79 (SD=1.06) in China, 16.92 (SD=1.06) in the Philippines, 14.85 (SD=.69) in Indonesia, 13.62 (SD=1.01) in Sri Lanka, 13.51 (SD=1.05) in Thailand, and 14.17 (SD=.83) in Pakistan. Male adolescents comprised 42.2 to 75.1% and female participants comprised 24.8 to 57.1% of the whole participating country population.

Table 2 displays the types of physical activities and mental health outcomes of students across different countries in this study. In the Philippines, 52.7% (3723) of those who exercised for 60 minutes reported 11.6% (825) being lonely and 13.6% (994) being anxious. Students in Sri Lanka reported 14.1% (366) walking/biking and 2.2% (821) being depressed.

Table 3 depicts the association between the types of physical activity (exercising for 60 minutes per day within a week and walking/biking) and adolescent mental health variables (loneliness, depression, anxiety, suicidal ideation, and suicide attempts). Lower exercising for 60 minutes per day within a week was associated with a decrease in the likelihood of loneliness in Pakistan [OR: .73, 95% CI: .55, .97], lower likelihood of anxiety in the Philippines [OR: .72, 95% CI: .55, .95], lower odds of depression in China [OR: .65, 95% CI: .49, .85], and higher likelihood of suicide attempts in the Philippines [OR: 1.39, 95% CI: 1.03, 1.86]. Higher walking/biking was correlated with increased odds of loneliness in the Philippines [OR: 1.35,

95% CI: 1.13, 1.62)]. Lower walking/biking was significantly associated with lower odds of loneliness in Sri Lanka [OR: .69, 95% CI: .49, .98)], lower likelihood of anxiety in China [OR: .51, 95% CI: .31, .82)], lower odds of suicidal ideation [OR: .71, 95% CI: .51, .98)] in China. Low levels of walking/biking were correlated with an increase in the likelihood of suicide attempts in Sri Lanka [OR: 1.45, 95% CI: 1.10, 1.93)].

## DISCUSSION

Physical activity appears to facilitate positive mental health outcomes in young population (Mangerud, Bjerkeset, Lydersen, & Indredavik, 2014), based on the existing empirical evidence in the western context (e.g., Brosnahan, Steffen, Lyle, Patterson, & Boostrom, 2004) and high income countries from east (e.g., Ho, Louie, Chow, Wong, & Ip, 2015; Nagata et al., 2016). However, little is known about the possible protective role of physical activity in the prevention of poor mental health among adolescents in middle-income countries. Therefore, this study addresses a largely neglected area of research about the relationship between physical activity and adolescent mental health in middle-income countries. Accordingly, the present study findings fill this important research gap which may be beneficial to guide further research.

### *Prevalence of adolescent physical activity*

This study found that, in general, low prevalence of physical activity was observed across countries and this finding concordances with the fact that 81% of adolescents aged 11-17 years are physically inactive worldwide (World Health Organization, 2015). On the one hand, the

current study findings on adolescent physical activity slightly varied across countries considering that physical activity can differ among socio-cultural settings, religious beliefs or availability of facilities. For example, female Pakistanis are less likely to engage in sports most probably due to the shortage of qualified teachers and facilities, a cultural perception of physical education as a non-educational leisure-time activity, and also strong religious beliefs that appear to withdraw female adolescents from sports (UN Committee on the Elimination of Discrimination against Women, 2015). For instance, based on the Qur'an, physical activity participation of women is prohibited most probably due to too much body expose in front of men while exercising (De Knop, Theeboom, & Wittock, 1996). Similarly, a lack of outdoor playgrounds may contribute to the low prevalence of physical activity in Pakistani youth (Almas *et al.*, 2013).

Another possible reasons of this finding can be relevant to the excessive use of TV or video games (passive games) which are widespread in China (Tudor-Locke *et al.*, 2003a), Thailand (Ar-yuwat *et al.*, 2013; Teerarungsikul *et al.*, 2009), and Sri Lanka (Shriharan *et al.*, 2014) that may lead adolescents to be less physically active (Dutra, *et al.*, 2015; Graves *et al.*, 2007). There are also multiple physical activity programs provided for students that may not meet students' unique needs since those programs are mainly adapted from west in which adolescents can be more prone to engage in some certain types of physical activities (Chotibang *et al.*, 2009). Similarly, there is a low prevalence of physical activity regarding walking or cycling in Filipino adolescents which may be a result of socio-cultural differences considering female Filipino students are less likely to join in-leisure time physical activities than the compulsory physical education (Gems, 2004). In Indonesia, one study found that mode of transportation to school (e.g., bicycle, car, bus, motorcycle) and spending more time indoors

could adversely affect the prevalence rates of physical activity, because children taking part in passive games tend to be less physically active (Collins *et al.*, 2008).

Additionally, recesses are not included in school settings in Sri Lanka (Shriharan *et al.*, 2014) that may limit school-going adolescents' in-leisure time physical activities. Furthermore, there is a high prevalence of exercising for 60 minutes per day within a week in Thai and Filipino adolescents given the primary source of physical activity is considered household chores (Tudor-Locke *et al.*, 2003b). Season could be another significant predictor of young individuals' engagement in physical activities. Children are more likely to join physical activities on dry days rather than rainy weather (Harrison *et al.*, 2015) which may affect the current study findings considering the majority of participating countries (the Philippines, Indonesia, Thailand, and Sri Lanka) are tropical settings mostly consist of rainy days. Another reason could be due to the limited availability of outdoor play areas for adolescents. For instance, one study found that the limited space for play may reduce the prevalence of Hong Kong Chinese children's physical activities (Johns and Ha, 1999). In conclusion, the slight differences were observed between the types of physical activity among different countries which highlight the necessity to investigate the link between physical activity and mental health in young people regarding seasonal and geographical location.

#### *Association between physical activity and mental health*

The results of the present study showed some mixed observations about the risk for poor mental health in terms of depression, loneliness, anxiety, suicidal ideation, and suicide attempts. In other words, the ways in which different types of physical activity result in mental health differed to varying degrees across countries.

Replicating prior literature (Biddle and Asare, 2011; Zobairy *et al.*, 2013), this study found that high levels of exercising for 60 minutes per day within a week were significantly associated with a decrease in the likelihood of anxiety in the Philippines and China. Likewise, this study documented that high levels of exercising for 60 minutes per day within a week also linked to lower odds of loneliness in Pakistan which is consistent with existing research showing that loneliness may reduce physical activity (Hawkey *et al.*, 2009; Steptoe *et al.*, 1996). Especially, participation in team sports may increase the communication between team members reducing the likelihood of loneliness based on a systematic review of Pels and Kleinert (2016) and anxiety (Taliaferro *et al.*, 2008). Therefore, further research may focus on the quality of relationships among individuals in team sports to decrease loneliness and anxiety.

On the contrary, low levels of exercising for 60 minutes per day within a week strongly associated with lower odds of depression in Chinese adolescents which contrasts existing studies (Dopp *et al.*, 2012; Rothon *et al.*, 2010). One of the reasons could be that there may be some differences between types and context of physical activity (e.g., lone and group physical activity) based on the peer-reviewed literature (Birkeland *et al.*, 2009). Team physical activity may be beneficial for social support that can be lacking in those with depicting depressed mood (Toseeb *et al.*, 2014). However, the GSHS lacks data on the context of physical activity so we are unable to investigate this relationship.

One can argue that exercising may reduce the likelihood of suicidality. Present finding does not support this argument, however. High levels of exercising for 60 minutes per day within a week were correlated with an increase in the likelihood of suicide attempts in the Philippines in contrast to other studies which found that exercising may be a protective factor against

suicidality (Cho, 2014; Sibold *et al.*, 2012). There can be sample-specific variation due to other factors not included here due to the GSHS data. For example, while some scholars suggested that suicide attempts can be investigated in terms of excessive exercise which can elevate the risk for suicidality (Lee *et al.*, 2013; Unger, 1997), others noted that the physical contexts of physical activities (e.g., exercising in green environment) may help produce better health (Gladwell *et al.*, 2013).

Apart from the aforementioned findings, this study also found some contradictory observations about the relationship between walking/biking and adolescent mental health outcomes. Low levels of walking/biking were significantly associated with an increase in the likelihood of loneliness in the Philippines. Low levels of walking/biking also resulted in higher odds of suicide attempts in Sri Lankan adolescents. Interestingly, lower walking/biking was correlated with decreased odds of loneliness in Sri Lanka. Unexpectedly, low levels of walking/biking were linked to lower odds of suicidal ideation in China. The present study findings can solely hypothesize about the relationship of between walking/biking and mental health outcomes. This deserves further investigation to tease out other unobserved factors which may lead to diverse mental health outcomes associated with walking/biking. For instance, it could well be that there are other distinctive features which are not measured in the present study due to the GSHS data. Such may explain the controversy findings about the association between physical activity and mental health. The GSHS does not include, for example, any information on social networks or safe neighborhoods. Based on existing studies, the more supportive social networks are available to adolescents, the more they will be willing to engage in physical activities (Kuo *et al.*, 2009). Similar to social networks, safe neighborhoods can predict youth's

participation in physical activity (dos Santos Lopes *et al.*, 2014). These results may inform scholars to incorporate aforementioned factors in future research to foster positive mental health in school-going adolescents.

### LIMITATIONS

Several limitations should be noted in this study. First, data were based on adolescents' self-report on selected variables; this may be subject to underreporting and biased recall. Next, current sample design does not allow for causal inferences. A further potential limitation relates to the mental health questions. Depression, loneliness, and anxiety were assessed by single question which were confined to the GSHS data. While not sufficient for diagnostic purposes, these questions can capture the predictors of clinical depression among adolescents. Moreover, because the study findings were based on school samples only, they will not be representative of out-of-school youth, who may be at increased risk for poor mental health. Additionally, due to the GSHS, socioeconomic status was only assessed by the hunger in this study. In fact, researchers should seek to employ individual levels of SES (e.g., family income) rather than country or regional indicators of SES (e.g., nutrition) since the latter solely considers the inequalities regarding geographical differences (Torsheim, Currie, Boyce, & Samdal, 2004). For example, the inequalities at the country level are more likely to elevate the odds of self-rated poor mental health (Torsheim *et al.*, 2004). Therefore, future studies should target to conduct individual-level of SES in terms of self-rated mental health. Types of physical activity may also be different between rural and urban areas (Joens-Matre *et al.*, 2008). However, the GSHS (2003-2009) was collected based on national levels rather than on a distinct separation between urban or rural areas. Therefore, we cannot focus on the differences between the types of physical



activities in rural and urban settings. Finally, this study did not include specific measures of other factors (e.g., parent modeling, parental education level) that may confound the associations observed between physical activity and mental health problems (Hyoungsook & Kim, 2008). Despite these and other limitations, the current study, based on a large representative sample data set of adolescents from middle-income countries, provided a useful piece of empirical evidence to the existing literature on middle-income countries (Richards *et al.*, 2014) that the role of physical activity on mental health may vary across countries.

### IMPLICATIONS

This study adds to the limited research on the link between adolescent mental health and physical activity in middle-income countries. The outcomes of this study may outline a number of significant implications for future research. First, research, that underpins protective factors of youth mental health embedded in unique socio-cultural contexts, is essential for evidence-based efforts (Sturgeon, 2006). A qualitative approach regarding individual or focus group interviews can be helpful for youth to reveal their own experiences on physical activity embedded in socio-cultural contexts in the way providing rigorousness and accuracy to the study (Wells *et al.*, 2012) given the fact that culture seems to impact young individuals' choices of physical activities (Ramanathan and Crocker, 2009). Further studies regarding both qualitative and quantitative research can also embrace unique socio-cultural contexts of adolescents' physical activity to promote positive mental health (Babakus and Thompson, 2012). Additionally, longitudinal studies of poor mental health can be necessary to conceptualize the etiological pathways from physical activity as one of the protective factors for the promotion of positive mental health in adolescents. Therefore, a more sophisticated measure of adolescent mental health might clarify

the accurate relationship between physical activities and mental health. More importantly, in terms of feasibility, physical activity seems to be cost effective for the articulation of better mental health in youth in high-income countries (Wu, Cohen, Shi, Pearson, & Sturm, 2011). This may also be beneficial for middle-income countries due to possible lacking adequate budget to allocate for research on positive mental health promotion in school-based interventions. In looking forward, the contribution of empirical evidence in utilization of physical activity service provision in school settings may make a significant contribution to the existing literature on the association between physical activity and mental health in middle-income countries.

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Table 1. Response rates and sample size of countries

Country	Survey year	Response rate			Total sample	Boys		Girls	
		Percentage				Age		Age	
		School	Student	Overall *	Number	N (%)	Mean±SD	N( %)	Mean±SD
China	2003	100	99	99	2348	1131(48.2)	14.95±1.12	1208(51.5)	14.79±1.06
Philippines	2003	99	85	84	7338	2961(42.2)	15.99±1.07	4116(57.1)	16.92±1.06
Indonesia	2007	98	95	93	3116	1476(47.5)	14.85±.91	1624(52.1)	14.85±.69
Sri Lanka	2008	100	89	89	2611	1129(43.4)	14.83±.97	1455(55.9)	13.62±1.01
Thailand	2008	100	93	93	2767	1364(49.3)	14.67±1.06	1394(55.9)	13.51±1.05
Pakistan	2009	88	87	76	5192	3892(75.1)	14.25±.82	1285(24.8)	14.17±.83

\* Overall response rate (school response rate multiplied by student response rate)

Table 2. Prevalence of mental health outcomes and physical activity types in schools by country

	China	Philippines	Indonesia	Sri Lanka	Thailand	Pakistan
	Percentage (Number)					
Loneliness <sup>a</sup>	6.7(157)	11.6(825)	8.9(274)	7.3(188)	7.9(217)	12.1(623)
Depression <sup>b</sup>	19.0(442)	44.9(3206)	22.4(695)	32.2(821)	16.7(446)	-
Anxiety <sup>c</sup>	4.6(107)	13.6(994)	7.8(243)	4.9(128)	6.7(186)	8.6(442)
Suicidal ideation <sup>d</sup>	14.4(337)	19.3(1371)	4.7(147)	10.3(261)	8.6(235)	7.3(375)
Suicide attempts <sup>e</sup>	6.8(159)	19.4(1372)	3.7(113)	13.5(345)	10.0(271)	7.5(386)
Exercised for 60 minutes <sup>f</sup>	16.3(381)	52.7(3723)	42.9(1332)	36.0(931)	55.0(1493)	34.5(1770)
Walking/biking <sup>g</sup>	22.7(530)	7.5(528)	15.9(493)	14.1(366)	15.1(427)	15.9(815)

Note: Source: <sup>a-g</sup> Global School-based Health Survey 2003-2008

(<http://www.who.int/chp/gshs/datasets/en/>)



Table 3. Binomial regression analyses of adolescent mental health by country

		Loneliness		Depression		Anxiety		Suicidal ideation		Suicide attempts	
		OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
China											
	Exercised for 60 minutes	.84	.54-1.33	<b>.65</b>	<b>.49-.85*</b>	.74	.44-1.23	.90	.65-1.24	.72	.46-1.12
	Walking/biking	.73	.43-1.13	.81	.61-1.09	<b>.51</b>	<b>.31-.82*</b>	<b>.71</b>	<b>.51-.98*</b>	.75	.48-1.18
Philippines											
	Exercised for 60 minutes	.93	.67-1.29	1.05	.85-1.29	<b>.72</b>	<b>.55-.95*</b>	1.19	.90-1.58	<b>1.39</b>	<b>1.03-1.86*</b>
	Walking/biking	<b>1.35</b>	<b>1.13-1.62*</b>	.97	.87-1.08	.92	.79-1.09	.90	.78-1.04	.98	.84-1.13
Pakistan											
	Exercised for 60 minutes	<b>.73</b>	<b>.55-.97*</b>	-	-	.96	.70-1.33	.96	.70-1.33	1.05	.76-1.44

	Walking/biking	1.08	.88-1.33	-	-	1.20	.94-1.54	.88	.68-1.14	.87	.68-1.12
Indonesia											
	Exercised for 60 minutes	1.08	.73-1.21	.94	.72-1.21	.77	.52-1.12	.85	.51-1.40	.82	.47-1.41
	Walking/biking	.91	.68-1.22	1.08	.89-1.32	1.32	.96-1.81	1.40	.93-2.10	1.58	1.01-2.47
Sri Lanka											
	Exercised for 60 minutes	.81	.51-1.30	.95	.73-1.24	.71	.42-1.19	.77	.52-1.14	.77	.55-1.09
	Walking/biking	<b>.69</b>	<b>.49-.98*</b>	1.05	.87-1.28	1.28	.83-1.95	.99	.73-1.35	<b>1.45</b>	<b>1.10-1.93*</b>
Thailand											
	Exercised for 60 minutes	.75	.48-.116	.81	.59-1.11	.94	.57-1.56	1.07	.67-1.69	1.08	.71-1.65
	Walking/biking	1.11	.80-1.53	1.04	.82-1.32	.94	.66-1.34	.86	.62-1.19	.83	.62-1.12

\* Statistically significant  $p < .05$  as indicated in bold OR: Odds Ratio CI: Confidence Interval

Note: Regression model was adjusted for age, gender, hunger (as a proxy for SES), bullying, parental monitoring, and close friends