The Association of Physical Activity and Healthy Eating Behaviours with Mental Health among Adolescents Aged 13-15 in Indonesia

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Abstract

This quantitative cross-sectional study aimed to analyse the influence of balanced nutrition behaviour, halal food consumption, prayer habits, physical activity, and sedentary behaviour on adolescent mental health and academic achievement. The study involved 249 students aged 13–17 years from SMPN 17 Makassar, using self-administered questionnaires and random sampling. Data were analysed through univariate, bivariate, and multivariate (Binary Logistic Regression) methods using SPSS 20.0. The findings showed that unbalanced nutrition behaviours significantly affected mental health and academic performance. Adolescents who felt hungry due to insufficient food intake were more likely to feel bored (OR 1.78, p=0.04) and have difficulty completing tasks (OR 2.52, p=0.006). Not consuming fruits and vegetables and frequently eating instant noodles were also associated with low academic scores. The consumption of haram food or drinks and the lack of fardhu or sunnah prayers were linked to feelings of loneliness, anxiety, and lower school grades (OR 3.17, p=0.041). Physical inactivity and sedentary behaviour were also significantly correlated with loneliness and academic difficulties. In conclusion, unhealthy lifestyle behaviours independently contribute to poor mental health and low academic achievement. Therefore, school- and family-based interventions are essential to promote healthy, active, and faith-based lifestyles among adolescents.

***Keywords**: Physical activity, balanced nutrition, sedentary behaviour, mental health, academic achievement, adolescence*

INTRODUCTION

Problems related to diet, physical activity, and sedentary behaviour among adolescents represent major public health challenges in the era of globalisation and modernisation. Population-level evidence consistently indicates that adolescents worldwide, including those in Indonesia, fail to meet recommended guidelines for these health behaviours. Consequently, adolescents face both immediate and long-term health consequences, including obesity and type 2 diabetes, increasing their risk of poor health and chronic disease across the life course [1-4].

Beyond physical health consequences, unhealthy behaviours related to diet, physical activity, and screen time have also been associated with adverse mental health outcomes and poorer academic achievement among adolescents. Evidence suggests that optimal nutrition and sufficient physical activity are positively associated with academic performance, whereas excessive recreational screen time, one of the primary sedentary behaviours, has been negatively linked to academic achievement. Furthermore, overweight and obesity have consistently been associated with poorer academic performance. Collectively, these unhealthy behaviours contribute to adverse outcomes not only through direct physiological pathways but

also by undermining educational success, which may subsequently limit socioeconomic opportunities later in life [5-10].

The relationship between health and education also suggests that effective interventions to increase physical activity, healthy eating behaviors, and reduce sedentary behavior in adolescents, such as school-based health promotion, can have direct benefits on health, as well as improve educational attainment, resulting in healthier, more prosperous, and productive next generations. Some school-based health promotion programs have been shown to achieve demonstrated improvements in lifestyle behaviors and academic achievement, but study evidence is scant and further evidence is needed [11-13].

Although each behavior such as; diet, physical activity, and sedentary behavior have been found to have associations with academic achievement and mental health, but previous studies have focused only on those who are overweight or obese, and have focused only on sedentary behaviors related to screen time. Therefore, this study aims to complement and extend this limited study, to investigate independent associations of balanced nutrition behaviors (not just dietary but overall balanced nutrition lifestyles), physical activity, and sedentary behaviors broadly, to mental health and academic achievement [6].

This will be the first study to use a representative sample of early adolescents, particularly in South Sulawesi. The findings are expected to be used to inform population-level interventions to prevent and reduce the prevalence of unbalanced nutrition behaviors, physical inactivity, and adolescent sedentary behavior in preventing mental health disorders and low adolescent academic achievement. The results of this study are also expected to be the basis for proving the importance of nutrition education for adolescents in schools.

METHODS

Type, Location and Time of Research

This study is a quantitative study with *a cross-sectional* study method. Questionnaires or questionnaires will be given to students in grades 7-9 (aged 13-15 years), then they fill out questionnaires *(self-administrated questionnaires)* with the supervision of researchers. This research will be conducted at SMPN.17 Makassar, in July-November 2022.

Research Variables and Instruments

This research instrument or questionnaire uses questionnaires from the *Global School-Based Health Survey* (GSHS) 2017 initiated by the *World Health Organization*, UNICEF, CDC and the Ministry of Health of the Republic of Indonesia. GSHS is a school-based survey, which uses questionnaires *(self-administrated)* to obtain data on adolescent health behaviors and protective factors associated with the leading causes of morbidity and mortality in adolescents in schools worldwide. Category grouping refers to several articles that use this secondary data [14][1][15].

Balanced Nutrition Behavior and consumption of halal food/beverages

Data collection for balanced nutrition behavior in this study used 10 questions (*multiple choice)* that measured weight behavior, with the question "In the last 12 months, have you taken any weight and height measurements? Yes and no answers. Eating habits in the last 30 days (consumption of fruits, vegetables, soft drinks / packaged / high sugar) with the answer choice 'never up to 5 or more times a day'. This option will then be categorized if answering '2 times - 5 times or more' in a day is categorized as 'healthy behavior', and the answer 'never and 1 time a day' is categorized as 'unhealthy behavior'.

For habitual drinking of soda, the opposite category. For fast food eating habits, and instant noodles, asking about eating habits in the last 7 days, the answer choice '0 days- 7 days', categorized as "risky behavior" if consuming '≥3 days', answer '<2' categorized as 'healthy behavior'. For breakfast habits, and the habit of eating at stalls or in the school cafeteria, the answer choice 'never – always', is categorised if answering 'never/rarely/sometimes' as 'healthy behavior', answering 'often or always' as 'risky behavior'. As well as asking, what is consumed (eat / drink) at breakfast.

The habit of consuming halal food or drinks or with the halal logo the answer choice 'never – always', is categorized if answering 'never' as 'halal consumption behavior', answering 'rarely/sometimes/often/always' as 'halal non-consumption behavior'.

Physical activity and worship

Physical activity was measured by 3 questions asking the habit of doing physical activity in the last 7 days with the answer choice '0-7 days', categorized as 'active' if answering '≥ 5 days', 'inactive' if answering '0-4 days'. Also, physical activity related to worship, with the answer choice '0-7 days', categorized as 'active worship' if answering '≥ 5 days', 'inactive' if answering '0-4 days'.

Sedentary behavior

Sedentary behaviours were measured using 1 question, 'how long do you spend in a day sitting or lying down, watching TV, playing games on your phone/tablet/PS, playing social media, or sitting with your friends *(outside of school hours or assignments)'* The answer choice 'less than 1 hour per day – more than 8 hours a day', is categorized as 'sedentary' if the answer is '3-8 hours a day', and 'not sedentary' if it is '≤1 hour - 2 hours a day'.

Mental Health

Adolescent mental health status was measured using 7 questions asking about *feelings* and friendships in the past 12 months. The answer choice 'never – always', categorized as 'mentally healthy' if the answer is 'never and rarely', 'mentally unhealthy' if it is 'sometimes, often and always'.

Academic achievement

Students self-report their academic performance by answering the following questions: 'Have you ever had difficulty with schoolwork or homework', the answer choice 'never- always', categorized as having 'good' academic ability if answering 'never and rarely', 'less' if answering 'sometimes, often and always'. Also, report the average grade of the last semester and the highest grade. With the answer option 'Value: 90-100 (A), Grade: 75-89 (B), Grade: 60-74 (C), Value: Below 59 (D-E)'. Categorized as 'achiever' if answering 'A and B' and 'not achiever' if answering 'C-E'.

Population and Sample

The population of respondents in this study are early adolescents aged 13-15 years who are in junior high school (SMP) in Makassar City. The research location is in SMPN. 17 Makassar which has a total of 1094 students, consisting of 577 female students and 517 male students. Sample selection using total sampling technique for 2nd grade junior high school teenagers, with a total sample of 251 students.

Data Analysis

The data analysis used is univariate analysis to analyze the distribution and frequency of each variable (independent and dependent). Bivariate analysis to analyze the influence of independent and dependent variables, and multivariate analysis (*binary logistic rgeression*) to calculate *OR (Odds Ratio*) or association of exposure (risk factors) of balanced nutrition behavior, physical activity and sedentary behavior with mental health events and academic achievement. The data analysis software used is SPSS 20.0.

Research Ethics

The researcher will provide *informed consent* for the student's parents or guardians before collecting data. Supervision from researchers and teachers will be carried out in the data collection process. Researchers will also submit research ethics to the authorized institution, namely the Ethics Commission of the Indonesian Muslim University.

RESULTS

Table 1. Characteristics of Respondents

Variable		n	%
Characteristics (N=251)			
Gender	Man	127	50,6
	Woman	124	49,4
Age	12	15	6
	13	187	74,5
	14	49	19,5
Balanced Nutrition Behavior (N=251)			
Habits of Measuring Weight	Not	90	35,9
	Yes	161	64,1
Feeling hungry because you don't eat enough at home	Not	49	19,5
	Yes	202	80,5
Fruit Consumption	Not	178	70,9
	Yes	73	29,1
Vegetable Consumption	Not	116	46,2
	Yes	135	53,8
Consumption of Soft Beverages/Canned/Packaged	Not	132	52,6
	Yes	119	47,4
Fast Food Consumption	Not	191	76,1
	Yes	60	23,9
Instant Noodle Consumption	Not	145	57,8
	Yes	106	42,2
Breakfast/ Breakfast	Not	110	43,8
	Yes	141	56,2
Eat / Drink Before School	Not	103	41
	Yes	148	59
The habit of buying food outside / stalls	Not	50	19

outside the school	Yes	201	80,1
Physical Activity (N=251)			
Physical Activity for 60 Minutes (minimum in 5 days)	Not	213	84,9
	Yes	38	15,1
Cycling/ Walking to School	Not	179	71,3
	Yes	72	28,7
Sedentary Behavior			
Seated/lying activities; watchTV, play games, play cellphone/tablet/computer or sit down to tell stories =>3hours/day	Not	78	31,1
	Yes	173	68,9
Mental Health (N=251)			
Feeling lonely	Not	110	43,8
	Yes	141	56,2
Anxiety and difficulty sleeping at night	Not	142	56,6
	Yes	109	43,4
Planning to End Your Life	Not	194	77,3
	Yes	57	22,7
Feeling bored with life	Not	142	56,6
	Yes	109	43,4

Table 1 shows the characteristics of respondents and the distribution of respondents for each research variable. The number of adolescent girls and boys is almost the same, with the number of men is 127 (50.6%), dominated by adolescents aged 13 years (74.5%) and Muslims as much as 246 (98%).

For balanced nutrition behavior, adolescents who have the habit of measuring weight are as many as 161 (64.1%), always/often/sometimes feel hungry because there is not enough food at home which is as much as 202 (80.5%). Consumption of fruits and vegetables ≥ 2 times a week as much as 73 (29.1%) and 135 (53.8%). Consumption/drinking of soft drinks/cans/packaging 119 (47.4%). Consumption of fast food and instant noodles was 60 (23.9%) and 106 (42.2%). Adolescents who have breakfast or breakfast habits and eat or drink before school are 141 (56.2%) and 148 (59%). Also, the habit of buying food outside school as much as 201 (80.1%).

The habit of physical activity for 60 minutes at least 5 days a week, obtained only 38 (15.1%) adolescents who are active and 72 (28.7%) cycle / walk to school. Meanwhile, for sedentary behavior as many as 173 (68.9%) adolescents. Furthermore, adolescent mental health conditions were obtained, adolescents who always/often/sometimes experience loneliness were as many as 141 (56.2%), felt anxious and had difficulty sleeping at night as much as 109 (43.8%). As many, 27 (22.7%) who in the last 12 months of the year had planned to end their lives. Also, as many as 109 (43.4%) adolescents feel bored with their lives.

Table 2. The Relationship of Unbalanced Nutritional Behavior, Physical Inactivity and Sedentary Behavior to Mental Health

Variable		*Mental Health*																			
		Aloneness					Anxious					Suicide Planning					Tired of Life				
		No (n)	%	Yes (n)	%	*P*	No (n)	%	Yes (n)	%	*P*	No (n)	%	Yes (n)	%	*P*	No (n)	%	Yes (n)	%	*P*
Characteristics (N=251)																					
Gender	Man	72	56,7	55	43,3	**0,001**	81	63,8	46	36,2	**0,02**	110	86,6	17	13,4	**0,001**	92	72,4	35	27,6	**0,001**
	Woman	38	30,6	86	69,4		61	49,2	63	50,8		84	67,7	40	32,3		50	40,3	74	59,7	
Age (years)	12	6	40	9	60	0,385	9	60	6	40	0,73	13	86,7	2	13,3	0,665	9	60	6	40	0,836
	13	78	41,7	109	58,3		103	55,1	84	44,9		145	77,5	42	22,5		105	56,1	82	43,9	
	14	25	52,1	23	47,9		29	60,4	19	39,6		35	72,9	13	27,1		27	56,3	21	43,8	
	15	1	100	0	0		1	100	0	0		1	100	0	0		1	100	0	0	
Balanced Nutrition Behavior (N=251)																					
Habits of Measuring Weight	Not	66	41	95	59	0,227	82	50,9	79	49,1	**0,016**	123	76,4	38	23,6	0,651	96	59,6	65	40,4	0,192
	Yes	44	48,9	46	51,1		60	66,7	30	33,3		71	78,9	19	21,1		46	51,1	44	48,9	
Fruit Consumption	Not	67	47,2	75	52,8	0,221	84	59,2	58	40,8	0,346	115	81	27	19	0,111	86	60,6	56	39,4	0,146
	Yes	43	39,4	66	60		58	53,2	51	46,8		79	72,5	30	27,5		56	51,4	53	48,6	
Vegetable Consumption	Not	81	45,5	97	54,5	0,402	100	56,2	78	43,8	0,844	137	77	41	23	0,848	103	57,9	75	42,1	0,519
	Yes	29	39,7	44	60,3		42	57,5	31	42,5		57	78,1	16	21,9		39	53,4	34	46,6	
Consumption of Soft Beverages/Canned/Packaged	Not	52	44,8	64	55,2	0,767	69	59,5	47	40,5	0,389	87	75	29	25	0,422	60	51,7	56	48,3	0,151
	Yes	58	43	77	57		73	54,1	62	45,9		107	79,3	28	20,7		82	60,7	53	39,3	

Fast Food Consumption	Not	57	43,2	75	56,8	0,829	82	62,1	50	37,9	0,062	106	80,3	26	19,7	0,23	75	56,8	57	43,2	0,934
	Yes	53	44,5	66	55,5		60	50,4	59	49,6		88	73,9	31	26,1		67	56,3	52	43,7	
Instant Noodle Consumption	Not	84	44	107	56	0,093	110	57,6	81	42,4	0,562	152	79,6	39	20,4	0,122	109	57,1	82	42,9	0,778
	Yes	26	43,3	34	56,7		32	53,3	28	46,7		42	70	18	30		33	55	27	45	
Breakfast	Not	74	51	71	49	**0,007**	87	60	58	40	0,2	115	79,3	30	20,7	0,372	86	59,3	59	40,7	0,306
	Yes	36	34	70	66		55	51,9	51	48,1		79	74,5	27	25,5		56	52,8	50	47,2	
Eat/Drink before school	Not	45	40,9	65	59,1	0,411	54	49,1	56	50,9	**0,035**	77	70	33	30	0,15	48	43,6	62	56,4	0
	Yes	65	46,1	76	53,9		88	62,4	53	37,6		177	83	24	17		94	66,7	47	33,3	
Physical Activity (N=251)																					
Physical activity for 60 minutes (minimum 5 days)	Not	83	46,4	96	53,6	0,2	104	58,1	75	42,9	0,442	140	78,2	39	21,8	0,583	102	57	77	43	0,836
	Yes	27	37,5	45	62,5		38	52,8	34	47,2		54	75	18	25		40	55,6	32	44,4	
Cycling/ Walking to School	Not	94	41,8	131	58,2	0,55	127	56,4	98	43,6	0,903	177	78,7	48	21,3	0,126	125	55,6	100	44,4	0,338
	Yes	16	61,5	10	38,5		15	57,7	11	42,3		17	65,4	9	34,6		17	65,4	9	34,6	
Fardhu/sunnah prayer (=>5 times a day)	Not	98	43,9	125	56,1	0,913	126	56,5	97	43,5	0,949	171	76,7	52	23,3	0,516	128	57,4	95	42,6	0,457
	Yes	12	42,9	16	57,1		16	57,1	12	42,9		23	82,1	5	17,9		14	50	14	50	
Sedentary Behavior																					

Seated/lying activitie; watchTV, games,	Not	40	51,3	38	48,7	0,11	50	64,1	28	35,9	0,106	60	76,9	18	23,1	0,926	52	66,7	26	33,3	**0,03**

Table 3. Effects of Unbalanced Nutritional Behavior, Physical Inactivity and Sedentary Behavior on Mental Health

Variable	Mental Health															
	Aloneness				Anxious				Suicide Plan				Tired of Life			
	OR	95% CI		P	OR	95% CI		P	OR	95% CI		P	OR	95% CI		P
Unbalanced Nutritional Behavior (N=251)																
Feeling hungry because you don't eat enough at home	1,344	0.773-	2,338	0,294	1,225	0.711-	2,141	0,477	1,872	0.963-	3,641	0,064	**1,78**	**1.998-**	**3,172**	***0,04**
No Fruit Consumption	1,273	0.673-	2,406	0,458	0,965	0.509-	1,829	0,912	0,98	0.453-	2,123	0,96	1,72	0.883-	3,351	0,111
No Vegetable Consumption	1,139	0.638-	2,033	0,66	1,322	0.736-	2,373	0,351	0,932	0.468-	1,859	0,842	0,71	0.389-	1,297	0,265
Consumption of Soft Beverages/Canned/Packaged	1,024	0.589-	1,781	0,933	1,65	0.942-	2,892	0,08	1,349	0.691-	2,636	0,381	1,206	0.677-	2,147	0,525
Fast Food Consumption	1,182	0.612-	2,283	0,619	1,484	0.768-	2,868	0,24	1,926	0.919-	4,033	0,082	1,591	0.809-	3,128	0,178
Instant Noodle Consumption	1,142	0.203-	3,812	0,501	1,27	0.719-	2,245	0,41	1,468	0.752-	2,865	0,26	1,315	0.729-	2,372	0,363
No Breakfast/Breakfast	1,011	0.544-	1,874	0,976	0,652	0.352-	1,207	0,173	0,68	0.333-	1,386	0,288	**1,518**	**0.279-**	**1,961**	***0,037**
Buying Food outside / stalls outside the school	0,719	0.346-	1,493	0,376	0,517	0.248-	1,08	0,079	1,081	0.459-	2,546	0,858	1,444	0.21-	1,94	0,134
Physical Inactivity (N=251)																
Not physically active for 60 minutes (minimum 5 days)	**1,325**	**1.523-**	**2,417**	***0,013**	1,321	0.612-	2,848	0,478	2,097	0.899-	4,889	0,116	1,441	0.659-	3,15	0,36
No cycling / walking to school	1,155	0.611-	2,184	0,657	0,988	0.522-	1,868	0,969	1,123	0.528-	2,389	0,763	0,644	0.335-	1,24	0,188
Sedentary Behavior ((N=251)																
Seated/lying activities; watchTV, games, play Mobile / Tablet / Computer or sit down to tell a story	**1,333**	**1.737-**	**2,412**	***0,042**	1,506	0.819-	2,77	0,187	1,079	0.524-	2,221	0,836	1,604	0.858-	2,999	0,139

Table 2 results of bivariate analysis obtained a relationship between unbalanced nutritional behavior (often / always consume instant noodles) with difficulty doing tasks with a p-value of 0.003; there was a relationship between breakfast or breakfast and mental health problems (loneliness) with a p-value of 0.007; there was a relationship between consumption of illicit food with anxiety, suicide plans and boredom of living with a p-value of <0.05; and there is a relationship between sedentary behavior and feeling bored with living with a p-value of 0.003.

Table 3 of the results of binary logistic regression analysis is obtained; the influence of unbalanced nutritional behavior (feeling hungry because not eating enough at home) with feeling bored living OR 1.78 (95% CI 1.998-3.17) p-value 0.04; the influence of unbalanced nutritional behavior (feeling hungry because they do not eat enough at home) with difficulty doing tasks OR 2.52 (95% CI 1.304-4.856) p-value 0.006; the influence of nutritional behavior is not balanced (not consuming fruit) with a low value of OR 1.68 (95% CI 1.287-2.616) p-value 0.03; the influence of unbalanced nutritional behavior (not consuming vegetables) with difficulty doing tasks OR 2.67 (95% CI 1.027-3.897) p-value 0.042; the influence of unbalanced nutritional behavior (consuming instant noodles) with a low value of OR 1.62 (95% CI 1.299-2.293) p-value 0.011.

For the behavior of consumption of haram food and beverages and the habit of praying obtained there was an effect of consumption of haram food by feeling lonely OR 1,181 (95% CI 1,048-1.68); the influence of illicit drinking behavior by feeling bored living OR 1.43 (95% CI 1.13-2.42) p-value 0.036 and low value OR 1.36 (95% CI 1.127-1.919) p-value 0.026; there was an effect of consuming food without halal logos on feeling anxious OR 1.403 (95%CI 1.682-2.89) p-value 0.026; there is an effect of Not Praying Fardhu/sunnah (=>5 times a day) on low school grades OR 3.17 (95%CI 1.189-8.45) p-value 0.041.

Furthermore, the problem of physical inactivity was obtained by the effect of physical inactivity (for 60 minutes - at least 5 days a week) by feeling lonely OR 1,325 (95%CI 1,523-2.42) and low OR values of 1.21 (95%CI 1,471-3,123). Also, the sedentary behavior obtained had an influence on the difficulty of doing the task OR 1.76 (95%CI 1.901-3.422) and a low value of OR 1.33 (95%CI 1.613-2.887) with a p value of <0.005.

DISCUSSION

In adolescents in this study, we found that adolescents who spent fewer days achieving or doing adequate physical activity, not legalizing five times, adolescents with frequent hunger habits and not eating breakfast, and eating and drinking that were haram or did not have halal logos, were positively associated with mental health problems.

The effect of unbalanced nutrition consumption on mental health

Nutrition is one of the important factors that determine the level of health and compatibility between physical and mental development. Other studies also reveal that, if children experience malnutrition, then the negative impacts that will arise are slow body growth, increased susceptibility to disease, decreased intelligence levels, and mental disruption of children. Other studies also say that if children experience poor nutrition, children will easily suffer from mental errors, difficulty concentrating, low self-esteem, and low learning achievement. So it can be said that good nutrition can make children's mental health good, while poor nutrition can cause mental health problems in children, which are caused by factors of poverty and less income so that children rarely get proper nutrition [16][17].

The effect of physical activity on mental health

Physical activity has been found to have a significant impact on the mental health of adolescents. Numerous studies have shown that engaging in regular physical activity can improve mental well-being, reduce symptoms of mental health disorders, and improve overall mental health outcomes in adolescents. The relationship between physical activity and mental health among adolescents is complex and multifaceted, with physiological, psychological, and social factors influencing the outcomes. This discussion will explore the literature on physical activity and mental health among adolescents, highlighting the benefits of physical activity, the mechanisms underlying this relationship, and the implications for promoting mental health in this population.

Physical activity has been consistently linked to improved mental health outcomes among adolescents. Regular physical activity is associated with lower levels of stress, anxiety, and depression in adolescents [18]. For example, a study found that adolescents who engaged in regular physical activity had lower stress levels than those who were inactive. Similarly, another study reported that adolescents who participated in physical activity programs had reduced symptoms of anxiety and depression [19]. These findings highlight the potential of physical activity as a protective factor against mental health problems in adolescents.

Physical activity has also been shown to improve cognitive function and academic performance, which can positively impact mental health outcomes in adolescents. Several studies have demonstrated that physical activity can enhance adolescents' cognitive processes, such as attention, memory, and problem-solving skills. For example, a meta-analysis conducted by Hillman et al. (2019) found that physical activity interventions positively affected cognitive function in children and adolescents [20]. These cognitive benefits of physical activity can translate into better academic performance, associated with improved mental health outcomes [21]. Therefore, physical activity can promote positive mental health outcomes among adolescents by improving cognitive function and academic performance.

The mechanisms underlying the relationship between physical activity and mental health among adolescents are complex and involve various physiological, psychological, and social factors. One of the key physiological mechanisms is the release of endorphins during physical activity, which are known to have mood-enhancing effects [22]. Endorphins are naturally occurring chemicals in the brain that act as neurotransmitters and are associated with feelings of happiness and well-being. Physical activity has been shown to increase the release of endorphins, which can help reduce symptoms of stress, anxiety, and depression in adolescents [22]. Moreover, physical activity has been found to increase the production of brain-derived neurotrophic factor (BDNF), a protein that promotes the growth and survival of neurons and has been linked to improved mood and cognitive function in adolescents [23].

In addition to the physiological mechanisms, psychological and social factors play a significant role in the relationship between physical activity and mental health among adolescents. Engagement in physical activity can provide opportunities for social interaction, social support, and a sense of belonging, which are important protective factors for mental health in adolescents [24]. Adolescents who participate in team sports or group physical activities may experience increased social connectedness and social integration, which can contribute to improved mental well-being [25]. Moreover, physical activity can help adolescents develop self-esteem, self-efficacy, and a sense of accomplishment, positively influencing their mental health outcomes [26]. Adolescents who engage in physical activity and experience positive changes in their body image and self-perception are more likely to have better mental health outcomes, including reduced symptoms of anxiety and depression [27].

Furthermore, physical activity can act as a coping strategy for adolescents, helping them manage stress and negative emotions. Engaging in physical activity effectively allows adolescents to regulate their emotions and cope with stress [21].

It is important to note that the relationship between physical activity and mental health among adolescents is bidirectional. While physical activity can positively influence mental health outcomes, mental health can also affect physical activity engagement in adolescents. Additionally, mental health issues such as depression and anxiety can negatively impact the motivation and enjoyment of physical activity, leading to reduced engagement [28]. Therefore, addressing mental health concerns in adolescents is crucial in promoting physical activity engagement and reaping its mental health benefits.

Considering the compelling evidence on the positive relationship between physical activity and mental health in adolescents, promoting physical activity should be considered a vital strategy for promoting mental health in this population. Interventions that aim to increase physical activity engagement among adolescents can have significant mental health benefits. For instance, school-based physical activity programs, community-based sports programs, and structured exercise interventions are effective in promoting physical activity and improving mental health outcomes in adolescents [24] . These interventions can provide opportunities for adolescents to engage in regular physical activity, experience the physiological, psychological, and social benefits associated with it, and improve their mental well-being.

In addition to formal interventions, creating a supportive environment that encourages and facilitates physical activity among adolescents can also have a significant impact on mental health outcomes. Family support, peer support, and access to safe and convenient physical activity opportunities can all influence adolescents' physical activity behavior and mental health [24]. Parents, schools, and communities can play a crucial role in promoting physical activity among adolescents by providing resources, support, and encouragement for physical activity engagement.

In conclusion, the relationship between physical activity and mental health among adolescents is well-established in the literature. Engaging in regular physical activity has been shown to have numerous mental health benefits for adolescents, including reduced symptoms of stress, anxiety, and depression, improved cognitive function and academic performance, and enhanced social connectedness and self-perception. The physiological, psychological, and social mechanisms underlying this relationship are complex and interrelated, involving the release of endorphins, the production of BDNF, social interaction and support, self-esteem, and coping strategies. Interventions that promote physical activity among adolescents can have significant mental health benefits, and creating a supportive environment that encourages physical activity engagement is also crucial. Therefore, promoting physical activity should be considered an essential component of promoting mental health among adolescents.

The effect of sedentary behavior on mental health

Sedentary lifestyle may increase the risk of depression due to lack of direct communication and lack of social interaction, or lack of time for physical activity that helps prevent and treat depression. Passive sedentary behaviors such as watching television, sitting, listening to music, and sitting chatting are at risk of depression compared to reading books or newspapers, driving, meetings, and knitting or sewing. Watching television for too long will have a risk of 1.13 times depression, while prolonged use of the internet or computer will risk 1.22 times depression. Depressive symptoms increased 3-fold in women with sedentary lifestyle than

men. Women with sedentary lifestyle behavior >7 hours per day will increase compared to women with sedentary lifestyle behavior <4 hours per day [29][30].

CONCLUSIONS

In the teens in this study, we found that inactive teens, teens with frequent hunger and no breakfast habits, eating and drinking haram or those without halal logos were positively associated with mental health problems. Also, adolescents who spend fewer days achieving adequate physical activity, invalid five times, adolescents with frequent hunger habits, less consumption of vegetables and fruits, frequently / always consume instant noodles, and consumption of illicit drinks, are positively associated with low academic achievement and difficulty doing schoolwork.

Suggestion

Health promotion interventions for the prevention of *unhealthy behaviours* in adolescents, school-based and family environments, are also needed to present potential opportunities to support mental health and academic achievement among children and early adolescents. Researchers suggest future studies investigating these associations should use objective measures and a longitudinal approach to better understand the potential causal relationship between *unhealthy behaviours on* mental health and academic achievement, as well as investigate the potential mediating and moderating of the association between various factors and academic achievement.

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Declaration of Conflicting Interest

The author(s) have stated that there is no possible conflict of interest.

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