PHYSICAL ACTIVITY AND MENTAL HEALTH. IS ACHIEVING THE PHYSICAL ACTIVITY GUIDELINES ASSOCIATED WITH LESS DEPRESSIVE SYMPTOMS AMONG UNDERGRADUATES AT THE UNIVERSITY OF TURKU, FINLAND?

Walid El Ansari[1, 2, 3, 4], **Abdul Salam**[5]

[1]Department of Surgery, Hamad General Hospital, Doha, Qatar
[2]College of Medicine, Qatar University, Doha, Qatar
[3]Weill Cornell Medicine, Doha, Qatar
[4]School of Health and Education, University of Skövde, Skövde, Sweden
[5]Department of Epidemiology and Biostatistics, King Fahad Specialist Hospital, Dammam, Saudi Arabia

SUMMARY

Objectives: Virtually no previous research assessed physical activity (PA) of university students in Finland, and their associations with depressive symptoms, whilst simultaneously controlling for potential confounders.

Methods: Students at the University of Turku (1,177) completed an online health and wellbeing questionnaire that assessed depressive symptoms (22 items), as well as their achievement of the guidelines of four forms of low, moderate, vigorous, and muscle strengthening PA (LPA, MPA, VPA, MSPA, respectively). We explored the associations of depressive symptoms with these PA forms, accounting for socio-demographic and health confounders (age, gender, year of study, marital status, accommodation during semesters, self-rated health).

Results: Achievement of PA guidelines was generally low for these young adult Finnish undergraduates. Bivariate relationships (no controlling for confounders) between depressive symptoms and four forms of PA guidelines achievement showed that in males, good/very good/excellent self-rated health, and achievement of the MSPA guidelines were significantly negatively associated with depressive symptoms. Conversely, low PA was significantly positively associated with depressive symptoms. Multiple regression (controlling for confounders) showed that achievement of the MSPA guidelines was independently significantly negatively associated with depressive symptoms; and whilst achievement of the MPA and VPA guidelines was negatively associated with depressive symptoms, the relationships did not reach statistical significance. Likewise, low PA was positively associated with depressive symptoms, but the relationships were again not statistically significant.

Conclusion: Universities would benefit from multipronged strategies and approaches employing effective interventions aimed at improving students' general awareness of their health and promoting more physically active lifestyles among students.

INTRODUCTION

The high risk of depressive symptoms among university students is a worldwide concern. In the USA, 8% and 9.3% of students screened positive for depression at the beginning and middle of the year (1); and the prevalence of any depressive or anxiety disorder was 15.6% for undergraduates and 13.0% for graduate students (2). In the UK and Hong Kong, respectively, 10% of students had mild to moderate depression, and 9% had moderately severe to severe depressive symptoms (3, 4). Likewise, depressive symptoms were more prevalent in Eastern than Western Europe (modified Beck Depression Inventory, M-BDI scores ≥ 35 suggesting depressive symptoms, Germany 26.7/22.8%, Denmark 24.9/12.1%, Poland 45.5/27.3%, Bulgaria 42.9/33.8% for female/male students, respectively) (5). Similarly, 20.6% of students in the UK had M-BDI depression score > 5th quintile (6). Elsewhere, students reported depressive moods during the academic year (7).

Among university students, physical activity (PA) has relationships with depressive symptoms, and vigorous PA may help students reduce depressive symptoms (8). For instance, in Hong Kong, those regularly exercising had fewer depressive symptoms (4); and in the UK, students with high PA had the lowest depression, whilst those with low PA had the highest depression levels (3). In the USA, students meeting PA guidelines reported lower depression than those not meeting PA guidelines (p = 0.02) (9). Conversely, as sitting hours increased, students' depression sig-

nificantly increased despite controlling for confounders (10). The level of PA seems to also matter, while leisure time PA (LTPA) level was not associated with psychiatric comorbidities among depressed patients, however, the higher the LTPA level was, the less the participants suffered from depressive symptoms (11).

Among university students, several variables are associated with PA and also with depressive symptoms and/or stress. Gender, living situation and year of university study may influence students' PA behaviours (12). Vigorous PA (VPA) and moderate PA (MPA) significantly predicted depression for males but not females (8), and depressive symptoms differed by gender (13). As for year of study and age, fifth-semester students had more depression than their second-semester counterparts (14). In terms of self-rated health, others (15) have suggested links between PA and decreasing depressive symptoms among young women, independent of pre-existing physical and psychological health. Thus, in assessing the links between PA and depressive symptoms, several socio-demographic and health variables need to be accounted for.

The literature suggests knowledge gaps. No previous research seems to have assessed, among Finnish university students, the relationship between achieving PA guidelines and mental health (depressive symptoms). The very few studies that evaluated PA among Finnish students assessed different outcomes e.g., the associations between achievement of PA guidelines and self-reported health complaints or academic performance (16, 17). Likewise, very few Finnish studies assessed PA in relation to depressive symptoms, and these were population-based among older individuals. For instance, a population study examined the association of LTPA and psychiatric comorbidities among patients aged ≥35 years suffering from depressive symptoms (11). A second study among 45–74 years old Finnish individuals found that the prevalence of depressive symptoms was higher in participants with low LTPA compared with high LTPA participants (18). To the best of our knowledge, the current study is the first to assess, among Finnish undergraduates, the relationship between achieving the guidelines of different PA types and depressive symptoms.

Therefore, the present study addressed these knowledge gaps to assess the achievement of guidelines of four types of PA: low (LPA), moderate (MPA), vigorous (VPA), and muscle strengthening (MSPA). The study evaluated the relationships of these PA types in relation to self-reported depressive symptoms among undergraduates at the University of Turku, Finland. The study also accounted for 5 socio-demographic variables (gender, age, year of study, marital status, living arrangements), and a health variable (self-rated health). The specific objectives were to:
- describe the characteristics of the undergraduates and their achievement of guidelines of four forms of PA;
- assess the prevalence of depressive symptoms; and
- assess the association between the achievement of guidelines of four forms of PA and depressive symptoms, before and after controlling for respondents' demographic characteristics and health variables using bivariate and multivariate analyses, respectively.

We also compared the findings of the current study with results of similar research elsewhere and discussed their generalizability.

MATERIALS AND METHODS

Sample, Ethics and Procedures
The Research and Ethics Committee at the University of Turku in Turku, Finland, approved the study (Approval # Lausunto 10/2010). A full description of the sample, ethics and procedures has been detailed elsewhere (19–21). An email outlining the research aims and objectives was mailed to all (4,387) undergraduates at all seven faculties of the University of Turku inviting them to participate in the survey. Responses to the survey were automatically saved and forwarded to the Student Management Office at the University. The number of responses was 1,177 (response rate: 27%). Students' mean age was about ≈ 23 (SD 5) years and 832 (70.4%) were females.

Questionnaire
The questionnaire was about general self-reported health. It collected socio-demographic information (gender, age, year of study, marital status, living arrangements during university terms); lifestyle behaviours (various forms of PA) as well as depressive symptoms; and was field-tested across many undergraduate students (6, 22–26).

Age, gender and year of study at university were self-reported.

Marital status: "What is your marital status?" Response options included single, married, or other (please specify), dichotomized into 'single' vs. 'married or in relationship' (7, 16, 21).

Accommodation (living arrangements) during semester time: "Where do you live during university/college term time?", dichotomized into 'living with parents' vs. 'not living with parents' (16, 17, 21).

Health awareness: (one item) asked about general awareness (surveillance) of their health "To what extent do you keep an eye on your health?" 4-point response: 1 = 'not at all', and 4 = 'very much') (16, 17).

PA Variables
LPA (1 item): defined as being 0 vigorous and 0 or 1 day of moderate exercise in the past 7 days (27).

MPA (1 item): "On how many of the past 7 days did you participate in moderate exercise for at least 30 minutes e.g., biking slower than 10 miles per hour, brisk walking, water aerobics, gardening, tennis (doubles), or dancing (social)?" Participants responded with 0–7 days. We employed a cut-off of ≥5 days/week (28).

VPA (1 item): "On how many of the past 7 days did you participate in vigorous exercise for at least 20 minutes – exercise for at least 20 minutes that made you sweat or breathe hard, such as basketball, jogging, fast dancing, swimming laps, jumping rope, tennis (singles), fast bicycling, or similar aerobic activities?" Students responded with 0–7 days. We employed a ≥3 days/week cut-off, in line with the American Heart Association guidelines (28).

MSPA (1 item): "On how many of the past 7 days did you do exercises to strengthen or tone your muscles (such as toe touching, knee bending, leg stretching, or push-ups, sit-ups, or weight lifting)?" Participants answered 0–7 days. We used the cut-off of ≥2 days/week (28).

Depressive Symptoms Variables

Depressive symptoms were measured using the Modified Beck Depression Inventory (M-BDI) (29–31). A six-point Likert scale measured its frequency in the last 4 weeks (past few days in our questionnaire) (with the two extreme categories labelled as 0 = 'never', 5 = 'almost always'). Sample items include: "I feel sad", "I feel I am being punished", "I have thoughts of killing myself", "I have lost interest in other people". The reduction in the number of items per symptom is consistent with another recent modification of BDI (BDI-II) (29). The versions of the BDI compute a single score for individual respondents by summing their responses for all items of the scale. Using a sample of the general German population (30, 31), the authors demonstrated its construct validity and equivalence compared to the original BDI and provided a cut-off score for screening for clinically relevant depressive symptoms at ≥ 35, corresponding to the 85th percentile of the representative German population sample (32). This scale has been used in student wellbeing surveys in many countries (6, 13, 23, 24). We used the 5th quintile (80th percentile) to categorize depressive symptoms as high, and in our sample, Cronbach's alpha of depressive symptoms was 0.941.

Statistical Analysis

Descriptive and inferential statistics were used. Quantitative variables (e.g. age) are presented as mean ± standard deviation (SD) for normally distributed data, while numbers (percentage) were used for qualitative variables (e.g. gender) for the whole sample. Bivariate analysis was performed using simple binary logistic regression to assess the relationship of socio-demographic data (age, gender, marital status, year of study, accommodation arrangements during semesters); health (self-rated general health); and four levels of PA achievement (low PA, achieved recommended level of moderate PA, achieved recommended level of vigorous PA, and achieved recommended level of muscle strengthening exercises) with mental wellbeing variable (depressive symptoms). Odds ratio (OR), 95% confidence interval (CI) with their significance value were reported.

Multiple binary logistic regression models identified each of the four level of physical activity achievement (low PA, achieved recommended level of moderate PA, achieved recommended level of vigorous PA, and strengthening exercises) associated with depressive symptoms (M-BDI depression score $\geq$5th quintile) after adjusting for age, gender, marital status, year of study, and self-rated health. Four separate models were made due to multi-collinearity among physical activity achievement. Model 1 represents the association between low PA and depressive symptoms, Model 2 represents the association between MPA and depressive symptoms, Model 3 denotes the association between VPA and depressive symptoms, and Model 4 is the association between SE and depressive symptoms. Each model was adjusted for age, gender, marital status, year of study, and self-rated health. Wald test computed on each factor determined significance. Adjusted odds ratio (AOR) and 95% confidence interval for AOR were reported. Statistical significance was set at p-value < 0.05 (two-tailed). Hosmer-Lemeshow goodness-of-fit statistics assessed whether the model adequately described the data. Statistical analyses were undertaken using Statistical Package for Social Sciences Version 24 (SPSS).

RESULTS

General, PA and Mental Health Characteristics of the Sample

Table 1 shows the socio-demographic, health related, PA and mental health characteristics of students at the University of Turku (N=1,177). Mean student age was 22.96 years, females comprised more than two thirds of the sample (70.4%), and about half the respondents were single. About 33.7% were living with their parents. Almost 50% of the students were in the first year at university. The majority of participants self-rated their health as good/very good/excellent, although about one fifth of the sample had a M-BDI depression score $\geq$5th quintile. Roughly one fifth of the sample (18.6%) had low PA, while 17%, 29% and 41.5% achieved the guidelines for MPA, VPA and MSPA, respectively.

Table 1. Socio-demographic, physical activity and mental health characteristics among undergraduates, University of Turku, Finland (N=1,177)

Variable	Total 1,177
	n (valid %) of sample
Age, years[a] (M, SD)	22.96 (5.21)
Gender	
Male	346 (29.6)
Female	832 (70.4)
Marital status	
Married or in relationship	593 (50.7)
Single	576 (49.3)
Accommodation during semester	
With parents	394 (33.7)
Not with parents	776 (66.3)
Year of study	
1st	553 (47.2)
2nd	344 (29.4)
3rd	251 (21.4)
$\geq$ 4th	23 (2.0)
Self-rated health	
Poor/fair	87 (7.4)
Good/very good/excellent	1,083 (92.6)
Depressive symptoms (M-BDI depression score)	
< 5th quintile	939 (79.8)
$\geq$ 5th quintile	237 (20.2)
Physical activity achievement	
Low PA[b]	219 (18.6)
Achieved recommended level of moderate PA[c]	198 (17.0)
Achieved recommended level of vigorous PA[c]	336 (29.0)
Strengthening exercises (at least twice per week)[c]	484 (41.5)

[a]Mean (standard deviation); numbers might not sum up to total because of missing values; [b]low PA = 0 vigorous and 0 or 1 day of moderate exercise in the past 7 days (27); [c]as recommended by guidelines (28)

Bivariate Relationships between Sample Characteristics and Depressive Symptoms

Table 2 shows the bivariate relationships between socio-demographic, health related, and four levels of PA with depressive symptoms among undergraduates at the University of Turku. Male gender, good/very good/excellent self-rated health, and achievement of the MSPA guidelines were each significantly negatively associated with depressive symptoms. Conversely, low PA was significantly positively associated with depressive symptoms.

Independent Associations of Achievement of Four Types of PA with Depressive Symptoms (Multivariate Analysis)

Table 3 shows four models depicting the independent associations of low PA or the achievement of guidelines of MPA, VPA and MSPA with depressive symptoms, after controlling for potential confounders. Only achievement of the MSPA guidelines was independently significantly negatively associated with depressive symptoms. For both MPA and VPA, although achievement of the guidelines was negatively associated with depressive symptoms, the relationships did not reach statistical significance. Likewise,

low PA was positively associated with depressive symptoms, but again, the relationship did not reach statistical significance. In terms of the potential confounders, older age and female gender were negatively and significantly associated with depressive symptoms for low PA and also for achievement of guidelines of each of the other three forms of PA. Likewise, self-rated health reported as good/very good/excellent was negatively associated with depressive symptoms regardless of whether respondents had low PA or achieved the guidelines of any of the other three forms of PA. None of the remining variables was independently associated with depressive symptoms.

DISCUSSION

Depression impacts college life and is linked to poor diet, lack of exercise, poor sleep habits, and noncompliance with medical treatment recommendations (33). The current study appraised achieving the guidelines of 4 PA forms: LPA, MPA, VPA, and MSPA; and the associations of these PA forms with depressive symptoms among undergraduates, whilst controlling for potential confounders. The main finding is that only achievement of the

Table 2. Bivariate analysis of associations between socio-demographic factors, health, four levels of physical activity, and depressive symptoms among undergraduates, University of Turku, Finland

Variable	Depressive symptoms (M-BDI depression score ≥ 5th quintile)		
	OR	**95% CI**	**p-value**
Age (years)	0.982	0.952–1.012	0.229
Gender			
Male	**0.563**	**0.399–0.794**	**0.001**
Female	1		
Marital status			
Married or in relationship	1		
Single	1.01	0.756–1.340	0.964
Year of study			
1st	0.506	0.203–1.262	0.144
2nd	0.533	0.210–1.347	0.183
3rd	0.766	0.301–1.947	0.575
≥4th	1		
Accommodation during semester			
With parents	1		
Not with parents	1.063	0.783–1.443	0.695
Self-rated health			
Poor/fair	1		
Good/very good/excellent	**0.092**	**0.057–0.149**	**<0.001**
Physical activity achievement			
Low PA[a]	**1.428**	**1.011–2.017**	**0.043**
Achieved recommended level of moderate PA[b]	0.899	0.609–1.329	0.594
Achieved recommended level of vigorous PA[b]	0.802	0.578–1.112	0.185
Strengthening exercises (at least twice per week)[b]	**0.527**	**0.387–0.716**	**<0.001**

[a]Low PA – 0 vigorous and 0 or 1 day of moderate exercise in the past 7 days (27); [b]as recommended by guidelines (28)

Table 3. *Four models depicting independent associations of achievement of four PA types guidelines with depressive symptoms among undergraduates, University of Turku, Finland*

Variable	Depressive symptoms							
	Model 1		Model 2		Model 3		Model 4	
	AOR (95% CI)	p-value	AOR (95% CI)	p-value	AOR (95% CI)	p-value	AOR (95% CI)	p-value
Physical activity								
Low PA	1.240 (0.841–1.828)	0.278	—	—	—	—	—	—
Moderate PA	—	—	0.966 (0.630–1.482)	0.876	—	—	—	—
Vigorous PA	—	—	—	—	0.995 (0.696–1.422)	0.979	—	—
Muscle strengthening PA	—	—	—	—	—	—	**0.675 (0.481–0.947)**	**0.023**
Age (years)	**0.963 (0.928–0.999)**	**0.045**	**0.960 (0.924–0.997)**	**0.034**	**0.961 (0.926–0.998)**	**0.041**	**0.960 (0.925–0.997)**	**0.033**
Gender (male)	**0.432 (0.290–0.644)**	**<0.001**	**0.429 (0.287–0.640)**	**<0.001**	**0.426 (0.285–0.637)**	**<0.001**	**0.461 (0.308–0.690)**	**<0.001**
Marital status (single)[a]	1.036 (0.709–1.512)	0.855	1.023 (0.700–1.496)	0.906	1.016 (0.695–1.485)	0.936	1.013 (0.692–1.482)	0.947
Accommodation (not with parents)[b]	1.052 (0.705–1.570)	0.804	1.057 (0.708–1.579)	0.787	1.058 (0.707–1.583)	0.783	1.066 (0.714–1.593)	0.754
Year of study[c]								
1st	0.420 (0.156–1.130)	0.086	0.413 (0.154–1.110)	0.080	0.416 (0.155–1.117)	0.082	0.429 (0.160–1.147)	0.092
2nd	0.425 (0.157–1.153)	0.093	0.432 (0.159–1.171)	0.099	0.436 (0.161–1.179)	0.102	0.421 (0.156–1.139)	0.089
3rd	0.667 (0.246–1.807)	0.426	0.655 (0.242–1.774)	0.405	0.651 (0.240–1.763)	0.398	0.659 (0.244–1.779)	0.411
Self-rated health (good/very good/ excellent)[d]	**0.071 (0.042–0.120)**	**<0.001**	**0.071 (0.042–0.120)**	**<0.001**	**0.073 (0.043–0.123)**	**<0.001**	**0.075 (0.044–0.127)**	**<0.001**

Models represent the association between low PA and depressive symptoms (Model 1), association between MPA and depressive symptoms (Model 2), association between VPA and depressive symptoms (Model 3), association between SE and depressive symptoms (Model 4). Each model controlled for age, gender, marital status, year of study, and self-rated health. AOR – adjusted odds ratio; CI – confidence interval; PA – physical activity; — not applicable; [a]reference group: married or in relationship; [b]reference group: living with parents; [c]reference group: ≥ 4th year; [d]reference group: poor/fair self-rated health. Numbers in bold indicate statistical significance.

MSPA guidelines was independently significantly negatively associated with depressive symptoms.

A concern is that about one fifth of our sample had a M-BDI depression score $\geq$ 5th quintile, suggesting depression. Depression has been reported among students, and our findings resonate with undergraduates from 7 UK universities (employed the same research tool as in the current study), where 20.6% of the sample had M-BDI score > 5th quintile (6). In Hong Kong, 68.5% of respondents had mild/severe depressive symptoms (4). Similarly, the proportion of students with MBDI scores $\geq$ 35 ($\approx$ 85th percentile) for female students was > 40% (Poland, Bulgaria) to 25% (Denmark, Germany); and for males, it fluctuated (22.8% Germany, 12.1% Denmark, 27.3% Poland, 33.8% Bulgaria) (5). Hence, an implication of the current research is for universities to implement systematic strategies to monitor the mental and psychological health of their students and improve the effectiveness of existing counselling programmes.

An equal concern is that roughly one fifth (18.6%) of our respondents reported low PA; and only 17% and 29% achieved the MPA and VPA guidelines, respectively. These latter findings of low level of achievement of the MPA and VPA guidelines support research among undergraduates in the UK, where only 12.4% and 33.1% of the sample achieved the recommendations for MPA and VPA, respectively (6). Likewise, the MPA and VPA levels of our Finnish sample compare unfavourably with PA levels of students from 4 universities in 3 Midwestern states in the USA, where 39% and 56% met the MPA and VPA guidelines, respectively (27). Thus, such findings of a high prevalence of low PA, and conversely, low prevalence of achievement of the MPA and VPA guidelines among these young adults call for university initiatives that include attractive university PA and sport programmes, enabling active transport, as well as launching PA campaigns and educational activities.

In terms of the PA-depression relationship among this sample of Finns, although the achievement of both the MPA and VPA guidelines were negatively associated with depressive symptoms, the relationships were not statistically significant. Such findings support other research among college freshmen aged 15–24 years, where there were no associations between MPA and VPA and depressive symptoms (34). Nevertheless, our findings of the lack of significant association between MPA and VPA and depressive symptoms contrast with some studies, where students who reported regular exercise had significantly fewer depressive symptoms (4). Such contrast might be attributed to the fact that in the current sample, the prevalence of depression was 20.2%, however, only 17% and 29% of our respondents achieved the MPA and VPA guidelines, respectively. It could be that our triad of sample size, low prevalence of depression, and more importantly, quite low levels of achieved MPA and VPA guidelines rendered the relationships between MPA and VPA with depressive symptoms not statistically significant, despite that these relationships were in the expected direction (negative association). Future research would benefit to confirm the relationship between PA intensity and depressive symptoms (34).

Equally, we observed that low PA was positively associated with depressive symptoms, but again the relationship was not significant, possibly for the same reasons. In support, others reported that lower PA could be associated with higher depressive symptoms (35).

Among the current sample, only the achievement of the MSPA guidelines was independently significantly negatively associated with depressive symptoms. In the UK, physically active students, regardless of the type of PA, were significantly more likely to perform muscle strengthening exercises (6). Our sample's MSPA guideline achievement (41.5%) was higher than the 23.9% of undergraduates in the UK (6), suggesting that muscle stretching and muscle strengthening workouts, muscle conditioning activities, and toning generally might be more popular among Finnish students than in the UK. Stretching is beneficial to prevent joint and muscle stiffness, provides nutrients to soft tissues and ligaments, and counteracts tissue degradation (36). Muscle strengthening exercises are viewed as low intensity PA, and our findings support that MPA and VPA were not associated with depressive symptoms among students, whilst low-intensity PA was inversely associated with depressive symptoms (34). Along a similar path, research found that low-intensity exercise is effective in improving depressive symptoms among inactive older persons (37). Few studies assessed the association between exercise intensity and depressive symptoms (34), and discrepancy in findings may be due to inconsistency in the assessment of PA intensity and lack of control for confounders (34).

Our MSPA findings support that regular exercise could decrease the occurrence of depression, although the mechanisms remain unclear. Both physiological and psychological mechanisms (4) could be involved, where monoamine and endorphin neurotransmitter systems improve self-esteem and perception through self-actualisation and gaining pleasure from social circles (38). Chronic inflammation may contribute to depressive symptoms (39). PA mitigates symptoms of depression by reducing inflammation, and moderate-intensity PA may be optimal for mental health promotion by decreasing TNF-α (40). Notably, in Finland, as in other EU countries, the most common mental disorders are anxiety and depressive disorders, which affect 4% and 6% of Finns, respectively (41).

The current study has limitations. The cross-sectional design limits the ability to determine causation; hence relationships are associations and directionality cannot be inferred. We invited all students from one university using universal sampling rather than random sampling. However, our response rate was low, and self-selection cannot be ruled out. There is the possibility that severely depressed individuals who had socially isolated themselves were not reached by this online survey. Nevertheless, such convenience samples are not uncommon in student surveys in many countries, even in national health surveys, where respondents self-select themselves to participate (42). Responses are self-reported, as the study used the MBDI to assess depressive symptoms experienced by the students; no clinical diagnoses were undertaken by healthcare professionals. Self-reporting of the estimated PA levels could be subject to social desirability and sociability bias; objectively measured PA was not undertaken. As the study was a general health survey examining many lifestyle, behavioural, health and wellbeing issues, we did not assess other types of PA e.g., work-related, transport-related and domestic-related activities. Similarly, we did not explore the relationships of smoking as a potential confounder for the PA-depression relationship; and information on students' nutritional habits would have been useful, given the links between depression and nutrition. Given these limitations, generalization of the findings requires caution.

Nevertheless, the findings substantiate some of the relationships but, contrary to other research, in the present study, multiple variables that could be associated with university students' PA were considered simultaneously (adjusted models). Such adjustment could have possibly resulted in fewer significant associations than with other techniques, e.g., univariate analysis. To the best of our knowledge, the current study is first to assess, among Finnish university students who were not primarily identified as having mental health problems, the relationship between guidelines achievement of different types of PA and depressive symptoms whilst considering a variety of possible confounders.

CONCLUSION

Achievement of PA guidelines was generally low for this sample of young adult Finnish undergraduates. Only achievement of the MSPA was independently significantly negatively associated with depressive symptoms. The other PA types were associated with depression in appropriate directions but were not statistically significant, probably due to the prevalence level of depression, and more importantly, low levels of achieved PA guidelines. Universities would benefit from multipronged strategies and approaches employing effective interventions to improve students' awareness of their health and promote more physically active lifestyles; and potential mental health problems among university students need to be proactively and continually monitored by academic institutions.

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