

# Are lower levels of physical activity and self-rated fitness associated with higher levels of psychological distress in Croatian young adults? A cross-sectional study

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## Background

Although previous evidence has shown that physical activity and physical fitness lower the level of psychological distress, little is known of simultaneous associations between of physical activity and physical fitness and with psychological distress, especially in young adults. Therefore, the main purpose of the present study was to explore both separate and simultaneous association between physical activity and physical fitness with psychological distress.

## Methods

Participants in this cross-sectional study were 2100 university students (1041 men and 1059 women) chosen from 8 faculties in the city of Zagreb. Physical activity, physical fitness and psychological distress were assessed using structured questionnaires. The associations were examined using logistic regression analysis.

## Results

After adjusting for gender, body-mass index, self-rated health, material status, binge drinking, chronic disease/s and sleep quality, 'insufficient' physical activity (OR=2.60; 95% CI 1.92-3.52) and 'lower' levels of physical fitness (tertile 2; OR=1.94; 95% CI 1.25-3.01 and tertile 1; OR=2.59; 95% CI 1.65-4.08) were remained associated with 'high' psychological distress. When physical activity and physical fitness were entered simultaneously into the model, 'insufficient' physical activity (OR=2.35; 95% CI 1.72-3.21) and 'lower' levels of physical fitness (tertile 2; OR=1.77; 95% CI 1.24-2.77 and tertile 1; OR=2.00; 95% CI 1.26-3.20) remained associated with 'high' psychological distress.

**Conclusions** Our study shows that both 'insufficient' physical activity and 'lower' levels of physical fitness are associated with 'high' psychological distress, even after adjusting for numerous covariates. Therefore, special policies aiming to increase the levels of physical activity and fitness are warranted.

# Are lower levels of physical activity and self-rated fitness associated with higher levels of psychological distress in Croatian young adults? A cross-sectional study

**Running title:** Physical activity and distress

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# **Abstract**

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## 58 Introduction

59 Mental health disorders have become one of the main public health problems worldwide, with  
 60 special increasing prevalence among youth (Costello et al., 2003). Approximately 30% of  
 61 children and adolescents present mental disorders in the United States (Costello et al., 2003). In  
 62 Croatia, the prevalence of mental disorders among youth is 15.7% (Rudan et al., 2005), girls  
 63 experienced high psychological distress more frequently in the last 30 days, compared with boys  
 64 (33% vs. 16%) (Novak and Kawachi, 2015). In general, psychological distress is a term  
 65 frequently used to describe the experience of unpleasant emotions and feelings that influence on  
 66 everyday functioning (Perales, del Pozo-Cruz and del Pozo-Cruz, 2014) and has been  
 67 consistently associated with cardiovascular (Mensah and Collins, 2015), metabolic (Newcomer,  
 68 2007) and musculoskeletal (Patten, Williams and Wang, 2006) diseases, cancer (Kisely, Crowe  
 69 and Lawrence, 2013) and overall mortality (Walker, McGee and Druss, 2015).

70 Treatment for depression is antidepressant medication (Barbour, Hoffman and Blumenthal,  
 71 2013), which is expensive with potential side effects. Nevertheless, regular physical activity may  
 72 serve as a protective factor against mental disorders. Physical activity is defined as “any bodily  
 73 movement produced by skeletal muscles that results in energy expenditure and can be  
 74 categorized into occupation, sports, conditioning, household, or other activities” (Caspersen,  
 75 Powell and Christenson, 1985). The health benefits of physical activity on mental health have  
 76 been well-documented (World Health Organization, 2010). Specifically, Larun et al. (2006) in  
 77 their meta-analytical review showed, that vigorous physical activity had small effect in reducing  
 78 anxiety or depression symptoms in youth. One meta-analysis showed that overall effects of  
 79 physical activity on mental health were small, yet significant and indicated that physical activity  
 80 led to improvements of mental health outcomes in children (Ahn and Fedewa, 2010). To  
 81 determine causal direction, one longitudinal study showed that the number of hours spent in  
 82 physical activity per week at age 15-16 was negatively associated with emotional symptoms in  
 83 boys, yet no associations were found in girls (Sagatun et al., 2007). The same study also showed,  
 84 that boys and girls who spent 5-7 hours of physical activity per week at the same age had the  
 85 least mental difficulties reported after a three year of follow-up (Sagatun et al., 2007). While  
 86 physical activity is related to the body movement, physical fitness represents “a set of attributes  
 87 that people have or achieve” (Caspersen, Powell and Christenson, 1985). In general, physical

fitness has two components: 1) health-related and skill-related, where each component has a set of sub-components (Caspersen, Powell and Christenson, 1985). (Similar studies aiming to explore the associations between physical fitness and psychological distress have also shown, that young adults with higher levels of cardio-respiratory, strength and flexibility fitness (Pouzelo-Carrascosa et al., 2017; Jeoung, Hong and Lee, 2013) have significantly lower levels of mental health disorders, compared to their peers with lower levels of fitness and higher levels of mental health disorders.

Previous studies have tried to explain the complexity and mutual processes of biological and psychological factors that physical activity has on mental health (Faulkner and Taylor, 2009). In terms of biological factors, physical activity has beneficial effects on neurotransmitters (monoamines, dopamine, endorphin), which play an important role in regulating stress and emotions and rewarding motivation (Paluska and Schwenk, 2000). Psychological factors include self-esteem, self-efficacy and distraction, and physical activity/fitness play an important role in increasing such perceptions (Ekeland et al., 2004).

Thus, according to the literature, it is well-established, that both physical activity and physical fitness have beneficial role on mental health. However, little is known about the relationship these two potential factors with mental health in young adults. Young adulthood is characterized by the onset of which mental health problems start to occur (Kessler et al., 2005). On the other hand, it has been reported that 40% of young adults from United States do not meet the recommendations of National physical activity guidelines (150 min of moderate or 75 min of vigorous physical activity weekly) leading to excessive weight gain (Malhotra et al., 2013) and other diseases (Warburton, Nicole and Bredin, 2006).

Since young adults represent a risk group for higher levels of mental health disorders and lower levels of physical activity, it is necessary to explore these associations. Therefore, the main purpose of the present study was to explore both separate and simultaneous associations of physical activity and physical fitness with psychological distress in a large sample of young adults.

## Materials and Methods

# 117 *Participants*

118 This study was conducted among university students in Zagreb, the capital city of Croatia with  
 119 approximately 1000000 citizens. The University of Zagreb is composed of 33 faculties  
 120 (departments) and between 65000 to 70000 students attend the University every year. A random  
 121 sampling approach was used to select faculties. At the first stage, we randomly selected 8 out of  
 122 33 faculties. The randomization was done with replacement, where each faculty had unique  
 123 number and was drawn from the box. At the second stage, we contacted teachers from each  
 124 faculty to help us organize the sampling procedure. A recruitment announcement was sent via  
 125 emails and e-newsletter to the teachers with a request to pass the study information to students.  
 126 All 8 faculties agreed to take part in the study, representing 2320 students enrolled in the 2017  
 127 academic year. Of these, 2100 students (1041 men and 1059 women, aged 18-24 years) provided  
 128 full data (90.5%) and were enrolled in further analysis. Students came from a variety of social  
 129 (psychology, political sciences, economy and business), technical (computing, information  
 130 technologies, electrical engineering, civil engineering, mechanical engineering, graphics arts and  
 131 naval architecture) and health-related (medical doctors, physiotherapists, nurses) sciences.  
 132 Before the main analysis, we examined the differences between the participants and non-  
 133 participants in terms of gender, age, body-mass index, self-rated health and psychological  
 134 distress. No significant differences were observed and no potential bias was made ( $p=0.21-0.74$ ).  
 135 All the analysis and procedures were anonymous and in accordance with the Declaration of  
 136 Helsinki and approved by the Institutional Review Board of the Faculty of Kinesiology (Ethics  
 137 code: 16/2017). Also, all participants gave their written informed consent for participation in the  
 138 study.

# 139 *Outcome variable*

140 Psychological distress was assessed by using Kessler's 6-item questionnaire: (1) "How often  
 141 during the past 30 days did you feel nervous?", (2) "How often during the past 30 days did you  
 142 feel hopeless?", (3) "How often during the past 30 days did you feel restless or fidgety?", (4)  
 143 "How often during the past 30 days did you feel so depressed that nothing could cheer you up?",  
 144 (5) "How often during the past 30 days did you feel that everything was an effort?" and (6)  
 145 "How often during the past 30 days did you feel worthless?" (Kessler et al., 2003). Each question  
 146 is scored from 0 (none of the time) to 4 (all of the time). Scores of each question are summed up

ranging from 0-24, with lower score indicating lower level of psychological distress. Kessler et al. (2003) showed, that responses  $<13$  points vs.  $\geq 13$  points discriminated participants without and with psychological distress.

### *Physical activity*

To assess physical activity in the last 7 days, we used International Physical Activity questionnaire, a reliable and valid instrument designed to measure physical activity in respondents between ages 18-65 (Craig et al., 2003). Specifically, this measure assesses the types of intensity of physical activity during the day to estimate total physical activity measured in metabolic equivalent units-min/week. We created a dichotomized variable, where ‘sufficiently active’ participants participated in at least (1) 150 min/week in moderate physical activity or (2) 75 min of vigorous physical activity or (3) an equivalent combination of both compared with ‘insufficiently active’ participants (World Health Organization, 2010).

### *Physical fitness*

Self-rated physical fitness was assessed by using one-time question: “How would you rate your physical fitness?” ranging from 1 (very poor) to 10 (excellent) (Plante, LeCaptain & McLain, 2000). This measure has previously been correlated with measures of objective physical fitness and perceived well-being (Plante, Lantis & Checa, 1998) and used in similar studies (Gerber et al., 2010).

### *Covariates*

Previous studies have shown, that body-mass index, socioeconomic status, alcohol consumption, having a long-term health condition, self-rated health and sleep quality are known or suspected to influence psychological distress and we included them as covariates in the analysis (Novak and Kawachi, 2015; Perales, del Pozo-Cruz and del Pozo-Cruz, 2014; Sagatun et al., 2007). Participants self-reported their height in meters (m) and weight in kilograms (kg), from which body-mass index ( $\text{kg}/\text{m}^2$ ) was calculated. Before the study began, we had chosen 35 men and 40 women to validate self-reported height and weight with the objective measure taken by trained survey staff. Pearson's coefficient of correlation showed excellent relationship between two measures in men ( $r=0.96$ ) and women ( $r=0.97$ ). For the purpose of this study, we divided body-

mass index score into two categories: (1) normal ( $<25 \text{ kg/m}^2$ ) vs. (2) overweight/obesity ( $\geq 25 \text{ kg/m}^2$ ). Although not appropriate as a clinical tool, self-reported BMI serves as a valid tool for epidemiological surveys, especially in young adults (Meyer et al., 2012). Self-rated health was assessed using one-item question: “How would you rate your health?”. Answers were arranged along a Likert-type scale as follows: (1) very poor, (2) poor, (3) fair, (4) good and (5) excellent. For the purpose of this study, we dichotomized the outcome variable into 'good' (fair, good and excellent) vs. 'poor' (very poor and poor) self-rated health (Štefan et al., 2017). Material status was assessed by one question: “How would you perceive your material status, based on your parents’ occupation?”. Responses were: (1) low, (2) medium and (3) high. We created two categories as follows: (1) low and (2) medium/high. Binge alcohol consumption was assessed by one question: “How often do you have (for men) 5 or more and (for women) 4 or more drinks on one occasion?” (Peltzer and Pengpid, 2016). Those who had (for men) 5 or more and (for women) 4 or more drinks on one occasion were categorized as “Yes”, compared to “No” group who had less drinks on one occasion. The presence or absence of a chronic disease was asked by one-item question: “Have you ever been told by a doctor, that you suffer from any kind of chronic disease?” with “Yes” and “No” answers. To assess sleep quality, we asked about current self-perceived state of sleep quality: “How would you perceive your sleep quality?”. Answers were arranged across a four-item scale as follows: (1) very good, (2) good, (3) poor and (4) very poor. Very good and good collapsed into 'good' and poor and very poor into 'poor' sleep quality.

# *Data analysis*

Basic descriptive statistics of the study participants are presented as frequencies (N) and percentages (%). Differences between categorical variables between ‘low’ and ‘high’ psychological distress were analyzed using Chi-square test. To explore the associations between physical activity and physical fitness with psychological distress, we performed a set of logistic regression analyses. We calculated odd ratios (ORs) with 95% confidence intervals (95% CIs). ‘High’ psychological distress was the main outcome of the present study. First, we explored the association between ‘insufficient’ physical activity and ‘high’ psychological distress in model 1. Second, we explored the association between ‘low’ physical fitness and ‘high’ psychological distress. Since physical fitness was assessed by a ten-item scale, we calculated median and



interquartile range (25<sup>th</sup> and 75<sup>th</sup> percentile range), in order to categorize participants into three groups (tertiles): (1) <25<sup>th</sup> percentile as ‘low’, (2) 25<sup>th</sup>-75<sup>th</sup> percentiles as ‘medium’ and (3) >75<sup>th</sup> percentile as ‘high’ physical fitness. Finally, we entered both physical activity and physical fitness simultaneously into the model (model 3). Significance was set up at  $\alpha \leq 0.05$  and it was one sided (1-sided). All the analysis were performed in Statistical Package for Social Sciences Software, ver. 22 (IBM Corp., Armonk, NY, USA).

## Results

Basic descriptive statistics of the study participants are presented in table 1. The prevalence of ‘high’ psychological distress was 10.6%, while 22.6% and 28.2% of the study participants were ‘insufficiently’ active and were in the ‘lowest’ physical fitness group. We found that higher percentage of ‘insufficiently’ active participants and those with ‘lower’ levels of physical fitness reported having ‘high’ psychological distress in the last 30 days. Also, higher percentage of women, those participants who reported having poor self-rated health, low material status, binge drinking, having a chronic disease and poor/very poor sleep had ‘high’ psychological distress in the last 30 days.

The associations between physical activity, physical fitness and psychological distress are presented in table 2. In model 1, ‘insufficient’ physical activity (OR=2.60; 95% CI 1.92-3.52) was associated with ‘high’ psychological distress. In model 2, those participants in lower tertiles (tertile 2; OR=1.94; 95% CI 1.25-3.01 and tertile 1; OR=2.59; 95% CI 1.65-4.08) were more likely to experience ‘high’ psychological distress. Finally, when both physical activity and physical fitness were entered simultaneously into the model (model 3), OR for ‘insufficient’ physical activity (OR=2.35; 95% CI 1.72-3.21) and for ‘lower’ levels of physical fitness (tertile 2; OR=1.77; 95% CI 1.14-2.77 and tertile 1; OR=2.00; 95% CI 1.26-3.20) decreased, but remained associated with ‘high’ psychological distress. All three models were adjusted for gender, body-mass index, self-rated health, material status, binge drinking, chronic disease/s and sleep quality. The association between physical fitness and physical activity was moderate ( $r=0.33$ ,  $p<0.001$ ) and variance inflation factors test (VIF) showed no multicollinearity (1.00 to 1.10).

## 234 Discussion

235 The main purpose of the present study was to explore both separate and simultaneous  
236 associations between physical activity and physical fitness and psychological distress in a large  
237 sample of young adults. Both ‘insufficient’ physical activity and ‘lower’ levels of physical  
238 fitness were associated with ‘high’ psychological distress after adjusting for gender, body-mass  
239 index, self-rated health, material status, binge drinking, chronic disease/s and sleep quality.

240 Our results are in line with previous studies aiming to explore the associations between physical  
241 activity/fitness and mental health (Sagatun et al., 2007; World Health Organization, 2010; Larun  
242 et al., 2006; Pozuelo-Carrascosa et al., 2017; Jeoung, Hong and Lee, 2013). Specifically, Sagatun  
243 et al. (2007), in their three-year longitudinal study showed, that weekly hours of physical activity  
244 were negatively associated with emotional symptoms or peer problems only in boys, but not in  
245 girls. As mentioned before, mental health is a complex state comprised of behavioral,  
246 psychological and social components (Paluska and Schwenk, 2000; Ekeland et al., 2004;  
247 Bandura, 1977). A few previous studies have shown, that participants, who are engaged in  
248 regular physical activity displays much less inhibition in social behavior (Kirkcaldy, Shephard  
249 and Siefen, 2002) and scored lower on psychological discomfort captured by loneliness,  
250 hopelessness and shyness (Page and Tucker, 1994) compared to their physically inactive peers.  
251 In addition to physical activity, studies aiming to explore the associations between physical  
252 fitness and mental health disorders have shown that higher levels of cardio-respiratory, strength  
253 and flexibility fitness are significantly associated with decreased mental health disorders,  
254 compared to participants with lower levels of physical fitness (Pouzelo-Carrascosa et al., 2017;  
255 Jeoung, Hong and Lee, 2013). Our results confirmed strong negative association between self-  
256 perceived physical fitness and psychological distress, that is, ‘lower’ levels of physical fitness  
257 were associated with ‘high’ psychological distress.

258 The mechanism underlying the association between physical activity/fitness and mental health is  
259 not clearly understood (Blake, 2012). Previous meta-analytical reviews have shown small  
260 clinical effect that physical activity has on mental health (Larun et al., 2006; Ahn and Fedewa,  
261 2010; Rimer et al., 2012). Although small, positive benefits of physical activity on health  
262 outcomes have been well-documented (Warburton, Nicole and Bredin, 2006). In terms of mental  
263 health, physical activity serves as beneficial factor for neurotransmitters in the brain, leading to

increased levels of motivation and positive emotions and reducing stress and pain (Paluska and Schwenk, 2000; Ekeland et al., 2004; Bandura, 1977). Our results also showed that among numerous factors we adjusted for, the strongest association was between 'very poor/poor' sleep quality and 'high' psychological distress, which is similar to other studies (Feng et al., 2014). Such associations between sleep quality and psychological distress could be mediated by physical activity which regulates temperature following exercise and the onset of sleep declines through vasodilatation of peripheral heat dissipation (Driver and Taylor, 2000). In that way, by affecting on sleep quality, physical activity decreases psychological distress and improves behavioral and emotional regulations.

Our study has some limitations. First, we used a cross-sectional design, in order to determine the associations between physical activity and physical fitness with psychological distress. To determine the causality, Reichenheim and Coutinho (2010) reported that the main outcome of the study should be frequent and might be different among subjects, due to a dynamic population. Second, we used subjective measures to assess psychological distress, physical activity, physical fitness and other covariates. However, self-reported measures are largely used in epidemiological studies. But, due to a better precision, future studies should use direct measurement method (motor and functional fitness tests) over a longer period of time, in order to track and establish causal direction of the association between physical activity/fitness and psychological distress.

## Conclusions

Our results show strong associations between 'insufficient' physical activity and 'lower' levels of physical fitness with 'high' psychological distress in a large sample of young adults. Findings of this study should be taken into account, when establishing and implementing special strategies and policies that leverage higher participation in physical activity in order to decrease 'high' psychological distress.

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# References

1. Ahn S, Fedewa AL. 2010. A meta-analysis of the relationship between children's physical activity and mental health. *Journal of Pediatric Psychology* 36:385-397.
2. Bandura A. 1977. Self-efficacy: Toward a unifying theory of behavioural change. *Psychological Review* 84:191-215.
3. Blake H. Physical activity and exercise in the treatment of depression. 2012. *Frontiers in Psychiatry* 3:106.
4. Caspersen CJ, Powell KE, Christenson GM. 1985. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public Health Reports* 100:126-131.
5. Costello EJ, Mustillo S, Erkanli A, Keeler G, Angold A. 2003. Prevalence and development of psychiatric disorders in childhood and adolescence. *Archives of General Psychiatry* 60:837–844.
6. Craig CL, Marshall AL, Sjöström M, Bauman AE, Booth ML, Ainsworth BE, Pratt M, Ekelund U, Yngve A, Sallis JF, Oja P. 2003. International physical activity questionnaire: 12-country reliability and validity. *Medicine and Science in Sports and Exercise* 35:1381-1395.
7. Driver HS, Taylor SR. 2000. Exercise and sleep. *Sleep Medicine Reviews* 4:387-402.
8. Ekeland E, Heian F, Hagen KB, Abbott J, Nordheim L. 2004. Exercise to improve self-esteem in children and young people. *Cochrane Database of Systematic Reviews* 1:CD003683.
9. Faulkner G, Taylor A. 2009. Promoting physical activity for mental health: A complex intervention? *Mental Health and Physical Activity* 1:1-3.
10. Feng Q, Zhang Q, Du Y, Ye Y, He Q. 2014. Associations of physical activity, screen time with depression, anxiety and sleep quality among Chinese college freshmen. *PLoS ONE* 9:e100914.

11. Gerber M, Brand S, Holsboer-Trachsler E, Puhse U. 2010. Fitness and exercise as correlates of sleep complaints: is it all in our minds? *Medicine and Science in Sports and Exercise* 42:893-901.
12. Jeoung BJ, Hong M-S, Lee YC. 2013. The relationship between mental health and health-related physical fitness of university students. *Journal of Exercise Rehabilitation* 9:544-548.
13. Kessler RC, Barker PR, Colpe LJ, Epstein JF, Gfroerer JC, Hiripi E, Howes MJ, Normand SL, Manderscheid RW, Walters EE, Zaslavsky AM. 2003. Screening for serious mental illness in the general population. *Archives of general psychiatry* 60:184-189.
14. Kessler RC, Berglund P, Demler O, Jin R, Merikangas KR, Walters EE. 2005. Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication. *Archives of general psychiatry* 62:593-602.
15. Kirkcaldy BD, Shephard R, Siefen G. 2002. The relationship between physical activity and self-image and problem behavior among adolescents. *Social Psychiatry and Psychiatric Epidemiology* 37:544-550.
16. Kisely S, Crowe E, Lawrence D. 2013. Cancer-related mortality in people with mental illness. *JAMA psychiatry* 70:209-217.
17. Larun L, Nordheim LV, Ekeland E, Hagen KB, Heian F. 2006. Exercise in prevention and treatment of anxiety and depression among children and young people. *Cochrane Database of Systematic Reviews* 3:1-47.
18. Malhotra R, Ostbye T, Riley CM, Finkelstein E. 2013. Young adult weight trajectories through midlife by body mass category. *Obesity* 21:1923-1934.
19. Mensah GA, Collins PY. 2015. Understanding mental health for the prevention and control of cardiovascular diseases. *Global heart* 10:221-224.
20. Meyer KA, Wall MM, Larson NI, Laska MN, Neumark-Sztainer D. 2012. Sleep duration and BMI in a sample of young adults. *Obesity (Silver Spring)* 20:1279-1287.
21. Newcomer JW. 2007. Metabolic syndrome and mental illness. *The American journal of managed care*. 13:170-177.
22. Novak D, Kawacki I. 2015. Influence of different domains of social capital on psychological distress among Croatian high school students. *International Journal of Mental Health Systems* 9:18.

23. Page RM, Tucker LA. 1994. Psychosocial discomfort and exercise frequency: an epidemiological study of adolescents. *Adolescence* 29:183-191.
24. Paluska SA, Schwenk TL. Physical activity and mental health. 2000. Current concepts. *Sports Medicine* 29:167-180.
25. Patten SB, Williams JV, Wang J. 2006. Mental disorders in a population sample with musculoskeletal disorders. *BMC Musculoskeletal Disorders* 7:37.
26. Peltzer K, Pengpid S. 2016. Sleep duration and health correlates among university students in 26 countries. *Psychology, health & medicine* 21:208-220.
27. Perales F, del Pozo-Cruz J, del Pozo-Cruz B. 2014. Impact of physical activity on psychological distress: a prospective analysis of an Australian national sample. *American Journal of Public Health* 104:91-97.
28. Plante TG, Coscarelli L, Caputo D, Oppezzo M. 2000. Perceived fitness predicts daily coping better than physical activity. *International Journal of Stress Management* 7:182–192.
29. Plante TG, Lantis A, Checa G. 1998. The influence of perceived versus aerobic fitness on psychological health and physiological stress responsivity. *International Journal of Stress Management*, 5:141–156.
30. Pozuelo-Carrascosa DP, Martínez-Vizcaíno V, Sánchez-López M, Bartolomé-Gutiérrez R, Rodríguez-Martín B, Notario-Pacheco B. 2017. Resilience as a mediator between cardiorespiratory fitness and mental health-related quality of life: A cross-sectional study. *Nursing & health sciences* 19:316-321.
31. Rimer J, Dwan K, Lawlor DA, Greig CA, McMurdo M, Morley W, Mead GE. 2012. Exercise for depression. *Cochrane Database of Systematic Reviews* 7:CD004366.
32. Rudan V, Begovac I, Szivovicza L, Filipovic O, Skocic M. 2005. The child behavior checklist, teacher report form and youth self report problem scales in a normative sample of Croatian children and adolescents aged 7–18. *Collegium Antropologicum* 29:17–26.
33. Sagatun A, Sogaard AJ, Bjertness E, Selmer R, Heyerdahl S. 2007. The association between weekly hours of physical activity and mental health: A three-year follow-up study of 15–16-year-old students in the city of Oslo, Norway. *BMC Public Health* 7:155.
34. Štefan L, Juranko D, Prosoli R, Barić R, Sporiš, G. 2017. Self-reported sleep duration and self-rated health in young adults. *Journal of Clinical Sleep Medicine* 13:899-904.

35. Walker ER, McGee RE, Druss BG. 2015. Mortality in mental disorders and global disease burden implications: A systematic review and meta-analysis. *JAMA psychiatry*. 72:334-341.
36. Warburton DER, Nicol CW, Bredin SSD. 2006. Health benefits of physical activity: the evidence. *CMAJ: Canadian Medical Association Journal* 174:801-809.
37. World Health Organization. 2010. Global recommendations on physical activity for health. Geneva, Switzerland: WHO Press.

**Table 1**(on next page)

Basic descriptive statistics of the study participants, Croatia (2017)

\*Chi-square test



# Basic descriptive statistics of the study participants, Croatia (2017)

Study variables	Total sample (N=2100)	Low psychological distress (N=1878)	High psychological distress (N=222)	<i>p</i> -value*
	N (%)	N (%)	N (%)	
<b>Physical activity</b>				
Sufficient	1626 (77.4)	1502 (92.4)	124 (7.6)	
Insufficient	474 (22.6)	376 (20.0)	98 (80.0)	<b>&lt;0.001</b>
<b>Physical fitness</b>				
Tertile 3 (highest)	601 (28.6)	572 (95.2)	29 (4.8)	
Tertile 2	907 (43.2)	809 (90.2)	98 (10.8)	
Tertile 1 (lowest)	592 (28.2)	497 (84.0)	95 (16.0)	<b>&lt;0.001</b>
<b>Gender</b>				
Men	1041 (49.6)	975 (93.7)	66 (6.3)	
Women	1059 (50.4)	903 (85.3)	156 (14.7)	<b>&lt;0.001</b>
<b>Body-mass index</b>				
Normal	1765 (84.0)	1577 (89.3)	188 (10.7)	
Overweight/obesity	335 (16.0)	301 (89.9)	34 (10.1)	0.847
<b>Self-rated health</b>				
Good	1935 (92.1)	1750 (90.4)	185 (9.6)	
Poor	165 (7.9)	120 (77.6)	37 (22.4)	<b>&lt;0.001</b>
<b>Material status</b>				
Middle/high	2048 (97.5)	1839 (89.8)	209 (10.2)	
Low	52 (2.5)	39 (75.0)	13 (25.0)	<b>0.002</b>
<b>Binge drinking</b>				
No	1530 (72.9)	1391 (90.9)	139 (9.1)	
Yes	570 (27.1)	487 (85.4)	83 (14.6)	<b>&lt;0.001</b>
<b>Chronic disease/s</b>				
No	1905 (90.7)	1721 (90.3)	184 (9.7)	
Yes	195 (9.3)	157 (80.5)	38 (19.5)	<b>&lt;0.001</b>
<b>Sleep quality</b>				
Very good/good	687 (32.7)	658 (95.8)	29 (4.2)	
Poor/very poor	1413 (67.3)	1220 (86.3)	192 (13.7)	<b>&lt;0.001</b>

\*Chi-square test

## Table 2 (on next page)

Odd ratios for high psychological distress of the study participants, Croatia (2017)

Model 1: examine the associations of physical activity with psychological distress adjusted for gender, body-mass index, self-rated health, material status, binge drinking, chronic disease/s and sleep quality. Model 2: examine the associations of physical fitness with psychological distress adjusted for gender, body-mass index, self-rated health, material status, binge drinking, chronic disease/s and sleep quality. Model 3: examine the associations of physical activity and physical fitness entered simultaneously into the model with psychological distress adjusted for gender, body-mass index, self-rated health, material status, binge drinking, chronic disease/s and sleep quality. \*\*\* $p < 0.01$ ; \*\* $p < 0.01$ ; \* $p < 0.05$

# Odd ratios for high psychological distress of the study participants, Croatia (2017)

Study variables	Physical activity and psychological distress	Physical fitness and psychological distress	Physical activity and physical fitness with psychological distress
	OR (95% CI)	OR (95% CI)	OR (95% CI)
<b>Physical activity</b>			
Sufficient	1.00		1.00
Insufficient	2.60 (1.92-3.52)***		2.35 (1.72-3.21)***
<b>Physical fitness</b>			
Tertile 3 (highest)		1.00	1.00
Tertile 2		1.94 (1.25-3.01)**	1.77 (1.14-2.77)*
Tertile 1 (lowest)		2.59 (1.65-4.08)***	2.00 (1.26-3.20)**
<b>Gender</b>			
Men	1.00	1.00	1.00
Women	2.18 (1.57-3.02)***	2.17 (1.57-3.01)***	2.00 (1.44-2.78)***
<b>Body-mass index</b>			
Normal	1.00	1.00	1.00
Overweight/obesity	1.09 (0.71-1.67)	1.01 (0.66-1.55)	1.02 (0.66-1.57)
<b>Self-rated health</b>			
Good	1.00	1.00	1.00
Poor	2.13 (1.38-3.30)***	2.03 (1.31-3.12)***	2.04 (1.31-3.16)***
<b>Material status</b>			
Middle/high	1.00	1.00	1.00
Low	2.32 (1.14-4.74)*	2.12 (1.04-4.33)*	2.22 (1.08-4.53)*
<b>Binge drinking</b>			
No	1.00	1.00	1.00
Yes	1.71 (1.26-2.33)***	1.76 (1.30-2.38)***	1.75 (1.28-2.93)**
<b>Chronic disease/s</b>			
No	1.00	1.00	1.00
Yes	1.91 (1.26-2.89)***	1.96 (1.30-2.95)***	1.94 (1.28-2.93)**
<b>Sleep quality</b>			
Very good/good	1.00	1.00	1.00
Poor/very poor	3.44 (2.28-5.19)***	3.34 (2.22-5.04)***	3.29 (2.18-4.98)***

**Model 1:** examine the associations of physical activity with psychological distress adjusted for gender, body-mass index, self-rated health, material status, binge drinking, chronic disease/s and sleep quality.

**Model 2:** examine the associations of physical fitness with psychological distress adjusted for gender, body-mass index, self-rated health, material status, binge drinking, chronic disease/s and sleep quality.

**Model 3:** examine the associations of physical activity and physical fitness entered simultaneously into the model with psychological distress adjusted for gender, body-mass index, self-rated health, material status, binge drinking, chronic disease/s and sleep quality.

\*\*\*p<0.01; \*\*p<0.01; \*p<0.05