Self-Reported Physical Activity and Aerobic Fitness are Differently Related to Mental Health

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Abstract

Background: A relevant, but overlooked question is if self-reported physical activity and aerobic fitness are differently related to mental health.

Purpose: To examine the relation between mental health and level of self-reported physical activity (SRPA) and aerobic fitness (AF), and whether AF mediates the relation between SRPA and mental health. *Methods*: Participating in the study were 177 voluntary subjects (49% men, 51% women) with a mean age of 39 years. Symptoms of depression and anxiety were measured through the Hospital Anxiety and Depression (HAD) scale, and the Shirom-Melamed Burnout Questionnaire (SMBQ) was used to evaluate self-reported symptoms of burnout. Leisure time SRPA during the last three months were measured using a single item. AF was measured by using the Åstrand bicycle test.

Results: Self-reported physical activity, but not AF, was significantly related to self-reported symptoms of depression, anxiety, and burnout. Light to moderate physical activity that is performed regularly seems to be associated with more favorable mental health pattern compared with physical inactivity. No support was found for the mediating effect of AF of the physical activity–mental health relationship.

Conclusions: Self-reported behavior of regular physical activity seems to be more important to monitor than measures of AF when considering the potential preventive effects of physical activity on mental health.

Keywords: fitness; physical activity; depression; anxiety; burnout

1. Introduction

The evidence linking regular physical activity to mortality, morbidity, and health is today well documented (Blair, Cheng, & Holder, 2001). The beneficial effect of physical activity for different dimensions of mental health (MH) has also become increasingly evident and the inverse association between physical activity (PA) and symptoms of depression is well known (Teychenne, Ball, & Salmon, 2008). The literature also supports a negative relationship between PA and level of anxiety symptoms, although less studied than depression (Strohle, 2009). We also showed that self-rated participation in PA lowered the risk of developing mental health problems, including burnout in a two year follow-up (Jonsdottir, Rodjer, Hadzibajramovic, Borjesson, & Ahlborg, 2010).

Aerobic fitness (AF), often referred to as the golden standard of PA related measures (Ainsworth, 2009) has been shown to be a stronger predictor of physiological health parameters, such as cardiovascular health and mortality, compared with self-rated physical activity (SRPA) (Blair et al., 2001; Myers et al., 2004; Williams, 2001). As has been pointed out in several studies, PA is a behaviour whereas AF is a physiological attribute that is influenced by other variables aside from PA, such as sex, age, genotype and other behavioral determinants.(Hamer & Stamatakis, 2010; Lee et al., 2011). It can thus be speculated that SRPA and AF may act independently on mental health outcomes, and that the patterns of association between SRPA and MH may be different from the association of AF with MH.

Few studies have concomitantly examined the relationship of both SRPA and AF with MH, and the results have been inconclusive. In an early study, Thirlaway and Benton (Thirlaway & Benton, 1992) demonstrated that SRPA, rather than AF (cardiovascular fitness), was related to better mental health and mood. On the contrary, Tolmunen and colleagues (Tolmunen et al., 2006) found that low AF (maximal oxygen uptake) but not SRPA, was related to elevated depressive symptoms in middle-aged men. However, in a later study on the

same sample, they found both higher SRPA and AF to be related to less risk for hopelessness (Valtonen et al., 2009). Moreover, Hamer and Stamatakis (Hamer & Stamatakis, 2010) recently found that SRPA, but not objectively assessed moderate to vigorous physical activity, was associated with psychological health. However, these previous studies mostly used only one global measure of MH, such as subjective well-being, rather than a specific component of MH, such as depression or anxiety.

Moreover, the question whether AF mediates the relation between PA and MH has been raised. Some researchers have suggested that the relationship of MH with PA cannot simply be attributed to changes in AF (Martinsen et al., 1989; Salmon, 2001). The lack of relationship between a change of fitness level and symtoms of depression in previous studies partly supports that other factors than fitness are important in mediating the treatment effect of depression (Dunn, Trivedi, & O'Neal, 2001; King, Taylor, Haskell, & DeBusk, 1989; E. Martinsen, Morgan WP, 1997). However, despite the inconsistent results in previous research, no study, to our knowledge, has actually tested the hypothesis if AF mediates the relation of PA with different components of MH (including depression, anxiety, and burnout) according to modern recommended mediation analytical procedures (Cerin, 2010; Preacher & Hayes, 2004).

A general problem in previous studies on PA and MH has been linked to floor or ceiling effects (Brosse, Sheets, Lett, & Blumenthal, 2002; Morgan, 1997) and a lack of sufficient variation in terms of MH and quality of life scores, in particular in nonclinical samples. Also, some studies have studied only men (Valtonen et al., 2009). To remedy these problems, we choose to consciously stratify our sample according to self-reported stress levels, a general proxy closely related to other measures of mental health, and include the same number of men and women. Hence, we included 20 men and 20 women for each of five self-reported stress levels, ranging from “not at all stressed” to “very much stressed.”

The purpose of the present study was to examine: (a) the relation between different MH symptoms (depression, anxiety, and burnout) and SRPA level, and AF; and (b) whether AF mediates the relation between SRPA and mental health.

2. Methods

2.1. Participants and inclusion procedure

Subjects to this study were recruited at the Institute of Stress Medicine in Gothenburg, Sweden, from an ongoing longitudinal cohort study and from advertisements in daily newspapers. The general aim of the cohort study was to investigate different aspects of psychosocial work environment, stress, and stress-related health.The study population of the longitudinal cohort study comprises a random sample of 6000, mainly health care workers (82%) employed by Region Västra Götaland (5300 out of 48,600 employees) and workers at the social insurance offices (700 out of 2200 employees). Only employees with at least one year employment, and working at least 50% of full-time, were selected for randomization. The participants in the present study fulfilled the following primary inclusion criteria: in general good health, not taking any medication, aged 25–50, and having a body mass index between 18.5 and 30 kg/m^2. The study subjects underwent a screening test, including anthropometric measurements and blood samples to ensure the following exclusion criteria: anemia, current infection, diabetes, thyroid illness, vitamin B12 deficiency, or excessive consumption of alcohol. In total 200 (100 men and 100 women) participants were included.

The subjects answered this screening question that measures perceived stress: “Stress means a situation in which a person feels tense, restless, nervous, or anxious, or is unable to sleep at night because his/her mind is troubled all the time. Do you currently feel this kind of stress?” The response was recorded on a five-point Likert scale varying from “not at all” to “very much.” This single-item question was originally used in the Nordic Questionnaire for

Psychological and Social Factors at Work (QPS Nordic) (Elo, Leppanen, & Jahkola, 2003). This single-item measure of stress has in previous studies been associated with psychological and physical symptoms as well as mental resources (Elo et al., 2003). Consecutive inclusion was then applied depending on the answer, resulting in a stratified sample of equal distribution of participants in each of the five stress categories, 20% in each. The purpose of this procedure was to get a variation in terms of degrees of perceived stress and mental health. The inclusion and assessment period was spread across the year for all the different stress-groups. Therefore there were no general differences between the stress groups in terms of when, (during which season) they were included and assessed.

We also aimed at having an even distribution of women and men in the study and therefore created altogether ten groups (five groups of women with different levels of perceived stress and five groups of men with different levels of perceived stress). Only those with complete data for all the variables used in the analyses were included in this study (*n*=177); 51% were women, and the mean age for the total group was 39.1 (SD: 8.1). Seventy-four percent reported being married or living with someone, whereas 26% reported living alone. In terms of occupation, 62% had an occupation that requires higher education (college/university degree), 27% had an occupation that did not require higher education, and 11% were students and participants without any present occupation. Ninety-one percent of the participants were nonsmokers. The study was approved by the regional ethical review board in Gothenburg, Sweden, and all participants signed an informed consent form before participation.

2.2. Measures

2.2.1 Mental health measures

The Hospital Anxiety and Depression (HAD) scale was used to assess symptoms of anxiety and depression. The scale was originally developed for non-psychiatric clinics as a tool to determine the presence of anxiety disorders and depression (Zigmond & Snaith, 1983). The HAD scale includes 14 items, seven items for anxiety (HAD-A) and seven items for depression (HAD-D). The sum score of each subscale is used to classify "non-cases" (0–7), "cases" (8>). The HAD scales have been found to have satisfactory reliability and validity (Bjelland, Dahl, Haug, & Neckelmann, 2002). Based on recent recommendations, we used a score of eight and above on each scale to classify increased anxiety or depressed mood (Bjelland et al., 2002; Brennan, Worrall-Davies, McMillan, Gilbody, & House, 2010).

The Shirom-Melamed Burnout Questionnaire (SMBQ) (Melamed, Kushnir, & Shirom, 1992) was used to evaluate self-reported burnout. Different aspects of burnout (physical fatigue, emotional exhaustion, tension, listlessness, and cognitive weariness) were measured by using 22 items with scales from 1 (almost never) to 7 (almost always). The SMBQ has been demonstrated to correlate highly with other reliable burnout measurements, such as Maslach Burnout Inventory (Grossi, Perski, Evengard, Blomkvist, & Orth-Gomer, 2003). In the present study, we used a score of above 3.75 to classify high burnout (Grossi et al., 2003).

2.2.2. Aerobic fitness (AF)

Aerobic fitness was measured by the Åstrand indirect test of maximal oxygen uptake (VO_{2max}) (Åstrand, 2003). This submaximal test was performed in the morning (starting at 7:00 am, 7:30 am, or 8:00 am) on a bicycle ergometer (Monark Ergomedic 828E). The pedaling frequency was 50 rpm, and the workload was adjusted so that the heart rate was kept between 130 bpm and 160 bpm in subjects younger than 40 years and between 120 bpm and 150 bpm in those older than 40 years. The subjects graded their perceived exertion on the Borg scale (Borg, 1970) and were advised to maintain their exercise intensity comparable to a

level between 13 and 14 (slightly strenuous). According to the Åstrand test instructions, a steady state is reached when the heart rate after five and six minutes is stable. If a steady state is not established by then, the test continues until it is. The peak oxygen uptake (L/min) was estimated by use of a nomogram based on sex, workload, and mean steady-state value of heart rate (Astrand & Ryhming, 1954). A correction factor for age was used, and the value of oxygen uptake was finally corrected for body weight and expressed as peak VO_{2max} (ml/kg/min), representing the aerobic fitness.

2.2.3 Self-reported physical activity (SRPA)

The participants rated their physical activity level according to an adapted version of the widely used four-level scale originally developed by Saltin and Grimby (Saltin & Grimby, 1968). This simple instrument has been shown to discriminate between sedentary and active counterparts regarding maximal oxygen uptake (Saltin, 1977) and has been validated against biological measures (Aires, Selmer, & Thelle, 2003). The participants reported the level that best corresponded to their SRPA during the last three months: (a) mostly sedentary (group 1); (b) light physical activity (such as gardening or walking or bicycling to work) at least two hours a week (group 2); (c) moderate physical activity (such as doing aerobics, dancing, swimming, playing football, or heavy gardening) at least two hours a week (group 3); or (d) vigorous physical activity several times a week, at least five hours with high intensity (group 4).

Due to few responses in the fourth category, we reduced the four categories to three distinctive groups of sedentary, light physical activity (LPA), and moderate to vigorous physical activity (MVPA), which includes both groups 3 and 4. This item has a clear dimension of intensity and in the statistical analysis is referred to as physical activity intensity level.

2.3. Statistical analyses

Descriptive statistics are given in terms of count and percentages for categorical variables and means and standard deviation (SD) for continuous variables. Mental health outcomes were dichotomized according to cutoff scores recommended in previous research, and logistic regressions were performed to analyze their relation to SRPA and AF. Obtained odds ratios (OR) along with the corresponding 95% confidence intervals (CI) were presented as estimates of effect measures. The variables of age, gender, BMI, occupation, smoking, and marital status were considered as possible confounders. The model building strategy was based on recommendations by Hosmer and Lemeshow (Hosmer & Lemeshow, 2000). First, the explanatory variables (that is, the three physical activity measures SRPA and PF) as well as confounders (age, gender, BMI, occupation, smoking, and marital status) were tested in univariate logistic regressions. In multivariate models, predicting variables were included (one at a time for each outcome) along with confounders whose *p* values in the univariate analyses were ≤0.25 (full model). Variables were excluded from the multivariate model if their *p* values were >0.1 (reduced model). Removed variables were added back in the model if the test comparing reduced and full models were significant ($p<0.05$) or if the coefficient estimates changed by >20% between the models. Only the final models are shown in the results. To investigate the unique relation of each predictor to the mental health outcomes (HAD-A, HAD-D, and SMBQ), we first entered AF and SRPA as predictor separately in the two analyses (that is, one analysis with AF as predictor and one with SRPA as predictor). In the next step, both AF and SRPA were entered as predictors simultaneously in the same analysis to examine whether the potential significant link between the predictors and the mental health outcomes remained when controlling for the other one.

To test whether PF mediated the relationship between SRPA and the three mental health variables, we followed the recommendations suggested by Preacher and Hayes (Preacher &

Hayes, 2004) and Cerin (2010) and examined indirect effects using a bootstrapping resampling approach. More specifically, we used the script version of the INDIRECT macro described in Preacher and Hayes (2008) to calculate product-of-coefficients and asymmetric 95% confidence intervals based on 1000 resamples. In these analyses, the a path represents the relation between SRPA and aerobic fitness, the c path and c-prime path are the total effect and direct effect of SRPA on mental health, and finally the b path is the relation between aerobic fitness and mental health.

3. Results

3.1. Descriptive statistics

The mean age of the participants was 39 years (SD 8.1) and the mean body mass index was 23.6 (SD 2.6). Other descriptive statistics are shown in Table 1. Missing data resulted in a total sample of 177 for the analyses. The missing data were evenly distributed across gender (10 women, 13 men) and the five stress groups created from the question about stress used for inclusion (groups 1 and 5 containing the least and most stressed individuals respectively) (four from group 1, three from group 2, five from group 3, five from group 4, and six from group 5).

The majority of the participants (83%) engaged in at least light physical activity during the past 3 months. The aerobic fitness scores ranged from 22 to 68 ml/kg per minute with a mean of 40.4 (SD 8.8). Participants reporting engaging in MVPA the last three months had higher AF compared with individuals who were mostly inactive or engaged in LPA ($p<.001$).

To check whether our stratification strategy provided us with a variation in terms of mental health, we examined the variation in mental health (proportion of cases) depending on the self-reported stress level used for inclusion. There was a significant difference between stress groups in terms of proportion of cases for depression ($Z=-2.85$, $p=.004$), anxiety

(Z=−5.47, p<.001), and burnout (Z=−5.15, p<.001), with cases increasing with higher levels of perceived stress. The number of cases, based on the recommended cutoffs [43, 44], for depression, anxiety, and burnout are described in Table 1.

3.2. Self-reported physical activity intensity, aerobic fitness, and mental health

Tables 2 and 3 demonstrate the OR for analyses where PF and SRPA predicted—both when entered separately and simultaneously—cases of depression, anxiety, and burnout. When predictor variables were entered separately, the analyses showed that individuals reporting LPA or MVPA were significantly less likely to be classified as having elevated scores on depression, anxiety, and burnout compared to those who were sedentary (Table 2). No differences were found between the LPA and MVPA groups in terms of depression, anxiety or burnout. Better AF (higher estimated maximal oxygen uptake) was marginally related to being classified as having a HAD-D score below the cutoff (OR: 0.91; 95%; CI: 0.83–0.99) and was not significantly related to anxiety or burnout (Table 2).[1]

When the two predictors (SRPA and AF) were entered simultaneously, only SRPA were significantly and negatively related to symptoms of depression, anxiety and burnout (Table 3). Hence, the negative and significant associations between SRPA and mental health variables remained when AF was controlled for. However, the relations between AF and mental health variables were not significant, mirroring the findings from the first step when both predictors were entered separately.

[1] In complementary analyses we used continuous (total) scores for the outcomes (depression, anxiety and burnout) rather than dichotomised scores and cut-offs. These analyses, using ANOVAs, demonstrated that individuals engaged in more SRPA had significantly lower total scores in depression (F(2,176) =14.82, p<.001), anxiety (F(2,176) =9.23, p<.001), and burnout (F(2,176) =12,52, p<.001). More specifically, the sedentary group revealed higher depression, anxiety and burnout scores compared with the LPA and MVPA groups. No differences were found between the LPA and MVPA groups. For AF, participants were divided into three groups based on their AF score: low (23-36ml/kg per minute), medium (37-43 ml/kg per minute) and high (44-68 ml/kg per minute) AF. No significant differences were found between the groups in terms of mental health.. The largest differences were found between the low and high AF groups in depression, where the high AF group revealed non-significantly (p=0.12) lower depression scores.

3.3. Aerobic fitness as a mediating variable in the self-reported physical activity–mental health relation

The results from the mediating analyses are shown in Table 4. The path between SRPA and aerobic fitness (a path) was positive and significant. Both the total effect and direct effect (c path and c-prime path) of SRPA on mental health were significant for all of the three mental health variables (depression, anxiety and burnout). The paths (b path) between aerobic fitness and mental health were however not significant for any of the three mental health variables. More importantly, the bootstrap analyses with 1,000 samples demonstrated that the mediating effect of aerobic fitness was not significantly different from zero for any of the three mental health variables. The indirect effects with 95% confidence intervals were estimated to be between −.54 and .17 for depression; between −.04 and .24 for anxiety; and between −.15 and .13 for burnout. To summarize, we found no support in any of the three different analyses for the mediating effect of aerobic fitness in the physical activity–mental health relationship.

4. Discussion

This study suggests that SRPA, but not AF, is significantly related to MH, when measured as self-reported symptoms of depression, anxiety, and burnout. These associations remained also when AF was entered as a predictor simultaneously as SRPA and thus was controlled for. Our results thereby support the recent findings of Hamer and Stamatakis (Hamer & Stamatakis, 2010) that SRPA is robustly associated with mental health variables, with no such association between mental health and AF. Moreover, our findings expand the results of Hamer and Stamatakis as we found a similar patterns of associations, not only for one global measure of mental health (psychological distress), but for three relevant and

independent (albeit strongly related) factors of MH: symptoms of depression, anxiety and burnout. The negative relationship between SRPA and MH found in our study was captured through the use of a single self-report item measuring SRPA. Thus, our results, together with the findings of previous studies (Hamer & Stamatakis, 2010; Thirlaway & Benton, 1992), indicate that self-report measures of PA may be more informative, compared with measures of AF, when relating to MH.

The associations of SRPA and MH instruments in our study do not seem to mirror a simple linear dose response relationship. The threshold affecting mental health is already seen for light physical activity and no differences were found in MH between more active individuals engaged in MVPA compared with LPA. Thus, in terms of dose response, our results support previous studies and reviews (Scully, Kremer, Meade, Graham, & Dudgeon, 1998; Teychenne et al., 2008).

From a broader applied perspective, the aspects of dropout, adherence, and injuries are vital to consider when using exercise in the prevention of mental illness. Consequently, finding the minimal level of physical activity necessary for mental health benefits is of high clinical and practical interest. The support for the effect of a relatively low intensity level of physical activity for lower symptoms of depression, anxiety and burnout is important as these less intensive types of exercise tend to be related to better adherence and less injuries (Pollock et al., 1991).

An important question is what factors mediate the physical activity–mental health relationship; that is, what are the potential mechanisms? Interestingly, no support was found for the notion that AF mediates the relation between SRPA and mental health, mirroring previous reviews and studies that show little support for an association between psychological factors and physiological fitness (Dunn et al., 2001; King et al., 1989; E. W. Martinsen, Strand, Paulsson, & Kaggestad, 1989). In other words, the association of regular physical

activity and mental health does not seem to work primarily via improved fitness and cardiovascular physiological change. A number of other factors have been identified as more likely mediators. These include, for example, central mediating biological systems (such as monoamines/serotonin and regulation of hypothalamic-pituitary-adrenal axis) and psychological and psychosocial factors (such as improved cognitive functioning, behavioral activation processes, overall self-esteem, domain-specific self-evaluations linked to the body and self-efficacy, perceptions of mastery, competence and control over one's health and body) (Brosse et al., 2002; De Moor, Boomsma, Stubbe, Willemsen, & de Geus, 2008; Dishman et al., 2006; Foley et al., 2008; Wipfli, Landers, Nagoshi, & Ringenbach, 2009). Also, as regular physical activity and exercise are related to improved self-perceptions and perceived competence regarding ones body and its functioning (Lindwall, Lindgren, E-C. , 2005), the role of these concepts as mediating variables in the exercise–mental health relationship may be of more interest. Finally, the degree of intrinsic motivation and self-determination in LPA and activity preferences may also act as potential mechanisms (Cerin, Leslie, Sugiyama, & Owen, 2009; Sonnentag, 2001).

Several limitations should be mentioned. As our study was cross-sectional, we cannot draw any conclusions in terms of causality. Not only may physical activity lead to more positive mental health, but it is also very conceivable that lack of mental health (that is, symptoms of depression, anxiety, and burnout) may result in an increased risk for inactivity highlighting the potential reciprocal nature of the exercise–mental health relationship (Lindwall, Larsman, & Hagger, 2011). Also cases of depression are very few in this study, thus caution regarding these results should be mentioned. However, our complementary analyses also showed that higher SRPA is clearly associated with lower total depression scores. Hence, when viewing depression more as a continuum of severity rather than as distinct categories (depressed/not depressed) based on dichotomized cut-offs, our results

firmly support the notion the being regularly active is related to less depression symptoms. Moreover, although we managed to create a significant variation in terms of perceived stress and mental health, thereby avoiding floor and ceiling effects, it can be argued that we did not have the same large variation in terms of physical activity. Overall, our sample was quite active and only a relatively small proportion of the sample reported being mostly inactive or never exercising, which could indirectly have resulted in a lack of sufficient variation in AF and thereby less power to detect associations between AF and mental health in both the logistic regression analyses and mediation analyses.. However, contradicting this notion, the AF scores demonstrated a quite large range (range from 22 to 68 ml/kg per minute) and spread (a standard deviation of 8.78 for the full sample) and despite the narrower span of the SRPA score, we still found significant associations with mental health for that measure.

In terms of generalizability, our sample comprised mostly of individuals who were married or living with someone and having jobs that required higher education. As socioeconomic status and marital status have been linked to mental health status, our results may not be generalized to populations characterized by low socioeconomic status and single-living individuals. Moreover, our non-clinical sample was relatively healthy and active. Therefore, it is unclear how the results of the study would generalize in clinical samples with medical diagnoses or inactive overweight samples.

Future controlled trials should examine the effect of both physical activity and fitness on a broad range of mental health factors, and investigate the potential mediating effect of fitness on a variety of samples using recommended analytical procedures for testing mediating effects (Cerin, 2010; Preacher & Hayes, 2004). For example, using prospective studies, cross-lagged panel designs could be used to more reliably investigate the reciprocal nature of physical activity, fitness, and mental health across time. Moreover, future studies should

examine whether objectively measured physical activity (e.g., using accelerometer) are related to similar mental health outcomes as self-report measures of PA.

Our study supports the notion that frequent and at least light to moderate physical activity is associated with lower levels of depression, anxiety, and burnout, and more favorable mental health. Conversely, aerobic fitness was not related to any of the mental health factors. From a measurement perspective, simple self-report questionnaires of physical activity may reveal more important information in the relation with mental health compared with measures of AF.

From a clinical perspective, physical activity of low to moderate intensity may be perceived as a particularly effective type of behavioral activation (Dimidjian et al., 2006) that has proved to be an effective approach in clinical treatment of depression. From a measurement point of view, self-reported instruments of physical activity are generally considered as less reliable and thereby less preferred than measures such as AF (Ainsworth, 2009). However, as AF is influenced not only by environmental factors such as physical activity but also to a large proportion by genetics (Bouchard, 1994), it should be viewed as an indirect measure of physical activity. Also, as supported by previous reviews and studies (Blair et al., 2001; Ekblom-Bak, Hellenius, Ekblom, Engstrom, & Ekblom, 2009; Lee et al., 2011; Williams, 2001), it seems as if SRPA and AF have independent and different relations to physiological health and mortality, suggesting that SRPA and AF may capture somewhat different dimensions of the concept of physical activity. The results of our study further support this perspective as AF and SRPA showed quite different relations to MH across all three mental health factors. Therefore it is important for researchers and practitioners to be aware that fitness measures and SRPA are not per definition the same thing and may relate differently to health, in particular if one is looking at both physiological and mental health parameters at the same time.

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Table 1

Descriptive statistics (frequency, means, and SD) of the main variables in the study (*n*=177)

	Full Sample (n=177)	Cases depression (n=12)	Cases anxiety (n=59)	Cases burnout (n=52)
	n (%)	*n* (%)	*n* (%)	*n* (%)
Gender				
Men	87 (49)	6 (7)	27 (31)	20 (23)
Women	90 (51)	6 (7)	32 (35)	32 (36)
Occupation[1]				
RUE	110(62)	7 (6)	36 (32)	31 (28)
NRUE	48 (27)	1 (2)	17 (35)	13 (27)
SoU	19 (11)	4 (21)	6 (32)	8 (42)
Marital status				
Single	46 (26)	4 (9)	17 (37)	14 (30)
Married/living with someone	131 (74)	8 (6)	42 (32)	38 (29)
Smoking status				
Nonsmoker	161 (91)	9 (6)	53 (33)	46 (29)
Smoker	16 (9)	3 (19)	6 (38)	6 (38)
SRPA				
Sedentary	30 (17)	6 (20)	19 (63)	18 (60)
LPA	65 (37)	3 (5)	19 (29)	20 (31)
MVPA	82 (46)	3 (4)	21 (25)	14 (17)
Aerobic fitness[2], M (SD)	40.39 (8.78)	35.75 (10.05)	40.31 (8.84)	39.00 (8.51)

[1] RUE = Requiring university education; NRUE = Not requiring university education; SoU = students or unemployed
[2] ml/kg per minute
SRPA = Self-reported physical activity intensity
LPA= Light physical activity
MVPA= Moderate to vigorous physical activity

Table 2.

Final models demonstrating odds ratios for aerobic fitness and self-reported physical activity in predicting symptoms of depression, anxiety, and burnout when entered separately in analyses

Variable	Depression		Anxiety		Burnout	
	n (%)	OR (95% CI)	*n* (%)	OR (95% CI)	*n* (%)	OR (95% CI)
SRPA						
Sedentary	6 (20)	1	19 (63)	1	18 (60)	1
LPA	3 (5)	**0.19 (0.05; 0.84)**	19 (29)	**0.24 (0.10; 0.60)**	20 (31)	**0.30 (0.12; 0.73)**
MVPA	3 (4)	**0.15 (0.04; 0.65)**	20 (24)	**0.19 (0.08; 0.46)**	14 (17)	**0.14 (0.05; 0.35)**
Aerobic fitness mean (SD)	35.8 (10.1)	**0.91* (0.83; 0.99)**	40.3 (8.8)	1.0* (0.97; 1.04)	39.0 (8.5)	0.97* (0.94; 1.01)

HAD = Hospital Anxiety and Depression scale; LPA = Light physical activity; MVPA = Moderate to vigorous physical activity; SRPA = Self-reported physical activity intensity.
The following confounders were adjusted for: age, gender, BMI, occupation, smoking, and marital status
* odds ratio for 1 point increase in AF
Significant associations are highlighted in bold

Table 3.
Odds ratios for aerobic fitness and self-reported physical activity in predicting depression, anxiety, and burnout when entered simultaneously in analyses

Variable	Depression	Anxiety	Burnout
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Aerobic fitness score	0.93* (0.85; 1.02)	1.01* (0.96; 1.05)	0.99* (0.95; 1.04)
SRPA			
Sedentary	1	1	1
LPA	**0.11 (0.02; 0.62)**	**0.22 (0.08; 0.56)**	**0.27 (0.11; 0.70)**
MVPA	**0.17 (0.03; 0.88)**	**0.18 (0.07; 0.46)**	**0.06 (0.07; 0.40)**

LPA = Light physical activity
MVPA = Moderate to vigorous physical activity
SRPA = Self-reported physical activity intensity
The following confounders were adjusted for: age, gender, BMI, occupation, smoking, and marital status
* odds ratio for 1 point increase in AF
Significant associations are highlighted in bold

Table 4.

Mediating effects of aerobic fitness in the relationship between self-reported physical activity and mental health variables

Mental health variable (dependent variable)	SRPA to aerobic fitness[1]	Aerobic Fitness to Mental Health[2]	Total effect of SRPA on Mental health[3]	Direct effect of SRPA on Mental health[4]	Bootstrap results for indirect effect[5]
	Coefficient [a] (SE)	Coefficient (SE)	Coefficient (SE)	Coefficient (SE)	$\alpha\beta$[6] (SE) (95% CI)
Depression	3.22 (0.77)**	-0.05 (0.04)	-1.00 (0.40)*	-0.89 (0.42)*	-0.19 (0.19) (-0.54, 0.17)
Anxiety	3.22 (0.77)**	0.02 (0.02)	-0.77 (0.21)**	-0.84 (0.22)**	0.07 (0.07) (-0.04, 0.24)
Burnout	3.22 (0.77)**	-0.00 (0.02)	-0.96 (0.23)**	-0.96 (0.24)**	-0.02 (0.07) (-0.15, 0.13)

[1] Independent variable to mediator (a path); [2] Direct effect of mediator on dependent variable (b path); [3] Total effect of independent variable on dependent variable (c path); [4] Direct effect of independent variable on dependent variable (c-prime path); [5] Bootstrap results based on 1000 resamples
[6] product-of-coefficient estimate; [a] unstandardized regression coefficient; SE= standard error