


# Mental health and physical activity in vocational education and training schools students: a population-based survey

Christine Tøfting Jensen<sup>1</sup>, Clara Heinze<sup>1</sup>, Per Kragh Andersen<sup>2</sup>, Adrian Bauman<sup>3</sup>, Charlotte Demant Klinker <sup>1</sup>

<sup>1</sup> Health Promotion Research, Copenhagen University Hospital – Steno Diabetes Center Copenhagen, Herlev, Denmark

<sup>2</sup> Department of Biostatistics, University of Copenhagen, Copenhagen, Denmark

<sup>3</sup> Prevention Research Collaboration, School of Public Health, University of Sydney, Sydney, NSW, Australia

**Correspondence:** Charlotte Demant Klinker, Steno Diabetes Center Copenhagen, Borgmester Ib Juuls Vej 83, 2730 Herlev, Denmark, Tel: +45 (0) 27 29 06 80, e-mail: [charlotte.demant.klinker@regionh.dk](mailto:charlotte.demant.klinker@regionh.dk)

**Background:** The prevalence of young people not adhering to the World Health Organization (WHO) physical activity guidelines is high, especially among students in vocational education and training, compared to fellow peers. Also, low levels of mental health have been found in this group, however, to a lesser degree than peers in general education. As positive mental health aspects have more generally been found to be associated with increased likelihood of physical activity in young people, this study examined the association between mental health and physical activity among Danish students in vocational education and training. **Methods:** Students in vocational education and training ( $N = 5277$ , mean age 24.3 years, range 15.8–64.0 years) responded to a national representative survey assessing four aspects of mental health (well-being, self-efficacy, self-esteem and life satisfaction) and physical activity. Physical activity was dichotomized as adherence to the WHO minimum guidelines or not. Logistic regression was used to examine if each mental health aspect was associated with physical activity in crude and adjusted models. **Results:** A positive dose–response association was found between all aspects of mental health and adherence to WHO physical activity guidelines. However, the association between self-esteem and physical activity was modified by gender, with a dose–response relationship found only among males. **Conclusions:** Higher levels of positive mental health were associated with better odds of achieving WHO physical activity guidelines in a dose–response-manner. Prospective studies are needed to further elucidate the causal relationship between mental health and physical activity. Future interventions must pay attention to differential gender effects.

## Introduction

Physical activity (PA) has many health benefits. In the short term, PA can promote well-being as well as prevent musculoskeletal pain and obesity.<sup>1,2</sup> In the long term, regular PA can reduce premature non-communicable disease morbidity and mortality.<sup>3</sup> The World Health Organization (WHO) recommends that individuals aged 18–64 engage in at least 150 weekly minutes of at least moderate-intensity physical activity or 75 weekly minutes of vigorous-intensity physical activity (VPA) or an equivalent combination of moderate-to-vigorous physical activity (MVPA).<sup>4</sup> However, around one in four Europeans aged 18–64 years old does not achieve the minimum PA guidelines.<sup>5</sup> In general, a larger proportion of young adults meet the guidelines than older adults,<sup>5,6</sup> but many are still not meeting the WHO PA guidelines. In Denmark, 30% of students in vocational education and training (VET-students) do not meet the WHO minimum PA guidelines,<sup>7</sup> while in general upper secondary education the corresponding percentage is 12–16%.<sup>8</sup> A similar pattern exists in other Scandinavian countries with students in general upper secondary education being significantly more physically active than students in vocational secondary education.<sup>9–11</sup> Vocational education and training (VET) is a practice-oriented education that gives students the competences to handle skilled jobs after graduation. The relatively high proportion of VET-students who are insufficiently physically active is both problematic for the individual due to the consequences related to

inactive lifestyle listed above and also for the society as chronic disease costs attributable to inactivity will eventually be incurred.<sup>12</sup> There is limited research on understanding PA among VET-students that might inform interventions in this sector.

One important individual correlate of PA is psychological factors and broader mental health.<sup>6,13</sup> Mental health is a multidimensional construct as defined by WHO: ‘... a state of well-being in which an individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and is able to make a contribution to his or her community’.<sup>14</sup> Mental health consists of both hedonic (feeling good, e.g. positive emotions and life satisfaction) and eudaimonic dimensions (functioning well, e.g. managing everyday challenges, sensing meaning in life and having close social relationships), thus, it is more than the absence of mental disorders.<sup>15–17</sup> No agreed best practice to measure mental health exists, but there is a growing consensus that measuring mental health requires aspects of both dimensions.<sup>15</sup> Therefore, this article includes both hedonic aspects of mental health (life satisfaction and self-esteem), a eudaimonic aspect (self-efficacy) and a multidimensional measure (mental well-being). Collectively, we refer to them as positive mental health.

Mental health aspects are linked to uptake or maintenance of health-promoting behavior including PA,<sup>13,16</sup> among them self-efficacy is a consistent determinant of PA in adults.<sup>6</sup> However, most evidence regarding mental health correlates of PA is limited by the many different definitions of mental health and PA.<sup>13</sup>

In Denmark, the mean age of VET-students is 23.9 years,<sup>18</sup> similar to the sample in this article, making them comparable in relation to age with college or university students. Among college or university students life satisfaction is positively associated with leisure time PA in a dose-response manner,<sup>19</sup> while stress and depressive symptoms are negatively associated with meeting MVPA guidelines.<sup>20</sup> Many previous studies among adolescents or young adults have focused on how adherence to PA guidelines may impact mental health with assumptions that PA is a health-promoting behavior that may improve mental health or that PA is a way to increase social interaction and increase mental health.<sup>2</sup> Kimiecik<sup>16</sup> suggests the link between mental health and health behaviors including PA is likely to be dynamic and reciprocal. A recent study among shows that insufficiently physically active emerging adults have higher odds for not experiencing high mental health, both when it is measured solely as the hedonic dimension, the eudaimonic dimension and as a multidimensional measure.<sup>17</sup> This is in line with others' studies among college and university students showing that students who either meet the MVPA or VPA guidelines have lower odds of perceived stress, mental distress symptoms or social isolation<sup>21–23</sup> and higher odds of experiencing happiness, personal well-being and mental well-being.<sup>22,23</sup> Regardless of directionality, the existing evidence suggest a positive association between positive mental health aspects and adherence to PA guidelines. If this applies to VET-students too, one might expect they have low levels of positive mental health as the group has a high prevalence of not meeting WHO PA guidelines. Preliminary Danish representative surveys show, however, identical shares of high positive mental health aspects, such as life satisfaction, self-esteem and self-efficacy among VET-students and students in general upper secondary education,<sup>7,8</sup> despite the prevalence of inactive VET-students being double the one among peers in general upper secondary education. This made us question whether an association between positive mental health and PA exists among VET-students. To our knowledge, only two studies<sup>11,24</sup> have investigated this association among VET-students. Both studies found, to some extent, a positive association between positive mental aspects and PA.<sup>11,24</sup> Given the relative high prevalence of insufficiently physically active VET-students and the paucity of studies investigating mental health correlates of PA within this population, it is relevant to further investigate if positive mental health is associated with meeting WHO PA guidelines among VET-students. The aim of this study is to investigate if four mental health measures are associated with adherence to WHO PA guidelines among Danish VET-students.

## Methods

### Context

VET refers to different subsectors of the education system across Europe.<sup>24</sup> This article defines VET as secondary education as in Denmark, where VET is structured as a dual apprenticeship system in which students alternate between school-based learning and company-based training. In Denmark, the 100+ different programs offered are structured into four main educational programs: (i) food, agriculture and hospitality, (ii) administration, education and business service, (iii) care, health and pedagogy and (iv) technology, construction and transportation.<sup>25</sup> Most educations are offered at two levels: VET-normal, where students achieve a journeyman's certificate, and VET-higher, where students also achieve a general secondary education diploma. Duration of the VET in Denmark is usually 4 years (range: 2–5.5), but longer for VET-higher.<sup>25</sup> Admission to Danish VET requires completed compulsory school. In 2020, 20% of VET-students entered VET directly after compulsory school,<sup>26</sup> while many of the students entered later in life. Hence in 2020, only 32% of the Danish VET-students were aged 15–19 years,<sup>27</sup> which is lower than the European average of 50% aged 15–19 years participating in initial-VET.<sup>28</sup>

### Data collection

Data for this cross-sectional study were obtained from the Danish Health and Well-being Survey in VET schools 2019 (Health-VET 2019) assessing lifestyle behaviors, mental and general health among a national representative sample of VET-students.<sup>7</sup> Data were collected in Spring 2019 using an electronic survey, which took around 45 min to answer. In accordance with Danish Data Protection Agency rules and regulations,<sup>27</sup> students were informed of the voluntary nature of the survey and that their responses may be used for research and statistical purposes. They consented to participate before answering the survey and were given oral and written information that at any time they could withdraw. In Denmark, no ethical approval of the study was needed.<sup>28</sup> Of the invited VET schools, 68% agreed to participate. At participating schools all students present at the day of data collection were invited to participate. The estimated student response rate was 95%. It is not possible to calculate the exact response rate due to lack of information on (i) number of total enrolled students at the VET school and (ii) the number of student who were absent as they were apprenticed to a company.<sup>7</sup> For more information on sampling see Reference.<sup>29</sup>

### Measures

#### Physical activity

PA was measured as adherence to the WHO minimum PA guidelines using the Nordic Physical Activity Questionnaire-short comprising two open-ended questions of the weekly duration of MVPA and VPA. This measure is validated to monitor adherence to WHO PA guidelines among  $\geq 16$  years Danes.<sup>30</sup> MVPA above 35 h/week and VPA above 21 h/week was classified as missing.<sup>30</sup> Moreover, improbable answers on PA (e.g. shorter duration of MVPA than of VPA alone) were coded as missing. In analyses, PA was defined as adherence to WHO minimum guideline or not.

#### Hedonic aspects of mental health: self-esteem and life satisfaction

Self-esteem was measured by level of agreement with the statement: 'I am good enough the way I am'.<sup>7</sup> Responses were on a five-point-scale: strongly agree/agree/neither agree nor disagree/disagree/strongly disagree. Self-esteem was categorized into high (strongly agree/agree), moderate (neither agree nor disagree) or low (disagree/strongly disagree). Self-esteem is considered a hedonic aspect, which is in line with how it is used in the Danish version of the Health Behaviour in School-aged Children study.<sup>31</sup> Life satisfaction was measured by a simplified version of the Cantril Ladder.<sup>32</sup> Life satisfaction is commonly considered a hedonic aspect of mental health.<sup>19</sup> Students were shown a scale from 0 to 10 and asked to respond to the question: 'At the scale 10 indicates the "best possible life" and 0 "the worst possible life" for you. Where on the ladder do you feel you stand at the moment?' Life satisfaction was included as a continuous variable in analyses and dichotomized into high (score  $\geq 6$ ) or low (score  $\leq 5$ ) in the descriptive analysis.

#### Eudaimonic aspect of mental health: self-efficacy

General self-efficacy was measured by a single item: 'How often can you manage the things you decide to do?'<sup>7</sup> and responses were measured on a five-point-scale: very often/often/sometimes/rarely/never. Self-efficacy was categorized into high (very often/often), moderate (sometimes) or low (almost never/never). Self-efficacy is considered a eudaimonic aspect as it encompasses a belief in one's capabilities to do what is required to manage a situation,<sup>33</sup> reflecting a resilience resource to positive functioning.

## Multidimensional measure: mental well-being

Mental well-being was assessed using the short version of Warwick–Edinburgh mental well-being scale (SWEMWBS), which consists of seven items comprising both hedonic and eudaimonic aspects of mental health during the last 14 days.<sup>34</sup> Responses were given on a five-point scale: never/almost never/sometimes/often/very often. The categories were slightly altered from the validated ones to make them comparable to categories used in other Danish youth surveys. The score on each item was summed to an overall score and then scored using the recommended conversion table.<sup>35</sup> Mental well-being was included as a continuous variable in the analyses, and categorized into high, moderate and low in the descriptive analysis using mean  $\pm 1$ SD as cut points.

## Demographic and educational factors

Gender and age were included as covariates as they have been seen to influence mental health<sup>7,33</sup> and PA.<sup>6</sup> Information on gender and age was extracted from the unique Danish civil registration number (CPR-number) assigned to all Danish citizens or self-reported in case of missing data on CPR-number. Gender was coded binary (male/female) and age continuous. The following educational factors were included as covariates as results of a preliminary study<sup>7</sup> indicate that they may confound a potential association between positive mental health and PA. VET-specific information on the four main educational programs and the two educational levels was obtained from the survey and categorized in accordance with terminology of the Danish Ministry of Education. Data on location of VET schools was based on the address of each school and categorized into the five geographic regions of Denmark.

## Data analysis

Adherence to WHO PA guidelines by demographic and educational factors and mental health was inspected using  $\chi^2$ -tests. A dropout analysis was conducted to compare students without information on PA to students included in this study. Associations between each aspect of mental health and adherence to WHO PA guidelines were analyzed using logistic regression with adherence to the guidelines as the outcome variable. Unadjusted odds ratios (OR crude) and adjusted odds ratios (OR adjusted) with 95% confidence intervals (95% CI) were reported. Linearity of mental well-being and life satisfaction was examined separately in logistic regression including a squared version of each variable. A significant quadratic association between life satisfaction and WHO minimum PA guidelines appeared; hence the adjusted association will be presented graphically. Analyses were adjusted for gender, age, main educational program, educational level and location of the VET school. Interactions between gender and each aspect of mental health were examined in each adjusted model. Gender-specific OR are presented for significant interactions. All statistical analyses were performed in SPSS Statistics version 25 using a significance level of 0.05.

## Results

This study is based on the Health-VET 2019 ( $n = 6239$ ). Students were excluded if they had missing data on PA ( $n = 870$ ), gender ( $n = 23$ ) or age ( $n = 69$ ) leaving a subsample of 5277 students included in this study. A dropout analysis showed a lower mean score of mental well-being among students who were excluded due to missing PA data compared to those included (23.4, SD: 4.3 vs. 24.0 SD: 4.0;  $P < 0.001$ ), and more boys were non-responders than girls (15.9% vs. 11.4%;  $P < 0.001$ ). However, no difference was found regarding the distribution of self-efficacy, self-esteem, life satisfaction or age.

Descriptive results on the study population are shown in [table 1](#). Just over half were male (54.4%), with a mean age of 24.3 years (SD: 9.2). A total of 70% of students achieved the WHO minimum PA

guidelines. [Table 1](#) also shows the percentage of students attaining the WHO minimum PA guidelines by demographic and educational factors and level of mental health. Within each category of mental health, the highest proportion of students adhering to PA guidelines is among students having the highest level of mental health. Male students are more likely to be sufficiently physically active than females. The proportion of students meeting WHO minimum guidelines differs significantly across the five Danish regions. The distribution of the remaining covariates did not differ significantly among students who met the minimum guidelines and students who did not.

[Table 2](#) shows the crude and adjusted associations between positive mental health and meeting the WHO minimum PA guidelines. In both crude and adjusted analyses, positive mental health is associated with PA in a positive dose–response manner among VET-students. Thus, higher levels of positive mental health are associated with higher odds of meeting the WHO minimum PA guidelines. This is the case for self-efficacy and mental well-being, but the associations between self-esteem and life satisfaction and PA are complex. First, gender modifies the association between self-esteem and PA, with self-esteem only being associated with adherence to WHO minimum PA guidelines among male students. Secondly, life satisfaction is only associated with WHO minimum PA guidelines until it reaches a certain level (see [figure 1](#)), indicating a threshold effect. Thus, students with lower levels of life satisfaction would have increased benefits through PA if their level of life satisfaction is elevated, whereas this is not the case for students already reporting high life satisfaction.

## Discussion

This article explored whether positive mental health is associated with achieving WHO PA guidelines among Danish VET-students, and whether these associations were moderated by gender. Overall, positive mental health was associated with PA in a dose–response manner. An exception was the association between self-esteem and PA as it was modified by gender, and the association was only seen among males.

Despite the high prevalence of non-adherence to WHO PA guidelines among the Danish VET-students and a relative high proportion of students scoring high on positive mental health, we found a positive dose–response association in accordance with the existing evidence among college and university students.<sup>22,23</sup> Thus, the association seems robust across students with different socioeconomic status (SES). This may reflect a common characteristic as VET-students internationally more often have parents with low SES than other students.<sup>36</sup> This is also the case in Denmark.<sup>18</sup> Moreover, the association seems robust across the teenager to young adult age group as the Danish VET-student population is relatively old (mean age 24 years) relative to the younger VET-students included in previous studies (mean age 17–18 years). Despite differences in either age or SES the findings of this article are in line with previous findings, e.g. we showed self-efficacy was associated with PA like a study showing a combined measure of self-efficacy and perceived behavioral control was correlated with MVPA among VET-students.<sup>11</sup> Furthermore, our results indicate a dose–response relationship between self-efficacy and PA, which is consistent with findings of a population-wide study among adults aged  $\geq 16$  years old.<sup>37</sup> Regarding life satisfaction, our results are somewhat similar to findings of a large study showing a dose–response association between life satisfaction and leisure time PA among university students.<sup>19</sup> However, the magnitude of the association did not level off with increased level of life satisfaction, as we found. To our knowledge, no other study has shown a similar association between life satisfaction and adherence to PA guideline. Our curvilinear dose–response association is, however, in accordance evidence on associations between PA

**Table 1** Characteristics of students' demographic and educational factors, mental health and PA (n, %) and percentage adhering to WHO minimum PA guidelines in each subgroup, N = 5277

		Distribution of characteristic n %		Percentage adhering to WHO minimum PA guidelines	P
Adhere to WHO minimum PA guidelines	Yes	3711	70.3	–	–
	No	1566	29.7	–	–
Gender	Male	2869	54.4	72.1	0.002
	Female	2408	45.6	68.2	
Age range: 15.8–64.0	Mean age (SD)		24.2 (9.2)	–	–
	15 to <19 years	2022	38.3	72.1	0.079
	19 to 25.9 years	1833	34.7	69.0	
	≥26 years	1422	26.9	69.5	
Main educational program	Food, agriculture and hospitality	748	14.2	67.2	0.255
	Administration, commerce and business service	901	17.1	71.0	
	Care, health and pedagogy	1571	29.8	70.5	
	Technology, construction and transportation	2057	39.0	71.0	
Educational level	VET-normal	4287	81.2	69.8	0.066
	VET-higher	990	18.8	72.7	
Regional location of the VET school	Capital Region of Denmark	988	18.7	72.3	<0.001
	Region Zealand	885	16.8	70.7	
	North Denmark Region	723	13.7	62.5	
	Central Denmark Region	1377	26.1	72.5	
	Region of Southern Denmark	1304	24.7	70.6	
Self-esteem	High	3798	71.9	72.2	<0.001
	Moderate	1119	21.2	66.9	
	Low	360	6.8	61.1	
Life satisfaction	Mean score (SD)		7.3 (1.7)	–	–
	High (score ≥6)	4453	84.4	71.3	<0.001
	Low (score ≤5)	824	15.6	65.2	
Self-efficacy	High	4386	83.1	72.1	<0.001
	Moderate	817	15.5	63.4	
	Low	74	1.4	41.9	
Mental well-being	Mean score (SD)		23.97 (4.03)	–	–
	High (score ≥28.00)	808	15.3	76.1	<0.001
	Moderate (19.95–27.99)	3765	71.3	70.6	
	Low (score ≤19.94)	704	13.3	62.2	

SD, standard deviation; PA, physical activity; WHO, World Health Organization; P, P-values for  $\chi^2$ -test.

**Table 2** OR and 95% CI for the associations between mental health and adherence to WHO 'minimum' PA guidelines

		Crude		Adjusted <sup>a</sup>			
		OR	95% CI	OR		95% CI	
				Male	Female	Male	Female
Self-esteem	High	1		1	1		
	Moderate	0.78	(0.68–0.90)*	0.71	0.87	(0.58–0.88)*	(0.71–1.07)
	Low	0.61	(0.48–0.76)**	0.43	0.81	(0.30–0.61)**	(0.60–1.09)
Life satisfaction		1.34	(1.13–1.60)*		1.35		(1.13–1.60)*
Life satisfaction <sup>b</sup>		0.98	(0.97–0.994)*		0.98		(0.97–0.994)*
Self-efficacy	High	1			1		
	Moderate	0.67	(0.57–0.79)**		0.67		(0.57–0.79)**
	Low	0.28	(0.18–0.45)**		0.28		(0.17–0.44)**
Mental well-being		1.05	(1.03–1.06)**		1.05		(1.03–1.07)**

PA, physical activity; WHO, World Health Organization.

a: Adjusted for gender, age, main educational program, educational level and regional location of the VET school.

b: Squared life satisfaction, see figure 1 for graphical presentation.

\*:  $P < 0.05$ ;

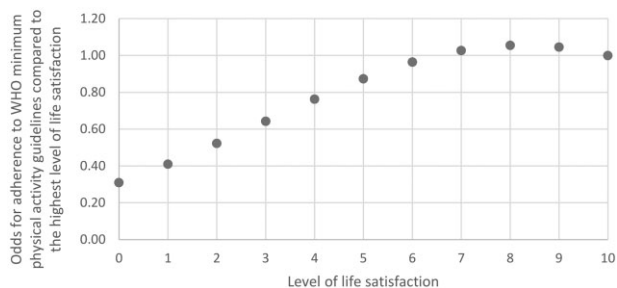
\*\* :  $P < 0.001$ .

volume and some health outcomes, showing that the relative health benefits diminish at higher levels of PA.<sup>38</sup>

As mentioned earlier, many cross-sectional studies have found PA to be a correlate of mental health, results in line with our findings. University students adhering to WHO minimum PA guidelines have

higher odds of happiness and personal well-being than students with lower levels of PA.<sup>22,23</sup> Moreover, university students' level of MVPA is associated with mental well-being in dose–response manner,<sup>23</sup> as we found. As such, this article adds to a growing body of literature suggesting that positive mental health is associated with PA in young





**Figure 1** Odds for adherence to WHO minimum physical activity guidelines compared to the highest level of life satisfaction

adults, and more specifically among an understudied group, namely VET-students.

Approximately 70% of the Danish VET-students met WHO minimum PA guidelines with males being more likely to adhere than females. Compared to studies investigating populations of young adults, this is a high proportion meeting the guideline. Particularly considering that PA declines with increasing age and that the Danish VET population is generally older than VET-students in many other European countries. For example, in a representative sample of Irish university students 64.3% of the students met WHO minimum PA guidelines, with males being more likely to meet the guidelines than females.<sup>22</sup> A similar pattern occurred among Swiss VET-students, of whom 52.6% met PA guidelines.<sup>39</sup> As PA is measured similarly across these studies, this cannot explain the different results. More likely, our finding reflects a true difference in PA in these populations.

A strength of this article is the examination of different aspects of mental health, representing both the hedonic (self-esteem and life satisfaction) and the eudaimonic (self-efficacy) dimension of mental health as well as a multidimensional measure (mental well-being) as correlate of adherence to WHO PA guidelines. We have shown how each of these mental health dimensions and multidimensional measure were associated with adherence to the WHO minimum PA guidelines. Moreover, we ran an additional analysis with the WHO upper limit PA guidelines of 300 min of MVPA as the outcome and showed overall similar results (see [Supplementary tables S1 and S2](#)). WHO recently updated the PA guidelines to specify a range of 150–300 min of MPA or 75–150 min of VPA weekly or a combination of MVPA.<sup>38</sup> Our results indicate that students scoring high on positive mental health have higher odds meeting WHO guidelines irrespective of whether it is the minimum or upper limit guidelines compared to students with lower scores on positive mental health.

For self-esteem, we found a gender-specific association with PA, possibly due to the global operationalization of self-esteem used. Rosenberg et al.<sup>40</sup> emphasize that specific and global self-esteem are distinct, but related concepts, and specific self-esteem is more relevant to behavior while global self-esteem is more relevant to overall mental health.

Further strengths of this study are the examination of associations between different positive mental health aspects and PA, the large representative sample of VET-students as an understudied group. Moreover, the use of validated measures of PA as well as controlling for demographic and educational factors is strengths. Limitations are the cross-sectional design making it impossible to determine the direction of the association. Secondly, information on mental health and PA are self-reported, which may introduce social desirability bias. Moreover, the survey included non-validated Danish response categories of SWEMWBS, which could lead to an overestimation of mental well-being due to the wording of highest response categories (very often in our version as compared to the validated always). Finally, the relatively large proportion of students excluded on missing PA is a limitation. However, the dropout analysis showed that

only the mental well-being mean score and the distribution of gender differed significantly between included and excluded students.

VET is a promising setting for PA promotion.<sup>36</sup> Although this study cannot identify best practice PA interventions for VET-students, it does suggest the potential PA benefits of promoting positive mental health of VET-students. Future longitudinal studies are needed to elucidate better causal information regarding the direction of association between mental health and PA.

## Supplementary data

[Supplementary data](#) are available at *EURPUB* online.

## Funding

This work was supported by The Danish Health Authority (grant number 1-1010-308/56).

*Conflicts of interest:* None declared.

## Key points

- A total of 70% of students in vocational education and training schools in Denmark adhere to WHO minimum physical activity guidelines.
- Mental well-being, life satisfaction and self-efficacy are associated with adherence to WHO minimum physical activity guidelines in a dose–response manner.
- Self-esteem is associated with meeting WHO minimum physical activity guidelines, but only among male students.
- The study indicates that health promoters can increase physical activity among students in vocational education and training by promoting mental well-being reflecting both hedonic and eudaimonic aspects of mental health or solely by promoting either a hedonic aspect (life satisfaction) or a eudaimonic aspect (self-efficacy).

## References

- 1 Janssen I, LeBlanc AG. Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. *Int J Behav Nutr Phys Act* 2010;7:40.
- 2 Lubans D, Richards J, Hillman C, et al. Physical activity for cognitive and mental health in youth: a systematic review of mechanisms. *Pediatrics* 2016;138:e20161642.
- 3 Lee I-M, Shiroma EJ, Lobelo F, et al. Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. *Lancet* 2012;380:219–29.
- 4 World Health Organization. Global Recommendations on Physical Activity for Health. 2010. Available at: <http://www.ncbi.nlm.nih.gov/books/NBK305057/> (17 June 2020, date last accessed).
- 5 Gerovasili V, Agaku IT, Vardavas CI, Filippidis FT. Levels of physical activity among adults 18–64 years old in 28 European countries. *Prev Med* 2015;81:87–91.
- 6 Bauman AE, Reis RS, Sallis JF, et al. Correlates of physical activity: why are some people physically active and others not? *Lancet* 2012;380:258–71.
- 7 Ringgaard LW, Heinze C, Andersen NBS, et al. Sundhed og Trivsel på erhvervsuddannelser 2019 (Health and Well-being at Vocational Education and Training 2019). 2020.
- 8 Pisinger V, Thorsted A, Jezek AH, et al. *Sundhed og Trivsel på Gymnasiale Uddannelser 2019 (Health and Well-Being at Upper Secondary Education 2019)*. Copenhagen: Statens Institut for Folkesundhed, 2019.
- 9 Westerstahl M, Barnekow-Bergkvist M, Jansson E. Low physical activity among adolescents in practical education. *Scand J Med Sci Sports* 2005;15:287–97.

- 10 Heradstveit O, Haugland S, Hysing M, et al. Physical inactivity, non-participation in sports and socioeconomic status: a large population-based study among Norwegian adolescents. *BMC Public Health* 2020;20:1010.
- 11 Hankonen N, Heino MTJ, Kujala E, et al. What explains the socioeconomic status gap in activity? Educational differences in determinants of physical activity and screentime. *BMC Public Health* 2017;17:144.
- 12 Ding D, Lawson KD, Kolbe-Alexander TL, et al. The economic burden of physical inactivity: a global analysis of major non-communicable diseases. *Lancet* 2016;388:1311–24.
- 13 Cortis C, Puggina A, Pesce C, et al. Psychological determinants of physical activity across the life course: a 'DEterminants of DIet and Physical ACTivity' (DEDIPAC) umbrella systematic literature review. *PLoS One* 2017;12:e0182709.
- 14 World Health Organization. Mental Health: Strengthening Our Response. 2018. Available at: <https://www.who.int/news-room/fact-sheets/detail/mental-health-strengthening-our-response> (10 October 2021, date last accessed).
- 15 Stewart-Brown S. Defining and measuring mental health and wellbeing. In: Knifton L, Quinn N, editors. *Public Mental Health: Global Perspectives*. Maidenhead: Open University Press, 2013: 33–42.
- 16 Kimiecik J. The eudaimonics of health: exploring the promise of positive well-being and healthier living. In: Vittersø J, editor. *Handbook of Eudaimonic Well-Being*. Cham: Springer International Publishing, 2016; 349–70.
- 17 Sofija E, Harris N, Phung D, et al. Does flourishing reduce engagement in unhealthy and risky lifestyle behaviours in emerging adults? *IJERPH* 2020;17:9472.
- 18 Erhvervsuddannelser i Danmark 2019 (Vocational education and training in Denmark 2019). Danmarks Statistik, 2019.
- 19 Grant N, Wardle J, Steptoe A. The relationship between life satisfaction and health behavior: a cross-cultural analysis of young adults. *Int J Behav Med* 2009;16:259–68.
- 20 Dinger MK, Brittain DR, Hutchinson SR. Associations between physical activity and health-related factors in a national sample of college students. *J Am Coll Health* 2014;62:67–74.
- 21 VanKim NA, Nelson TF. Vigorous physical activity, mental health, perceived stress, and socializing among college students. *Am J Health Promot* 2013;28:7–15.
- 22 Murphy MH, Carlin A, Woods C, et al. Active students are healthier and happier than their inactive peers: the results of a large representative cross-sectional study of university students in Ireland. *J Phys Act Health* 2018;15:737–46.
- 23 Budzynski-Seymour E, Conway R, Wade M, et al. Physical activity, mental and personal well-being, social isolation, and perceptions of academic attainment and employability in university students: the Scottish and British Active Students Surveys. *J Phys Act Health* 2020;17:610–20.
- 24 European Centre for the Development of Vocational Training. Vocational Education and Training in Europe, 1995-2035: Scenarios for European Vocational Education and Training in the 21st Century. 2020. Available at: [https://op.europa.eu/publication/manifestation\\_identifier/PUB\\_TIRF19002ENN](https://op.europa.eu/publication/manifestation_identifier/PUB_TIRF19002ENN) (11 September 2020, date last accessed).
- 25 Vocational Education and Training in Denmark. Ministry of Children and Education. 2019. Available at: <https://eng.uvm.dk/upper-secondary-education/vocational-education-and-training-in-denmark> (10 October 2021, date last accessed).
- 26 Styrelsen for IT og Læring. Hvad vælger eleverne, når de forlader grundskolen efter 9. og 10. klasse i 2020 (What Do the Pupils Choose When Graduating from Compulsory School After Either 9. or 10. Grade in 2020)? Undervisningsministeret, 2020. Available at: <https://www.stil.dk/aktuelt/uvvm/2020/mar/200326-de-unge-soeger-ungdomsuddannelser-ligesom-sidste-aar> (14 February 2021, date last accessed).
- 27 Datatilsynet. Danish Data Protection Legislation. Available at: <https://www.datatilsynet.dk/english/legislation/> (28 September 2021, date last accessed).
- 28 National Committee on Health Research. Act on Research Ethics Review of Health Research Projects. Available at: <https://en.nvk.dk/rules-and-guidelines/act-on-research-ethics-review-of-health-research-projects> (28 September 2021, date last accessed).
- 29 Klinker CD, Aaby A, Ringgaard LW, et al. Health literacy is associated with health behaviors in students from vocational education and training schools: a Danish population-based survey. *IJERPH* 2020;17:671.
- 30 Danquah IH, Petersen CB, Skov SS, Tolstrup JS. Validation of the NPAQ-short – a brief questionnaire to monitor physical activity and compliance with the WHO recommendations. *BMC Public Health* 2018;18:601.
- 31 Ramussen M, Kierkegaard L, Rosenwein SV, et al. Skolebørnsundersøgelsen 2018: helbred, trivsel og sundhedsadfærd blandt 11-, 13- og 15-årige skoleelever i Danmark (The Health Behaviour in School-aged Children 2018: Health Status, Well-Being and Health Behaviour Among 11-, 13-, and 15-Year Old Pupils in Denmark). Statens Institut for Folkesundhed, 2019.
- 32 Levin KA, Currie C. Reliability and validity of an adapted version of the Cantril Ladder for use with adolescent samples. *Soc Indic Res* 2014;119:1047–63.
- 33 Nielsen L, Stewart-Brown S, Vinther-Larsen M, et al. High and low levels of positive mental health: are there socioeconomic differences among adolescents? *J Public Ment Health* 2016;15:37–49.
- 34 Koushede V, Lasgaard M, Hinrichsen C, et al. Measuring mental well-being in Denmark: validation of the original and short version of the Warwick-Edinburgh mental well-being scale (WEMWBS and SWEMWBS) and cross-cultural comparison across four European settings. *Psychiatry Res* 2019;271:502–9.
- 35 Collect, Score, Analyse and Interpret WEMWBS. Warwick Medical School. Available at: <https://warwick.ac.uk/fac/sci/med/research/platform/wemwbs/using/howto> (26 October 2020, date last accessed).
- 36 Grüne E, Popp J, Carl J, Pfeifer K. What do we know about physical activity interventions in vocational education and training? A systematic review. *BMC Public Health* 2020;20:978.
- 37 Phongsavan P, McLean G, Bauman A. Gender differences in influences of perceived environmental and psychosocial correlates on recommended level of physical activity among New Zealanders. *Psychol Sport Exerc* 2007;8:939–50.
- 38 Bull FC, Al-Ansari SS, Biddle S, et al. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *Br J Sports Med* 2020;54:1451–62.
- 39 Gerber M, Lang C, Feldmeth AK, et al. Burnout and mental health in Swiss vocational students: the moderating role of physical activity. *J Res Adolesc* 2015;25:63–74.
- 40 Rosenberg M, Schooler C, Schoenbach C, Rosenberg F. Global self-esteem and specific self-esteem: different concepts, different outcomes. *Am Sociol Rev* 1995;60:141–56.