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1
2 **HEALTH-RELATED CORRELATES OF PSYCHOLOGICAL WELL-BEING AMONG GIRLS AND**
3 **BOYS 6-8 YEARS OF AGE - THE PANIC STUDY**

4
5 **Abstract**

6
7 **Aim:** Due to limited knowledge on differences in the correlates of psychological well-being (PSWB)
8 between girls and boys, we compared the correlates of PSWB between primary school girls and boys.

9 **Method:** A population sample of 412 children participated in the Physical Activity and Nutrition in
10 Children (PANIC) Study. Parents completed a questionnaire including 19 questions on the
11 components of PSWB, and a PSWB score was computed. We assessed correlates of PSWB, including
12 physical activity, sedentary behavior, cardiorespiratory fitness, diet quality, body fat content, sleep
13 duration, sleep disordered breathing (SDB), prevalent diseases, and parental characteristics. We used
14 logistic regression to analyze the risk of being in the lowest third of PSWB score.

15 **Results:** Low parental education was associated with increased risk (odds ratio [OR] 2.34, $p=0.039$)
16 and high cardiorespiratory fitness with decreased risk (OR 0.26, $p=0.006$) of poor PSWB in girls. At
17 least 2 hours of screen-based sedentary behavior per day (OR 1.93, $p=0.037$), daily parental smoking
18 (OR 2.10, $p=0.034$), and SDB (OR 4.24, $p=0.003$) were related to increased risk of poor PSWB in
19 boys.

20 **Conclusions:** There are large differences in the correlates of PSWB between girls and boys. Most of
21 these correlates are modifiable and related to the health behavior of children and their parents.

22
23 **Key words** psychological well-being, children, SDB, health behavior

24
25
26 **What is already known on this topic**

- 27
28
- Correlations between psychological and physical well-being, psychological and social well-being and physical and social well-being are high.
 - Lower levels of physical activity and higher levels of screen-based sedentary behavior, obesity, inadequate sleep quantity and quality, chronic diseases and socioeconomic conditions of the family are associated with impaired psychological well-being in children.
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34 **What this paper adds:**

- 35
- There are large differences in the correlates of psychological well-being between girls and boys.
- 36

- 37 • The correlates of psychological well-being are related to the health behavior of children and
38 their parents.
- 39 • The correlates of psychological well-being in children are modifiable.

40 **Introduction**

41

42 The World Health Organization (WHO) defines mental health as a state of well-being in which
43 individuals, regardless of age, realize their potential, cope with the normal stresses of life, work
44 productively, and are able to make a contribution to community. The WHO further defines health as a
45 state of complete physical, mental, and social well-being, and not only the absence of disease or
46 infirmity.¹

47

48 Lower levels of physical activity and higher levels of screen-based sedentary behavior have been
49 linked to poorer psychological and psychosocial well-being among children.²⁻⁴ Some studies have
50 observed an association between higher levels of screen-based sedentary behavior and poorer
51 psychological well-being only in boys or girls.⁴ There are few if any studies on the associations of
52 cardiorespiratory fitness and dietary factors on psychological well-being among children. Overweight
53 and obese children have been reported to be more likely to have psychological problems than normal-
54 weight children, although the contribution of adiposity to mental health may be relatively small
55 among younger children.^{5,6} Inadequate sleep quantity and quality have also been linked to many
56 psychological phenomena, such as poor attention, impulse control, and behavior regulation, among
57 children and adolescents.⁷ Moreover, some chronic diseases have also been associated with impaired
58 psychological well-being among children.⁸⁻¹¹ Socioeconomic conditions of the family, such as low
59 parental education, low family income, single custody, and unemployment,^{12,13} as well as smoking and
60 a high alcohol consumption of the parents may also impair children's well-being.

61

62 Few studies have comprehensively investigated the correlates of psychological well-being among
63 children and compared these correlates in girls and boys. We therefore investigated whether physical
64 activity, sedentary behavior, cardiorespiratory fitness, diet, body fat content, sleep duration, sleep
65 disordered breathing (SDB), asthma, parental education, household income, parental unemployment,
66 and parental smoking and alcohol consumption are associated with psychological well-being in a
67 population sample of children 6-8 years of age. We hypothesized that there are some differences in the
68 correlates of psychological well-being between girls and boys.

69

70 **Subjects and methods**

71

72 **Study design and study population**

73 The present analyses are based on the cross-sectional baseline data of the Physical Activity and
74 Nutrition in Children (PANIC) Study, which is an ongoing physical activity and dietary intervention
75 study in a population sample of primary school children from the city of Kuopio, Finland. Altogether

76 736 children 6-8 years of age were invited in the baseline examinations, and 512 children (70%)
77 participated. The present analyses are based on data from 412 children (205 girls, 207 boys) who had
78 complete data on variables needed in the analyses. **We chose variable for the analyses based on**
79 **existing evidence on the correlates of well-being among children and also utilized the comprehensive**
80 **data on possible correlates of well-being collected in the PANIC study.** The study protocol was
81 approved by the Research Ethics Committee of the Hospital District of Northern Savo. All
82 participating children and their parents gave their informed written consent.

83

84 **Assessment of psychological well-being**

85 The parents filled out a questionnaire concerning their children's psychological well-being. The
86 questionnaire was developed by the PANIC research group to assess the most important components
87 of well-being in general populations of children. The questionnaire included 19 items of psychological
88 well-being (timidity, tearfulness, insecurity, anxiety, frustration, depression, restlessness,
89 squeamishness or anger, aggressiveness, difficulties in concentration, problems in concentration at
90 home work, difficulties in home work, unwillingness to go to school, troublemaking in class,
91 discouragement, feeling of inferiority, forgetting things, sleeping difficulties and difficulties in
92 reaching the age-appropriate level in doing things). Each item was rated on a 5-point scale (0 = not at
93 all, 1 = once or twice during the previous 3 months, 2 = sometimes, 3 = often, 4 = every day or almost
94 every day). The rates were summed to form the psychological well-being score (range 0-76), a higher
95 score indicating a lower well-being. A separate score for more severely deteriorated psychological
96 well-being was computed by dichotomizing the individual items and then summing them. The highest
97 third of this sum was denoted the most deteriorated psychological well-being.

98

99 **Assessment of sleep and sleep disordered breathing (SDB)**

100 The sleep questionnaire was based on an established Basic Nordic Sleep Questionnaire that has been
101 used to screen for sleep disturbances and SDB.¹⁴ SDB was defined as apneas, frequent or loud
102 snoring, or nocturnal mouth breathing observed by the parents.¹⁵ Sleep duration was assessed using a
103 combined heart rate and movement sensor (Actiheart, CamNtech, Cambridge, UK).¹⁶ Children were
104 asked to wear the Actiheart device continuously for at least four consecutive days. Sleep duration was
105 analyzed manually from heart rate and movement data by one exercise specialist and was confirmed
106 by one physician, if needed.

107

108 **Assessment of body composition and cardiorespiratory fitness**

109 Body fat percentage and lean body mass were assessed by dual-energy x-ray absorptiometry (DXA)
110 (Lunar Prodigy Advance, GE Healthcare, Madison, Wisconsin, USA).¹⁷ Cardiorespiratory fitness was
111 assessed by maximal exercise stress test using electromagnetic cycle ergometer (Ergoselect 200 K,
112 Ergoline, Bitz, Germany).¹⁸ We used the peak workload divided by lean body mass as the measure of

113 cardiorespiratory fitness.

114

115 **Assessments of physical activity and sedentary behavior**

116 Physical activity and sedentary behavior were assessed by the PANIC Physical Activity Questionnaire
117 filled out by the parents with their child at home.¹⁹ Total physical activity included organized sports,
118 organized exercise other than sports, unsupervised physical activity, physically active school
119 transportation, physical activity during recess, and physical education. Physical activity assessed by
120 the questionnaire had a moderate to strong correlation with physical activity assessed by combined
121 heart rate and movement sensing in a subsample of children.¹⁹ Total sedentary behavior included
122 screen-based sedentary behavior and other sedentary behaviors, as explained in detail earlier.¹⁹.

123

124 **Assessment of diet**

125 The consumption of foods and the intake of energy and nutrients were assessed by food records
126 administered by the parents on four predefined consecutive days.¹⁷ The food records were analyzed
127 using The Micro Nutrica® dietary analysis software, Version 2.5 (The Social Insurance Institution of
128 Finland). The Dietary Approach to Stop Hypertension (DASH) Score, that consisted of seven
129 components of diet (scored 1-5) and ranged between 7 and 35, was used as an indicator of a healthy
130 diet.²⁰ A higher DASH Score indicated a higher diet quality.

131

132 **Assessment of parental characteristics**

133 The characteristics of the parents were assessed using a structured questionnaire filled out by mothers
134 and fathers. Parental education was categorized as low, middle and high. Annual household income
135 was categorized as $\leq 30\,000$ €/year, $30\,001-60\,000$ €/year and $>60\,000$ €/year. The employment status
136 of mothers and fathers was categorized as unemployed and other (including employed, self-employed,
137 retired, and students). Both parents were also asked to report their daily smoking (yes, no) and alcohol
138 consumption (portions/week).

139

140 **Statistical methods**

141 The data were analyzed using the IBM SPSS Statistics for Windows software, Version 21.0 (IBM
142 Corp., Armonk, NY, USA). Cronbach's alpha was calculated to assess the internal consistency of the
143 psychological well-being score. The Chi-square Test was used to analyze differences in categorical
144 variables between girls and boys and between children with low and normal psychological well-being.
145 However, the Fisher's Exact Test was used when the numbers of children in some cells were small.
146 Differences in continuous variables between girls and boys and between children with low and normal
147 psychological well-being were analyzed using the Student's T-test for normally distributed variables
148 and the Mann-Whitney U-test for variables with skewed distributions. These analyses showed that
149 screen-based sedentary behavior, cardiorespiratory fitness, SDB, parental education, and daily

150 parental smoking differed between those with low psychological well-being and those with normal
151 psychological well-being among girls or boys. Logistic regression analysis was used to study the
152 associations of these variables with the risk of being in the lowest third of the psychological well-
153 being score adjusted for age in girls and boys separately. Differences and associations with a p-value
154 of ≤ 0.05 were considered statistically significant.

155

156 **Results**

157

158 The girls had a higher body fat percentage ($p < 0.001$) and total sedentary behavior ($p = 0.048$), a better
159 diet quality assessed by the DASH score ($p = 0.004$), higher psychological well-being ($p = 0.006$), and
160 lower cardiorespiratory fitness ($p < 0.001$), total physical activity ($p < 0.001$) and screen-based sedentary
161 behavior ($p < 0.001$) than the boys. Internal consistency for the psychological well-being score was
162 high (Cronbach's Alpha 0.91).

163

164 SDB was more common in boys with low psychological well-being than in boys with normal
165 psychological well-being ($p = 0.001$). Cardiorespiratory fitness was lower in girls with low
166 psychological well-being than in girls with normal psychological well-being ($p = 0.004$). Screen-based
167 sedentary behavior was higher ($p = 0.012$) and daily parental smoking ($p = 0.041$) was more common in
168 boys with low psychological well-being than in boys with normal psychological well-being.

169

170 Boys with SDB were four times more likely to have increased risk of low psychological well-being
171 than boys without SDB (Table 1). Girls who were in the highest third of cardiorespiratory fitness were
172 less likely to have low psychological well-being than girls in the lowest third. Boys with at least two
173 hours of screen-based sedentary behavior per day had two times higher risk of low psychological
174 well-being than boys with lower screen-based sedentary behavior. Moreover, boys whose parents
175 smoked daily had a higher risk of low psychological well-being than boys whose parents did not
176 smoke. Girls whose parents had lower education had a higher risk of low psychological well-being
177 than girls whose parents had higher education.

178

179 **Discussion**

180

181 This cross-sectional study in a population sample of children 6-8 years of age showed that boys had
182 lower psychological well-being than girls and that there are large differences in the correlates of
183 psychological well-being between girls and boys. SDB, daily parental smoking, and higher screen-
184 based sedentary behavior were associated with lower psychological well-being in boys, whereas lower
185 cardiorespiratory fitness and lower parental education were related to lower psychological well-being

186 in girls. Most of the correlates of psychological well-being among children are modifiable and related
187 to the health behavior of children and their parents. Future studies are warranted to confirm these
188 findings in other large population studies among children and to explain the observed gender
189 differences.
190

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245 **Table 1** Risk factors for having low psychological well-being in girls and boys

	Girls (n=205)		Boys (n=207)		p-value for interaction with gender
	OR [†] (95% CI)	p	OR [†] (95% CI)	p	
Sleep disordered breathing					0.013
No	1.00		1.00		
Yes	0.32 (0.08-1.24)	.099	4.24 (1.63-11.00)	.003	
Cardiorespiratory fitness, w/kg lean body mass					0.410
<3.48	1.00		1.00		
3.48-3.88	0.86 (0.43-1.71)	.663	0.66 (0.29-1.49)	.311	
>3.88	0.26 (0.10-0.68)	.006	0.63 (0.29-1.39)	.252	
Screen-based sedentary behavior					0.084
<2h/day	1.00		1.00		
≥2h/day	0.66 (0.31-1.42)	.291	1.93 (1.04-3.57)	.037	
Parental daily smoking					0.105
No	1.00		1.00		
Yes	0.69 (0.31-1.42)	.354	2.10 (1.06-4.15)	.034	
Parental education					0.755
Polytechnic or university	1.00		1.00		
Vocational	2.34 (1.05-5.25)	.039	1.07 (0.48-2.36)	.868	

246 [†]The values are odds ratios (OR) and their 95% confidence intervals (CI) from logistic regression
 247 models in which all these variables and age were entered simultaneously.