The association between chronic bullying victimization with weight status and body self-image: a cross-national study in 39 countries

Qiguo Lian [1,2] , Qiru Su [3] , Ruili Li [4] , Frank J Elgar [5] , Zhihao Liu [6] , Dongpeng Zheng [Corresp. 7]

[1] Key Lab. of Reproduction Regulation of NPFPC, SIPPR, IRD, Fudan University, Shanghai, China

[2] School of Public Health, Fudan University, Shanghai, China

[3] National Immunization Program, Chinese Center for Disease Control and Prevention, Beijing, China

[4] Children Health and Development Department, Capital Institute of Paediatrics, Beijing, China

[5] Institute for Health and Social Policy, McGill University, Montreal, Canada

[6] Institute for Health Education, Jiangsu Provincial Center for Disease Control and Prevention, Jiangsu, China

[7] Huajing Community Health Service Center, Shanghai, China

Corresponding Author: Dongpeng Zheng
Email address: Dongpeng.Zheng@huajing.org.cn

Background: Childhood obesity and school bullying are pervasive public health issues and known to co-occur in adolescents. However, the association between underweight or thinness and chronic bullying victimization is unclear. The current study examined whether chronic bullying victimization is associated with weight status and body self-image.

Methods: A school-based, cross-sectional study in 39 North American and European countries and regions was conducted. A total of 213,595 adolescents aged 11, 13, and 15 years were surveyed in 2009/10. Chronic bullying victimization was identified using the Revised Olweus Bully/Victim Questionnaire. Weight status was determined using self-reported height and weight and the body mass index (BMI), and body self-image was based on perceived weight. We tested associations between underweight and bullying victimization using three-level logistic regression models.

Results: Of the 213,595 adolescents investigated, 11.28% adolescents reported chronic bullying victimization, 14.80% were classified as overweight/obese according to age- and sex-specific BMI criteria, 12.97% were underweight, and 28.36% considered themselves a little bit fat or too fat, 14.57% were too thin. Bullying victimization was less common in older adolescent boys and girls. Weight status was associated with chronic bullying victimization (adjusted $OR_{underweight}$ =1.10, 95% CI= 1.05-1.16, p=0.002; adjusted $OR_{overweight}$ =1.40, 95% CI= 1.32-1.49, p<0.0001; adjusted OR_{obese} =1.91, 95% CI=1.71-2.14, p<0.0001). Body self-image also related to chronic bullying victimization (adjusted $OR_{too thin}$ =1.42 , 95% CI= 1.36-1.49, p<0.0001; adjusted $OR_{a little bit fat}$ =1.54, 95% CI=1.48-1.61, p<0.0001; adjusted $OR_{too fat}$ =3.30, 95% CI=2.96-3.68, p<0.0001).

Conclusions: Both perceived weight and self-rated overweight are associated with chronic bullying victimization. Both overweight and underweight children are at risk of being chronically bullied.

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4 Qiguo Lian [1,2] MD, Qiru Su [3] MD, Ruili Li [4] MD, Frank J Elgar [5] Ph.D., Zhihao Liu [6] MD,
5 Dongpeng Zheng [7] MD
6
7 [1] Key Lab. of Reproduction Regulation of NPFPC, SIPPR, IRD, Fudan University, Shanghai,
8 China
9 [2] School of Public Health, Fudan University, Shanghai, China
10 [3] National Immunization Program, Chinese Center for Disease Control and Prevention, Beijing,
11 China
12 [4] Children Health and Development Department, Capital Institute of Paediatrics, Beijing, China
13 [5] Institute for Health and Social Policy, McGill University, Montreal, Canada
14 [6] Institute for Health Education, Jiangsu Provincial Center for Disease Control and Prevention,
15 Jiangsu, China
16 [7] Huajing Community Health Service Center, Xuhui District, Shanghai, China

17 **Correspondence Author:**
18 Dongpeng Zheng
19 Huajing Community Health Service Center
20 180 Jianhua Road, Xuhui District, Shanghai, China, 200231
21 Email: Dongpeng.Zheng@huajing.org.cn
22 Telephone: 8621-6496-0088

23 **Abstract**

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25 to co-occur in adolescents. However, the association between underweight or thinness and chronic

26 bullying victimization is unclear. The current study examined whether chronic bullying

27 victimization is associated with weight status and body self-image.

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29 and regions was conducted. A total of 213,595 adolescents aged 11, 13, and 15 years were surveyed

30 in 2009/10. Chronic bullying victimization was identified using the Revised Olweus Bully/Victim

31 Questionnaire. Weight status was determined using self-reported height and weight and the body

32 mass index (BMI), and body self-image was based on perceived weight. We tested associations

33 between underweight and bullying victimization using three-level logistic regression models.

34 **Results:** Of the 213,595 adolescents investigated, 11.28% adolescents reported chronic bullying

35 victimization, 14.80% were classified as overweight/obese according to age- and sex-specific BMI

36 criteria, 12.97% were underweight, and 28.36% considered themselves a little bit fat or too fat,

37 14.57% were too thin. Bullying victimization was less common in older adolescent boys and girls.

38 Weight status was associated with chronic bullying victimization (adjusted $OR_{underweight}$ =1.10,

39 95% CI=1.05-1.16, p=0.002; adjusted $OR_{overweight}$ =1.40, 95% CI=1.32-1.49, p<0.0001; adjusted

40 OR_{obese} =1.91, 95% CI=1.71-2.14, p<0.0001). Body self-image also related to chronic bullying

41 victimization (adjusted $OR_{too\ thin}$ =1.42, 95% CI=1.36-1.49, p<0.0001; adjusted $OR_{a\ little\ bit\ fat}$=1.54,

42 95% CI=1.48-1.61, p<0.0001; adjusted $OR_{too\ fat}$ =3.30, 95% CI=2.96-3.68, p<0.0001).

43   **Conclusions:** Both perceived weight and self-rated overweight are associated with chronic

44   bullying victimization. Both overweight and underweight children are at risk of being chronically

45   bullied.

46

47 **Introduction**

48 School bullying is widely considered to be a public health concern for children and adolescents.

49 Bullying victimization has been found to be a common adverse life event in young people

50 worldwide (Anthony et al. 2010; Bowes et al. 2013). According to Dan Olweus, bullying is defined

51 as intentional harmful behavior, carried out repeatedly, against an individual who is unable to

52 defend themselves(Olweus 2013). Based on this definition, the Health Behavior in School-aged

53 Children (HBSC) study found that 45.2% of boys and 35.8% of girls in 40 countries were exposed

54 to bullying(Craig et al. 2009).

55 The predictors of bullying victimization include individual, family and school factors(Jeong et al.

56 2013). Children who are overweight/obese, with low self-esteem, come from low socioeconomic

57 households, have few friends and experienced child abuse are more likely to be bullied (Fanti &

58 Henrich 2015; Shetgiri 2013; Tippett & Wolke 2014). Some personal characteristics including

59 internalizing problems (depression, anxiety) could increase the risk for victimization(Shetgiri

60 2013). Living in a two-parent family with high parental support and positive adult role models can

61 protect against bullying perpetration(Tippett & Wolke 2014). Besides, a positive school climate

62 including adult support and peer support in school predicts within-class reduction of bullying(Gage

63 et al. 2014).

64 The published evidence shows short- and long-term adverse consequences for the victims of school

65 bullying. Compared to their peers, victims are at higher risk of a wide range of harmful effects,

66 such as loneliness, anxiety, depression and low self-esteem (Ranta et al. 2009; Stapinski et al.

67 2015). There is an increasing concern about chronic school bullying. Children who suffered more

68   frequent bullying by peers tend to display worse outcomes. These chronic victims tend to

69   experience more psychotic symptoms later in life as well as more anxiety problems such as

70   agoraphobia, panic disorder, and generalized anxiety(Kochenderfer & Ladd 1996). Compared to

71   occasional victims and non-bullied children, victims of chronic bullying are at elevated risk for

72   maladjustment, which may lead them to bully others or to self-harm(Bowes et al. 2013). Moreover,

73   school bullying can increase the risk for unhealthy behaviors that may lead to weight gain (e.g.,

74   increased caloric intake, binge eating, and increased sedentary activities) for individuals who are

75   targeted(Puhl & Luedicke 2012).

76   Childhood obesity also relates to various chronic health and social problems, including bullying

77   victimization(Puhl & Luedicke 2012). Up to 29% of children experienced bullying linked to their

78   weight status(Puhl & Luedicke 2012). Being overweight or obese is the primary reason that

79   children are bullied at school(Puhl et al. 2011). The evidence shows a positive association between

80   adiposity level and school bullying; that is, in general, children with overweight or obesity are

81   more likely to be victims of bullying than their normal-weight peers(Bacchini et al. 2015; Lumeng

82   et al. 2010) .Underweight children were also found to be at increased risk of being bullied

83   occasionally(Wang et al. 2010), however the association between underweight and chronic

84   bullying is still unclear. Aside from weight status, studies also found that self-image,

85   independently of weight status, is associated with peer victimization (Reulbach et al. 2013; Sutter

86   et al. 2015; Zequinão et al. 2017) . According to Reulbach et al., bullying perpetration was not

87   associated with body mass index (BMI) derived weight status but associated with perceived self-

88   description of weight(Reulbach et al. 2013). In another study, however, BMI z-score and body

89   dissatisfaction are both significant predictors of bullying victimization(Sutter et al. 2015).

90   Against this background, the present study examined the association between chronic bullying

91   victimization and adolescent's weight status, as determined using the body BMI z-scores, and with

92   body self-image, a subjective indicator of weight status. Also, we computed predicted probabilities

93   of chronic bullying victimization based on weight status and body-image. We hypothesized that

94   the probability of chronic bullying victimization would be lowest in normal weight status group

95   for both BMI and body-image indicators. Specifically, based on literature(Sutter et al. 2015;

96   Zequinão et al. 2017), we assumed that weight status and body-image are independent predictors

97   to chronic bullying victimization, and the associations of victimization with weight status and

98   body-image are consistent across countries.

99   **Materials & Methods**

100   **Study design and participants**

101   Data for this study were drawn from the 2009/10 HBSC study, a school-based cross-sectional

102   survey conducted in 39 North American and European countries and regions every four years

103   (Chester et al. 2015; Elgar et al. 2015). The study recruited an international sample (N=213,595)

104   of schoolchildren aged 11, 13 and 15 years using identical sampling methods, which is much larger

105   than required sample size for statistical power 0.8 estimated by retrospective power analysis. The

106   sampling unit was a classroom within schools selected by inverse probability weighting to

107   guarantee that students were equally likely to be sampled. The desired sample size for each age

108   group was 1,500 (750 boys, 750 girls) per country/region. Students anonymously completed the

109   self-administered questionnaires in classroom settings and handed them to teachers or well-trained

110   assistants.

111   The study was reviewed and approved by university-based or equivalent review boards. Parental

112   consent procedures depend on school district policy. Once obtained parental consent, students

113   provided their assent to participate.

114   **Measures**

115   **Outcome**

116   ***Chronic bullying victimization***

117   We measured the experiences of bullying victimization using the question: "How often have you

118   been bullied at school in the past couple of months" with options 0=I haven't been bullied, 1=Once

119   or twice, 2=2 or 3 times a month, 3=About once a week, 4=Several times a week. We recoded

120   items 1 and 2 as non-chronic bullying victimization, items 3 to 5 as chronic bullying victimization.

121   Before the question, there was a definitional statement of bullying adapted from the Revised

122   Olweus Bully/Victim Questionnaire to ensure consistency in responses(Olweus 1994) .

123   **Exposures**

124   ***Perceived weight status***

125   We calculated body mass index (BMI; kg/m^2) based on self-reported weight and height, converted

126   the BMI values to exact z-scores, then divided the adolescents into four categories (underweight,

127   normal weight, overweight and obese) according to age- and sex-specific z-scores cut-off points,

128   as recommended by the International Obesity Task Force(Cole et al. 2000; Cole et al. 2007) .

129   Although self-reported weight and height are vulnerable to reporting bias, several studies revealed

130   high correlations between reported and measured BMI in adolescents(Haines et al. 2008; Himes

131   et al. 2005; Paxton et al. 2004).

132   ***Perceived body-image***

133   To assess body self-image, we asked the participants whether they perceived their body as "Much

134   too thin," "A bit too thin," "About right," "A bit too fat," or "Much too fat." For consistency with

135   the classification of weight status, we combined the replies of the first two options ("much too

136   thin" and "a bit too thin") into "too thin."

137   **Confounders**

138   ***Socioeconomic status***

139   We measured socioeconomic status (SES) of the respondents using the Family Affluence Scale

140   (FAS). The scale is developed by HBSC Methodology Development Group, and comprised of

141   four items: "Does your family own a car, van or trunk?" (No=0, Yes=1, Yes, two or more=2);

142   "Do you have your own bedroom?" (No=0, Yes=1); "During the past 12 months, how many

143   times did you travel away on holiday (vacation) with your family?" (Not at all=0, Once=1,

144   Twice=2, More than twice=3); and "How many computers does your family own?" (None=0,

145   One=1, Two=2 More than two=3). The FAS has been validated as a better proxy of parental SES

146   and is less affected by nonresponse bias than other measures(Currie et al. 2008). We divided the

147   respondents into high (6-9), medium (3-5) and low (0-2) groups according to the total score

148   (range 0-9).

149 ***Family structure***

150 We recorded family structure as "traditional" if the participants lived with 'both biological

151 parents', and "non-traditional" if they lived with a 'single mother,' 'single father,' in a

152 'reconstituted family' or 'other.'

153 ***Classmate support***

154 We measured the perceived classmate support using a subscale of three items: "Students in my

155 class(es) enjoy being together," "Most of the students in my class(es) are kind and helpful" and

156 "Other students accept me as I am." Participants responded on a Likert scale of five points, from

157 "Strongly agree" to "Strongly disagree." In this paper, students who agreed or strongly agreed

158 with all the three statements were classified as having positive classmate relationships.

159 ***Country-level data***

160 We also collected the country-level data, including GDP per capita and Gini coefficient, on these

161 39 countries/regions (table 1).

162 **Statistical analysis**

163 We analyzed the data using Stata/SE 14.0. The prevalence estimates were presented separately for

164 each gender. Given these data were hierarchical, with individuals nested within schools, and

165 schools nested within countries, we tested associations of school bullying victimization between

166 weight status and body self-image separately for males and females using three-level logistic

167 regression models with adjustment for potential confounding by age, classmate support, family

168   structure, and FAS group. We weighted the data to adjust the clustered sampling design of the

169   survey. Odds ratios (ORs) and 95% confidential intervals (CIs) were used to measure the

170   association.

171   After fitting the logistic models, we computed and plotted the adjusted predicted probability of

172   being chronic bullying victims for weight status and body self-image by variables value using Stata

173   margins and marginsplot commands. Similarly, we estimated the average marginal effects of

174   weight status and body self-image.

175   **Results**

176   A total of 213,595 adolescents from 7,468 schools in 39 countries and regions were investigated,

177   of which 105,099 were boys, and 108,496 were girls, accounting for 49.20% and 50.80%,

178   respectively (table 1). In our sample, 22,822 (11.28%) adolescents were identified as having been

179   exposed to chronic bullying victimization. Also, 12.79%, 12.19% and 2.61% of the participants

180   were classified as underweight, overweight and obese according to age- and sex-specific BMI

181   criteria, while 14.57%, 24. 85% and 3.51% of the participants considered themselves too thin, a

182   little bit fat and too fat. The Gini coefficient in 2010 ranged from 24.82 to 44.05, with a mean of

183   31.94. The GDP per capita in 2010 ranged from 2,974 USD to 103,267 USD, and the average

184   value was 35,052 USD.

185   As illustrated in table 2 and figure 1, we noted that the prevalence of chronic bullying victimization

186   declined in older age groups, and this pattern remained consistent among boys and girls. The

187   prevalence of chronic bullying victimization was lowest among normal weight/about-right

188 populations and highest among obese/too-fat populations in both sex groups.

189 Next, we examined the associations between chronic bullying victimization with perceived weight

190 and perceived body-image respectively. The associations of individual-level confounders with

191 exposures and outcome were showed in table s1-s3 the Appendix. We controlled potential

192 confounders at the individual level (sex, age group, SES, classmate support and academic

193 achievement) and the macro level (country wealth and income inequality) and accounted for the

194 multilevel structure of the data. We found that weight status was associated with chronic bullying

195 victimization (adjusted $OR_{underweight}$=1.10, p=0.002; adjusted $OR_{overweight}$=1.40, p<0.0001; adjusted

196 OR_{obese}=1.91, p<0.0001) (table 3). The association between body self-image with chronic bullying

197 victimization was similar (adjusted $OR_{too\ thin}$=1.42, p<0.0001; adjusted $OR_{a\ little\ bit\ fat}$=1.54,

198 p<0.0001; adjusted $OR_{too\ fat}$=3.30, p<0.0001) (table 4). We also performed gender-specific

199 analyses that revealed there were no gender differences in obesity-related or fat-related chronic

200 bullying victimization (table 3-4). We examined the interactions between weight status, body-

201 image, and victimization, and did not observe positive results (table s4 in the Appendix).

202 We also computed the post-estimation predictions after fitting logistic models. As shown in figure

203 2 and table s5 in the Appendix, the estimated probabilities for weight status is 0.108 for

204 underweight, 0.100 for normal weight, 0.131 for overweight and 0.166 for obese, the estimated

205 probabilities were all higher in males than in females. On average, being underweight compared

206 with being normal weight increased the probability of chronic bullying victimization by

207 0.031(p<0.0001). Being overweight compared with being normal weight increased the probability

208 by 0.032(p<0.0001). Being obese compared with being normal weight increased the probability

209   by 0.067(p<0.0001). The estimated probabilities for body self-image were also calculated and

210   displayed in figure 2, and table s6 in the Appendix.

211   **Discussion**

212   This study involving 39 national representative samples of schoolchildren aged 11, 13 and 15 years

213   using identical sampling methods, revealed that both overweight/obese and self-rated overweight

214   were linked to increased risk of being chronic bullied. Furthermore, the study showed adolescents

215   with underweight also had a higher risk of being chronically bullied than normal-weight

216   adolescents, as their overweight/obese peers did. The link between underweight and chronic

217   bullying victimization is a valuable addition to the scientific literature on occasional bullying,

218   which suggests that vulnerable populations include not only adolescents with

219   overweight/obesity(Puhl & Luedicke 2012; Puhl et al. 2011) but also underweight adolescents.

220   To our knowledge, few studies have tested the association of chronic bullying victimization with

221   both weight status and body self-image using cross-national data. Previous research found that for

222   overweight and obese youth, weight stigmatization translates into pervasive victimization, teasing,

223   and bullying(Puhl & King 2013). While the weight-related bullying may be intuitive, the

224   association between underweight and school bullying may be less clear, although there is a

225   relationship between media influence and drive for thinness(Fernandez & Pritchard 2012). Using

226   the data from a large cross-national epidemiological sample, our results not only provide

227   supporting evidence for the relationship between chronic bullying and overweight/obesity but also

228   reveal the relationship between chronic bullying and underweight, for both boys and girls.

229   Specifically, the strength of associations (ORs) between chronic bullying victims and weight status

230 were 1.91, 1.40 and 1.10 for obesity, overweight and underweight, respectively. The marginal

231 predicted probabilities of being chronically bullied were 0.17 for obesity, 0.13 for overweight,

232 0.11 for underweight, and 0.10 for normal weight. The strength of association between chronic

233 bullying and underweight was relatively weaker but still significant.

234 School bullying focuses on differences, and the differences can be either real or perceived. We

235 found similar but stronger relationships between chronic bullying and perceived body self-image.

236 Our finding echoes earlier research indicating BMI z-score and physical appearance independently

237 predicted the victimization (Bacchini et al. 2017). The research also found that self-concept

238 mediated the relationship between BMI z-score and bullying victimization (Bacchini et al. 2017),

239 however, we didn't observe the interactions between perceived weight status and body self-image

240 and further research is needed.

241 In adolescence, especially in females, being taunted about being overweight or obese may

242 contribute to the development of eating disorders such as anorexia nervosa, and internalizing

243 problems such as suicidal thoughts and depression(Lian et al. 2017). Significant residual obesity

244 stigma remains against individuals who have lost weight(Latner et al. 2012). Furthermore, our

245 results also indicate that adolescents with "too thin" body self-image are still vulnerable to chronic

246 bullying(Wang et al. 2010). These findings further our understanding of the weight-related

247 bullying and can help develop targeted preventative strategies to stop or lessen school bullying.

248 Programs for bullying prevention should not overlook psychosocial and cultural interventions,

249 which can help adolescents cope with their weight status better (Wilson et al. 2013).

250 Our study focuses on a particularly vulnerable group of bullied children: those who experienced

251 chronic bullying victimization in school. In our sample from 39 countries, 11.28% of the children

252 suffered chronic bullying, while the prevalence rose to 24% in a long-term study followed children

253 from kindergarten through Grade 12 in the U.S. (Ladd et al. 2017). This inconsistency in

254 prevalence is partly due to an age difference between samples(Ladd et al. 2017), the age-range was

255 narrow in our study but broad in the U.S. study.

256 On average, the current study revealed an apparent gradual decline in reported chronic bullying

257 with older age groups, for both boys and girls. The trend is observable in other large studies (Ladd

258 et al. 2017; Olweus 1994; Rigby & Smith 2011; Wang et al. 2009). Bullying is more frequent in

259 early grade school, rather than in middle school and high school as popular media depicted(Ladd

260 et al. 2017). This age-related decline in school bullying could be explained in part by two

261 hypotheses: 1) the number of older pupils with opportunities to bully decreases with age; 2)

262 potential victims (usually younger students) are getting more socially skilled.(Smith et al. 1999)

263 The hypotheses indicate that modified playgrounds with increased opportunities for risk and

264 challenge(Farmer et al. 2017), and early skill training when younger students start school (Smith

265 et al. 1999) could help lessen school bullying.

266 **Strengths and Limitations**

267 Strengths of the current study include a sizeable cross-national sample, standardized questionnaire,

268 and the ability to perform subgroup analyses on the effects of chronic bullying on groups of

269 underweight and too thin individuals. This study uniquely examined the associations between

270 chronic bullying victimization and weight status defined by BMI and body-image. An important

271 limitation of the present study is the cross-sectional nature of the data, which does not allow us to

272 make causal interpretations. The relation between weight status and chronic bullying victimization

273 is dynamic. Actual and perceived weight can serve as both a cause and a consequence of being

274 bullied (Wilson et al. 2013). Therefore, longitudinal studies are needed to clarify the relationship.

275 Another limitation was that BMI calculations in our study were based on self-reported data from

276 the participants. Evidence supported the high correlation between self-reported and measured BMI

277 in adolescents(Himes et al. 2005; Paxton et al. 2004). However, misclassification of some

278 overweight and obese cases was likely (Elgar et al. 2005). Also, self-reported BMI overestimated

279 the prevalence of underweight in adolescents(Yngve et al. 2008). Third, our study only

280 investigated the general bullying in all forms and did not cover specific types of bullying such as

281 physical, verbal, relational and cyberbullying. Compared with underweight adolescents, peers with

282 overweight or obesity are targets of different kinds of bullying(Wang et al. 2010). Longitudinal

283 studies with more comprehensive data on bullying and weight status are needed to investigate this

284 more closely. Fourth, some of the important confounders including race/ethnicity and child abuse

285 were not included in the analysis because using a secondary data, which could potentially confound

286 the association of bullying victimization with perceived weight status and body self-image.

287 **Conclusions**

288 In conclusion, our findings have shown that both overweight and self-rated overweight relate to

289 chronic bullying victimization in adolescents. Also, adolescents with underweight and perceived

290 themselves as thin are both at higher risk of being chronically bullied than normal-weight peers.

291 Our study suggests that underweight adolescents need the same attention as their peers with

292 overweight or obesity do in the fight against school bullying.

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297 survey was conducted by Principal Investigators in 39 countries/regions. For details, see

298 http://www.hbsc.org.

299 **References**

300 Anthony BJ, Wessler SL, and Sebian JK. 2010. Commentary: Guiding a Public Health Approach to Bullying. *Journal*
301   *of Pediatric Psychology* 35:1113-1115. 10.1093/jpepsy/jsq083
302 Bacchini D, Licenziati MR, Affuso G, Garrasi A, Corciulo N, Driul D, Tanas R, Fiumani PM, Di Pietro E, Pesce S,
303   Crino A, Maltoni G, Iughetti L, Sartorio A, Deiana M, Lombardi F, and Valerio G. 2017. The Interplay
304   among BMI z-Score, Peer Victmization, and Self-Concept in Outpatient Children and Adolescents with
305   Overweight or Obesity. *Child Obes* 13:242-249. 10.1089/chi.2016.0139
306 Bacchini D, Licenziati MR, Garrasi A, Corciulo N, Driul D, Tanas R, Fiumani PM, Di Pietro E, Pesce S, Crinò A,
307   Maltoni G, Iughetti L, Sartorio A, Deiana M, Lombardi F, and Valerio G. 2015. Bullying and Victimization
308   in Overweight and Obese Outpatient Children and Adolescents: An Italian Multicentric Study. *PLoS ONE*
309   10:e0142715. 10.1371/journal.pone.0142715
310 Bowes L, Maughan B, Ball H, Shakoor S, Ouellet-Morin I, Caspi A, Moffitt TE, and Arseneault L. 2013. Chronic
311   bullying victimization across school transitions: The role of genetic and environmental influences.
312   *Development and psychopathology* 25:10.1017/S0954579412001095. 10.1017/S0954579412001095
313 Chester KL, Callaghan M, Cosma A, Donnelly P, Craig W, Walsh S, and Molcho M. 2015. Cross-national time trends
314   in bullying victimization in 33 countries among children aged 11, 13 and 15 from 2002 to 2010. *European*
315   *Journal of Public Health* 25:61-64. 10.1093/eurpub/ckv029
316 Cole TJ, Bellizzi MC, Flegal KM, and Dietz WH. 2000. Establishing a standard definition for child overweight and
317   obesity worldwide: international survey. *Bmj* 320:1240-1243.
318 Cole TJ, Flegal KM, Nicholls D, and Jackson AA. 2007. Body mass index cut offs to define thinness in children and
319   adolescents: international survey. *Bmj* 335:194. 10.1136/bmj.39238.399444.55
320 Craig W, Harel-Fisch Y, Fogel-Grinvald H, Dostaler S, Hetland J, Simons-Morton B, Molcho M, de Mato MG,
321   Overpeck M, Due P, Pickett W, Violence H, Injuries Prevention Focus G, and Group HBW. 2009. A cross-
322   national profile of bullying and victimization among adolescents in 40 countries. *Int J Public Health* 54:216-
323   224. 10.1007/s00038-009-5413-9
324 Currie C, Molcho M, Boyce W, Holstein B, Torsheim T, and Richter M. 2008. Researching health inequalities in
325   adolescents: The development of the Health Behaviour in School-Aged Children (HBSC) Family Affluence
326   Scale. *Social Science & Medicine* 66:1429-1436. http://dx.doi.org/10.1016/j.socscimed.2007.11.024

327   Elgar FJ, Pfortner TK, Moor I, De Clercq B, Stevens GW, and Currie C. 2015. Socioeconomic inequalities in
328   adolescent health 2002-2010: a time-series analysis of 34 countries participating in the Health Behaviour in
329   School-aged Children study. *Lancet* 385:2088-2095. 10.1016/s0140-6736(14)61460-4
330   Elgar FJ, Roberts C, Tudor-Smith C, and Moore L. 2005. Validity of self-reported height and weight and predictors
331   of bias in adolescents. *J Adolesc Health* 37:371-375. 10.1016/j.jadohealth.2004.07.014
332   Fanti KA, and Henrich CC. 2015. Effects of Self-Esteem and Narcissism on Bullying and Victimization During Early
333   Adolescence. *The Journal of Early Adolescence* 35:5-29. 10.1177/0272431613519498
334   Farmer VL, Williams SM, Mann JI, Schofield G, McPhee JC, and Taylor RW. 2017. Change of School Playground
335   Environment on Bullying: A Randomized Controlled Trial. *Pediatrics*. 10.1542/peds.2016-3072
336   Fernandez S, and Pritchard M. 2012. Relationships between self-esteem, media influence and drive for thinness.
337   *Eating Behaviors* 13:321-325. http://dx.doi.org/10.1016/j.eatbeh.2012.05.004
338   Gage NA, Prykanowski DA, and Larson A. 2014. School climate and bullying victimization: A latent class growth
339   model analysis. *School Psychology Quarterly* 29:256-271. 10.1037/spq0000064
340   Haines J, Neumark-Sztainer D, Hannan PJ, van den Berg P, and Eisenberg ME. 2008. Longitudinal and secular trends
341   in weight-related teasing during adolescence. *Obesity (Silver Spring)* 16 Suppl 2:S18-23.
342   10.1038/oby.2008.447
343   Himes JH, Hannan P, Wall M, and Neumark-Sztainer D. 2005. Factors associated with errors in self-reports of stature,
344   weight, and body mass index in Minnesota adolescents. *Ann Epidemiol* 15:272-278.
345   10.1016/j.annepidem.2004.08.010
346   Jeong S, Kwak D-H, Moon B, and San Miguel C. 2013. Predicting School Bullying Victimization: Focusing on
347   Individual and School Environmental/Security Factors. *Journal of Criminology* 2013:13.
348   10.1155/2013/401301
349   Kochenderfer BJ, and Ladd GW. 1996. Peer victimization: cause or consequence of school maladjustment? *Child Dev*
350   67:1305-1317.
351   Ladd GW, Ettekal I, and Kochenderfer-Ladd B. 2017. Peer Victimization Trajectories From Kindergarten Through
352   High School: Differential Pathways for Children's School Engagement and Achievement?
353   Latner JD, Ebneter DS, and O'Brien KS. 2012. Residual Obesity Stigma: An Experimental Investigation of Bias
354   Against Obese and Lean Targets Differing in Weight-Loss History. *Obesity* 20:2035-2038.
355   10.1038/oby.2012.55
356   Lian Q, Zuo X, Mao Y, Luo S, Zhang S, Tu X, Lou C, and Zhou W. 2017. Anorexia nervosa, depression and suicidal
357   thoughts among Chinese adolescents: a national school-based cross-sectional study. *Environmental Health*
358   *and Preventive Medicine* 22:30. 10.1186/s12199-017-0639-2
359   Lumeng JC, Forrest P, Appugliese DP, Kaciroti N, Corwyn RF, and Bradley RH. 2010. Weight status as a predictor
360   of being bullied in third through sixth grades. *Pediatrics* 125:e1301-1307. 10.1542/peds.2009-0774
361   Olweus D. 1994. Bullying at School: Basic Facts and Effects of a School Based Intervention Program. *Journal of*
362   *Child Psychology and Psychiatry* 35:1171-1190. 10.1111/j.1469-7610.1994.tb01229.x
363   Olweus D. 2013. School bullying: development and some important challenges. *Annu Rev Clin Psychol* 9:751-780.
364   10.1146/annurev-clinpsy-050212-185516
365   Paxton RJ, Valois RF, and Drane JW. 2004. Correlates of body mass index, weight goals, and weight-management
366   practices among adolescents. *J Sch Health* 74:136-143.
367   Puhl RM, and King KM. 2013. Weight discrimination and bullying. *Best Practice & Research Clinical Endocrinology*

368   *& Metabolism* 27:117-127. http://dx.doi.org/10.1016/j.beem.2012.12.002

369 Puhl RM, and Luedicke J. 2012. Weight-Based Victimization Among Adolescents in the School Setting: Emotional
370   Reactions and Coping Behaviors. *J Youth Adolesc* 41:27-40. 10.1007/s10964-011-9713-z

371 Puhl RM, Luedicke J, and Heuer C. 2011. Weight-based victimization toward overweight adolescents: observations
372   and reactions of peers. *J Sch Health* 81:696-703. 10.1111/j.1746-1561.2011.00646.x

373 Ranta K, Kaltiala-Heino R, Pelkonen M, and Marttunen M. 2009. Associations between peer victimization, self-
374   reported depression and social phobia among adolescents: the role of comorbidity. *J Adolesc* 32:77-93.
375   10.1016/j.adolescence.2007.11.005

376 Reulbach U, Ladewig EL, Nixon E, O'Moore M, Williams J, and O'Dowd T. 2013. Weight, body image and bullying
377   in 9-year-old children. *Journal of Paediatrics and Child Health* 49:E288-E293. 10.1111/jpc.12159

378 Rigby K, and Smith PK. 2011. Is school bullying really on the rise? *Social Psychology of Education* 14:441-455.
379   10.1007/s11218-011-9158-y

380 Shetgiri R. 2013. Bullying and Victimization Among Children. *Advances in pediatrics* 60:33-51.
381   10.1016/j.yapd.2013.04.004

382 Smith PK, Madsen KC, and Moody JC. 1999. What causes the age decline in reports of being bullied at school?
383   Towards a developmental analysis of risks of being bullied. *Educational Research* 41:267-285.
384   10.1080/0013188990410303

385 Stapinski LA, Araya R, Heron J, Montgomery AA, and Stallard P. 2015. Peer victimization during adolescence:
386   concurrent and prospective impact on symptoms of depression and anxiety. *Anxiety Stress Coping* 28:105-
387   120. 10.1080/10615806.2014.962023

388 Sutter C, Nishina A, and Adams RE. 2015. How you look versus how you feel: Associations between BMI z-score,
389   body dissatisfaction, peer victimization, and self-worth for African American and white adolescents. *Journal*
390   *of Adolescence* 43:20-28. https://doi.org/10.1016/j.adolescence.2015.05.002

391 Tippett N, and Wolke D. 2014. Socioeconomic status and bullying: a meta-analysis. *Am J Public Health* 104:e48-59.
392   10.2105/ajph.2014.301960

393 Wang J, Iannotti RJ, and Luk JW. 2010. Bullying Victimization Among Underweight and Overweight U.S. Youth:
394   Differential Associations for Boys and Girls. *Journal of Adolescent Health* 47:99-101.
395   https://doi.org/10.1016/j.jadohealth.2009.12.007

396 Wang J, Iannotti RJ, and Nansel TR. 2009. School bullying among adolescents in the United States: physical, verbal,
397   relational, and cyber. *J Adolesc Health* 45:368-375. 10.1016/j.jadohealth.2009.03.021

398 Wilson ML, Viswanathan B, Rousson V, and Bovet P. 2013. Weight Status, Body Image and Bullying among
399   Adolescents in the Seychelles. *International Journal of Environmental Research and Public Health* 10:1763-
400   1774. 10.3390/ijerph10051763

401 Yngve A, De Bourdeaudhuij I, Wolf A, Grjibovski A, Brug J, Due P, Ehrenblad B, Elmadfa I, Franchini B, Klepp
402   K-I, Poortvliet E, Rasmussen M, Thorsdottir I, and Perez Rodrigo C. 2008. Differences in prevalence of
403   overweight and stunting in 11-year olds across Europe: The Pro Children Study. *European Journal of Public*
404   *Health* 18:126-130. 10.1093/eurpub/ckm099

405 Zequinão MA, de Medeiros P, Rosário HRVd, Pelegrini A, Lopes L, Pereira B, and Cardoso FL. 2017. Association
406   between body dissatisfaction and bullying in children of socioeconomically vulnerable areas. *Porto*
407   *Biomedical Journal* 2:260-264. https://doi.org/10.1016/j.pbj.2017.04.010

408

Table 1(on next page)

Description of study sample (N=213,595)

1

Table 1 Description of study sample (N=213,595)

Characteristics	n(%)
Individual level	
Sex	
Male	105,099(49.20)
Female	108,496(50.80)
Age group (years)	
11	67,924(32.11)
13	71,975(34.02)
15	71,652(33.87)
Chronic bullying victimization	
No	179,581(88.72)
Yes	22,822(11.28)
Perceived weight status	
Underweight	22,227(12.79)
Normal weight	125,794(72.41)
Overweight	21,176(12.19)
Obese	4,528(2.61)
Perceived body-image	
Too thin	30,580(14.57)
About right	119,737(57.06)
A little bit fat	52,157(24.85)
Too fat	7,374(3.51)
Country level characteristics	**Mean(SD)**
Mean income per person (GDP per capita in USD)	35,052.34 (21,331.34)
Mean income inequality (Gini coefficient)	31.94(4.70)
Countries	39
Schools	7,468

2

PeerJ

Table 2(on next page)

The prevalence of chronic bullying victimization, by gender

1 Table 2 The prevalence of chronic bullying victimization, by gender

	Total, n (%)	Male, n (%)	Female, n (%)
Age group(years)	22,628(11.28)	12,282(12.51)	10,346(10.10)
11	8,515(13.25)	4,506(14.37)	4,009(12.18)
13	8,239(12.10)	4,452(13.42)	3,787(10.84)
15	5,874(8.61)	3,324(9.88)	2,550(7.37)
Perceived weight status			
Underweight	2,333(11.12)	1,035(13.34)	1,298(9.81)
Normal weight	11,852(9.90)	6,475(10.95)	5,377(8.87)
Overweight	2,841(14.09)	1,738(14.33)	1,103(13.72)
Obese	824(18.95)	511(18.98)	313(18.91)
Perceived body-image			
Too thin	3,736(12.98)	2,298(13.86)	1,438(11.78)
About right	10,380(9.13)	6,063(10.29)	4,317(7.88)
A little bit fat	6,614(13.12)	3,161(15.81)	3,453(11.34)
Too fat	1,790(25.02)	692(29.57)	1,098(22.81)

2

Table 3(on next page)

The association between weight status and chronic bullying victimization, OR (95%CI, p value)

Table 3 The association between weight status and chronic bullying victimization, OR (95%CI, p value)

	Total		Male		Female	
Fixed components						
Perceived weight status (base=Normal)[*]						
Underweight	1.10 (1.05-1.16,p= 0.0002)		1.16(1.07-1.27, 0.0002)	p=	1.07(1.00-1.13, p=0.0470)	
Overweight	1.40(1.32-1.49, 0.0001)	p<	1.31(1.22-1.41, 0.0001)	p<	1.56(1.43-1.70, 0.0001)	p<
Obese	1.91(1.71-2.14, 0.0001)	p<	1.81(1.63-2.01, 0.0001)	p<	2.09(1.67-2.61, 0.0001)	p<
Sex (base=Male)						
Female	0.77(0.72-0.83, 0.0001)	p<	--		--	
Age group (base=11)						
13	0.85(0.79-0.91, 0.0001)	p<	0.86(0.80-0.93, 0.0001)	p<	0.83(0.76-0.89, 0.0001)	p<
15	0.54(0.49-0.59, 0.0001)	p<	0.58(0.52-0.64, 0.0001)	p<	0.49(0.44-0.55, 0.0001)	p<
Classmate support (base=negative)						
Positive	0.33(0.30-0.38, 0.0001)	p<	0.35(0.31-0.40, 0.0001)	p<	0.31(0.27-0.35, 0.0001)	p<
Academic achievement (base=good)						
Average and below	1.32(1.26-1.39, 0.0001)	p<	1.22(1.15-1.29, 0.0001)	p<	1.46(1.37-1.56, 0.0001)	p<
SES (base=low)						
Medium	0.83(0.76-0.90, 0.0001)	p<	0.84(0.75-0.95, 0.0037)	p=	0.81(0.74-0.90, 0.0001)	p<
High	0.78(0.70-0.87, 0.0001)	p<	0.78(0.69-0.90, 0.0004)	p=	0.77(0.67-0.87, 0.0001)	p<
GDP per capita	1.00(1.00-1.00, 0.7015)	p=	1.00(1.00-1.00, 0.9736)	p=	1.00(1.00-1.00, 0.4887)	p=
GINI index	1.01(0.98-1.04, 0.3465)	p=	1.02(0.99-1.05, 0.1706)	p=	1.00(0.97-1.04, 0.7418)	p=
Constant	0.19(0.07-0.57, 0.0028)	p=	0.13(0.05-3.53, 0.0001)	p=	0.14(0.04-0.47, p=0.0015)	
Random components						
σ^2(country)	0.28		0.29		0.30	
σ^2(school)	0.14		0.17		0.19	
ICC(country)	0.08		0.08		0.08	
ICC(school)	0.11		0.12		0.13	

AIC#	98295	52144	46118
BIC#	98444	52273	46248

ICC=Intraclass correlation. AIC= Akaike's information criterion. BIC=Bayesian information criterion. # Goodness-of-fit index.

* Odds ratio adjusted for sex, age group, classmate support, academic achievement, SES, GDP per capita and GINI index.

Table 4(on next page)

The association between body self-image and chronic bullying victimization, OR (95%CI, p value)

Table 4 The association between body self-image and chronic bullying victimization, OR (95%CI, p value)

	Total		Male		Female	
Fixed components						
Perceived body-image (base=Normal)*						
Too thin	1.42(1.36-1.49, 0.0001)	p<	1.39(1.31-1.47, 0.0001)	p<	1.47(1.38-1.57, 0.0001)	p<
A little bit fat	1.54(1.48-1.61, 0.0001)	p<	1.60(1.50-1.71, 0.0001)	p<	1.50(1.42-1.59, 0.0001)	p<
Too fat	3.30(2.96-3.68, 0.0001)	p<	3.25(2.84-3.72, 0.0001))	p<	3.35(2.97-3.78, 0.0001)	p<
Sex(base=Male)						
Female	0.71(0.66-0.76, 0.0001)	p<	--		--	
Age group (base=11 years)						
13 years	0.82(0.76-0.87, 0.0001)	p<	0.84(0.78-0.91, 0.0001)	p<	0.78(0.72-0.88, 0.0001)	p<
15 years	0.52(0.47-0.57, 0.0001)	p<	0.57(0.51-0.63, 0.0001)	p<	0.46(0.0.41-0.52, 0.0001)	p<
Classmate support (base=negative)						
Positive	0.34(0.31-0.38, 0.0001)	p<	0.36(0.32-0.40, 0.0001)	p<	0.32(0.28-0.36, 0.0001)	p<
Academic achievement (base=good)						
Average and below	1.27(1.21-1.34, 0.0001)	p<	1.21(1.15-1.28, 0.0001)	p<	1.35(1.26-1.43, 0.0001)	p<
SES(base=low)						
Medium	0.84(0.78-0.91, 0.0001)	p<	0.87(0.77-0.98, 0.0255)	p=	0.81(0.74-0.88, 0.0001)	p<
High	0.79(0.72-0.87, 0.0001)	p<	0.81(0.71-0.83, 0.0026)	p=	0.76(0.68-0.84, 0.0001)	p<
GDP per capita	1.00(1.00-1.00, 0.8763)	p=	1.00(1.00-1.00, 0.8987)	p=	1.00(1.00-1.00, 0.6554)	p=
GINI index	1.02(0.99-1.05, 0.1914)	p=	1.02(1.00-1.05, 0.0914)	p=	1.01(0.98-1.05, 0.4553)	p=
Constant	0.17(0.06-0.51, 0.0015)	p=	0.10(0.04-0.28, 0.0001)	p<	0.11(0.03-0.34, 0.0004)	p=
Random components						
σ^2(country)	0.26		0.26		0.28	
σ^2(school)	0.14		0.16		0.19	
ICC(country)	0.07		0.07		0.07	

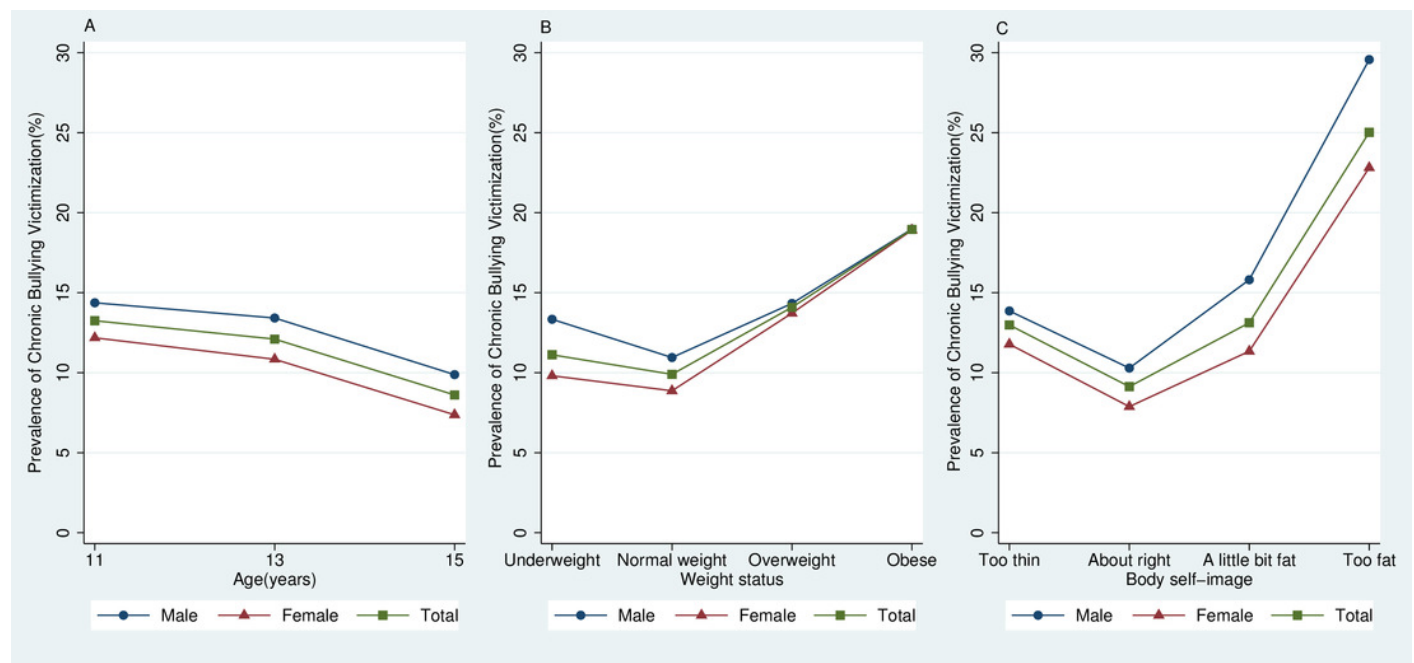|			
ICC(school)	0.11	0.11	0.13
AIC#	119053	62574	56454
BIC#	119206	62706	56587

ICC=Intraclass correlation. AIC= Akaike's information criterion. BIC=Bayesian information criterion. # Goodness-of-fit index.

* Odds ratio adjusted for sex, age group, classmate support, academic achievement, SES, GDP per capita and GINI index.

Figure 1

The prevalence of chronic bullying victimization by age, weight status and body self-image (n=213,595)

Figure 2

The estimated probabilities for weight status and body self-image