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1   **Association of poverty and social exclusion with Body Mass Index among Special Olympics**

2   **athletes in Europe**

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9

10   **Abstract**

11   *Objectives*: To examine the association of a risk of poverty and social exclusion (AROPE), age, and

12   gender with the Body Mass Index (BMI) status of European Special Olympics athletes.

13   *Methods:* BMI records were available for 1,905 children and youth and 5,517 adults from the Special

14   Olympics International (SOI) Health Promotion database. AROPE was extracted from EU Eurostat

15   statistics. Logistic regression analyses were used to predict BMI status.

16   *Results:* For children/youth and adults respectively, 9.4% and 6.3% were underweight and 25.3% and

17   44.6% were overweight/obese. Being underweight was significantly associated with higher AROPE

18   rates. Being female, and lower AROPE rates, were significantly associated with overweight/obesity for

19   both children/youth (OR=1.27; 95% CI: 1.07-1.50 and OR=0.97; 95% CI: 0.96-0.98) and adults

20   (OR=1.55; 95% CI: 1.39-1.72 and OR=0.96; 95% CI: 0.95-0.98).

21   *Conclusions:* The Europe 2020 "platform against poverty" strategy aims to ensure that those

22   experiencing poverty and social exclusion share the benefits of economic growth. These findings suggest

23   that SOI health promotion efforts to foster healthy BMI is needed and should be tailored to specific

24   social and economic circumstances in Europe.

25

28

29   **Introduction**

30   A flagship initiative of the Europe 2020 strategy is the "European platform against poverty" (European

31   Commission 2010, p.6). The initiative aims to reduce the number of people living in poverty by 25% by

32   2020, and to enable them to "live in dignity and take an active part in society" (European Commission

33   2010, p.19). To that end, the European Commission annually monitors indicators of poverty and social

34   exclusion (Eurostat 2016a). In 2014, 24.4% of the entire EU population and 27.8% of EU children lived

35   in households experiencing poverty or social exclusion (AROPE) (Eurostat 2016a). AROPE is defined in

36   the Europe 2020 strategy as the proportion of the population experiencing at least one of the following

37   conditions: at risk for monetary poverty, severe material deprivation, or living in a household with a very

38   low work intensity (Eurostat 2016c). What is unknown from these statistics is how European individuals

39   with an intellectual disability (ID) are impacted in terms of their health.

40

41   Intellectual disability

42

43   Intellectual disability (ID) is a disability characterised by significant limitations in intellectual

44   functioning and adaptive behaviour, with onset occurring in the person's developmental years (Schalock

45   2011). ID is a multidimensional state of human functioning and affects a person's everyday life.

46   Compared with people without an ID, individuals with an ID are socially vulnerable (McGrath et al.

47   2010), experience lower quality of life (Nota et al. 2007), have high rates of mental health concerns

48   (Bigby 2012), and they are less self-determined (Nota et al. 2007). Overall, the international literature

49   suggests that they are a vulnerable population that exists on the peripheries of society (Emerson 2007).

50   Poverty and ID are often present concurrently, and Emerson (2007) suggests that this association

51   reflects two distinct processes. First, poverty causes ID because those living in poverty are exposed to

52   environmental and psychosocial hazards such as poor nutrition and housing or environmental toxin.

53   Second, individuals with an ID and their families experience poverty because people with ID are often

54 excluded from the workforce and those caring for individuals with ID often assume additional financial

55 and social responsibilities (Emerson 2007). Emerson also notes that the association between poverty and

56 ID "…accounts in part for the health and social inequalities experienced by people with intellectual

57 disabilities and their families" (Emerson 2007, p.107). Therefore it might be expected that as a result of

58 their increased risk of exposure to poverty, people with ID will have poorer health and greater rates of

59 social exclusion than their peers without ID.

60

61 Overweight and obesity of individuals with ID in Europe

62

63 Adults with ID in countries of the EU generally have high rates of overweight and obesity, particularly

64 among women (Bhaumik et al. 2008; Gazizova et al. 2012; Melville et al. 2008). However, the vast

65 majority of studies showing this trend have been drawn from samples in the United Kingdom (Bhaumik

66 et al. 2008; Gazizova et al. 2012; Melville et al. 2008). Evidence from other EU countries is limited.

67 Smaller samples ($n = 38$) from Spain (Soler Marín and Xandri Graupera 2011) and ($n = 129$) from

68 Sweden (Bergström et al. 2013) and a larger sample ($n = 945$) of older adults with an ID from the

69 Netherlands (de Winter et al. 2012), show rates of obesity that are consistent with the findings from the

70 UK. These trends are a concern, since high BMI levels place individuals with ID at greater risk for

71 hypertension (Bhaumik et al. 2008; Sohler et al. 2009), hypercholesterolemia (Sohler et al. 2009), high

72 serum triglycerides (Gazizova et al. 2012), Type 2 diabetes (Sohler et al. 2009), and the metabolic

73 syndrome in general (Hsu et al. 2012).

74   There is limited research on the rates of obesity in children and youth with ID in the EU. Lloyd

75 et al. (2012) studied worldwide obesity rates in Special Olympics participants, and found in a sample of

76 1,137 children and youth participating in Special Olympics from Europe/Eurasia (n= 749 boys), that

77 21.9% of the boys and 30.9% of the girls were overweight or obese. However, the sample from Lloyd et

78 al.'s study included many Eurasian countries not in the EU; therefore it is difficult to generalize these

4

79 BMI findings to the EU. Country specific studies have also reported high rates of overweight and

80 obesity; for example a study (*n* = 1,120) in France demonstrated that 21.7% of the children with an ID

81 were overweight and an additional 10.1% were obese (Begarie et al. 2013). These authors also found that

82 19% of youth with ID were classified as overweight and a further 7.2% were obese. Despite these data

83 from one high-income country, the general picture of overweight/obesity rates among children and youth

84 with ID in the EU is unclear.

85

86 Underweight among individuals with ID in Europe

87

88 The rates of underweight (BMI ≤ 18.5) among adults with an ID in Europe range widely. In the UK,

89 when measured directly, the rates of underweight appear to range from 5-6% (Melville et al. 2008) to

90 18.6% (Bhaumik et al. 2008). However, Bhaumik et al. reported that the high rate of underweight was

91 associated with having profound ID, although these authors did not report the proportion of their sample

92 with profound ID. Excluding the very high rates of underweight reported by Bhaumik and colleagues

93 (2008), in general, rates of underweight among individuals with ID seem to be lower in EU countries

94 outside of the UK. In Spain, Soler Marin and Xandri Graupera (2011) found that 0% of women and 4.3%

95 of men with Down syndrome were underweight, and Bergström et al. (2013) found that 2.4% of their

96 sample 63 Swedish adults with ID were underweight. Where studies in the EU have reported the

97 underweight status of men and women separately, men have higher rates of underweight (Bhaumik et al.

98 2008; Melville et al. 2008; Soler Marín and Xandri Graupera 2011). Although evidence of morbidity and

99 mortality of underweight adults with an ID is not evident in the literature, underweight is associated with

100 an increased risk of respiratory disease and infection (Prospective Studies Collaboration 2009) as well as

101 hospitalization and all-cause mortality (Weitoft et al. 2008) in the general population.

102   Evidence related to rates of underweight in children and youth with ID is extremely limited. A

103 study from Turkey (*n* = 70) found 5.4% of children and youth with ID were underweight (Sari and

104   Bahceci 2012) and another study from Denmark (*n* = 117) on children and youth with autism spectrum

105   disorder found 31% of males and 12% of females were below the 10th BMI percentile (Mouridsen et al.

106   2002).

107

108   Disability and poverty

109

110   Disability, poverty, and social exclusion seem to be causally related, but the extent and significance of

111   the causal links between disability and poverty is expected to vary across disability types and across

112   communities (Braithwaite and Mont 2009). However, very little comparative quantitative research has

113   been undertaken (Braithwaite and Mont 2009). The impact of country economic status, specifically on

114   the BMI amongst individuals with an ID, has been examined in two recent studies using the Special

115   Olympics Healthy Athletes database; one paper focusing on children (Lloyd et al. 2014) and one

116   focusing adults (Temple et al. 2015). These related studies used The World Bank's classification of

117   country economic status to examine BMI among Special Olympics participants from 159 countries.

118   Among almost 20,000 adults, Temple et al. (2015) found that the rate of underweight was high in low-

119   income countries (17.2%), still relatively high in upper-middle income and low middle-income countries

120   (10.8% and 9.6%, respectively), and lowest in high-income countries (4.6%). Whereas obesity rose from

121   4.2% in low-income countries to 34.1% in high-income countries; however there were significant sex-

122   based differences with women more likely to be obese at every level of economy. Lloyd et al. (2014)

123   found, in a sample of 14,032 children and youth, that the proportion who were underweight was: 10.0%

124   in low-income countries, 2.0% in low-middle income countries, 3.2% in upper-middle income countries,

125   and 2.7% in high income countries. These data indicate that the rates of underweight of children and

126   youth with ID were higher than the rates published for children and youth with non-ID groups in the

127   same economic status (Lloyd et al. 2014). Lloyd and colleagues (2014) found the prevalence of

128   overweight and obesity, respectively were: 14.8% and 3.1% in low income countries, 23.6% and 5.4% in

129 low-middle income countries; 15.9% and 6.2% in upper-middle income countries, and 21.6% and 18.0%

130 in high income countries. These broad world trends in BMI status of adults and children with an ID

131 based on macro-level indicators have not been examined in regional samples. The aim of the current

132 study was to report the rates of underweight and overweight/obesity of children and youth, and adult

133 Special Olympics participants in the EU. In addition, we investigated the extent to which age, risk of

134 poverty, and social exclusion (measured by AROPE), and gender predicted rates of underweight and

135 overweight/obesity to better understand how personal and socio-economic variables impact on BMI

136 status in this sample of Special Olympics participants from the EU.

137

138 **Methods**

139 Data source

140 Special Olympics is a global not-for-profit sporting organization serving approximately 5 million people

141 with ID around the world (Special Olympics 2016). Special Olympics has programs in over 170

142 countries and offers free health screenings at local, State/Provincial, National, and World Games. Data

143 from the health screenings are entered into Special Olympics databases. Before participation in all

144 Special Olympics events, athletes and/or their guardians sign a medical release/consent form to

145 participate in their respective event(s). As part of this document, separate consent is given for the

146 participation in Healthy Athletes screenings which includes consent for the de-identified data to be used

147 to report on the health of Special Olympics athletes. Currently Special Olympics is the largest single

148 source of international health surveillance data and health services for people with ID in the world

149 (Special Olympics 2016). For the present study, Special Olympics provided access to the following

150 variables from their Health Promotion database: gender, age, event, location, delegation (specifically 28

151 EU-countries and three European Free Trade Association (EFTA) countries), height, and weight. The

152 AROPE rate for each of these EU-28 and EFTA countries was obtained from Eurostat (Eurostat 2016a).

153 The AROPE rate represents the proportion of the population experiencing monetary poverty, severe

154   material deprivation, or very low work intensity (Eurostat 2016b). Height and weight were assessed

155   directly by trained personnel at Special Olympics events using protocols developed by Special Olympics

156   (2007). Weight was measured to 0.1kg using digital scales and height was measured to the nearest 0.1cm

157   using portable stadiometers. Ethics approval for this secondary analysis was provided by the institutional

158   ethics review committee of each author's university.

159

160   Data cleaning and analyses

161

162   The initial data of 8,506 available entries for both children/youth aged 8-17 years old and adults aged 18-

163   65 years old from 2006-2013 were examined and filtered to remove extreme or missing values. This

164   methodology for data cleaning was based off previous studies using the Special Olympics database

165   (Temple et al. 2015). The values for inclusion of adults were height between 121.9cm and 238.8cm and

166   weight between 30.0kg and 317.5kg as identified in previous work (ALSWH 2007). For children/youth,

167   height and weight values between +/-5 z score as identified using the ZANTHRO macro for Stata were

168   retained (Vidmar et al. 2004).

169   Listwise deletions were used when anthropometric, gender, age, or country data were missing or

170   determined to be extreme; total number of cases excluded were 1099 (13%). Data from the EU-28 and

171   EFTA countries in the Eurostat database were extracted on February 16, 2016. The AROPE rate data for

172   each of the participant's home country were matched to the participants' event year (year in which the

173   SO event took place) that the healthy athlete data was collected. To increase the sensitivity of the

174   analysis, subgroup values from Eurostat were used. These subgroup data provide a specific AROPE rate

175   value for gender and the following age groups: <16y, 16-24y, 25-54y, and >54y.

176   The International Obesity Task Force (IOTF) cut points were used to determine overweight and

177   obese weight status for children (Cole et al. 2000) and the World Health Organization grade 1 thinness

178   value (an age-adjusted BMI of < 18.5) was used to compute underweight (Cole et al. 2007). For adults

179   World Health Organization (1995) cut-points: Underweight <18.5, Normal range 18.5-24.9, Overweight

180   25.0–29.9, and Obese ≥30 were applied.

181   A series of multiple logistic regressions were run to examine how the following model with three

182   predictor variables: gender (as a dichotomous variable; male = 0, female =1), age (as a continuous

183   variable), and AROPE rate (as a continuous variable) were associated with the likelihood (i.e. Odds

184   Ratio, OR) of being in a given weight status (underweight – not underweight or overweight/obese – not

185   overweight/obese). An OR is an indicator of the probability of a condition such as overweight/obesity

186   resulting from a unit change in a predictor e.g. age (Persoskie and Ferrer 2017). As such, and as an

187   example, a significant association between age and rate of overweight/obesity (e.g. OR = 1.04) means

188   that for every 1 year increase in age the odds of being overweight are increased by approximately 4%.

189   To adjust for the lack of independence associated with clustering by country a robust estimator

190   of variance was used with a clustering option. These analyses were performed for children and adults

191   separately. Data were analyzed using STATA/MP Version 12 for windows (StataCorp LP, College

192   Station, TX).

193

194   **Results**

195   A total of 7,422 (1,905 children/youth and 5,517 adults) Special Olympics participant BMI records were

196   available. Of the child/youth sample 173 were children < 12 years of age and 1,732 were 12 – 18 years of

197   age. Mean age, height, and weight as well as the proportion of children/youth and adults in each BMI

198   category are presented in Table 1. Table 2 shows that a higher AROPE rate (higher risk of poverty and

199   social exclusion) was significantly associated with higher rates of underweight for children/youth and

200   adults (OR = 1.03 and OR = 1.04, respectively). In addition, being older (OR = 1.06) and male (OR =

201   0.82) was associated with higher rates of underweight among children/youth; and being younger was

202   associated with higher rates of underweight among adults (OR = 0.94). Lower AROPE rates and being

203   female were significant predictors of overweight/obesity for both children/youth and adults (see Table 2).

204   Further, among adults, rates of overweight/obesity were higher with increasing age (OR = 1.04).

205

206   **Discussion**

207   The aim of this study was was to report the rates of underweight and overweight/obesity of children and

208   youth, and adult Special Olympics participants in the EU, and to examine the association of AROPE rate

209   with the BMI status of European Special Olympics participants. Results indicate that the rates of

210   underweight, overweight and obesity in European Special Olympics participants were higher than would

211   be expected in the general population. Our findings also indicate that the risk of poverty and social

212   exclusion (high AROPE rate) is associated with the BMI status (underweight and overweight/obese) of

213   both children and adults with ID who participate in Special Olympics in the EU.

214

215   Prevalence of underweight

216

217   Among the adults, rates of underweight were relatively consistent between males and females. This rate

218   of approximately 6% was higher than previously found among adult Special Olympics athletes from

219   Europe/Eurasia (i.e. around 4.5%); but similar to other studies of adults with ID in European countries

220   where BMI has been directly measured (Gazizova et al. 2012; Melville et al. 2008). In our data there was

221   that 82% of the adults who were underweight came from four countries, and more than half of those

222   came from one country. That particular country had one of the highest AROPE rates in 2010 indicating

223   an extreme risk of poverty and social exclusion for the entire country (Antufermo and Di Meglio 2012).

224   Our results indicate that individuals with ID are at high risk of being underweight when the AROPE rate

225   is high; and being underweight is a significant predictor of health. Although an overall underweight

226   prevalence of 6% at the population level is a relatively low prevalence from a public health perspective

227   (World Health Organization 1995), there were countries with higher overall rates of underweight, which

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228   suggests closer monitoring is needed. At an individual level, Special Olympics suggests that athletes

229   considered underweight should be referred to a health professional, however the extent to which this

230   referral is followed up by the individual, their family, or care-providers is unknown.

231   The underweight rate for children/youth was quite high at 9.4% in our study. Although many of

232   the underweight children/youth in this study were from countries with high rates of poverty and social

233   exclusion, this was not universally the case. Underweight was also evident in countries with low poverty

234   rates. Being underweight is a significant indicator of poor health in children and in adults (Black et al.

235   2003; Prospective Studies Collaboration 2009; Weitoft et al. 2008); and therefore, further surveillance is

236   needed to verify these findings and health promotion efforts are needed to identify the aetiology of the

237   underweight status in children and how to prevent it.

238

239   Prevalence of overweight and obesity

240

241   The proportion of overweight/obese adults in the present study was very similar to the proportion

242   identified as being overweight/obese in a Special Olympics sample from Europe/Eurasia (Temple et al.

243   2013). However, the rates of overweight/obesity in our study were lower than rates of overweight/obesity

244   among adults with ID in Sweden (69.9%) (Bergström et al. 2013), older adults with ID in the

245   Netherlands (males = 52.9%; females =75.1%) (de Winter et al. 2012), and adults with ID in the United

246   Kingdom (Melville et al. 2008). It is perhaps not surprising that our rates were lower than for individuals

247   with ID in the United Kingdom, since in the general population, the United Kingdom has the third

248   highest rate of excess weight in Western Europe (Ng et al. 2014). Furthermore, our sample was

249   considerably younger than the de Winter et al. sample, and as the odds of being overweight/obese

250   increase with age (Temple et al., 2014), lower rates of overweight and obesity seem sensible. However,

251   as the living circumstances of participants in this study are not known, it is unclear why the rate of

252   overweight/obesity was lower in the present study than the rate reported for those living semi-

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253   independently in Sweden (Bergström et al. 2013). Even though the rates of overweight/obesity in this

254   study were lower than in many previous studies, these rates were still high which is indicative of poor

255   health.

256   　　　　The combined overweight/obesity rate of children/youth in this study was 25.3%, with females

257   having significantly higher rates than males. Given that 90% of the children/youth in the present study

258   were 12 years of age or older, our findings suggest that more than a quarter of adolescents with ID

259   participating in Special Olympics in the EU are overweight/obese. This is particularly troubling since

260   childhood obesity status moderately predicts adult obesity status, and the persistence of obesity from

261   adolescence to adulthood is high (Simmonds et al. 2015). Research to elucidate factors contributing to

262   these high rates of obesity in young people with ID is urgently needed. This research needs to extend

263   beyond calorie input and output to include other known contributing factors such as the adequacy of

264   sleep, the impact of medications, syndrome specific factors, as well as key aspects of the child/youth's

265   social and cultural environment, for example: food as rewards, family socio-economic status, and foods

266   available at home and at school (Harrison et al. 2011).

267

268   Risk for poverty and limitations of the study

269

270   Higher rates of AROPE, defined in this study as higher risk of monetary poverty, material deprivation,

271   or low work-intensity (Eurostat 2016c), was significantly associated with higher rates of underweight for

272   children and adults. This means that for individuals with ID who are at high risk of poverty and social

273   exclusion, the risk of being underweight is also elevated. These findings are consistent with findings for

274   children (Lloyd et al. 2014) and adults (Temple et al. 2015) with ID in global samples stratified by

275   country economic status. For adult European Special Olympics participants, being younger and from a

276   country with higher rates of AROPE were associated with higher rates of underweight. However,

277   underweight was a more pervasive problem among children than adults in this sample, particularly

278   among boys. These underweight rates are higher than previously reported rates for children and youth

279   with ID in the region (Mouridsen et al. 2002; Sari and Bahceci 2012). Lower AROPE, defined in this

280   study as lower risk of monetary poverty, material deprivation, or low work-intensity, was significantly

281   associated with overweight/obesity for both children and adult Special Olympics participants. In other

282   words, the lower the risk of poverty and social exclusion, the higher the rates of overweight and obesity

283   in this sample. Again, these findings are consistent with data derived from global samples by Lloyd et al.

284   (2014) for children and Temple et al. (2015) for adults, where the high-income countries had the highest

285   proportion of overweight/obese participants and the low-income countries had the lowest proportion. In

286   addition to lower risk of poverty and social exclusion predicting overweight/obesity, being a female

287   Special Olympics athlete in our study was significantly associated with higher rates of

288   overweight/obesity; especially for adult athletes. This is also consistent with previous evidence that

289   children and adult female Special Olympics athletes from Europe/Eurasia (Lloyd et al. 2012; Temple et

290   al. 2013) and from high-income countries (Lloyd et al. 2014; Temple et al. 2015), have higher rates of

291   overweight/obesity than males.

292   The results of the present study show that higher poverty and social exclusion scores

293   were associated with high rates of underweight, while conversely, lower poverty and social

294   exclusion scores were associated with high rates of overweight/obesity among child and adult Special

295   Olympics athletes in Europe. As there are adverse health outcomes associated with both high rates of

296   underweight and with high rates of overweight/obesity (Prospective Studies Collaboration 2009), our

297   findings reveal that Special Olympics athletes living in European countries with both high and low rates

298   of poverty and social exclusion are at risk of poor health based on adverse BMI profiles. Further

299   investigation into the living circumstance of Special Olympics athletes in Europe is warranted, including

300   the availability of, and access to: appropriate nutrition, health promotion efforts, as well as health care

301   and surveillance. Special Olympics could also play a role in promoting healthy body weight among

302   athletes by increasing their health promotion efforts and support, particularly in countries with high

303   AROPE rates to mitigate the adverse effects of poverty and social exclusion on BMI status.

304   A limitation of our study is that we know the AROPE rate of each athlete's country but we do

305   not know the personal economic status of each individual. It is possible that individuals with ID in low

306   AROPE rate countries are also at risk of living in poverty and being socially excluded. In addition,

307   although we mention that several countries have especially high AROPE rates and associated high levels

308   of underweight and overweight/obesity, based on our data sharing agreement with SOI we are not

309   allowed to name the specific country/ies. Further, we do not know the etiology of ID, medication use,

310   athletes' living arrangements, associated health conditions and the like, because these are not part of the

311   database, and therefore association/s to AROPE could not be examined. However, this does not detract

312   from the general trends we found showing that high levels of poverty and social exclusion were

313   associated with poorer BMI status and by extension increased risk of poor health.

314   A final limitation of this study is the fact that all the participants were Special Olympics

315   participants limiting the generalizability of the results. It is possible that because all the participants in

316   this sample were competing at local, national and international sporting events that they were more

317   physically active than their peers with ID who do not regularly participate in Special Olympics.

318   Therefore, our results may in fact underestimate the health concerns of people with ID. However, Special

319   Olympics is an international organization with extensive reach and this is the largest global dataset on the

320   health of individuals with ID. The results are further bolstered by the fact that height and weight are

321   directly measured by trained professionals. More research is needed on a wider spectrum of participants

322   with ID to understand if these results are generalizable.

323

324

325   Compliance with Ethical Standards

14

326   All procedures performed in the study were in accordance with the ethical standards of the institutional

327   research committees of each participating university. (In order of authorship: University of Jyväskylä,

328   University of Victoria, University of Ontario Institute of Technology, and State University of New York

329   College at Cortland.)

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