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BODY MASS INDEX CHANGES IN CHILDREN AND ADOLESCENTS WITH INTELECTUAL DISABILITY DURING THE COVID-19 PANDEMIC

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ABSTRACT

Introduction: *Intellectual disability (ID) is a generalized neurodevelopmental disorder characterized by significantly impaired intellectual and adaptive functioning. Body mass index (BMI) is a value derived from the mass (weight) and height of a person. Due to the COVID-19 pandemic, there was a lockdown of all schools and other daily sport activities.*

Methods: *We measured the height and weight of 100 children and adolescents with intellectual disabilities. The measurements were taken in September 2020 and then six months later, in March 2021. The calculated BMI was transformed into age- and sex-standardized values (zBMI). Mean BMI and zBMI were compared over time and between sexes using a paired t-test and two-way mixed analysis of variance (ANOVA). The effect size was estimated using Cohen's d.*

Results: *On average across all groups, BMI increased by 0.5kg/m^2 in the studied period. The increase in mean BMI was statistically significant for both groups of girls; the difference between girls and boys in BMI increase was marginally statistically significant. The analysis of zBMI confirmed that the observed changes were likely not simply a consequence of maturation.*

Discussion: *One effect of the COVID-19 pandemic and restrictions related to it was the increase in BMI values in children and youth. With our results, we can relate this data also to the population with ID. Although we have provided intervention programs and encouraged pupils and their parents to be more physically active during lockdown,* *the importance of school and after-school activities regarding physical fitness status is clearly evident.*

Keywords: *body mass index, youth with intellectual disability, COVID-19 pandemic*

INDEKS TELESNE MASE PRI OTROCIH IN MLADOSTNIKIH Z MOTNJO V DUŠEVNEM RAZVOJU MED EPIDEMIJO COVIDA-19

IZVLEČEK

Uvod: *Motnja v duševnem razvoju je motnja, za katero je značilna pomembna omejitev tako intelektualnega delovanja kot prilagojenega vedenja, ki se kaže v pojmovnih, socialnih in praktičnih spretnostih prilagajanja. Indeks telesne mase (ITM) je antropološka mera, ki je definirana kot telesna masa v kilogramih, deljena s kvadratom telesne višine v metrih. V času pandemije COVID-19 je bilo uvedeno popolno zaprtje šol in ostalih dnevnih prostočasnih aktivnosti.*

Metode: *Septembra 2020 in ponovno marca 2021 smo izmerili maso in višino 100 mladostnikov z motnjo v duševnem razvoju,. Izračunane vrednosti ITM smo pretvorili v standardizirane (zITM) glede na starost in spol. Za primerjavo povprečja ITM in zITM med skupinami in skozi čas, smo uporabili test t in analizo variance, velikost učinka pa smo ocenili s Cohenovim d.*

Rezultati: *V povprečju se je ITM zvišal za 0,5 kg/m^2. Povečanje ITM je bilo statistično značilno pri obeh skupinah deklet; razlika med deklicami in dečki v povečanju povprečnega ITM je bila mejno statistično značilna. Analiza zITM je pokazala, da opažene spremembe po vsej verjetnosti niso bile zgolj posledica telesnega razvoja.*

Razprava: *Ena izmed posledic pandemije in restrikcij povezanih z njo, je tudi zvišanje ITM pri otrocih in mladostnikih. Z našimi rezultati lahko pokažemo, da se je ITM zvišal tudi pri osebah z motnjami v duševnem razvoju. Kljub interventnim programom med zaprtjem šol in spodbujanju učencev in staršev k večji aktivnosti, lahko vidimo kako pomembne so šolske in obšolske dejavnosti za razvoj in ohranjanje normalne telesne teže.*

Ključne besede: *indeks telesne mase, mladostniki z motnjo v duševnem razvoju, pandemija COVID-19*

INTRODUCTION

Intellectual disability affects about 1% of the population, and of those about 85% have mild intellectual disability (Schalock, Luckasson, & Tasse, 2021). Males are more likely to be diagnosed with intellectual disabilities than females. Intellectual disability is identified by problems in both intellectual and adaptive functioning (Schaepper, Hauser, & Kagadkar 2021). A full-scale IQ score of around 70 to 75 indicates a significant limitation in intellectual functioning. However, the IQ score must be interpreted in the context of the person's difficulties regarding general mental abilities. Three areas of adaptive functioning are considered: *Conceptual* – language, reading, writing, math, reasoning, knowledge, and memory; *Social* – empathy, social judgment, communication skills, the ability to follow rules and the ability to make and keep friendships; *Practical* – independence in areas such as personal care, job responsibilities, managing money, recreation, and organizing school and work tasks (Golubović, Maksimović, Golubović, & Glumbić, 2012). Adaptive functioning is assessed through standardized measures with the individual and interviews with others, such as family members, teachers, and caregivers. Intellectual disability is identified as mild (most people with intellectual disability are in this category), moderate or severe. The symptoms of intellectual disability begin during childhood; delays in language or motor skills may be seen by the age of two, but mild levels of intellectual disability may not be identified until school-going age. Intellectual disability can be associated with a genetic syndrome, such as Down syndrome or Fragile X syndrome; it may develop following an illness such as meningitis, whooping cough or measles; it may result from head trauma during childhood; or it may result from exposure to toxins such as lead or mercury. Other factors that may contribute to intellectual disability include brain malformation, maternal disease, environmental influences (alcohol, drugs, or other toxins), labor- and delivery-related events, infection during pregnancy, and problems at birth. Individuals with intellectual disabilities are at higher risk for health disparities including being overweight and obese; however, little is known at the population level about the BMI status of children and youth with intellectual disabilities (Lloyd, Foley, & Temple, 2014).

The *body mass index* (BMI) is defined as the body mass divided by the square of the body height (expressed in kg/m^2). It is a convenient rule-of-thumb to broadly categorize a person as underweight, normal weight, overweight, or obese based on tissue mass (muscle, fat, and bone) and height. Major adult BMI classifications are underweight (under $18.5kg/m^2$), normal weight (18.5 to 24.9), overweight (25 to 29.9), and obese (30 or more). When used to predict an individual's health, rather than as a statistical measurement for groups, the BMI has limitations that can make it less useful than some of the alternatives, especially when applied to individuals with abdominal obesity, short stature, or unusually high muscle mass (Temple, Foley, & Lloyd, 2014). People with BMIs under 20 and over 25 have been associated with higher all-cause mortality, with the risk increasing with distance from the 20–25 range. BMI is used differently for children. It is calculated in the same way as for adults but then compared to typical values for other children of the same age. Instead of comparison against fixed thresholds for underweight and overweight, the BMI is compared against the percentiles for children of the same sex and age (Ptomey et al., 2020). A BMI that is less than the 5th percentile is considered underweight and above the 95^{th} percentile is considered obese. Children with a BMI between the 85^{th} and 95^{th} percentile are considered overweight.

Obesity is a major health concern due to its increasing prevalence, particularly in people with intellectual disabilities. There has been a marked increase in the proportion of adults who were obese, from 13.2% in 1993 to 26.0% in 2013 for men, and from 16.4% to 23.8% for women (Health & Social Care Information Centre, March 2015). This is a cause of significant concern as obesity in turn increases the attributable risk for diabetes, cancer, and cardiovascular disease (Guh et al., 2009). Another cross-sectional study suggested a higher prevalence of obesity in people with intellectual disabilities when compared with the general population. The gender ratio showed that 39.3% of women and 27.8% of men with intellectual disability were obese compared to 25.1% of women and 22.7% of men in the general population (Melville et al., 2008).

The *coronavirus disease 2019 (COVID-19)* has an impact on physical activity (PA) behaviors worldwide. People around the world stayed at home and self-isolated, due to the lockdown policy. Although a lockdown is considered essential and the best recommendation for preventing the spread of the disease, it may create new challenges. Staying at home for a prolonged period can lead to disturbing consequences, such as weight gain, social isolation and may also cause a reduction in PA levels. The decrease in PA levels may be especially apparent among active individuals habitually practicing sports. Diminished PA resulting from home isolation may worsen a wide range of health conditions, including chronic ones, such as cardiac and metabolic diseases as well as infectious diseases, due to negative immune-modulation even without substantial weight gain. Therefore, maintaining an active lifestyle at home, including mainly PA, is extremely important for the general population's health, especially for people with additional risk factors, including older adults, during the quarantine (Dor-Haim, Katzburg, Revach, Levine, & Barak, 2021).

In relation to the facts outlined above, the aim of our observational study was to estimate the impact of COVID-19 and associated lockdown policy on the BMI of children and adolescents with intellectual disabilities in Slovenia.

METHODS

We measured the height and weight of 100 children and adolescents with moderate intellectual disability. They constituted a convenience sample of students of a special education center where the first author works. The sample consisted of 23 girls aged 6–14 years, 19 girls aged 15–26 years, 32 boys aged 6–14 years, and 28 boys aged 15–26 years.

The measurements were performed by the first author in September 2020 and then after six months, in March 2021, as part of regular physical education lessons. In the period between both measurements, the school was closed for 10 weeks due to the

COVID-19 pandemic. We calculated the BMI of all participants in both periods, and standardized the values based on age (in months) and sex, thus obtaining *z*BMI values according to WHO guidelines (World Health Organization, 2007). For the 17 participants aged 20 to 26 years, the standards for 19-year-olds were used (which are practically identical to those for adults).

The differences in mean BMI increase according to sex and age group were tested using a two-way analysis of variance (ANOVA). Mean BMI and *z*BMI were compared between the two measurements using a paired *t*-test within each group and the pooled sample. The effect size was estimated using Cohen's *d*. No a priori statistical power analysis or sample size estimation was performed.

The study was approved by the Committee for Ethical Issues in the Field of Sport of the Faculty of Sport, University of Ljubljana (no. 12/2022).

RESULTS

On average across all groups, BMI increased by 0.5 kg/m2 in the studied period. Descriptive statistics, results of paired *t*-tests and effect sizes for BMI and *z*BMI increase are reported in Table 1.

The increase in mean BMI was statistically significant for both groups of girls, marginally statistically significant for the younger boys and not statistically significant for older boys. ANOVA showed that the difference between girls and boys in BMI increase was marginally statistically significant (p=0.070 for the effect of gender); the effect of age group on mean BMI increase was not statistically significant (p=0.319), nor was there a statistically significant interaction (p=0.929). For the increase in *z*BMI, none of the effects was statistically significant (p=0.167 for gender, p=0.814 for age group, p=0.301 for interaction). These findings are illustrated in Figure 1.

Table 1: Descriptive statistics, results of paired t-tests, effect size estimates and estimates of relative BMI and zBMI increase in the studied period.

BMI		**September 2020**		**March 2021**				**relative change of mean**	**median relative change**
Group	**n**	**Mean**	**SD**	**Mean**	**SD**	**p (t-test)**	**d (95% CI)**		
Girls 6-14 y	21	20.4	6.2	21.3	7.1	0.007	0.65 (1.12, 0.17)	+4.4%	+3.4%
Girls 15-26 y	19	28.0	7.1	28.6	6.6	0.007	0.69 (1.19, 0.18)	+2.3%	+1.9%
Boys 6-14 y	32	20.6	5.1	21.0	4.8	0.056	0.35 (-0.01, 0.71)	+2.1%	+0.8%
Boys 15-26 y	28	23.7	5.2	23.9	4.9	0.415	0.16 (-0.22, 0.53)	+0.8%	+1.3%
zBMI		**September 2020**		**March 2021**				**relative change of mean**	**median relative change**
Group	**n**	**Mean**	**SD**	**Mean**	**SD**	**p (t-test)**	**d (95% CI)**		
Girls 6-14 y	21	0.72	1.64	0.80	1.75	0.369	0.20 (-0.23, 0.63)	+10.3%	+10,4%
Girls 15-26 y	19	1.46	1.54	1.62	1.37	0.006	0.71 (0.20, 1.21)	+11.2%	+11,0%
Boys 6-14 y	32	1.25	1.94	1.30	1.83	0.498	0.12 (-0.23, 0.47)	+4.0%	-8,5%
Boys 15-26 y	28	0.52	1.35	0.52	1.35	0.915	-0.02 (-0.39, 0.35)	-1.1%	+2,2%

Notes: *n* – sample size; SD – standard deviation; CI – confidence interval

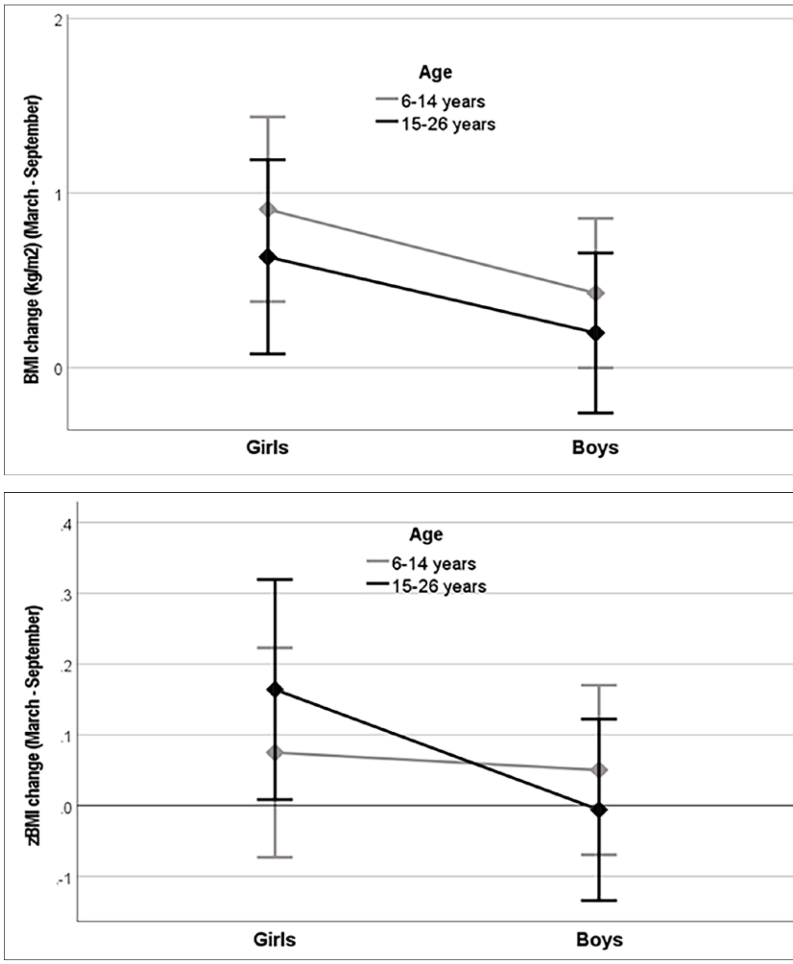

Figure 1: Mean BMI (top panel) and zBMI (bottom panel) change (with a 95% confidence interval, CI) from September to March according to sex and age group.

Because the groups did not differ statistically significantly in mean *z*BMI change, we analyzed the mean *z*BMI change between the two time points for the pooled sample. It was marginally statistically significant (p=0.075). Hence, the confidence interval for the estimated effect size contained zero, but very close to the lower limit (d=0.18, 95% CI -0.02 to 0.38), and the distribution of within-participant changes contained both positive and negative values, with the majority being positive (Figure 2). Overall, the mean within-participant increase in zBMI was 0.06.

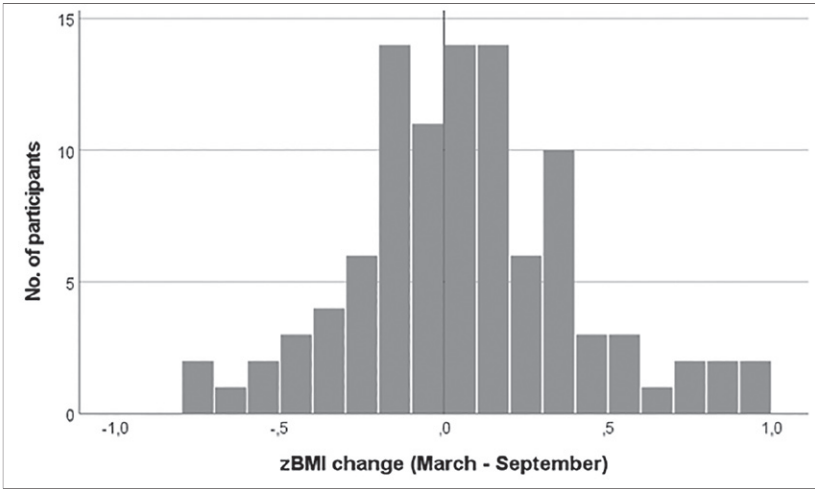

Figure 2: Mean BMI (top panel) and zBMI (bottom panel) change (with a 95% confidence interval, CI) from September to March according to sex and age group.

DISCUSSION AND CONCLUSION

Our data show that during the studied period, which included a 10-week lockdown, BMI in pupils with intellectual disabilities tended to increase on average more than what would be expected due to maturation alone. As expected, the average BMI of the pupils was higher than in their counterparts in the general population in the beginning (the starting mean *z*BMI values were positive), but this was more pronounced at the end of the studied period. In general, the effect seemed to be somewhat larger in girls than boys (and likely absent among the oldest boys).

Although we had online sports classes, supported and encouraged families to lead an active lifestyle and pupils returned to school much earlier than the majority population, there was still an increase in BMI in six months in all four groups. We assume that not only the school lockdown but also the general lockdown had an impact on increased BMI. There were a lot fewer possibilities for indoor and outdoor activities and there were no after-school activities, such as the Special Olympics program and training sessions, in which the population with intellectual disabilities is highly engaged (Lloyd, Temple, & Foley, 2012).

Studies related to the Slovenian SLOfit program suggest that the general fitness of the majority population dropped by 17% on average in almost all measurements of the SLOfit program. Part of those are also height and weight, and the BMI has increased in children and youth during the pandemic limitations on schools, sports programs and other social-life activities (Recek, 2020). Studies show that the intervention programs provided during lockdown were excellent; we had online classes, professional recommendations, TV and online classes, etc., to encourage pupils to be as active as possible and maintain their physical fitness. Although all the programs were successful in terms of time spent outside and being active, there was a lack of moderate-to-vigorous physical activity (MVPA). Studies suggest that most of the MVPA is performed in the school environment (Morrison, Meh, Sember, Starc, & Jurak, 2021). BMI status is a significant indicator of health, and these findings suggest that being overweight and obesity are significant health concerns for children and youth with intellectual disabilities. It is critical that health professionals increase health promotion efforts, including physical activity and healthy eating behaviors for children and youth with intellectual disabilities. We assume that the lockdown resulted in a reduction in physical activity below the minimum recommendations of health organizations, which is in line with other studies that showed a decline in physical activity levels during closure times (Chen et al., 2020, Balanzá-Martinez, Atienza-Carbonell, Kapczinski, & De Boni, 2020). The study suggests that pandemics such as the current pandemic pose unique health issues caused by the requirements to stay at home, leading to a reduction in physical activity, among all people and especially among physically active individuals habitually practicing sports (Ravalli, & Musumeci 2020).

Although a lockdown may be required to mitigate a pandemic, it also generates new health challenges. Staying at home for a prolonged period of time may increase sedentary habits and decrease physical activity levels that may lead to disturbing consequences such as an increased risk of worsening health conditions (including chronic ones), weight gain, insufficient sunlight exposure, social isolation, and poor metabolic health. A US study found that the COVID-19 pandemic period was associated with an excess increase in BMI of 0.24kg/m^2 per year more than in the previous pre-pandemic period, even when controlling for socioeconomic status, race and ethnicity, baseline BMI category, and type of BMI ascertainment. Our findings validate the predictions of many scholars that weight increases among children because of the cumulative effects of anticipated decreases in physical activity and increases in sedentary behavior, screen time, and high-calorie diets among children during the pandemic (Knapp et al, 2022). Altogether, sedentary behavior and low levels of physical activity can have adverse effects on a person's overall well-being and quality of life (Laron, & Goldwag, 2020). Several authors followed children and youth and their development during the pandemic; most of the findings report an increased BMI (Woolford et al., 2021). After such devastating results of so many studies, the health program and school prevention programs should increase the level of physical activity, promote a healthy and active life style and try to rebalance the current situation of increased BMI of youth after all the restrictions. We must not forget to also include pupils with intellectual disabilities, as they are even more affected by staying at home with even less social life and opportunities to be active and lead a healthy lifestyle.

The main limitation of our study is that we do not have strictly comparable data on how the 10-week lockdown affected the majority population in this age group. In addition, we only measured height, weight, and BMI, but we did not compare other potentially relevant indicators such as skinfold or general fitness level of the target population.

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