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Original Article

The relationship between executive functions and physical activity in children with an intellectual disability

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Abstract:
Background: Children with intellectual disabilities usually show impairments in executive functions. Most of the studies with children of typical development have shown positive influence of physical activity and exercise on executive functioning. Therefore, objective of the study was to examine relationship between physical activity and executive functions among children with mild and moderate intellectual disability, and to expand the body of knowledge on EF among children with ID.
Methods: One hundred and four children (62 boys and 42 girls) with intellectual disability from 7 to 18 years of age took part in the study. There were 49 children with mild and 55 with moderate intellectual disability. For assessment of executive functions, the authors used Behavior Rating Inventory of Executive Functions (BRIEF) – teacher version that was completed by 15 special education teachers of children participating in the study. Physical Activity in terms of light, moderate, vigorous and moderate to vigorous physical activity was assessed with GT3X Actigraph accelerometer during 7 consecutive days.
Results: Moderate and moderate to vigorous physical activity are significant predictors of initiate, working memory and plan/organize scales and metacognition index. In addition, age contributed to shift and metacognition index, gender to working memory and organization of materials, while level of intellectual disability was significant predictor of all BRIEF scales.
Conclusion: There is a significant relationship between physical activity and executive functions for specific components of these two domains. Future research may focus on determining appropriate physical activity and exercise intervention that would influence development of executive functions among children with intellectual disability.
Keywords: exercise, actigraph, BRIEF, intellectual disability, physical activity

Introduction

Children with intellectual disabilities (ID) often demonstrate impairments in executive functioning (Danielsson, Henry, Ronnberg, & Nilsson, 2010; Ikeda & Okuzumi, 2011; Memisevic & Sinanovic, 2014).
Executive functions (EF) are crucial for children's lifetime performance (Center on the Developing Child Harvard University, 2011). They are often connected with school readiness and school achievement (Morrison et al., 2010), physical health (Miller, Barnes, & Beaver, 2011), successful work (Bailey, 2007), social functioning (Diamond, 2012) and the quality of life (Brown & Landgraf, 2010). Based on various tests measuring different types of EF, they start to develop shortly after the birth and most significant development is occurring between the ages 3 to 5 (Anderson, 2003). Development further continues during adolescence and early adulthood and then it starts to decline in later life after 50's (Best & Miller, 2010).
There is a lot of different definitions and classifications of EF due to many theoretical backgrounds but many scientists agree that the core of EF are working memory, inhibition and cognitive flexibility/shifting (Diamond, 2012). The model that was chosen for this study defines EF as a collection of processes that are responsible for guiding, directing and managing cognitive, emotional, and behavioral functions, especially during new, problem-solving situations (Gioia, Isquith, Guy, & Kenworthy, 2000). Based on this approach, EF are composed of 8 subdomains as follows: inhibit (control impulses, self-control, resisting temptations), shift (cognitive flexibility, flexibly adapt to new situation or activity depending on circumstances), emotional control (modulate emotional responses appropriately), initiate (begin task or activity, generate ideas independently), working memory (hold information in mind for purpose of completing a task), plan/organize (anticipate future actions, set goals), organization of materials (keep workplace, play areas and materials in order) and monitor (check work, assess performance during and after task).

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Physical activity (PA) is defined as any bodily movement produced by skeletal muscles that result in energy expenditure (Caspersen, Powell, & Christenson, 1985) and the same definition is used for the purpose of this study. Participation in regular PA could bring important short- and long-term benefits for youth's health (Van Der Horst, Paw, Twisk, & Van Mechelen, 2007) especially in children's physical, social, cognitive and psychological development (Janssen & Leblanc, 2010).

Many studies investigated the importance of PA for individuals with ID (Frey, Stanish, & Temple, 2008; Hinckson & Curtis, 2013; Leung, Siebert, & Yun, 2017; Lloyd, 2016) and it was found they have lower PA levels then children without ID (Einarsson et al., 2015) and that PA produce great health benefit in this population.

During the last 20 years, the relationship between EF and PA has been extensively studied, but mostly among individuals of typical development, and a positive relationship between PA and EF has been found (Best, 2010; Diamond, 2015; Verburgh, Konigs, Scherder, & Oosterlaan, 2013). The earliest evidence about this relationship is coming from the middle of the previous century when Piaget and Inhelder (1966) discussed that the cognitive development relies on motor functioning. Relatively recent studies of individuals of typical development supported existence of relationship between development of motor skills and EF (Diamond, 2000). It was discovered that they develop at the same time and that they are using the same brain structures.

In the area of fitness research and its influence on cognition with typically developed individuals, positive influences of fitness training on cognitive function were reported (Etnier et al., 1997). Additionally, it was discovered that exercise broadly improves cognitive function across a number of domains, particularly EF (Colcombe & Kramer, 2003).

Another area of research that has received much attention is related to effects of acute/single bout exercise and several weeks' long chronic exercise on EF. The positive effects have been detected immediately following completion of single bouts of exercise (Hillman et al., 2009) and after chronic training (Davis et al., 2011) in typically developed children. Several studies with children with ID followed similar design and found positive relationship between EF and acute exercise (Chen et al., 2015; Vogt et al., 2013), as well as after long term exercise (Ringenbach et al., 2016). However, Diamond (2015) criticized the approach of exercise interventions based on activities such as running on treadmill or stationary cycling and argued that it is necessary to include activities that improve physical fitness but, at the same time, engaging motor skills and EF, bring enjoyment and provide sense of social belonging. Similar facts were already evidenced by Best (2010) who concluded that cognitively demanding exercise has stronger effects on EF.

This study aims to expand the knowledge base of the relationship between EF and PA among children with ID by including a wider range of EF and objectively measuring PA. This is especially important for the territory of Bosnia and Herzegovina (B&H) where this type of research is not performed very often, or not at all. The authors wanted to find out which level of PA influences EF the most and on what EF component specifically. Additional goal was to examine the status of EF and PA among children with ID. The authors hypothesize that spending more time in moderate, vigorous and MVPA will be associated with better results in EF. Beside PA, the authors also considered influence of age, gender and level of ID.

Methods

Participants

One hundred and four children took part in this study (62 boys and 42 girls with ID) from seven special schools and two special classes on primary and secondary school level in six larger cities in B&H. There were 49 children with mild ID (IQ range from 50–69; 29 boys and 20 girls) and 55 children with moderate ID (IQ range from 35–49; 33 boys and 22 girls). Information about children's IQ were based on World Health Organization (1992) and it was taken directly from the school's records. The children were included in case they were not diagnosed with Attention Deficit Hyperactivity Disorder, Autism Spectrum Disorders or Down syndrome. The age range of the children was from 7 to 18 with mean age of 14 and standard deviation (SD) 3.3. Only children that agreed to participate were included in the study and their parents or caregivers signed an informed consent. All procedures in the study were approved by Ethical Commission of Faculty of Physical Culture, Palacky University Olomouc.

Materials

Assessment of Executive functions

Behavior Rating Inventory of Executive Functions ([BRIEF]; Gioia, Isquith, Guy, & Kenworthy, 2000) is a questionnaire for assessment of EF behaviors in home and school environments. It has a parent and a teacher version and it is designed to be used among children ages from 5 to 18. Unlike performance based tests of EF that have certain limitations (Pennington & Ozonoff, 1996), BRIEF allows assessment of EF from the perspective of daily basic behavior and presents them in a more realistic everyday condition. In our study, the authors used a teacher version of BRIEF – which means that teachers were filling in the questionnaire under condition that they know the child(ren) for at least 6 months. BRIEF contains 86 items in eight theoretically and empirically derived clinical scales that measure different aspects of executive functioning: inhibit, shift,

emotional control, initiate, working memory, plan/organize, organization of material and monitor. Factor analysis of both versions of BRIEF supported two-factor model. The first factor was identified as Behavioral Regulation Index (BRI), which consists of scales inhibit, shift and emotional control. The second factor called Metacognition Index (MI) includes five remaining scales. The two factors demonstrate moderate correlation between each other and they are used for calculation of the Global Composite Index (GEC) score. BRIEF has two validity scales: Inconsistency – the extent to which respondent answers similar BRIEF items in an inconsistent manner; and Negativity – the extent to which respondent answers selected BRIEF items in an unusually negative manner. In our study, only two questionnaires showed elevated inconsistency scores and they are excluded from the analysis.
The BRIEF was translated into the Bosnian language for one of the earlier studies performed by Memisevic and Sinanovic (2014) using bilingual translation method. The instrument was not standardized and validated for Bosnian cultural environment but it is shown to be feasible and with same factor structure in use with children with ID as original version (Memisevic, 2015).
BRIEF teacher version was normed for 720 children and Cronbach alpha as measure of internal consistency ranged from 0.84 to 0.98.
Based on respondent's answers, raw scores are calculated and they are later transferred to *T* scores. T scores (M = 50, SD = 10 – based on normative sample) are used to interpret the child's level of EF as reported by parents/teachers on the BRIEF rating form. If *T* is at or above 65 it represents the 1.5 SD above the mean, which is recommended threshold for interpretation of a score as abnormally elevated. Lower scores indicate better functioning.

Assessment of Physical activity
The level of PA was assessed using the GT3X actigraph accelerometer (ActiGraph TM, Fort Walton Beach, FL, USA; Firmware 4.4.0).
The actigraph GT3X worn on the waist provides PA measurements such as activity counts, step counts, energy expenditure, activity levels, etc. Recorded changes of movement are converted into quantifiable digital signals called "counts" (Sirard & Pate, 2001) and its validity and reliability was verified under different conditions (Bassett et al., 2000).
The participants wore actigraphs for 7 consecutive days starting from the day after the instrument placement. Instructions were given to the participants and parents/caregivers both verbally and in written form while they provide information on how to wear the actigraph during all waking hours except while bathing, showering, swimming, sleeping and playing contact sports. The actigraph was fitted to a small bag and attached to the participant's right hip. Each bag had a number which was assigned to the actigraph and child wearing it. Actigraphs were programmed to measure activity in 30 second epochs. In order to be included in the analysis, the participants had to wear actgraph at least for 4 days (Berlin, Storti, & Brach, 2006) and 8 hours a day (Einarsson et al., 2015).
Non-wear time was considered as sequences of 60 minutes of zero and these periods were removed from the analysis. Assessment of PA included light PA, moderate PA, vigorous PA MVPA and the authors also measured sedentary behavior. The minimum number of counts for MVPA was defined at ≥ 2296 counts.min-1, sedentary activity as ≤ 100 counts.min-1 and vigorous was set on 4012 counts and above. These thresholds were first established by Evenson, Catellier, Gill, Ondrak, and McMurray (2008) and later independently validated by Trost, Loprinzi, Moore, and Pfeiffer (2011).

Data analysis
EF results are presented as T scores based on BRIEF Professional Manual for gender and age. Physical activity results are presented in number of minutes spent in certain PA level (light, moderate, MVPA and vigorous) and sedentary behavior. Physical activity data were analyzed with ActiLife 5, an ActiGraph's data analysis software platform.
Differences in BRIEF and PA scores in relation to gender, different age groups and level of intellectual disability were calculated with *t* test. Effect size in terms of Cohen's d (Cohen, 1992) was calculated for each difference (.20 – small; .50 – medium; .80 – High effect size). Relationship between BRIEF scales and PA levels was calculated with Pearson's correlation coefficient for continuous data. The relationship between the monitored variables was interpreted also by Cohen (1992): $r = 0$ – complete independence; $.00 < r < .20$ – very weak dependence; $.20 \leq r < .40$ – low dependency; $.40 \leq r < .70$ – medium dependence; $.70 \leq r < .90$ – high dependence; $.90 \leq r < 1.00$ – very high dependency; $r = 1$ – total dependency.
In search of causality, these relationships were further analyzed using simple linear regression.
An alpha level of 0.05 was set for all statistical tests. Statistical analysis has been performed using IBM SPSS Statistic v.23 and by G*Power for Effect size calculation.

Results

Descriptives and comparison of PA and EF results by gender, age and level of ID.
Descriptive results (means, standard deviation and number of participants) of EF assessment by gender and level of ID are shown in Table 1 (see below), whereas Table 2 (on the following page) shows the results of PA assessment by the same categories. Along with descriptive results, tables include comparisons between mean scores of EF and PA in relation to the same categories (gender and level of ID). Test of differences in PA and EF results by two age groups (7 to 14 and 15 to 18) were also conducted, but they are not presented in tabular form as only one result was significant. It is obvious from Table 2 that children with mild ID are more physically active then children with moderate ID and spend more time in each PA levels. The statistically significant difference was found in light PA, moderate PA, vigorous PA and MVPA with medium effect size. Boys were generally more active than girls and difference was significant in moderate PA and MVPA with medium effect sizes. As can be seen from Table 1, children with mild ID achieved better results in BRIEF scales than children with moderate ID. The difference in mean scores was significant for all BRIEF scales with large effect sizes. Children with mild ID scored clinically significant result only in shift, working memory and GEC, unlike children with moderate ID who had clinically significant score in all BRIEF scales. Overall, girls performed slightly better than the boys in EF results (see Table 1). A significant difference was found in working memory and organization of materials. The only statistically significant difference in results of EF related to age groups was found for a shift scale in favor of younger children.

Table 1
Descriptive results and difference between mean T-scores between boys and girls and between children mild and moderate ID

Var	Boys M(SD) n=62	Girls M(SD) n=42	t	p	Cohen's d*	Mild ID M(SD) n=49	Mod ID M(SD) n=55	t	p	Cohen's d*
Inh	67.4 (17.3)	64.6 (18.3)	0.80	.43	0.15	**58.9 (11.6)**	**72.8 (19.6)**	**-4.34**	**<.001**	0.86
Sh	78.6 (22.5)	77.2 (18.4)	0.37	.71	0.06	**67.2 (15.2)**	**87.7 (20.5)**	**-5.75**	**<.001**	1.14
EmC	71.1 (20.3)	67.4 (16.4)	0.99	.32	0.2	**63.1 (15.1)**	**75.3 (20.1)**	**-3.48**	**.001**	0.68
BRI	73.5 (19.5)	71.2 (15.2)	0.68	.50	0.13	**63.9 (12.6)**	**80.3 (18.3)**	**-5.24**	**<.001**	1.04
Int	72.9 (15.9)	68.6 (12.7)	1.48	.14	0.3	**64.2 (13.5)**	**77.4 (13.3)**	**-4.98**	**<.001**	0.98
WM	**77.3 (19.6)**	**69.6 (16.5)**	**2.08**	**.04**	0.42	**65.5 (14.9)**	**82 (18.4)**	**-5.01**	**<.001**	0.98
PO	69.3 (13.8)	64.9 (11.6)	1.67	0.10	0.34	**61.6 (10.9)**	**72.7 (12.7)**	**-4.73**	**<.001**	0.93
Org M	**71 (24.3)**	**61.7 (20.9)**	**2.03**	**.04**	0.41	**57.5 (16.1)**	**75.9 (25.4)**	**-4.35**	**.001**	0.86
Mon	70.9 (16.1)	69.8 (16.9)	0.34	.73	0.06	**62.9 (13.1)**	**77.2 (16.2)**	**-4.87**	**<.001**	0.97
MI	76,5 (17.9)	70.2 (16.2)	1.86	.07	0.4	**64.5 (13.1)**	**82.4 (16.6)**	**-6.03**	**<.001**	1.19
GEC	77.5 (20.4)	71.5 (14.8)	1.64	.10	0.33	**65.3 (13.6)**	**83.7 (18)**	**-5.85**	**<.001**	1.15

Note: Var, variable; M, mean; SD, standard deviation; ID, intellectual disability; Inh, inhibition; Sh, shift; EmC, emotional control; BRI, Behavioral Regulation Index; Int, Initiate; WM, working memory; PO, plan/organize; OrgM, organization of materials; Mon, monitor; MI, metacognition index; GEC, global composite index; * Cohen's d is calculated as Cohen d = M(boys/mild ID) – M(girls/moderate ID)/SD (pooled); bolded results are statistically significant; p < .05

Correlation between PA and EF
After testing the relationship (Pearson correlation coefficient) between PA and BRIEF scales in the whole sample of participants, the authors have found several significant negative correlations presented in Table 3 (see below). Light PA correlated with a shift scale only, while moderate PA and MVPA were in correlation with initiate, working memory and plan/organize scales and MI. Age correlated significantly with shift, MI and GEC, where results indicated worsening EF performance with age increase.

Table 2

Descriptive results and difference between mean PA scores between boys and girls and between children with mild and moderate ID

Var	Boys M (SD) n=62	Girls M (SD) n=42	t	p	Cohen's d*	Mild ID M(SD) n=49	Mod ID M(SD) n=55	t	p	Cohen's d*
LPA	269 (90.5)	248.9 (92.2)	1.10	.27	0.2	**295.5 (90.8)**	**230.1 (80.7)**	**3.89**	**<.001**	0.7
MPA	**30.7 (21)**	**20.9 (15.9)**	**2.54**	**.01**	0.5	**34.3 (20.4)**	**20.2 (16.5)**	**3.86**	**<.001**	0.7
VPA	9.7 (11.2)	7.3 (9.4)	1.18	.24	0.3	**11.4 (11.5)**	**6.5 (9.1)**	**2.41**	**.02**	0.5
MVPA	**42.3 (32.3)**	**27.5 (21.2)**	**2.58**	**.01**	0.5	**47.6 (31)**	**26.6 (23.7)**	**3.86**	**<.001**	0.7

Note: Var, variable; M, mean; SD, standard deviation; ID, intellectual disability; LPA, light physical activity; MPA, moderate physical activity; VPA, vigorous physical activity; MVPA, moderate to vigorous physical activity; * Cohen's d is calculated as Cohen d = M (boys/mild ID) – M(girls/moderate ID)/SD (pooled); bolded results are statistically significant; $p < .05$

Simple Linear Regression – Contribution of PA to EF

Based on Person Correlation coefficient testing and relationships found, Simple linear regression was performed in order to check contribution of different PA levels, age, level of ID and gender as independent variables on all BRIEF scales individually as dependent variables (see Figure 1 on the following page). As can be seen level of ID contributed significantly to all BRIEF scales, age significantly predicted scores of Shift and MI, whereas gender showed influence on the working memory and organization of materials. Moderate PA and MVPA significantly contributed to the scores of MI broad indices, as well as initiate, working memory and plan/organize scales.

Table 3

Pearson correlation coefficient between results of BRIEF scales and PA

Var	Inh	Sh	EmC	BRI	Int	WM	PO	OrgM	Mon	MI	GEC
LA	.049	**-.228***	-.046	-.058	-.163	-.142	-.183	-.079	-.027	-.161	-.118
MA	-.034	-.188	.036	-.066	**-.273****	**-.205***	**-.212***	-.078	-.101	**-.220***	-.156
VA	-.036	-.082	.086	-.014	-.14	-.155	-.137	-.069	-.051	-.158	-.092
MVPA	-.039	-.167	.064	-.052	**-.251***	**-.210***	**-.208***	-.084	-.092	**-.222***	-.148
Age	.036	**.388****	.095	.173	.182	.184	.176	.171	.075	**.227***	**.210***

Note: Var, variable; Inh, inhibition; Sh, shift; EmC, emotional control; BRI, Behavioral Regulation Index; Int, Initiate; WM, working memory; PO, plan/organize; OrgM, organization of materials; Mon, monitor; MI, metacognition index; GEC, global composite index; LPA, light physical activity; MPA, moderate physical activity; VPA, vigorous physical activity; MVPA, moderate to vigorous physical activity; bolded results are statistically significant; * $p < .05$; ** $p < .01$

Discussion

The relationship between PA and EF has been extensively studied among children with typical development, but possible association between these two domains among people with ID has received much more attention in the past decade.

The current study found that moderate PA and MVPA are significant predictors of initiate, working memory, plan/organize BRIEF scales and MI in 7 to 18 years old children with ID. The results supported findings from previous studies on the same topic that PA and movement bring benefits to cognitive development, and moreover, that level or intensity of PA plays important role in those benefits.

Our results are in line with study of Van Der Fels et al. (2015) among children of typical development that showed a strong connection between the motor skills development and EF (composite score of planning). Furthermore, our study is in line with studies showing positive relationship between planning and motor skills among children with ID (Hartman, Houwen, Scherder, & Visscher, 2010) and pervasive developmental disorder (Schurink, Hartman, Scherder, Houwen, & Visscher, 2012). Even though our study is not on motor skills specifically, it is already evidenced that children with ID have delays in motor development (Lloyd, MacDonald, & Lord, 2014) and that the motor skills (running, catching, throwing, etc.) are the foundation of later regular participation in PA and empirically proven to have positive impact on PA (Lubans, Morgan, Cliff, Barnett, & Okely, 2010).

The results of our study conflicted with those found by Van Der Fels et al. (2015) who found positive significant relationship between motor skills development and cognitive flexibility (shift). The similar was reported by Hartman et al. (2017) among children with ID who found positive significant relationship between skill related fitness (coordination and agility) and inhibition and cognitive flexibility (shift), but no significant associations were found with working memory and planning, which was completely opposite comparing to our study. The authors could assume that the reason why the authors have not found any significant relationship between PA and inhibition and cognitive flexibility is because activities of children participating in our study were mostly a sheer aerobic type such as walking and running, without engagement of cognitive side. In addition to this, studies have already shown that cognitive tasks put more requirement on inhibition (Rubia, Smith, Taylor, & Brammer, 2007) and cognitive flexibility (Specht, Lie, Shah, & Fink, 2009).

Level of ID was significant predictor for all BRIEF scales and 3 broad BRIEF indices. It was found that greater impairment of EF was followed by greater severity of ID. The findings are in line with earlier studies that have shown EF deficits among children with ID (Hartman et al., 2010; Memisevic & Sinanovic, 2014). Our study additionally supported general findings that working memory, shift and initiate scales are showing greatest impairments among children with ID (Memisevic & Sinanovic, 2014), which further proved validity of BRIEF as an instrument for assessment of EF.

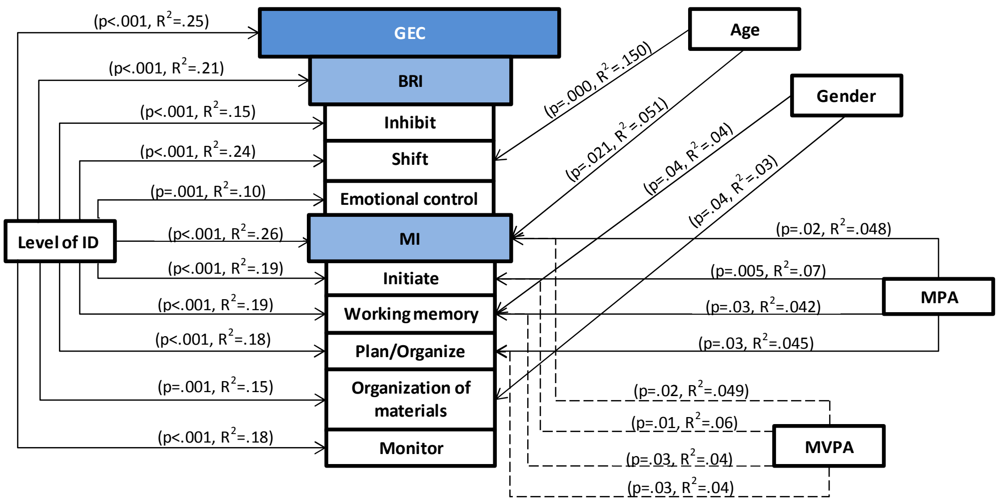

Figure 1. Simple linear regression showing contribution of PA, ID, age and gender to all BRIEF scales and 3 broad indices. ID= intellectual disability; BRI= Behavioral Regulation Index; MI= metacognition index; GEC= global composite index; MPA= moderate physical activity; MVPA= moderate to vigorous physical activity; $p < .05$

In relation to child's age, a positive significant correlation was found between age and shift scale and MI. It was found that with the increase of age, the scores of both domains of EF are increasing as well, or the dysfunction is bigger. These results are in agreement with study of Rosenthal et al. (2013) who found impairment in EF with increasing age among children with autism spectrum disorder using BRIEF (parent report) also, driven by MI scales (initiate, working memory and organization of materials). However, general agreement in the literature is that EF (mainly cognitive flexibility, working memory and inhibition) are improving from childhood to adulthood among people with typical development (Jacobsen, de Mello, Kochhann, & Fonseca, 2017) as well as among people with ID (Hartman et al., 2017). A potential reason why the same trend has not been found in our study is because in the group of older children (15–18 years of age), there were mostly children with moderate ID (more than 60 per cent) whose EF's were significantly more impaired in comparison with children with mild ID.

Considering results of gender effects, the authors have found a significant difference between mean scores of boys and girls in working memory and organization of materials scale in favor to girls. Our results conflict with study that also used BRIEF for EF assessment among children with ID where no differences were found between boys and girls in any of BRIEF scales (Memisevic & Sinanovic, 2014). In study of preterm-born children, Marlow et al. (2007) found out that girls outperformed boys in tests of EF. Also in some studies with children of typical development, it was found that girls achieved better results than boys in inhibition and verbal fluency (Ardila, Rosselli, Matute, & Guajardo, 2005). Unfortunately, the authors of the present paper have not found more similar studies among children with ID to further comment, so definitely more research is needed in this area.

The strength of our study lies in a relatively good sample of participants for population of children with ID in B&H and in a fact that this is, to our knowledge, the first study of this type conducted in B&H. There are few limitations in our study – there is a possible influence of additional variables to EF such as socioeconomic status of children (parental education, income level, etc.) that has not been included in the study. Additionally, there are some limitations for BRIEF related to objectivity and inter-rater reliability because different teachers might perceive certain behaviors differently. In order to avoid this, the authors provided teachers with clear instructions and also monitored data collection by checking potential concerns about completion of the BRIEF via e mail and phone. Limitation to PA is that norms for different PA levels are based on children of typical development so the authors cannot be sure it reflects reality among children with ID.

Conclusion

There is a relationship between shift, working memory, initiate, plan/organize BRIEF scales, MI and PA (moderate PA and MVPA) among 7- to 18-year-old children with ID. In order to determine how these two domains influence each other, the future research may focus on discovering what type of PA is beneficial for what type of EF; what kind of PA/exercise intervention, frequency and its duration is sufficient, and for what age and type of ID; and what assessment methods and research approaches would be the best to determine relationship between PA and EF. Given the importance of EF for children with ID and emerging evidence that these skills can be improved by PA/exercise, they deserve much greater attention in design of early care and educational programs.

Conflict of interest: The authors do not have conflict of interest to declare.

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