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Research Article

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Effects of Active School Transportation on Physical Fitness of Congolese Intellectual Disabilities Adolescents

Mabounda Kounga Paul Roger[1], Boussana Alain Marc[2], Agbodjogbé Wilfrid Kpèdétin Dieu-Donné[3]

[1]Laboratory of Education, Health, Expertise and Motor Performance (ESEPM), High Institute of Physical Education and Sports, Marien Ngouabi University, Brazzaville, Republic of Congo; [2]Laboratory of Education, Health, Expertise and Motor Performance (ESEPM), High Institute of Physical Education and Sports, Marien Ngouabi University, Brazzaville, Republic of Congo; [3]Motor skills, performance and sport health laboratory (LAMOP-2S) of the National Institute of Youth, Physical Education and Sport (INJEPS) of Porto-Novo/Bénin.

ABSTRACT

Introduction: Adolescents with intellectual disabilities (ID) tend to have poorer physical fitness than their typically developing peers. Active transport provides substantial health benefits from increased physical activity. But few is known on the Congolese normal-weight and overweight with intellectual disabilities.

Aim/Objectives: This study aimed to evaluate the effect of active school-home transportation on the physical fitness of Congolese adolescents with intellectual disability disorder.

Methods: A total of 28 adolescents with mild and moderate intellectual disability, were divided into normal-weight with intellectual disabilities (NWID, n = 18, age) and overweight with intellectual disabilities (OWID, n = 10, age). Their physical fitness parameters were assessed at three periods: on April-June 2023 (T0), October-November (T1) and December 2023 (T2). The active transportation (walking) and period of rest effects on adolescent's physical fitness were assessed on T0/ T2 and T1 respectively. Physical fitness parameters were related to movement functionality (the test of balance) and health-related condition (waist circumference, 6-minute walk tests, push-up and sit-stand tests).

Results: Waist circumference was significantly lowers (all $p < 0.05$) among NWID and OWID at T0 and T2 periods than on the T1 period. NWID scored significantly higher in flexibility, balance, push-up, 6MWT and VO2max (all $p < 0.01$) tests than OWID whereas OWID improve better the flexibility at the third period ($p > 0.05$). Compared to the second period, NWID scored significantly higher in the T0 period for balance, push-up and VO2max (all $p < 0.05$) and scored significantly higher in the T2 period for flexibility, balance, distance travel, push-up and VO2max (all $p < 0.05$).

Conclusion: Active transportation widely improved functionality and health related parameters of normal weight Congolese intellectual disabilities adolescents. School time periods exerted more effects on balance, flexibility, distance traveled, and cardiorespiratory fitness than the holyday on both normal weight and overweight groups.

Key Words: Physical fitness, Active school transportation, Intellectual disability, Congolese, Adolescents, Health

INTRODUCTION

The history of social, physical and mental disability is a long tragedy. Since ancient times, being born with a disability was unaccepted in society.[1,2] Those affected were killed or were synonymous with total discrimination within their families.[1,2,3] This ostracism bas been more dramatic in the case of people with mental disabilities due to the direct alteration of man's most precious instrument: intelligence (1). Mental disability includes psychological disability (pathologies) and intellectual disability. The latter, known as intellectual disability (ID) or "mental retardation", is a disability characterized by significant limitations in intellectual functioning and adaptive behavior, affecting a wide range of social and

Corresponding Author:
Mabounda Kounga Paul Roger, Laboratory of Education, Health, Expertise and Motor Performance (ESEPM), High Institute of Physical Education and Sports, Marien Ngouabi University, Brazzaville, Republic of Congo.

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practical everyday skills, and manifesting itself before the age of 18.[3] People with intellectual disability (ID) experience stigma, discredit and social isolation associated with feelings of shame, guilt and inferiority, which have a significant impact on their lives. As a result, they resist engaging in physical activity, exacerbating their disability and decreasing their fitness.[4]

Physical fitness is a set of attributes or abilities that a person possesses or can acquire to perform his or her daily physical activities in a healthy manner.[5] Theses determinants include factors related to the functionality of movements, such as balance, speed, strength, reaction speed and coordination. Other parameters are generally related to health, such as cardiorespiratory fitness, muscular strength, flexibility and body composition.[6-8] They are improved by the regular practice of physical activity.[9] The latter is related to work, home, leisure and transport.[10]

Transport physical activity is walking or cycling for all or part of a journey to any destination. Also known as active transport, it is a low-cost form of physical activity that can reduce both vehicle gas emissions and cardio-respiratory diseases.[11,12] Its impacts on improving the fitness of people with ID are of increasing interest.[4] Active school transportation has been shown to improve the fitness of ID subjects through the optimization of functional abilities such as sitting and getting up from a chair, moving faster and changing direction, from distance traveled to the six-minute walk test.[7,13,14] In the Republic of Congo, the daily lives of people with ID are not free from stigma and their notable absence from the practice of regular physical activity is very noticeable. Although the effects of active school transportation on their physical fitness are studied elsewhere,[9,11,12,14] these results should in no case be extrapolated to Congolese DI subjects due to the different social context. Therefore, this study aims to evaluate the effects of active school transportation on the physical fitness of Congolese ID.

MATERIAL AND METHODS

Study design

The comparison between groups was performed using several field fitness tests, recognized as relevant for ID subjects.[7,10,16,17] The performances achieved during these tests were considered as determinants of physical fitness in adolescence. The physical fitness assessment was carried out in April-June 2023 (T0), on October-November (T1) and on December 2023 (T2). The active transportation (walking) and period of rest effects on adolescent's physical fitness were assessed on T0/ T2 and T1 respectively. All testing procedures were performed by the same assessors. All ID subjects were familiarized with the procedures for conducting each test. The testing session took place between 09:00 and 11:00 h. The sessions started with the measurement of weight (body mass), height and waist circumference. All physical fitness tests were performed on a natural grass football field and the athletic track. The tests started after a standardized 15-minute warm-up.

Participants

The current follows up and descriptive study was conducted among adolescents. The study was conducted in government special schools of Brazzaville (Republic of Congo), among school-going adolescents aged 14 to 18 years old with intellectual disabilities. The study enrolled a total of 28 adolescents with intellectual disabilities (16 girls and 12 boys) selected by using a reasoned choice method from a group of 35 mild to moderately intellectually disabled people. They were divided into two groups: (i) the normal weight adolescents with intellectual disabilities group (NWID, n = 18) and (ii) overweight adolescents with intellectual disabilities group (OWID, n = 10).

They were included according to the following criteria: (1) being diagnosed with intellectual disability according to the Diagnostic and Statistical Manual of Mental Disorders - 5th edition;[15] (2) being adolescent (aged 14 to 18 years); (3) reside in Brazzaville, Republic of Congo; (4) use active transport (walking, cycling) between school and home. Exclusion criteria were: 1. using passive transportation (car, motorcycle) between homeschooling; 2. Individuals who cannot commit themselves for 1 year; 3. Individuals with other associated pathologies; 4. Contraindications to physical exercise; 5. Inability to walk unaided; 6. Profound intellectual disabilities disorder; 7. Inability to communicate; 8. Non-delivery of signed informed consent or assent letter.

The scientific committee of the Higher Institute of Physical Education and Sports (ISEPS) of Marien NGOUABI University approved the study design. Written informed consent was obtained from all parents after verbal and written explanation of the experimental design and potential risks of the study. The participants themselves also gave their consent to participate in accordance with the requirements of the Declaration of Helsinki of 2013. We also received formal approval from the authorities of the special school "Dix Maisons". To ensure the confidentiality of the respondents, all data were anonymized before analysis.

Data collection

Participants' age, gender, and comorbidities (including autism and epilepsy) were collected with the help of the physical education and sports teacher. Height (m) was measured with a Stanley somatometer; waist circumference (cm) was measured with a non-stretchable tape measure (Meterex type), horizontally halfway between the last rib and the top of the iliac crest; body weight (Kg) was measured using a personal scale (personal scale, model: 2003A, China); body mass index (Kg/m^2) was calculated based on weight and height. Normal-weight and overweight status were defined based on international age- and sex-specific BMI thresholds.[18]

Flexibility test

Particularly hamstring extensibility, was assessed with the Sit-and-reach (S&R) test.[19,20] After a warm-up, flexion-extension was performed using a specially designed box with a centimeter scale. The participant was asked to sit with the legs straight and to extend the hands as far forward as possible. The highest value was recorded for later analysis.

Balance test

It was measured using the Single-Leg Standing test [21], where participants were asked to flex the contralateral knee to 90° and stand on a supporting leg. A longer duration was recorded, indicating better balance performance.

Push-up test

Upper body muscular strength and endurance were assessed with the 90-degree.[22] Boys and girls used a starting position with their hands and knees touching the floor. The participant lowers his body until there is a 90-degree angle in the elbows (with the upper arms parallel to the floor). The final score is the number of push-ups correctly performed in 60 seconds.

Six-minute walk test

Functional exercise capacity and cardiovascular endurance were assessed with the 6-minute walk test or 6MWT. [23,24] Each participant independently walks 30 m in a corridor back and forth to cover the greatest possible distance in 6 min, with standardized encouragement. [24] The number of meters covered was recorded. Subsequently, cardiovascular endurance was estimated using the following formula: VO_2max (ml/kg/min) = 26.9 + 0.014 × 6MWT distance (m) – 0.38 × BMI (kg/m^2). [25]

Statistical analysis

All statistical data were processed using SPSS version 25 software (SPSS Inc., Chicago, IL, United States). Three steps were followed to analyze the data. The first step uses descriptive statistics to present continuous data as mean and standard deviation. In the second step, the Shapiro-Wilk test determined the normality distribution, and the Levene test assessed variance homogeneity. Since the heart rates showed non parametric characteristics, Mann-Whitney U test was used. In the third step, the percentages of students having achieved or not the MVPA intensity were compared with the Chi-square test. Statistical significance was determined using a p-value < 0.05.

RESULTS

Of the participants (Table 1), 18 were in the NWID group, and 10 were in the OWID group; 12 were males, and 16 were females. The mean age of the participants was 15.71 ± 0.01 years (15.30 ± 1.89 years in NWID group and 15.08 ± 0.63 years in OWID group. No age difference between the groups was observed ($p = 0.534$). The mean and standard deviation were 57.61 ± 0.44 kg, 1.61 ± 0.02 m, 22.30 ± 0.11 kg/ m^2, 113.30 ± 2.02 mm Hg, 67.42 ± 4.28 mm Hg, 82.90 ± 0.88 bpm, 3.05 ± 1.37 cm, 29.47 ± 4.27 seconds; 6.07 ± 2.50 times; 530.40 ± 7.41 m and 25.85 ± 0.14 ml/kg/min respectively for body mass, height, body mass index, SBP, DBP, HR rest, flexibility, balance, push up, distance traveled and maximum oxygen intake of the participants.

Weight was significantly better (all $p < 0.05$) among NWID and OWID at T0 and T2 periods than T1 period (Fig 1). No Weight difference between the T0 and T1 periods were observed ($p > 0.05$).

Waist circumference (WC) was significantly lower (all $p < 0.05$) among NWID and OWID at T0 and T2 periods than on the T1 period (Fig 2). No Weight and WC difference were observed between the T0 and T1 periods ($p > 0.05$).

NWID scored significantly higher in flexibility, balance, push-up, 6MWT and VO_2max (all $p < 0.01$) tests than OWID (Table 2) whereas OWID improve better the flexibility at the third period ($p > 0.05$).

Compared to the second period (Table 3), NWID scored significantly higher in the first period for balance, push-up and VO_2max (all $p < 0.05$) and scored significantly higher in the third period for flexibility, balance, distance travel, push-up and VO_2max (all $p < 0.05$). Compared to the third period, balance, distance traveled and push-up were significantly higher in the first period (all $p < 0.05$).

Compared to the second period (Table 4), OWID scored significantly higher in the first period for balance and distance traveled (all $p < 0.05$) and scored significantly higher in the third period for flexibility, balance, distance traveled and push-up (all $p < 0.05$). Compared to the first period, flexibility, balance, distance traveled and push-up were significantly higher in the third period (all $p < 0.05$).

DISCUSSION

The aim of this work was to evaluate the effects of active transport on the physical fitness of Congolese adolescents living with intellectual disabilities during two school periods and one holiday period. We observed that active school transportation improved flexibility, balance, muscular endurance and to some extent functional and physiological capacities. This improvement was more pronounced in NWID.

Regarding overall physical fitness, we observed significant improvements during the use of active school transportation compared to the rest period. Similarly, this general physical fitness was much improved in NWID than in OWID during the use of active school transportation. This result is consistent with the statements reporting that multimodal exercises are more effective in understanding the improvement of physical fitness in people with ID than monomodal exercises. [3,26] The benefit of active school transportation on the parameter related to movement functionality (balance) shows a significant improvement in NWID subjects. This specific exercise program could reduce the risk of falling by stimulating reaction time, cognitive performance, sensory stimulation and social interaction and would contribute to the improvement of neuroplasticity. [27,28] Active school transportation resulted in significant improvements in balance in the NWID and OWID. This result is consistent with previous studies that reported a significant improvement in balance after an intervention. [22,29,30] However, active school transportation did not improve balance in the OWID subjects. The lack of improvement in balance is probably related to the level of excess weight and the lack of opportunity to be physically active. Being physically inactive for long periods of time probably developed muscle weakness in these OWID subjects, which affected their balance. [31]

Furthermore, the health benefits of active school transportation in ID subjects (muscle strength, flexibility, and distance covered at 6MWT) also show the significant improvement in NWID subjects. This result is in agreement with previous studies which have shown that targeted exercise program have a significant effect on the physical state of ID. [14] Regarding body composition, Fig. 1 shows that adiposity (BMI and waist circumference) increased significantly during the period without active school transportation ($p < 0.001$ and $p < 0.001$, respectively). This result is consistent with that of many authors [32-35] and can be explained by the fact that these adolescents were less physically active by staying at home. It can also be explained by the nature of multidimensional deficiencies and a lack of information on appropriate exercise modalities. [32,35] This lack of physical exercise exposes them to the risk of exacerbating overweight and obesity. The increase in adiposity in our sample is further explained by the fact that these adolescents had not practiced sufficient physical activity to mobilize their body fat in general and their abdominal fat in particular. Thus, more effective options for practicing regular physical activity that would be particularly suitable for this special group should be further explored. [8]

Regarding muscle strength, we observed that active school transportation significantly improved it in NWID. This improvement in the lumbar extensor muscles probably, helped to perform activities of daily living. [36] Similarly, the baseline distance covered in the 6MWT test was significantly higher in NWID compared to others. The higher baseline performance could be attributed to the encouragement of the research team to the participants as well as to a lower baseline BMI. [37] The improvement in distance walked on the 6MWT in NWID may be due to muscle strengthening. [37]

The improved performance in NWID subjects could be explained by the effects of active school transportation on increasing the expression of neurotrophic factors (BDNF), increasing serotonin and norepinephrine, regulating HPA axis activity, and decreasing systemic inflammatory signaling. [38] However, in OWID, cognitive dysfunction led to greater impairment in activities of daily living and decreased the possibilities for optimal rehabilitation and physical abilities requiring following instructions. [31] In addition, the fact that their balance (an indicator of a person's ability to walk) was impaired made it even more difficult to turn and accelerate at each turn during the 6MWT test. [31] This poor performance of OWID in the 6MWT test could be attributed to their poor walking ability. [39]

CONCLUSION

Active school transportation like moderate-to-vigorous physical activity, improves physical fitness in adolescents with ID. These investigators reported that, active transportation between school and home widely improved functionality of movements (balance, flexibility, distance traveled) and health related parameters (cardiorespiratory fitness, muscular endurance and body composition) of normal weight Congolese intellectual disabilities adolescents. Furthermore, this study discovered that compared to holyday effects (T1), school time periods (T0 and T2) exerted more effects on balance, flexibility, distance traveled, and cardiorespiratory fitness in normal weight Congolese intellectual disabilities group. In overweight Congolese intellectual disabilities group, school time periods (T0 and T2) exerted more effects on balance, flexibility, distance traveled, cardiorespiratory fitness.

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Conflict of Interest

The authors declare no conflict of interest.

Authors' Contribution:

Author name	Contributions
Mabounda Kounga	Study design, methodology, formal analysis, manuscript preparation
Boussana Alain	Study design, editing, manuscript preparation
Agbodjogbé Wilfrid Kpèdétin Dieu-Donné	formal analysis, editing, manuscript preparation

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Table 1: Characteristics of Congolese adolescents in a situation of ID

	Mean ± SD	95 % IC
Groups NWID/ OWID	18/ 10	
Gender Boys/ Girls	12/ 16	
Age (year)	15.71 ± 0.01	15.70-15.72
Body mass (kg)	57.61 ± 0.44	57.47-57.75
Height (m)	1.61 ± 0.02	1.60-1.62
Body mass index (kg/ m²)	22.30 ± 0.11	22.26-22.33
SBP (mm Hg)	113.30 ± 2.02	112.67-113.93
DBP (mm Hg)	67.42 ± 4.28	66.30-68.76
HR rest (bpm)	82.90 ± 0.88	82.62-83.17
Flexibility (cm)	3.05 ± 1.37	2.62-3.48
Balance (seconds)	29.47 ± 4.27	28.14-30.80
Push up (times)	6.07 ± 2.50	5.29-6.85
Distance traveled (m)	530.40 ± 7.41	528.09-532.71
VO_2max (ml/kg/min)	25.85 ± 0.14	25.80-25.89

Note: SD: Standard Deviation; NWID: normal weight intellectual disability; OWID: overweight intellectual disability; SBP: Systolic blood pressure; DBP: Diastolic blood pressure; HR rest: Heart rate at rest; bpm: beats per minute; VO_2max: maximum oxygen intake.

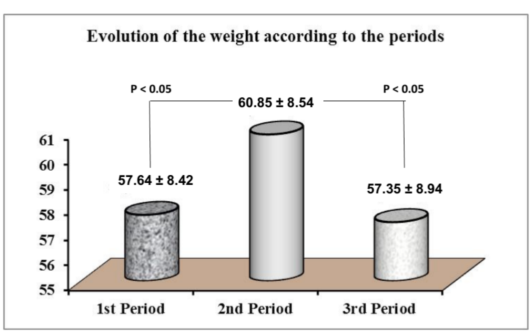

Figure 1: Evolution of weight according to school and rest periods.

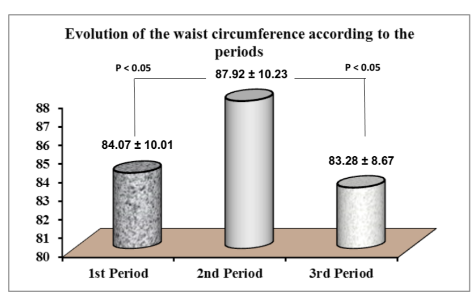

Figure 2: Evolution of waist circumference according to school and rest periods.

Table 2: Comparison of fitness parameters of ID subjects according to group

	Groups		p-value
	NWID (n = 18)	OWID (n = 10)	
1st period			
Flexibility (cm)	18.06**	8.10	0.001
Balance (seconds)	19.50***	8.10	0.000
Push up (times)	19.50***	5.50	0.000
Distance traveled (m)	19.50***	5.50	0.000
VO_2max (ml/kg/min)	19.33***	5.80	0.000
2nd period			
Flexibility (cm)	16.67***	7.00	0.000
Balance (seconds)	19.50***	5.50	0.000
Push up (times)	19.50***	5.50	0.000
Distance traveled (m)	19.50***	5.50	0.000
VO_2max (ml/kg/min)	18.67***	7.00	0.000
3rd period			
Flexibility (cm)	16.06	11.70	0.191
Balance (seconds)	19.50***	5.50	0.000
Push up (times)	19.50***	5.50	0.000
Distance traveled (m)	19.50***	5.50	0.000
VO_2max (ml/kg/min)	17.72**	8.70	0.004

Note: ID: intellectual disability; NWID: Normal weight with intellectual disability; OWID: Over weight with intellectual disability; P1: first period of evaluation; P2: second period and P3: third period. First and third periods are used to test school time effects; second period is used to test holyday effects; p-value: Difference between NWID and OWID ($p < 0.05$).
** $p < 0.001$
*** $p < 0.000$

Table 3: Comparison of fitness parameters among NWID group according to periods

	Flexibility	Balance	Distance	Push up	VO2max
Chi-square	6.230	46.010	16.449	43.766	9.645
ddl	2	2	2	2	2
p-value	0.044	0.000	0.000	0.000	0.008
1st vs **2nd period**					
Mean rank	21.39 *vs* 15.61	26.72* *vs* 10.28	25.42* *vs* 11.58	10.75 *vs* 28.25*	24.11* *vs* 12.89
p-value	0.104	**0.000**	**0.000**	**0.000**	**0.001**
1st vs **3rd period**					
Mean rank	17.83 *vs* 19.17	27.50* *vs* 9.50	22.97* *vs* 14.03	27.50* *vs* 9.50	20.75 *vs* 16.25
p-value	0.719	**0.000**	**0.010**	**0.000**	0.203
2nd vs **3rd period**					
Mean rank	14.28 *vs* 22.72*	9.50 *vs* 27.50*	16.31 *vs* 20.69	9.92 *vs* 27.08*	16.19 *vs* 20.81
p-value	**0.016**	**0.000**	0.214	**0.000**	0.192

Note: First and third periods are used to test school time effects; second period is used to test holyday effects.
** $p < 0.001$
*** $p < 0.000$

Table 4: Comparison of fitness parameters among OWID group according to periods

** p < 0.000

	Flexibility	Balance	Distance	Push up	VO2max
Chi-square	16.609	26.156	26.227	20.333	2.229
ddl	2	2	2	2	2
p-value	0.000	0.000	0.000	0.000	0.328
1st vs **2nd period**					
Mean rank	11.90 *vs* 9.10	15.50* *vs* 5.50	15.50* *vs* 5.50	9.25 *vs* 11.75	9.15 *vs* 11.85
p-value	0.315	**0.000**	**0.000**	0.353	0.315
1st vs **3rd period**					
Mean rank	6.60 *vs* 14.40*	5.50 *vs* 15.50*	15.50* *vs* 5.50	5.50 *vs* 15.50*	8.75 *vs* 12.25
p-value	**0.002**	**0.000**	**0.000**	**0.000**	0.190
2nd vs **3rd period**					
Mean rank	5.75 *vs* 15.25*	5.50 *vs* 15.50*	5.50 *vs* 15.50*	5.50 *vs* 15.50*	9.80 *vs* 11.20
p-value	**0.000**	**0.000**	**0.000**	**0.000**	0.577

Note: First and third periods are used to test school time effects; second period is used to test holyday effects.
** p < 0.001