Co-funded by the
Erasmus+ Programme
of the European Union

IKONS

Inclusive karate: a new perspective to decrease sedentary lifestyle and increase self-confidence in Down Syndrome

G.A. 2018-2512

Report of WP 4.1

Pilot action to validate and test the effectiveness of inclusive Karate training in DS individuals: Longitudinal Study (M3- M29)

Introduction.

In the following pages, a brief report for the results of the pilot action of the IKONS project (WP4).

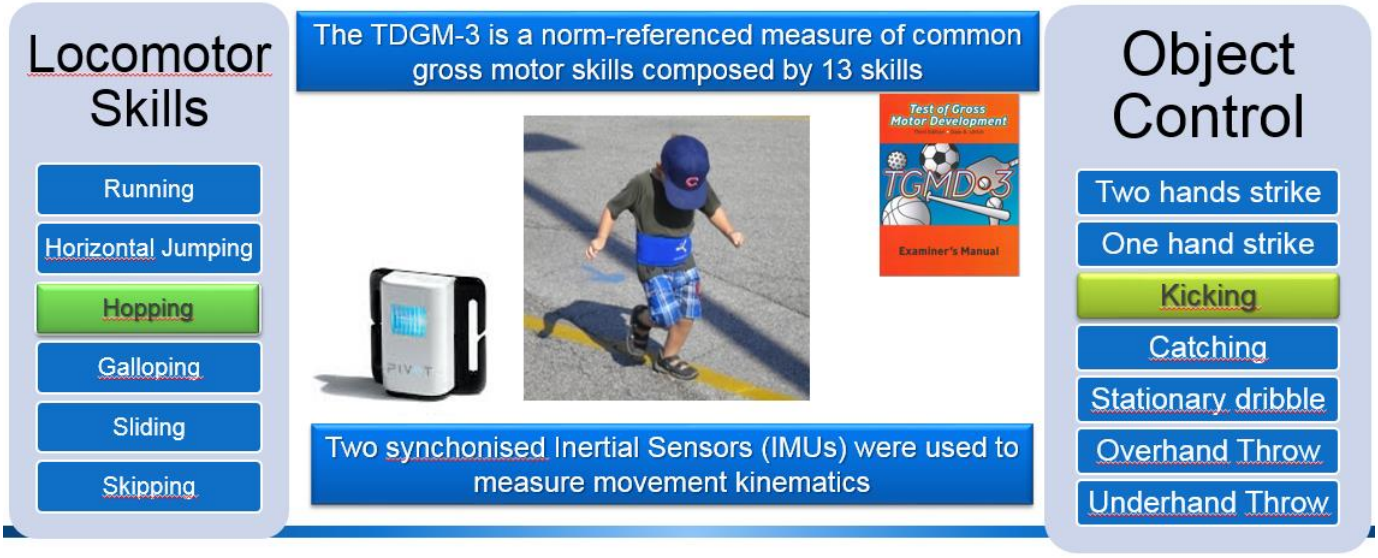
We also report the results of a preliminary (pre training) assessment specifically directed to assess differences between a part of the 60 IKONS Down Syndrome (DS)individuals and a group of individuals with Typical Development (TD).

To sum up, we will report here the results obtained for the Physical Tests (chapter 1), for the parents' questionnaire (chapter 2), for physical activity questionnaires (chapter 3) and for the physical activity monitor (chapter 4) will be presented.

CHAPTER 1 – Physical Tests

Chapter 1a. Pre-Training assessment Results - HOPPING

Before undergoing the 40 weeks of training, DS IKONS participants were assessed using the performance criteria of the test for gross motor development (TGMD-3).



The attention was specifically directed to the abilities of HOPPING and KICKING as these abilities are largely impaired in DS individuals.

Although this was not originally included in the IKONS project's outline, we decided to compare the results obtained for these two abilities in a limited group of DS individuals (N=24) with a group of Typically Developed (TD) individuals (N=21).

As far as hopping ability is concerned, a kinematics assessment was as well performed.

Namely, Center of mass and dominant leg kinematics during hopping over distance were recorded using two inertial measurement units positioned on the posterior aspect of the lower back and on the lateral malleolus of the hopping leg. From linear acceleration and angular velocity signals, hopping frequency (HF), cycle, stance and flight duration (CD, SD, FD), vertical stiffness (K_V) and peak to peak linear acceleration and angular velocities about the cranio-caudal, antero-posterior and medio-lateral axes were extracted.

Results

The qualitative assessment highlighted a poorer hopping performance in the DS group compared to the TD group. DS participants showed higher Hopping Frequency (HF) and KV (Vertical Stiffness), shorter CD, SD, FD and lower angular velocity about the cranio-caudal axis compared to the TD group. (Figure 2, 3, 4 and 5).

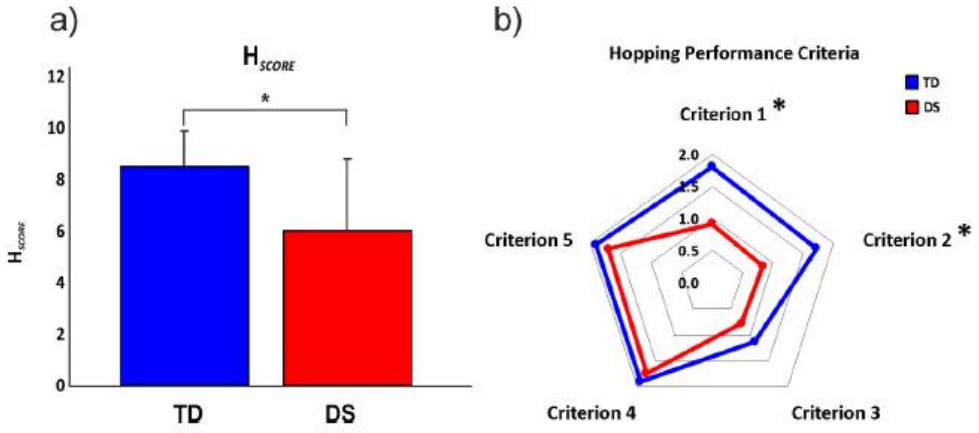


Fig. 2. a) Total hopping score obtained using the performance criteria of theTGMD-3 (H_{SCORE}). b) Individual performance criteria score – Criterion 1: Non-support leg swings forward in pendular fashion to produce force; Criterion 2: Foot of the non-support leg remains behind the body; Criterion 3: Arms are flexed and swings forward to produce force; Criterion 4: Takes off and lands three consecutive times on the preferred foot; Criterion 5: Takes off and lands three consecutive times on the non-preferred foot.

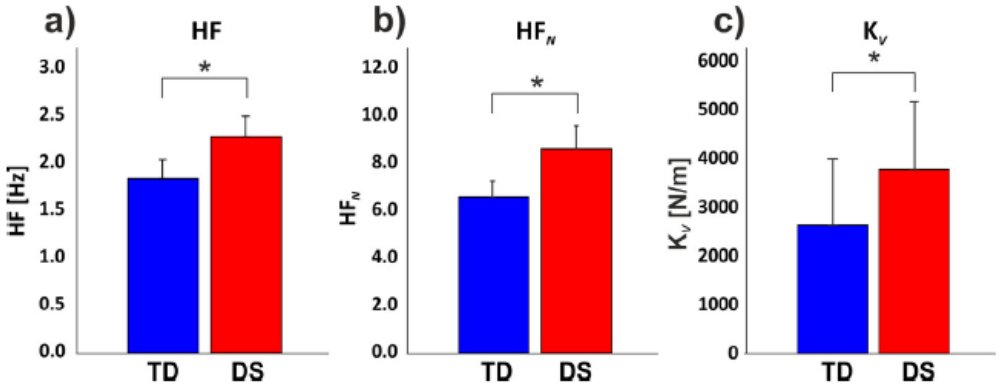


Fig. 3. a) Hopping frequency (HF) and b) normalized hopping frequency (HF_N) for DS (red columns) and TD individuals (blue columns).c) Vertical stiffness (K_V) reported for DS (red) and TD (blue) individuals during the hopping skill. *Denotes significant differences between the two groups. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

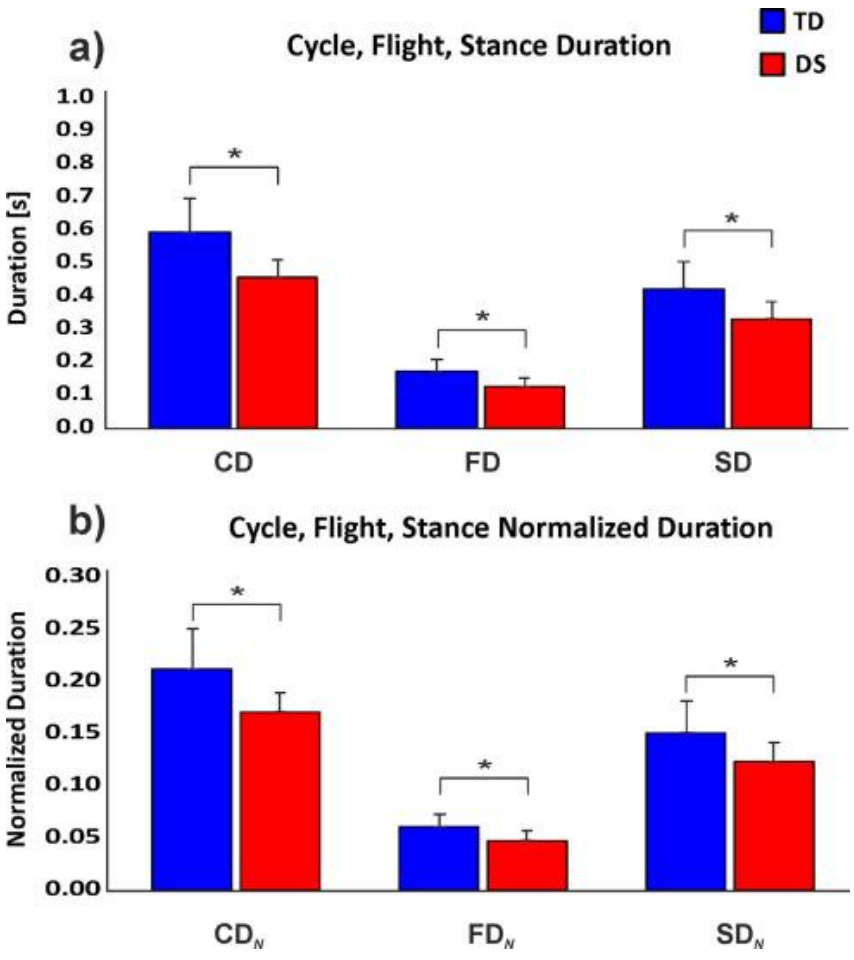


Fig. 4 a) Cycle (CD), Flight (FD) and Stance duration (SD) and b) normalized Cycle (CD_N), Flight (FD_N) and Stance duration (SD_N) for DS (red) and TD (blue) individuals. *Denotes significant differences between the two groups. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

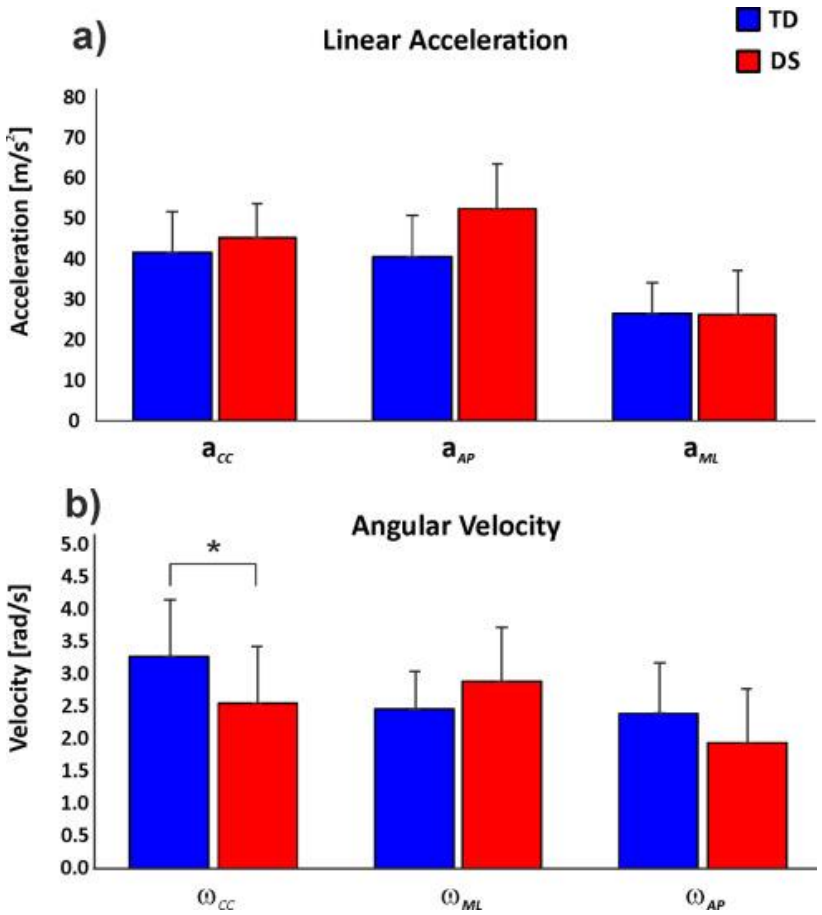


Fig. 5 a) Peak to peak linear acceleration on the cranio-caudal (a_{CC}), medio-lateral (a_{ML}) and antero-posterior (a_{AP}) axes reported for DS (red) and TD (blue) individuals b) Peak to peak angular velocity on the cranio-caudal (ω_{CC}), medio-lateral (ω_{ML}) and antero-posterior (ω_{AP}) axes reported for DS (red) and TD (blue) individuals. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Discussion

The poorer motor competence in hopping in individuals with DS compared to TD peers may be related to the shorter flight time and higher vertical stiffness observed in TD peers. The adopted instrumental approach, overcoming the limitations of subjective evaluations, represents a promising opportunity to quantify motor competence in hopping.

Highlights

- Adults with DS show lower motor competence in hopping compared to controls.
- Hopping frequency and vertical stiffness are higher in adults with Down Syndrome.
- Their lower motor competence is associated with shorter flight and stance duration.
- Hopping frequency can be used to predict motor competence in hopping adults.

Chapter 1a. REFERENCES

1. Quinzi, F., Camomilla, V., Bratta, C., Piacentini, M. F., Sbriccoli, P., Vannozzi, G.. **Hopping skill in individuals with Down syndrome: a qualitative and quantitative assessment**. *Human Movement Science* 78 (2021) ISSN: 0167-9457 Online ISSN: 1872-7646.
2. Quinzi, F., Sbriccoli, P., Camomilla, V., Piacentini, M. F., Vannozzi, G. **Assessing kicking motor competence in individuals with Down's syndrome through wearable motion sensors**. *J Intellect Disabil 2021, under review*
3. Sbriccoli, P., Camomilla, V., Vannozzi, G., Piacentini, M.F., Wynn, A., Bratta, C., Quinzi, F. **Gross Motor Functions Assessed Through The TGMD-3 In Down Syndrome Individuals And Related Gender Differences**. ACSM 2020 virtual meeting.

Chapter 1b. Pre-Training assessment Results - KICKING

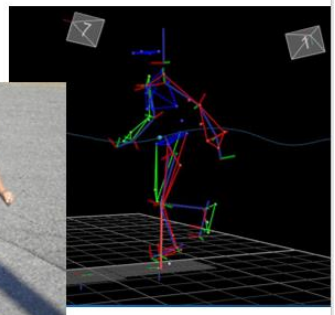
The following figures report the main results obtained as regards the Kicking ability ac compared between DS and TD individuals before the intervention through 40 weeks of specific adapted karate training.

Assessment

There is the need to investigate proficiency in motor skills through a developmental perspective, focusing on kicking quality performance within organized youth sports contexts and not only with exclusive reference to school.

Butterfield et al, 2012

How is it assessed?



The example of kicking

In individuals with DS (IDS), kicking competence has been mainly investigated in children using qualitative evaluations.

A general lower proficiency in kicking is shown compared to individuals with typical development (ITD).

Capio et al, 2018

What does biomechanics tell us?

ITD skilled kickers:
- exploit hip ROM about the ML axis of the body;
- quickly change pelvis orientation about ML and CC axes before ball contact.

In IDS kickers, arm and trunk actions do not evolve into a mature form passing from childhood to adolescence.

Materials and Methods

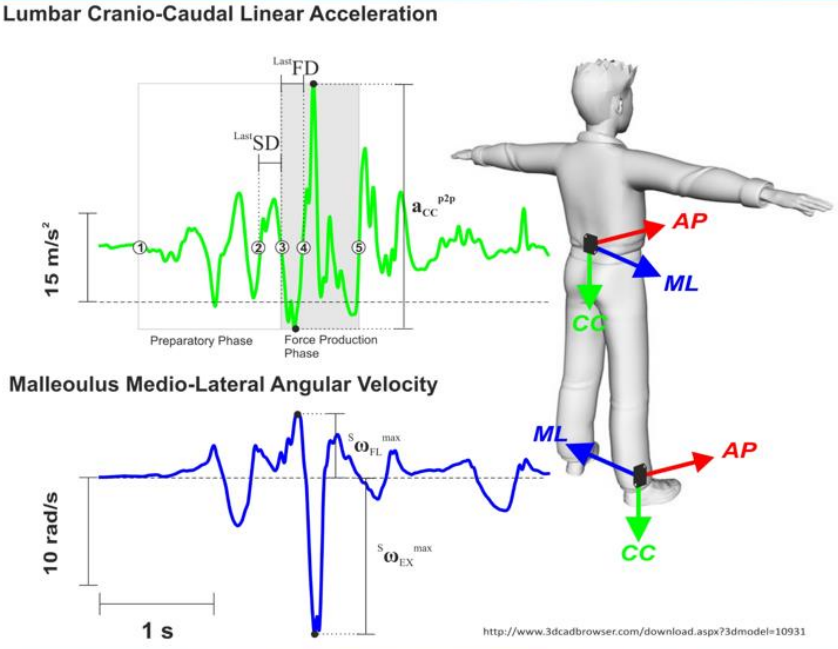
1° goal: identify a set of biomechanical parameters useful to highlight differences in motor competence

Quinzi et al, 2021, Human Mov Sci
Quinzi et al, J Intellect Disabil, submitted

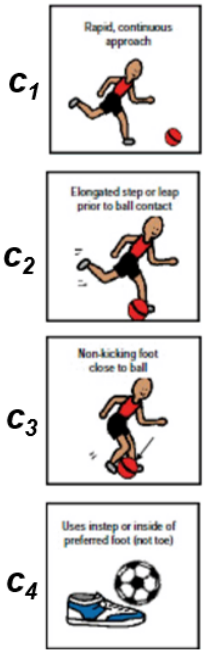
	ITD *(n = 21; 11 F)*	**IDS** *(n = 23; 8 F)*	*T-value*	*p-value*
Age [years]	*24.3±2.1*	*24.3±4.9*	*-0.05*	*0.95*
Mass [kg]	*63.9±11.6*	*60.4±11.9*	*0.98*	*0.32*
Stature [m]*	*1.66±0.06*	*1.54±0.09*	*5.02*	*<0.001*
BMI [kg/m²]*	*23.2±3.6*	*25.5±3.8*	*-2.07*	*0.044*
IPAQ [Met]*	*4026.2±3487.8*	*1309.2±1050.0*	*3.56*	*<0.001*

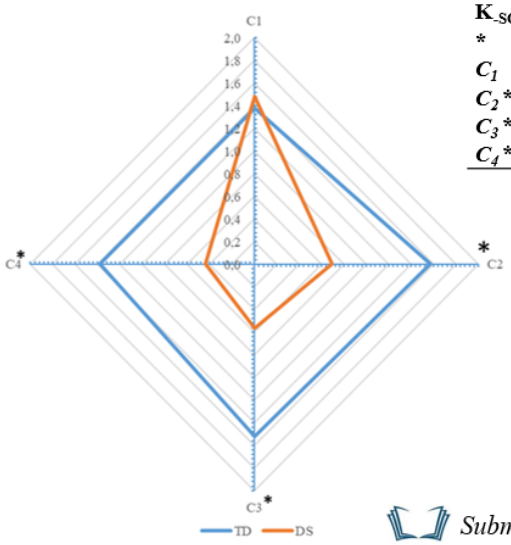
- Two trials for each locomotor and object control skills following TGMD-3 procedures

Kicking biomechanical parameters



Results



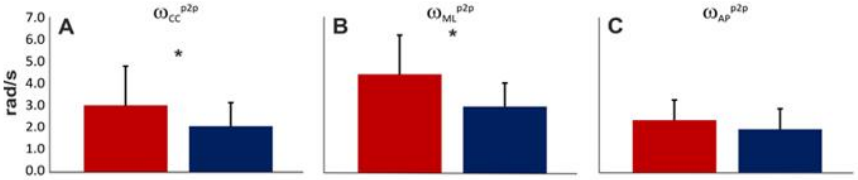


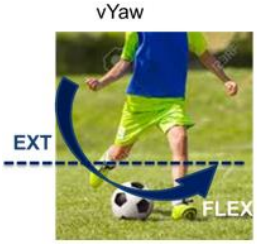
	ITD (*n = 21; 11 F*)	IDS (*n = 23; 8 F*)	Z-score	p-value
K_{-SCORE}				
*	*5.9±2.1*	*3.2±2.0*	*3.47*	*< 0.001*
C_1	*1.4±0.9*	*1.5±0.8*	*-0.23*	*0.810*
C_2 *	*1.6±0.7*	*0.7±0.9*	*2.87*	*0.003*
C_3 *	*1.5±0.8*	*0.6±0.8*	*3.14*	*0.002*
C_4 *	*1.4±0.9*	*0.4±0.8*	*2.84*	*0.004*

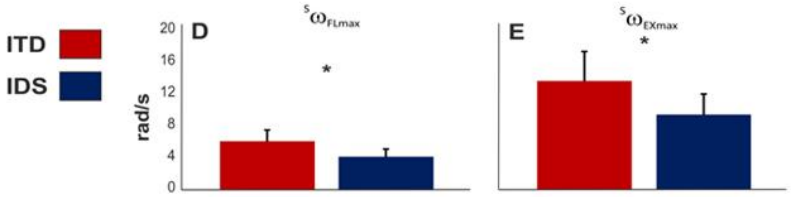
Capio et al, 2018

Submitted as Quinzi et al, J Intellect Disabil

Results







Submitted as Quinzi et al, J Intellect Disabil

DISCUSSION. According to the results above shown, the lower motor competence of DS in kicking compared to TD adults might be associated with lower angular velocities about the cranio-caudal and medio-lateral axes of the body and with a lower shank angular velocity about the medio-lateral axis. This behavior might be the result of orthopedic features of the pelvic girdle and possibly of a poorer neuromuscular control of core muscles. Future studies are needed, combining qualitative assessments of motor competence in kicking and electromyographic recordings of core muscles and orthopedic evaluations of the pelvic girdle, to further our knowledge on the possible causes of the observed motor competence in kicking in DS.

Chapter 1b. REFERENCES

1. Quinzi, F., Sbriccoli, P., Camomilla, V., Piacentini, M. F., Vannozzi, G. **Assessing kicking motor competence in individuals with Down's syndrome through wearable motion sensors**. *J Intellect Disabil 2021*, under review
2. Quinzi, F.. Vannozzi, G., Wynn, A., Sbriccoli, P., Piacentini, M.F., Camomilla, V. **Kicking Biomechanics in People with Down Syndrome and Typically Developing Children**. 2020 3d-AHM congress, virtual meeting.
3. Giuseppe Vannozzi Ph.D. Participation to ECSS 2021 Invited Symposium: **Advancing understanding of the inclusion of people with intellectual disabilities in sport and exercise –** Lecture: "*Participation in physical activity and sports in individuals with down syndrome: a new methodological approach*". ECSS 2021, virtual meeting.

Chapter 1c. PILOT STUDY RESULTS (Pre-Post Training Results)

Of the initial sixty-six participants that underwent the initial evaluation and were involved in the training, thirty-seven completed the whole training program and underwent the post-training assessment. The anthropometric characteristics of this group are reported in Table 1.

	DSG (n = 37)
Age [years]	*26.2(8.3)*
Mass [kg]	*67.0(12.2)*
Stature [m]	*1.56(0.09)*
BMI [kg/m2]	*27.5(5.4)*
IPAQ	*1699.4(1519.6)*
Females/Males	*10(27%)/27 (73%)*

Table 1. Anthropometric characteristics of the participants that completed the training and the post training assessment.

The evaluation of motor competence was carried out using the test for gross motor development version 3 (TGMD-3). This test encompasses thirteen skills belonging either to the locomotor (running-RU, galloping-GA, hopping-HO, sliding-SL, skipping-SK, horizontal jumping-HJ) or object control (two-hand striking-TH, one-hand striking-OH, overarm throwing-OT, underarm rolling-UR, stationary dribbling-SD, kicking-KI, catching-CA) classes. For each of these skills, the TGMD-3 foresees three to five performance criteria (depending on the skill). For each of these performance criteria, a point is awarded only if the execution of the skill fulfills the criteria. For each skill, the total score is the sum of the single performance criteria. The sum of the total score of the single skill is the total TGMD-3 score (^{TOT}TGMD-3). The sum of the scores of the skills belonging to the locomotor or object control skills is the total Locomotor score (^{LOC}TGMD-3) or total Object control score (^{OBJ}TGMD-3).

Significant differences were observed between the pre and post intervention assessments for the ^{TOT}TGMD-3 ($Z = -5.08$; $p < 0.0001$) and for the two locomotor ^{LOC}TGMD-3 ($Z = -4.36$; $p < 0.0001$), and

object control ^{OBJ}TGMD-3 ($Z = -4.86$; $p < 0.0001$) subtest with the post intervention assessment showing higher scores than the pre intervention assessment (Figure 1).

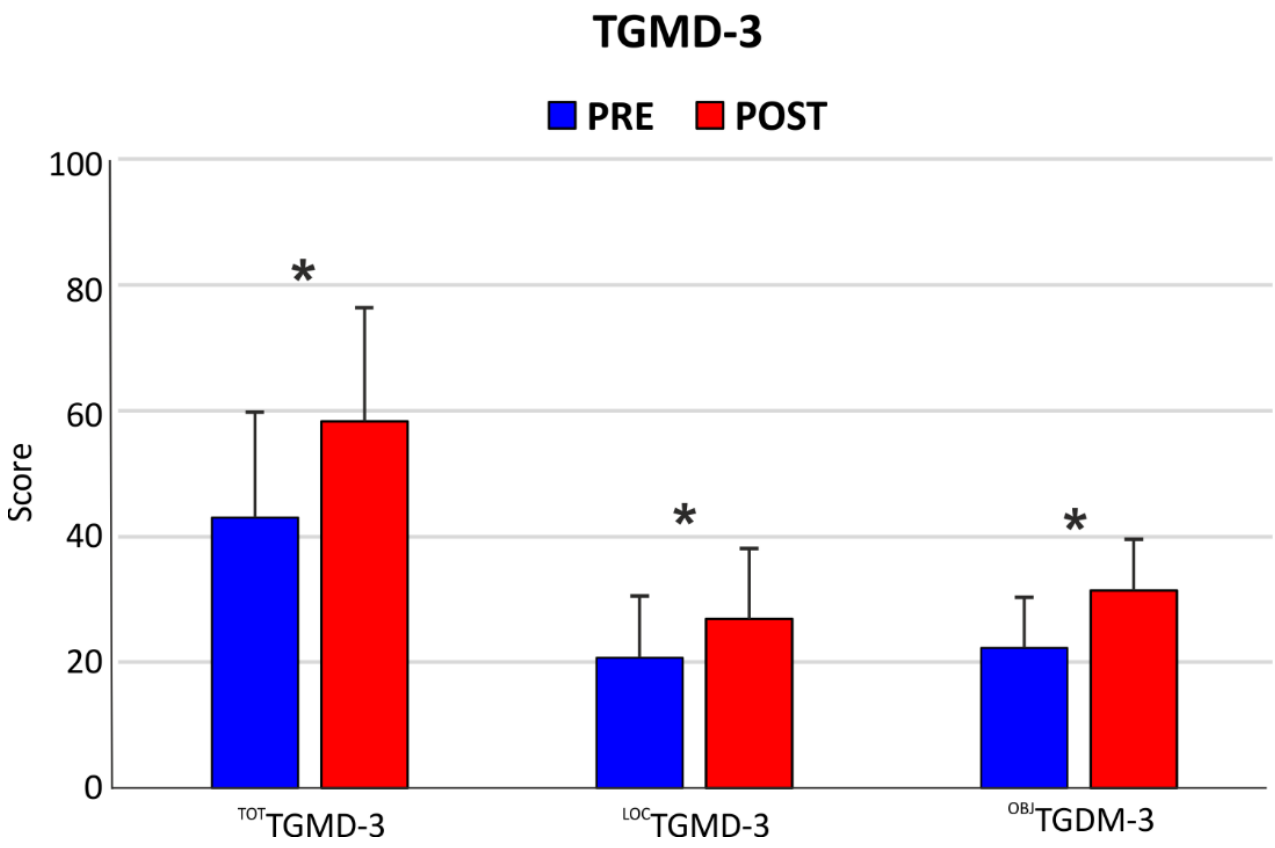


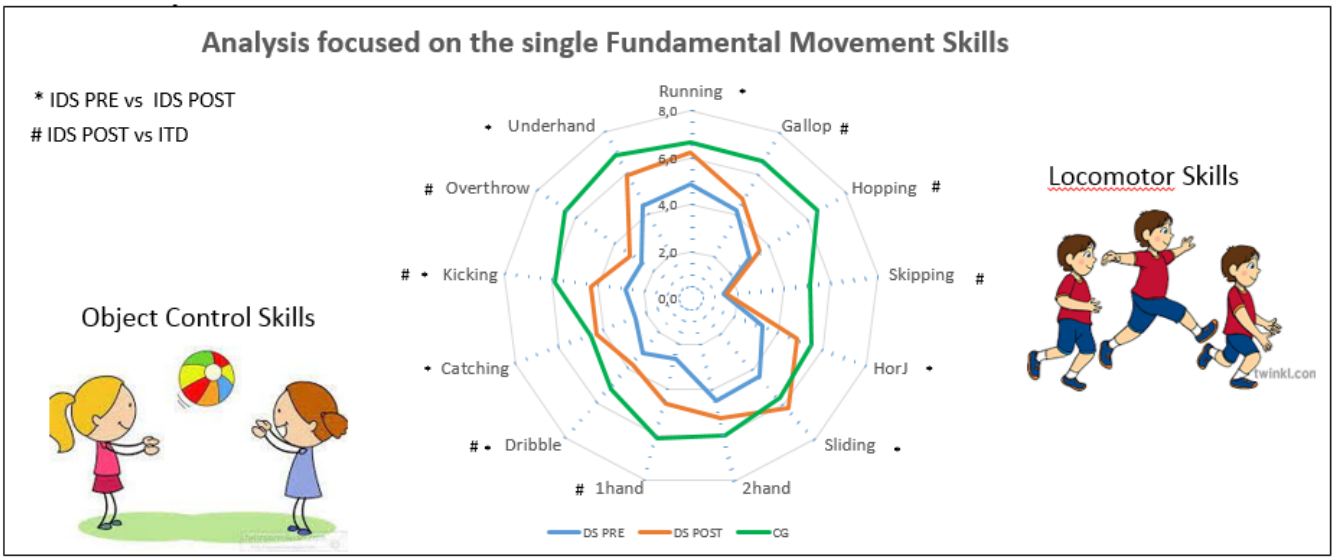
Figure 1. TGMD-3 Total, Locomotor, and Object control scores before (blue bars) and after (red bars) the adapted karate physical intervention. Data are reported as mean and SD. The significance level was set to $\alpha = 0.05$. Bonferroni corrected significance level was 0.016.

When the single skills were considered independently, seven skills showed increased scores in the post- compared to the pre-intervention assessment (Table 2). Of these skills, Running, Horizontal Jumping, and Sliding belonged to the locomotor subtest (three out of six skills in total for the locomotor subtest - 50%), whereas One-hand Striking, Catching, Kicking and Underhand Roll belonged to the object control subtest (four out of seven skills in total for the object control subtest - 57%).

Table 2. Mean and SD. Significance level = 0.05. Bonferroni corrected significance level = 0.0038

	DS-PRE (n = 37; 10F)	DS-POST (n = 37; 10F)	Z-value	p-value
Running*	*4.9(2.1)*	*6.2(2.5)*	*-3.551*	*0.00038*
Galloping	*4.2(2.4)*	*4.8(2.4)*	*-1.536*	*0.12462*
Hopping	*3.0(2.6)*	*3.6(2.6)*	*-1.804*	*0.07121*
Skipping	*1.4(2.0)*	*1.5(2.2)*	*-0.960*	*0.33720*
Horizontal Jumping*	*3.3(2.4)*	*4.8(2.5)*	*-3.153*	*0.00161*
Sliding*	*4.4(2.0)*	*6.2(2.7)*	*-4.091*	*0.00004*
Two-hand Striking	*4.5(2.2)*	*5.2(1.9)*	*-1.685*	*0.09207*
One-hand Striking*	*2.6(1.8)*	*4.6(2.2)*	*-3.895*	*0.00009*
Stationary Dribbling	*3.1(2.0)*	*3.8(2.2)*	*-2.332*	*0.01968*
Catching*	*2.5(1.6)*	*4.3(1.7)*	*-3.988*	*0.00006*
Kicking*	*2.8(2.5)*	*4.3(2.5)*	*-3.283*	*0.00102*
Overarm Throw	*2.6(2.2)*	*3.2(2.1)*	*-1.788*	*0.07370*
Underhand Roll*	*4.4(1.8)*	*5.9(1.3)*	*-4.247*	*0.00001*

Results



13 / 13 skills were different between IDS PRE and ITD

7 / 13 skills improved from PRE to POST

6 / 13 skills were similar between IDS POST and ITD

In preparation as Quinzi et al, Int J Environm Res Publ Health

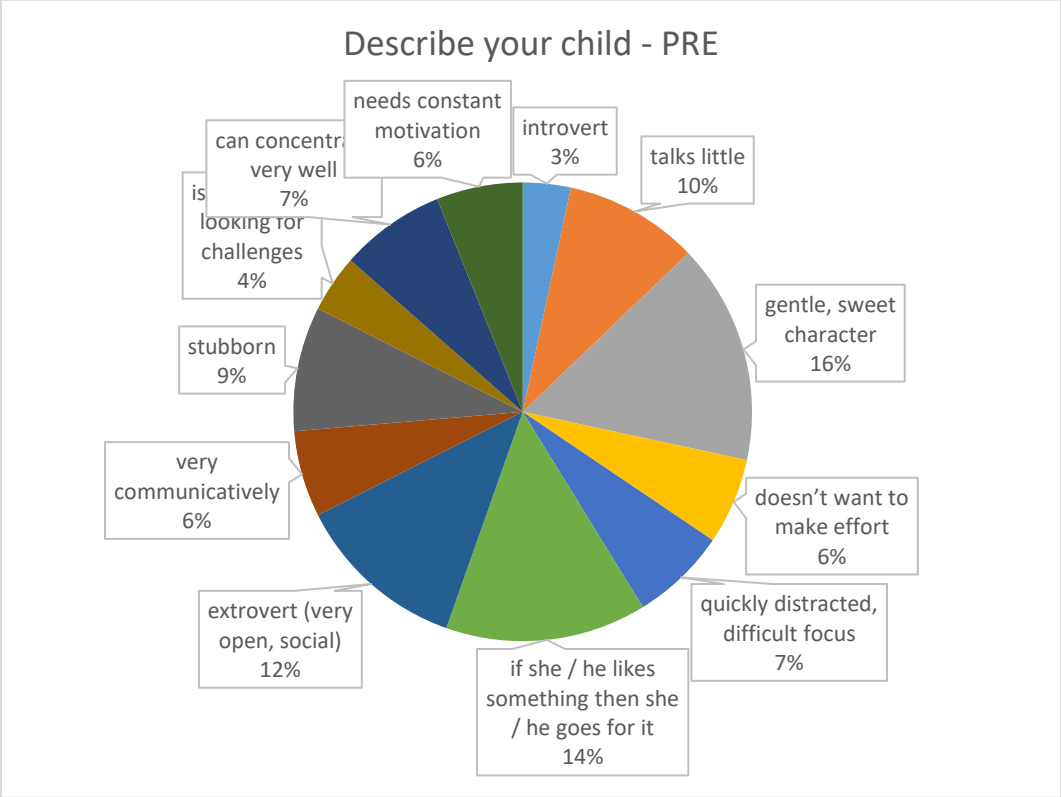
Chapter 1c. REFERENCES

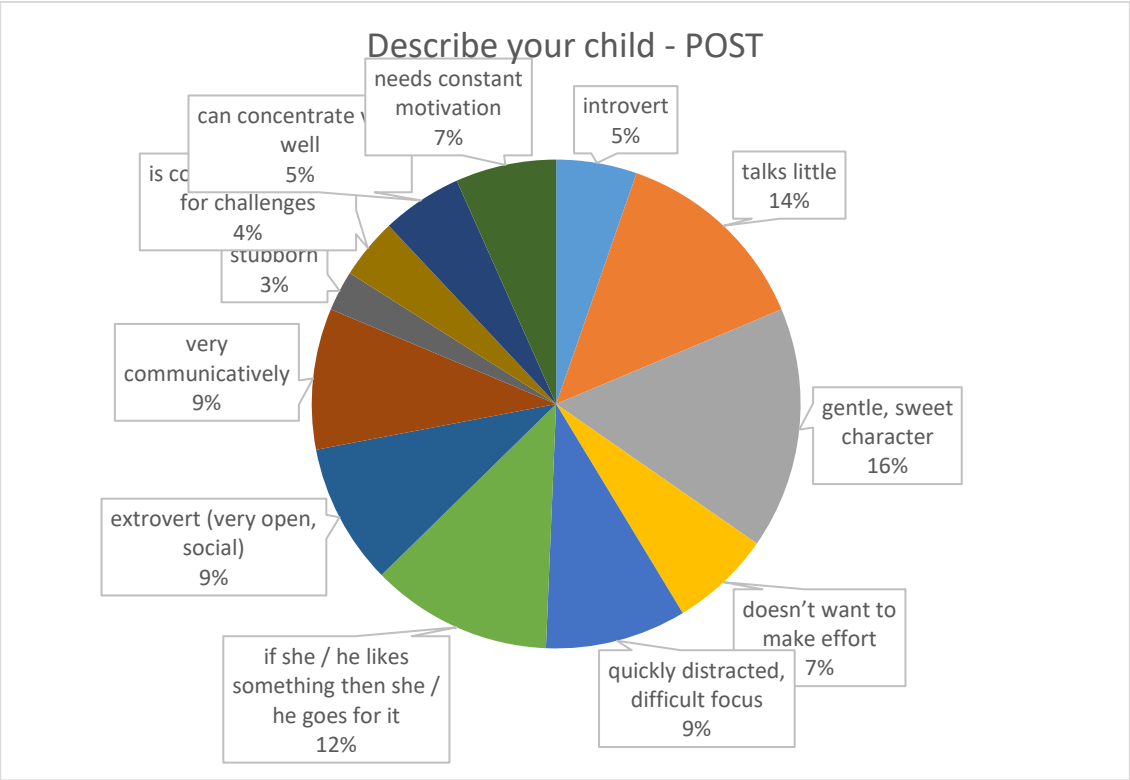
1. Quinzi, F., Camomilla, V., Piacentini, M.F., Sbriccoli, P., Boca, F., Bortels, E., Kathrein, E., Magyar, A., Verdone F., Vannozzi, G. **Motor Competence in individuals with Down syndrome: is an improvement still possible in Adulthood?** *In preparation, to be submitted, 2021*

Chapter 2 - Parents' Questionnaire

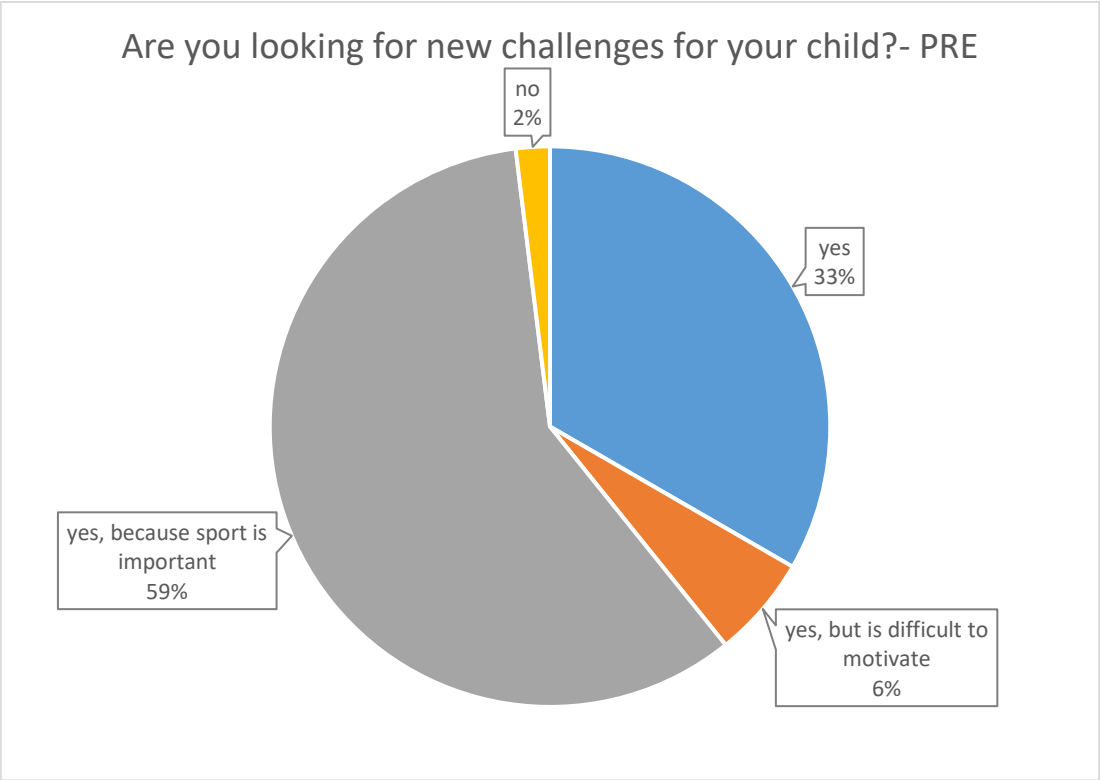
In the following pages the results of the parents' questionnaires will be presented. For each question (except questions 9 and 10), two graphs will be shown, the first shows the answers of the parents after the 1st month of training (PRE) and the second d refers to the answers provided after the 10th month of training (POST).

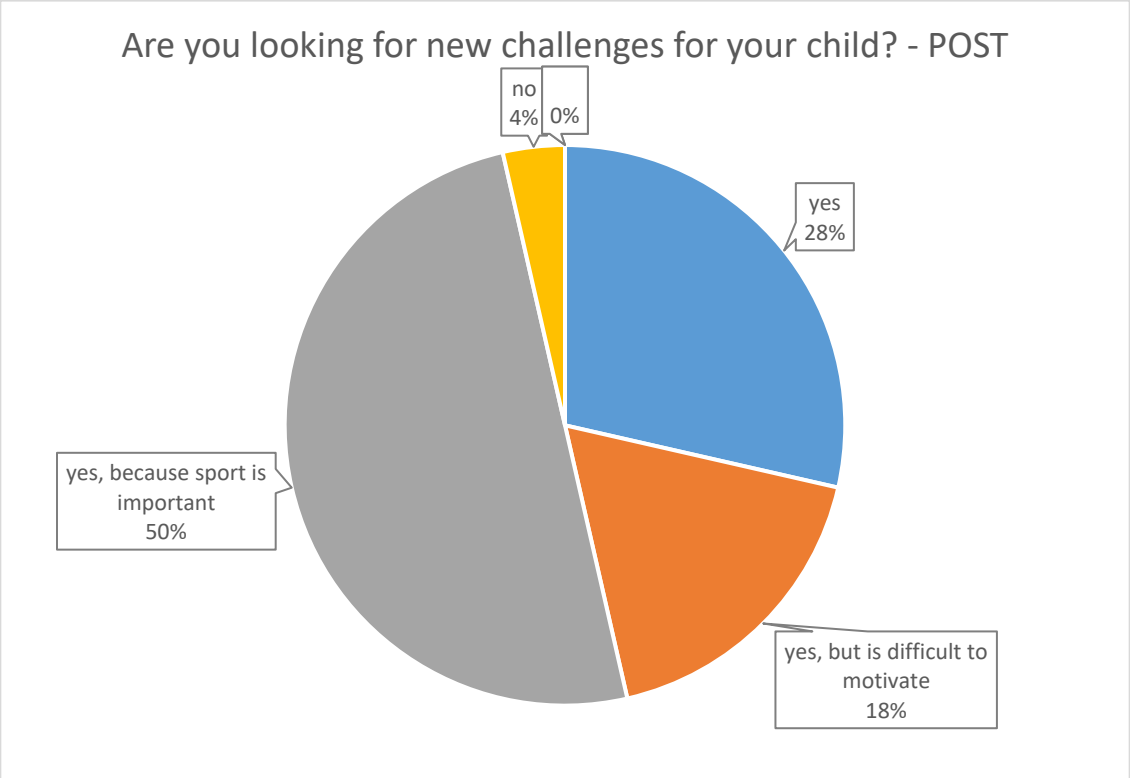
Q1 - Describe your child



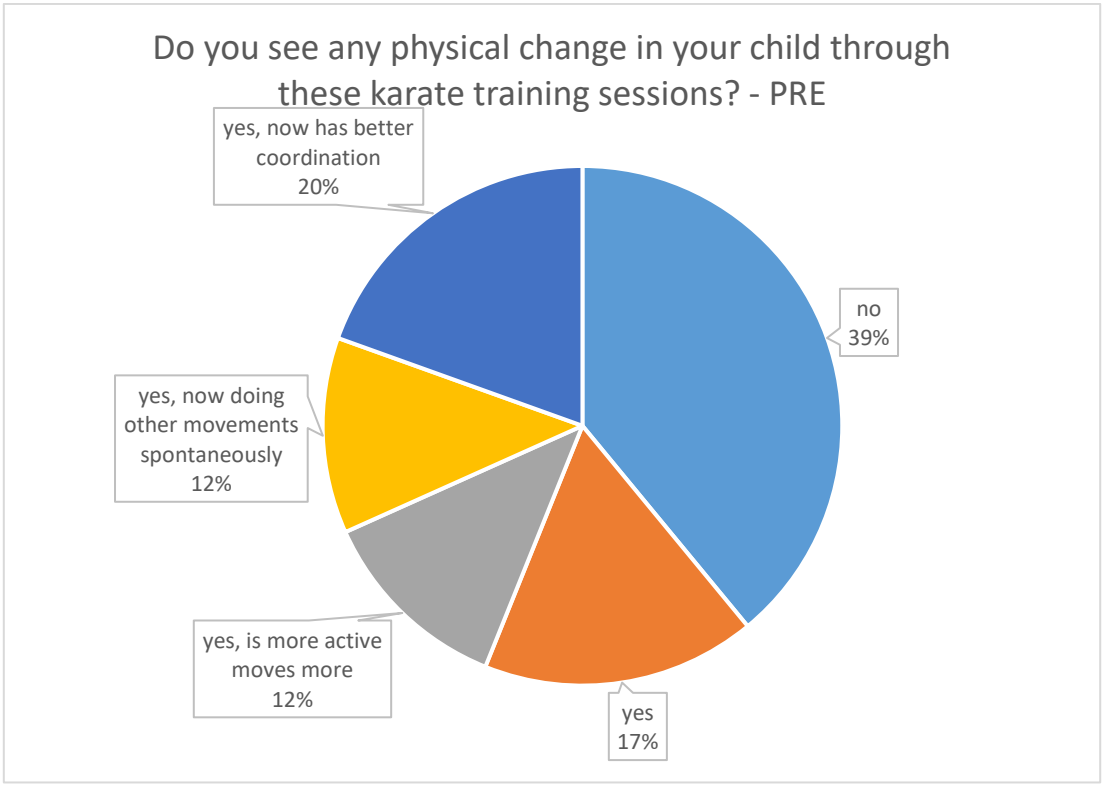


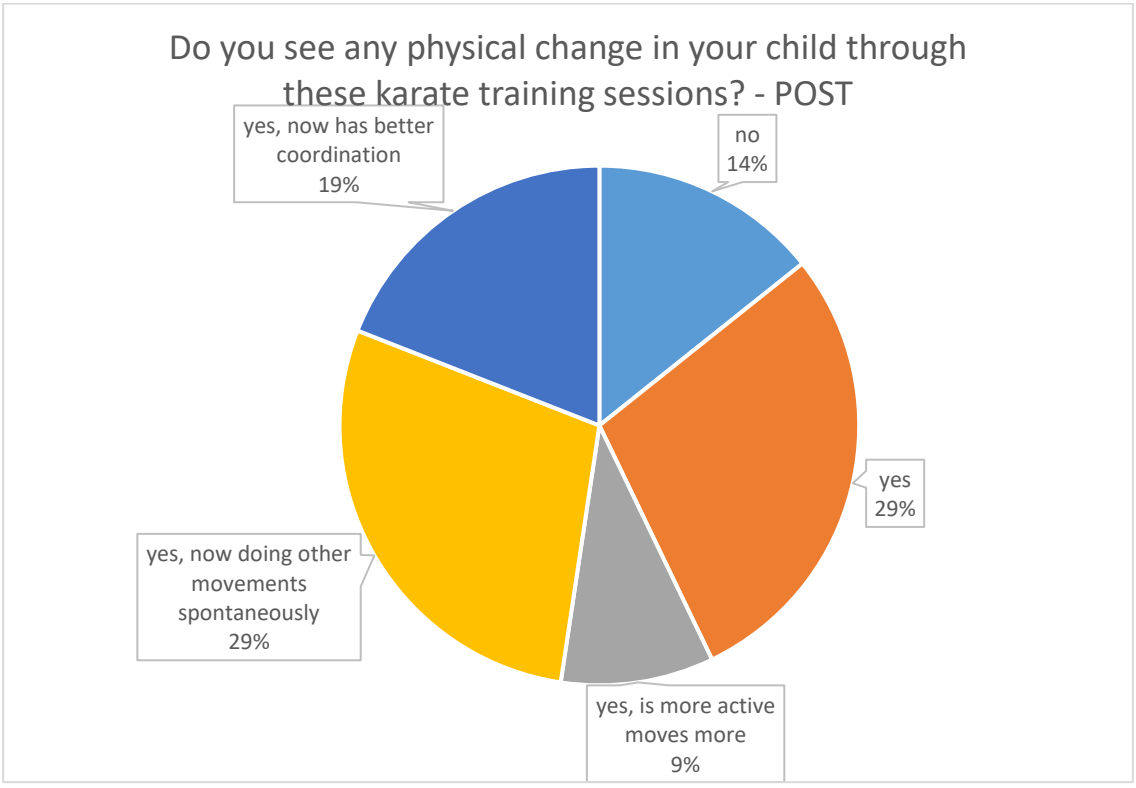
Q2- Are you looking for new challenges for your child?



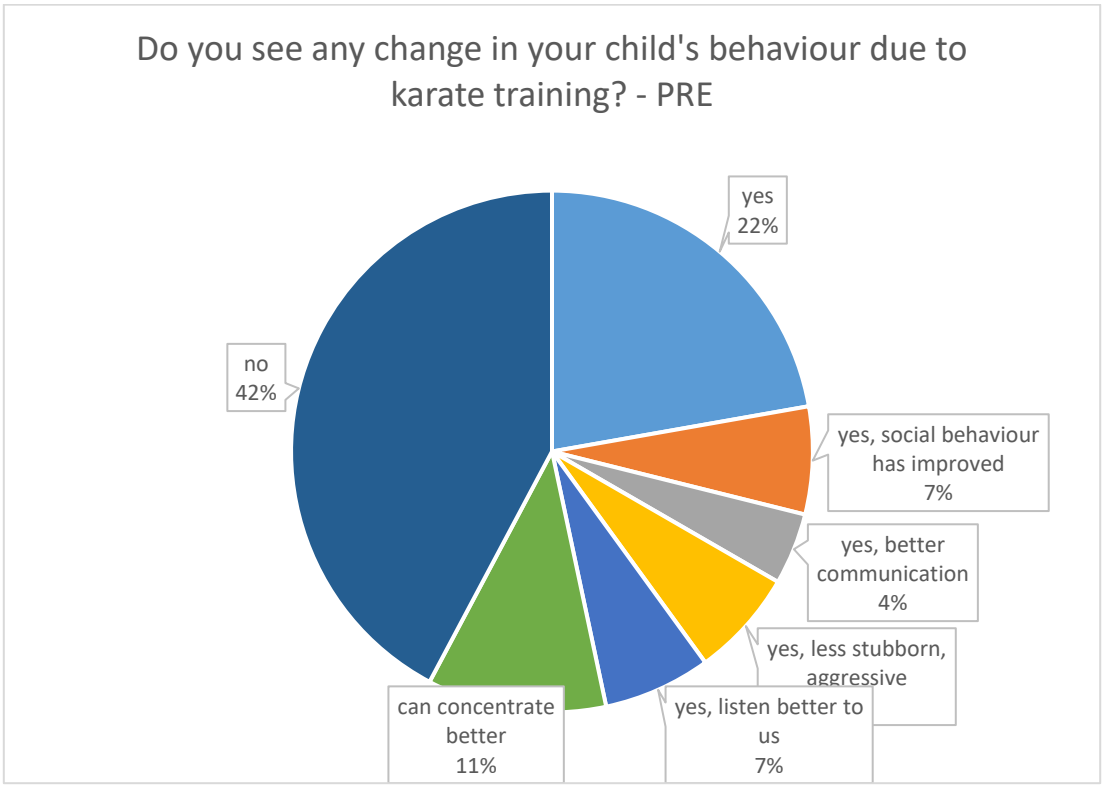


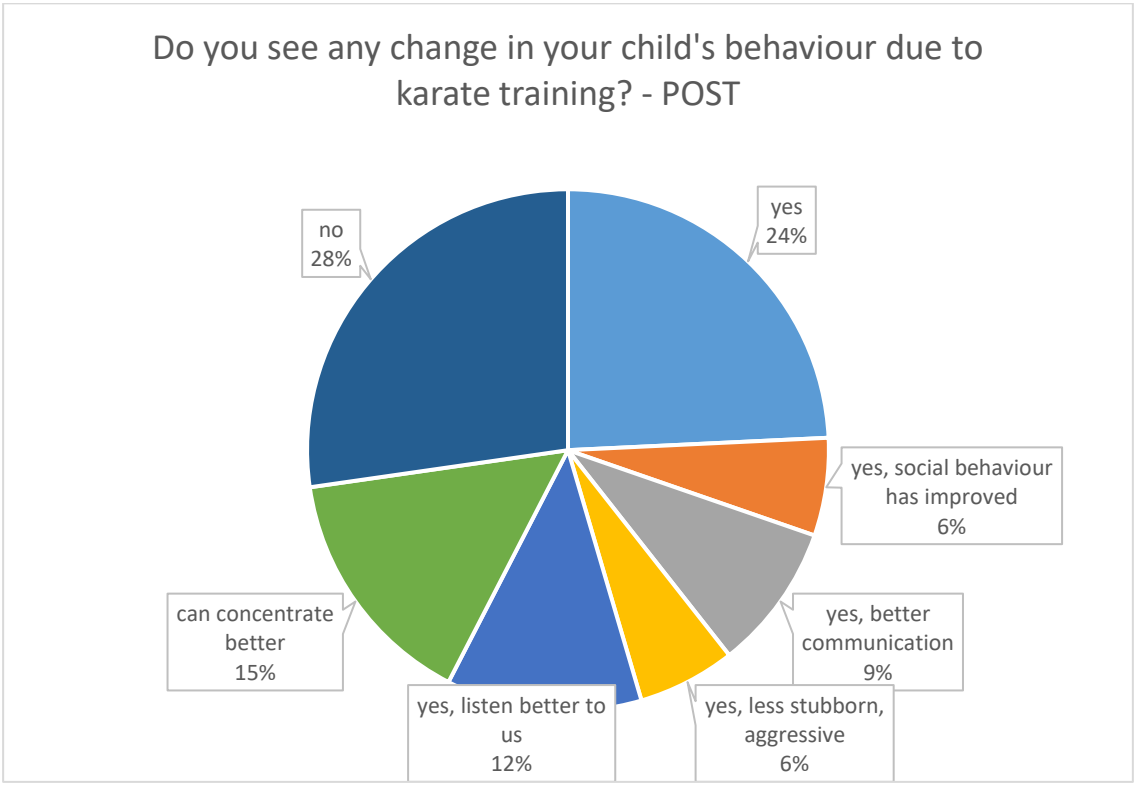
Q3 – Do you see any physical change in your child through these karate training sessions?


Do you see any physical change in your child through these karate training sessions? - PRE
yes, now has better coordination 20%
no 39%
yes, now doing other movements spontaneously 12%
yes, is more active moves more 12%
yes 17%

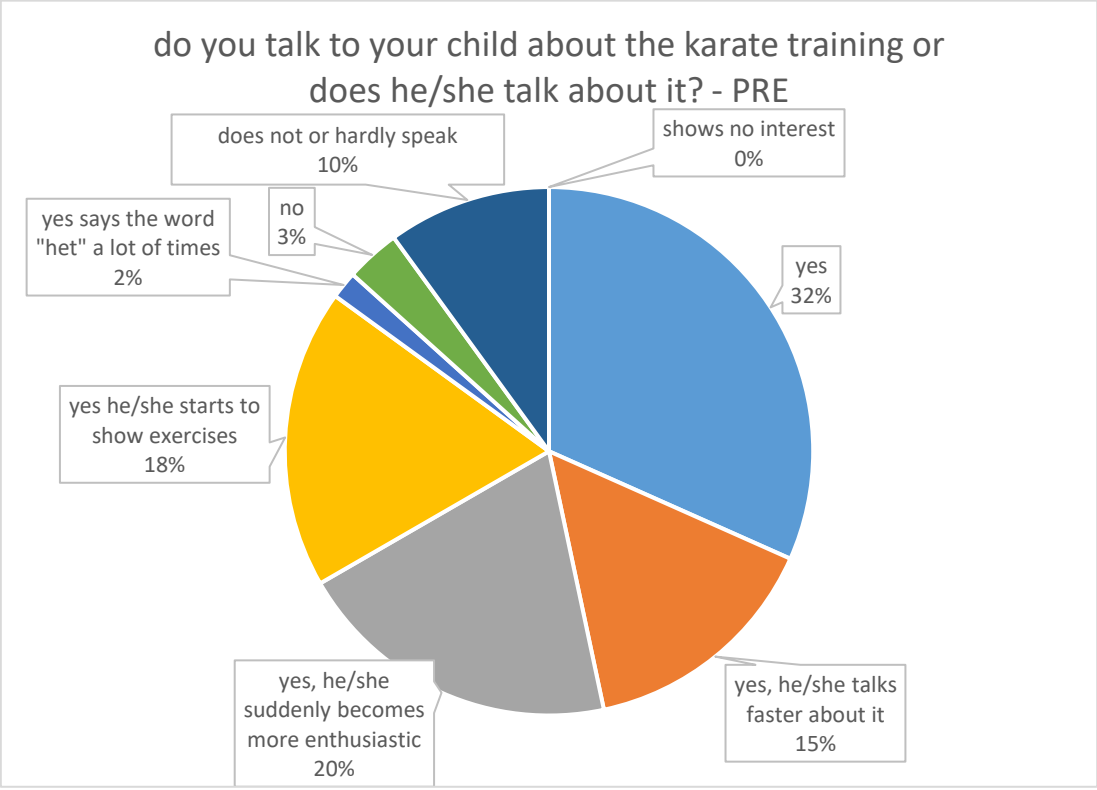

Do you see any physical change in your child through these karate training sessions? - POST
yes, now has better coordination 19%
no 14%
yes 29%
yes, now doing other movements spontaneously 29%
yes, is more active moves more 9%

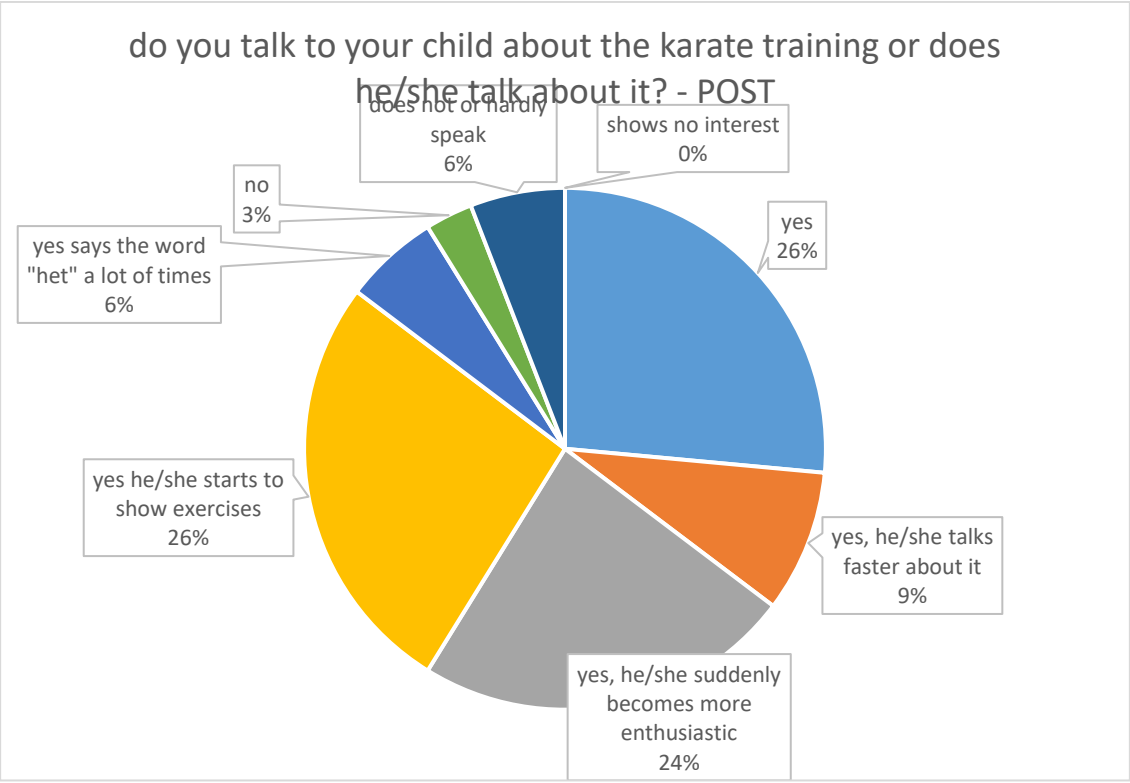
Q4 - Do you see any change in your child's behavior due to karate training?



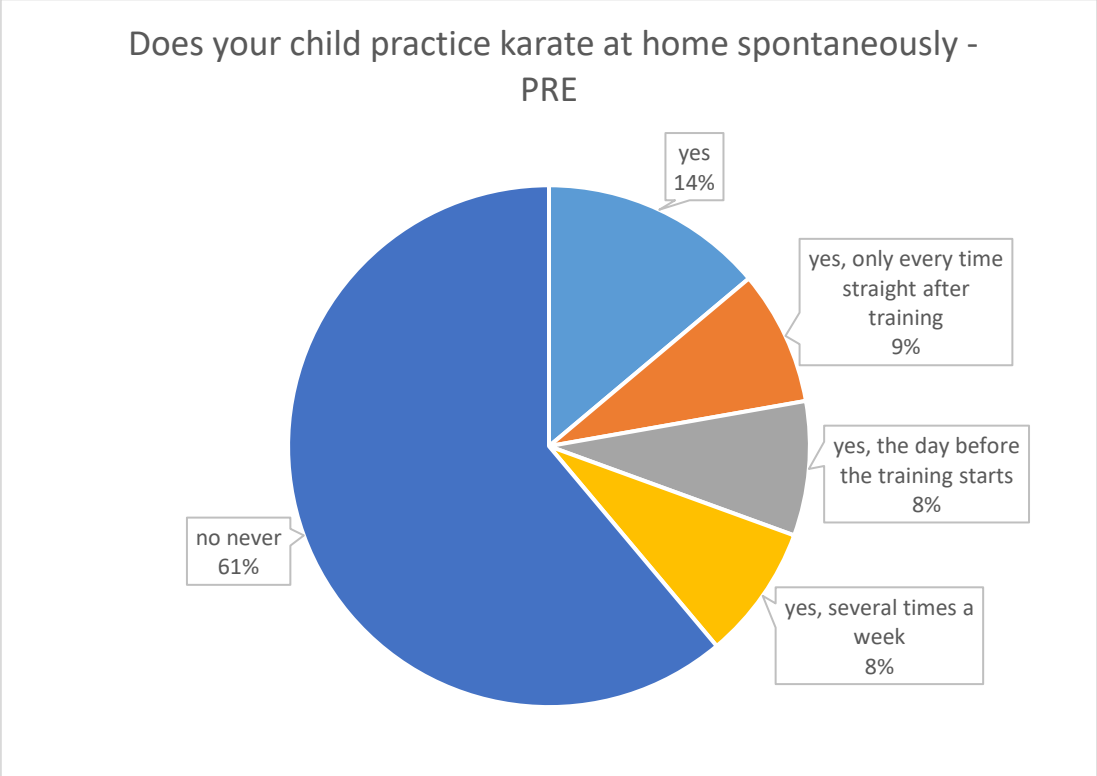


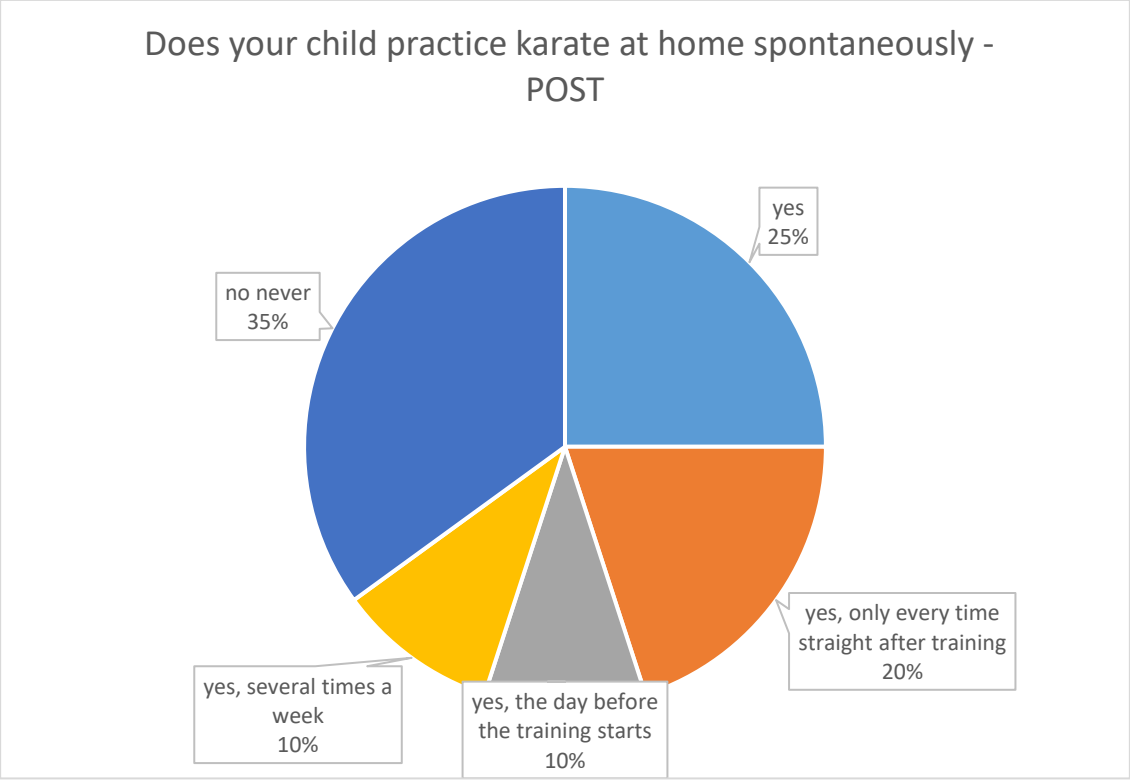
Q5 – Do you talk to your child about the karate training or foes he/she talks about it)



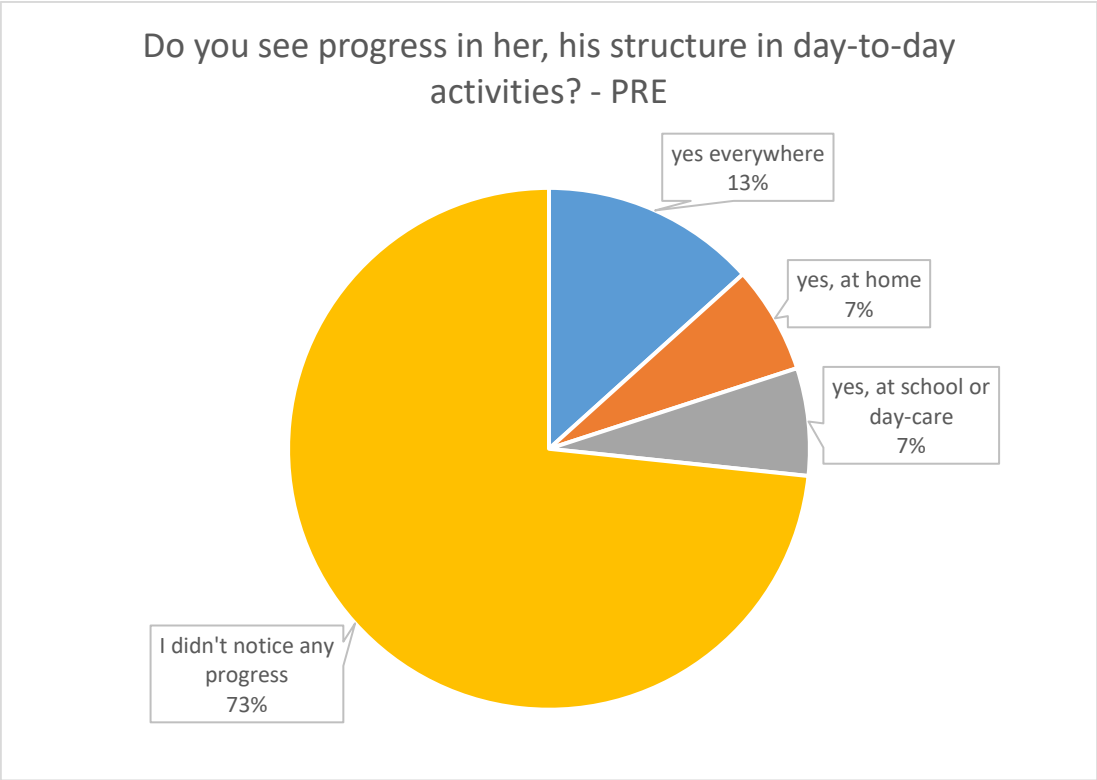


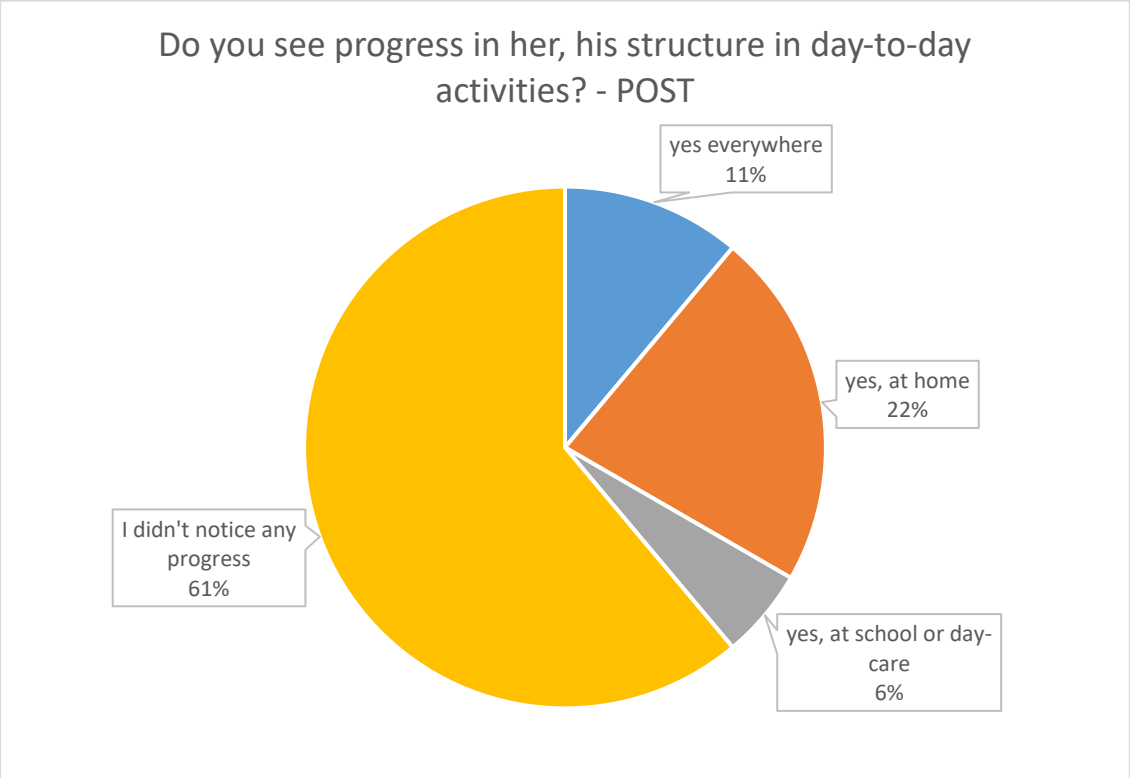
Q6 – Does your child practice karate at home spontaneously?



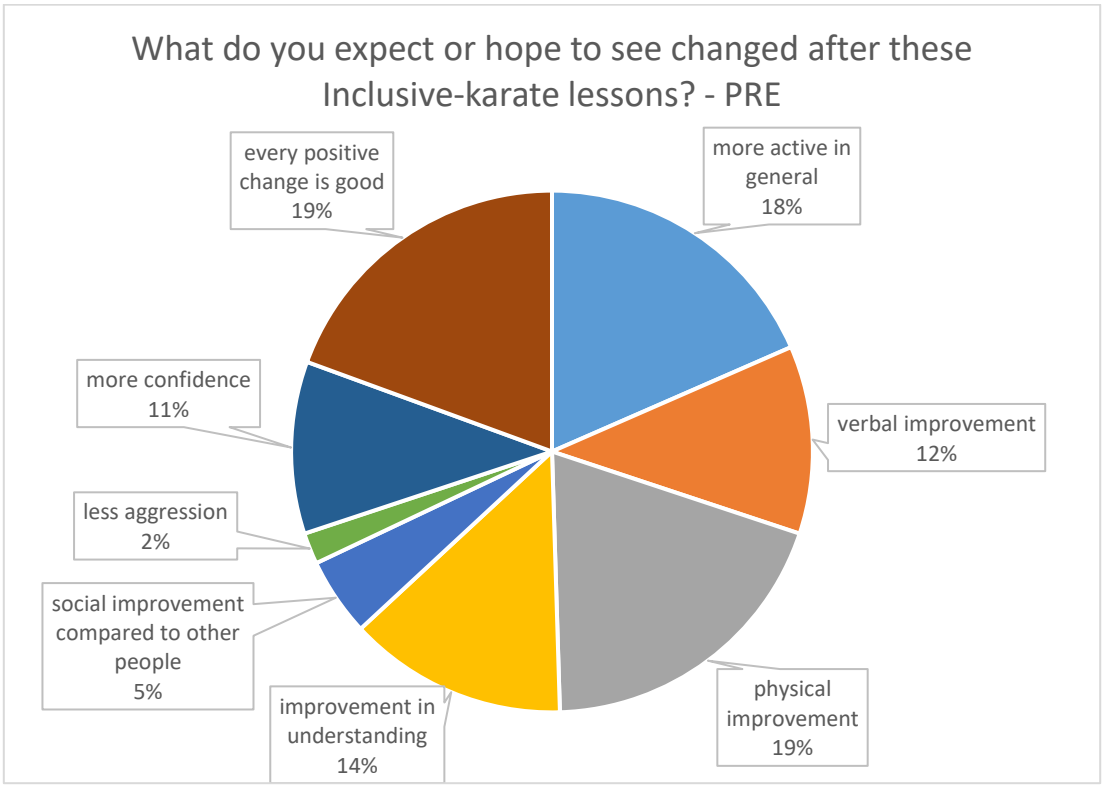


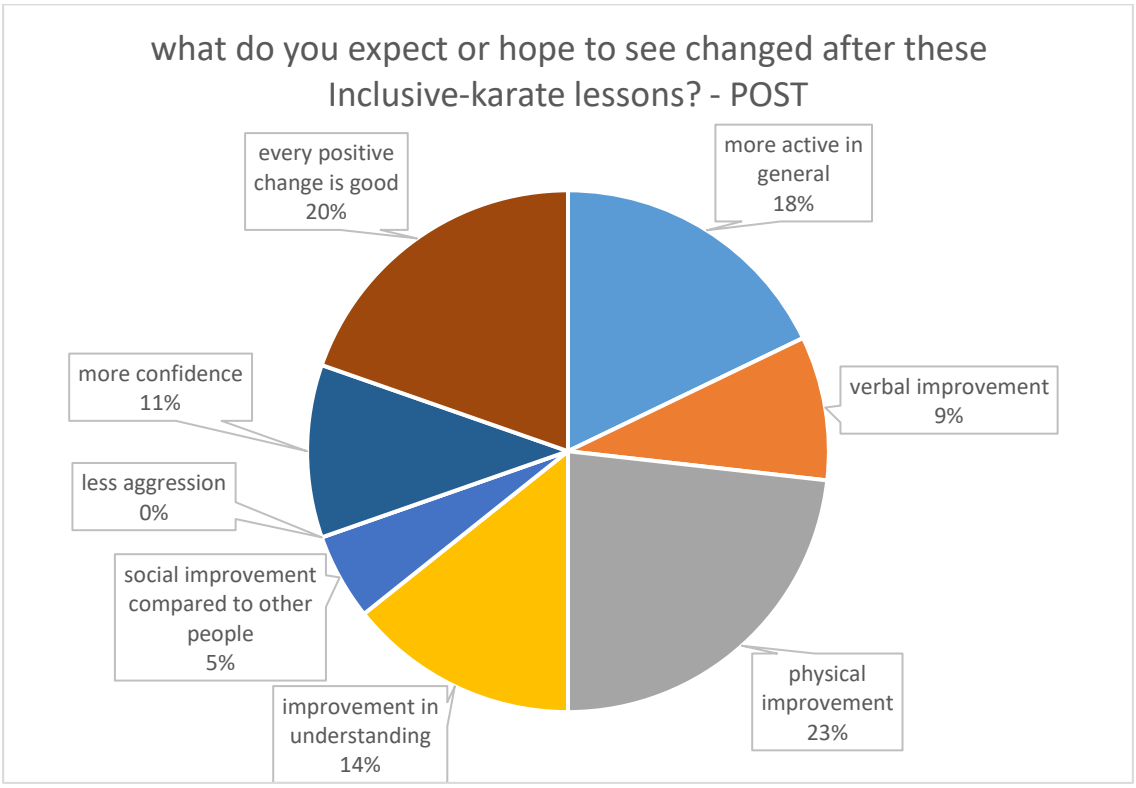
Q7 – Do you see progress in her/his structure in day-to-day activities?


Do you see progress in her, his structure in day-to-day activities? - PRE
yes everywhere 13%
yes, at home 7%
yes, at school or day-care 7%
I didn't notice any progress 73%

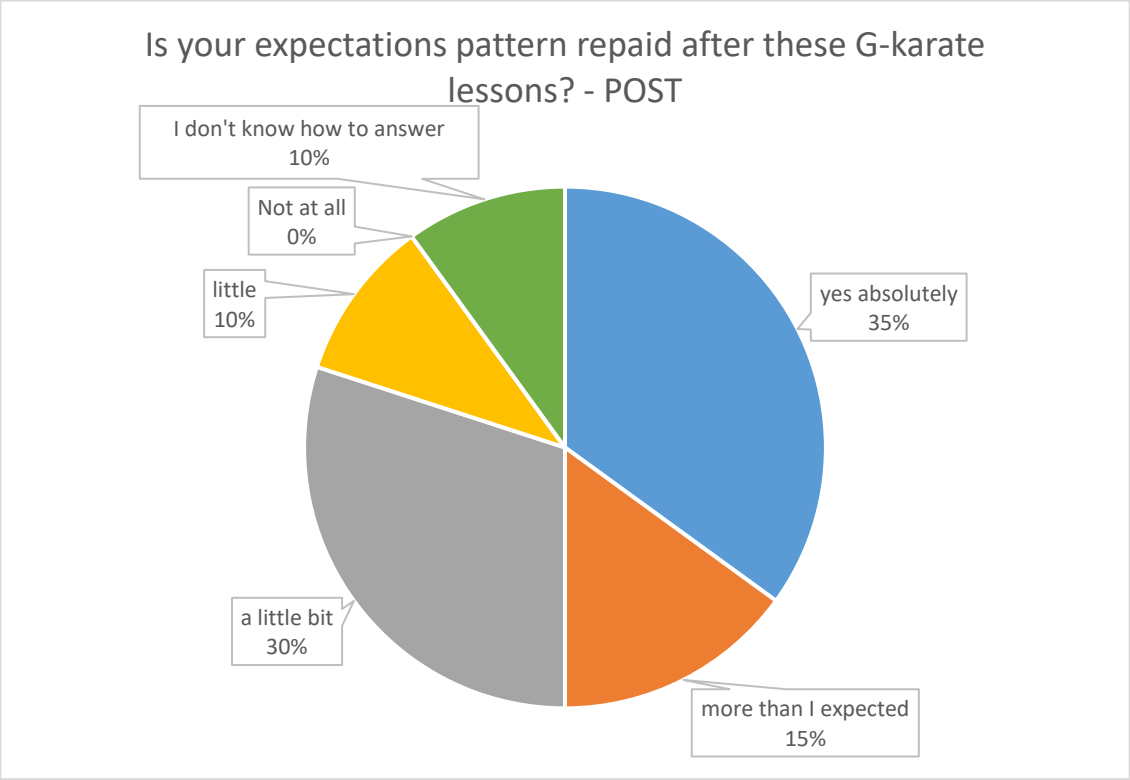

Do you see progress in her, his structure in day-to-day activities? - POST
yes everywhere 11%
yes, at home 22%
I didn't notice any progress 61%
yes, at school or day-care 6%

Q8 – What do you expect or hope to see changed after these inclusive karate lessons?

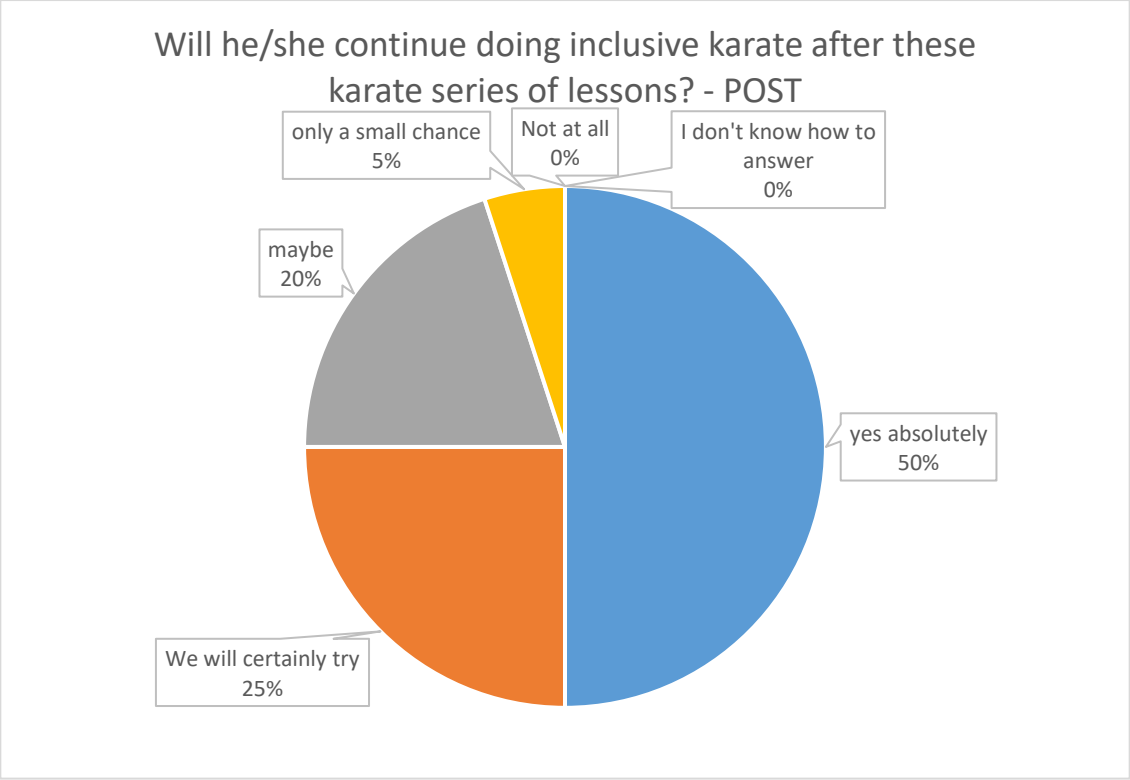




Q9 – Is your expectations repaid after these G-karate lessons?



Q10 – Will he/she continue doing inclusive karate after these karate series of lessons?

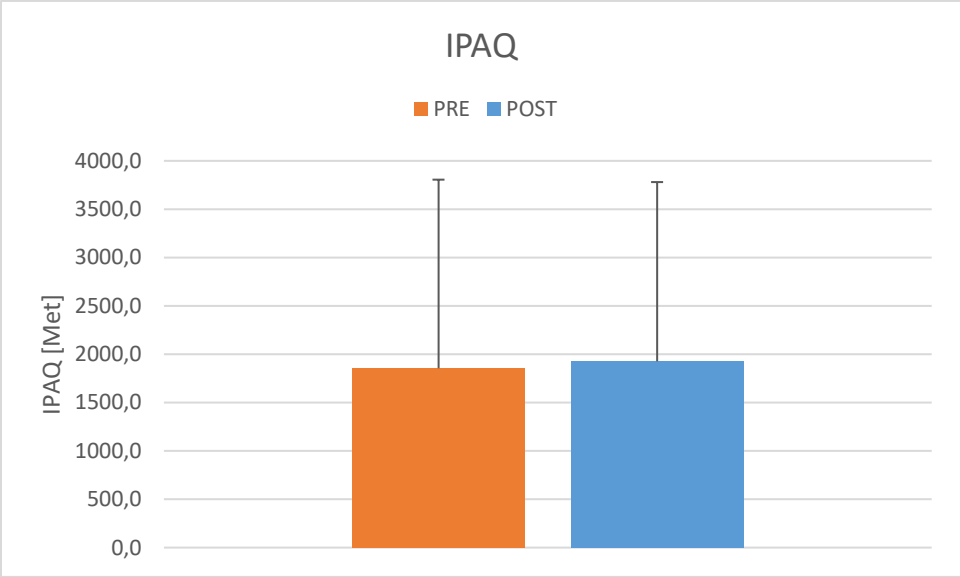


Chapter 2. REFERENCES

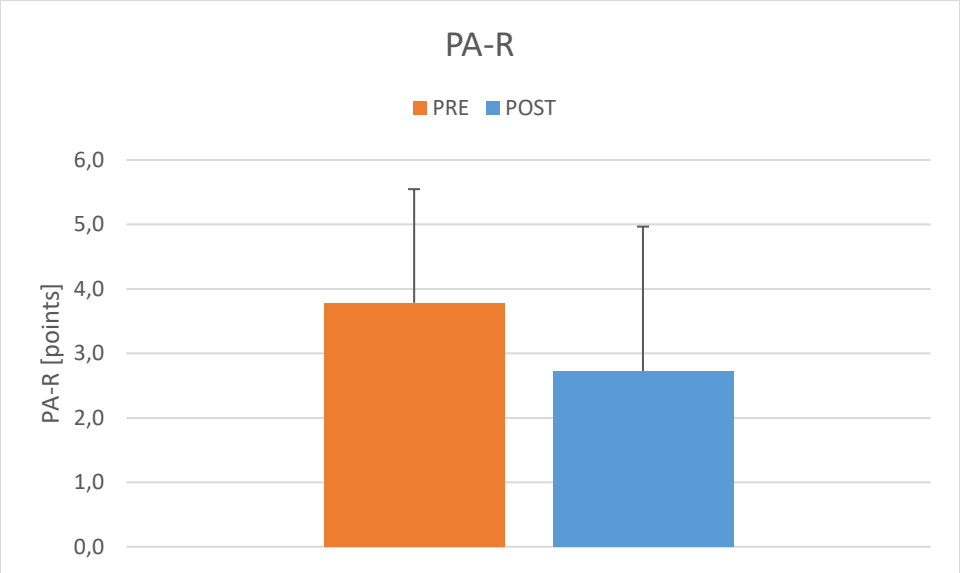
1. Piacentini Maria Francesca, Quinzi Federico, Camomilla Valentina, Vannozzi Giuseppe, Verdone Fabio, Sbriccoli Paola. **Sport participation in Europe in individuals with down syndrome: Data from the IKONS study**. XII SISMeS Congress, Padova (Italy), 8-10 Oct 2021.

CHAPTER 3. Physical Activity Questionnaires (IPAQ, PA-R)

In the following paragraphs the results of the analysis of the international physical activity questionnaire (IPAQ) and of the physical activity rating (PR-R) will be presented.



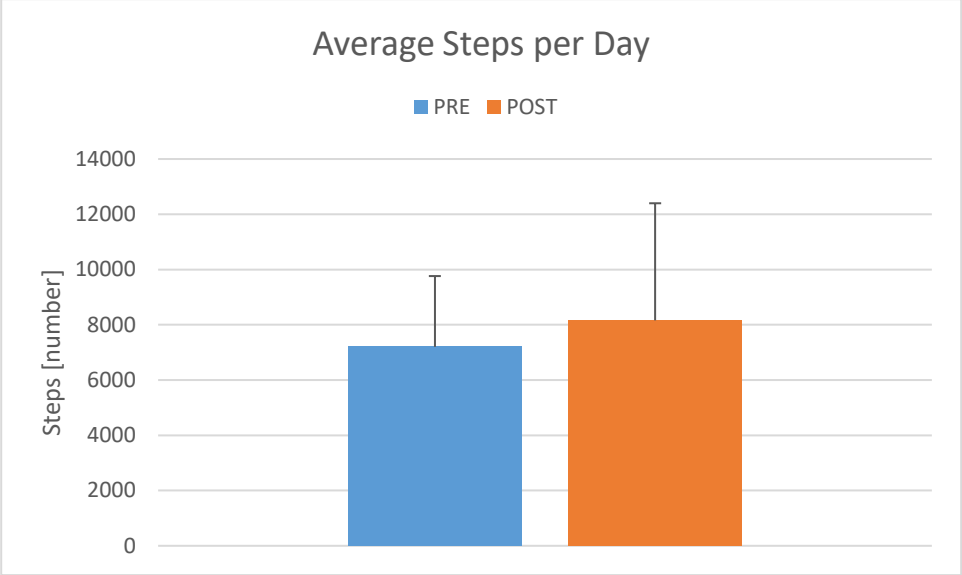
The statistical analysis performed on the international physical activity questionnaire showed no significant results of the training program on the amount of physical activity of the participants. Student T-test p = 0.92)



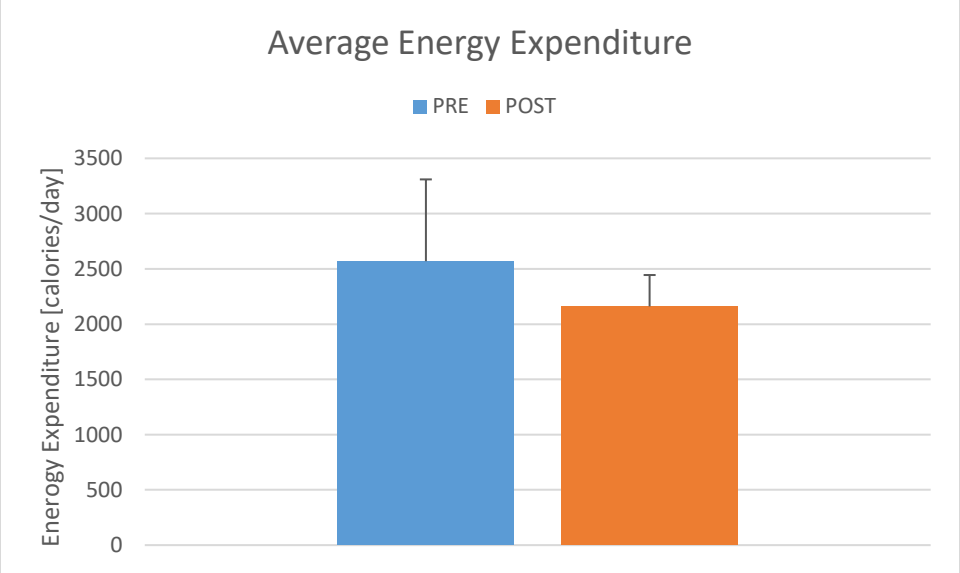
The same analysis showed no effect of the training on the PA-R score (Student T-test p = 0.15)

CHAPTER 5. Physical Activity Monitors (Fitbit watches)

The results of the analysis performed on the data obtained from the Physical activity monitor will be presented in the following paragraph.



The statistical analysis showed no significant difference ($p = 0.31$) between pre and post intervention assessments for the average number of steps per day.



Similarly no difference between pre and post training intervention assessments was observed for the average daily energy expenditure (Student test T; $p = 0.20$).

PUBLICATIONS AND INTERNATIONAL CONFERENCES LIST

FULL PAPERS

2. Quinzi, F., Camomilla, V., Bratta, C., Piacentini, M. F., Sbriccoli, P., Vannozzi, G.. **Hopping skill in individuals with Down syndrome: a qualitative and quantitative assessment**. *Human Movement Science 78 (2021) ISSN: 0167-9457 Online ISSN: 1872-7646*
3. Quinzi, F., Sbriccoli, P., Camomilla, V., Piacentini, M. F., Vannozzi, G. **Assessing kicking motor competence in individuals with Down's syndrome through wearable motion sensors**. *J Intellect Disabil 2021, under review*
4. Quinzi, F., Camomilla, V., Piacentini, M.F., Sbriccoli, P., Boca, F., Bortels, E., Kathrein, E., Magyar, A., Verdone F., Vannozzi, G. **Motor Competence in individuals with Down syndrome: is an improvement still possible in Adulthood?** *In preparation, to be submitted, 2021*

INTERNATIONAL CONFERENCES

1. Sbriccoli, P., Camomilla, V., Vannozzi, G., Piacentini, M.F., Wynn, A., Bratta, C., Quinzi, F. **Gross Motor Functions Assessed Through The TGMD-3 In Down Syndrome Individuals And Related Gender Differences**. ACSM 2020 virtual meeting.
2. Camomilla, V., Foresti, A., Annibali, R., Sbriccoli, P., Quinzi, F. **Biomechanical investigation of the kizami tsuki in karate athletes.** ESBS 2020 virtual meeting.
3. Quinzi, F.. Vannozzi, G., Wynn, A., Sbriccoli, P., Piacentini, M.F., Camomilla, V. **Kicking Biomechanics in People with Down Syndrome and Typically Developing Children**. 2020 3d-AHM congress, virtual meeting.
4. Giuseppe Vannozzi Ph.D. Participation to ECSS 2021 Invited Symposium: **Advancing understanding of the inclusion of people with intellectual disabilities in sport and exercise –** (Prof.sa MF Piacentini). Lecture: "*Participation in physical activity and sports in individuals with down syndrome: a new methodological approach*". ECSS 2021, virtual meeting.
5. Piacentini Maria Francesca, Quinzi Federico, Camomilla Valentina, Vannozzi Giuseppe, Verdone Fabio, Sbriccoli Paola. **Sport participation in Europe in individuals with down syndrome: Data from the IKONS study**. XII SISMeS Congress, Padova (Italy), 8-10 Oct 2021.