



IO5 - LONGITUDINAL STUDY RESULTS

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



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**THIS OUTPUT HAS BEEN REALISED WITH THE CONTRIBUTION
OF ALL THE PROJECT PARTNERS**

Edited by:



Partners involved:



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INTRODUCTION

In the following pages, we present a brief report for the results of the pilot action of the IKONS project: ***WP 4. Pilot action to validate and test the effectiveness of inclusive Karate training in DS individuals: Longitudinal Study.***

A longitudinal study design has been adopted and carried out to assess the effectiveness of inclusive karate training by recruiting groups of novice karate practitioners in Italy, Belgium, Romania, Austria, and Hungary and testing them, before and after the training according to the adapted inclusive karate training programme created.

Male and female individuals with DS (age range: 15-40 yrs old) have been recruited to assess the effectiveness of the adapted karate intervention on cognitive and motor functions. Individuals with any form of neuromuscular pathology, any injury in the head, upper or lower limb in the six months preceding the test will be excluded from the study.

The effectiveness of the training in terms of quality of life, ADL, cognitive and coordination aspects has been performed using quantitative and qualitative tests and questionnaires.

A battery of semi-quantitative or quantitative tests have been administered on the field, while quality of life and ADL aspects have been assessed through questionnaires.

Moreover, before, halfway through, and at the end of the intervention program, individuals have worn a portable accelerometer (Armband) for 24 h in order to evaluate total energy expenditure.

3

Testing DS individuals before and after the Inclusive Karate Training Programme

At the beginning and end of the training programme, two testing sessions (pre-intervention and post-intervention evaluation) have been carried out to monitor for possible effects of the adapted karate training. Testing has been performed in the training gym by the local coaches, under the supervision of university research staff traveling to the place of intervention, with appropriate experience in the relevant area of evaluation. The Università Foro Italico (IT) post doc researcher has traveled for the pre-training testing in Belgium, Austria, Hungary, Romania and Italy following the schedule indicated in the original plan of the project. As regards the post training testing, since due to Covid-19 emergency there was no possibility for traveling, the post training test were administered from coaches and personnel in each partner country. Data were then sent to the post doc researcher that processed and analyzed the data collected, thereby producing the final results.

All the assessment were carried out before and after the 40 weeks of training.

- 1. The effects of the adapted karate intervention on the performance of daily activities** has been carried out by means of the Movement Assessment Battery – Checklist 2 (MABC-2) by Henderson, Sugden, & Barnett (2007). This standardized, norm-referenced test contains eight tasks related to three specific areas: manual

dexterity, ball skills, and balance, both static and dynamic. In addition, to evaluate possible changes in their sedentary lifestyle, before, halfway through, and after the karate intervention, participants have worn a portable accelerometer for 24 h in order to estimate total energy expenditure.

- 2. The effect of the adapted karate intervention on basic and complex motor skills** has been assessed through the test for gross motor development-3 (TGDM-3, Ulrich, 2000). The TDGM-3 is a norm-referenced measure of common gross motor skills composed by 12 skills belonging to two classes, Locomotor skills (run, gallop, hop, leap, horizontal jump, slide) and Object Control (striking a stationary ball, stationary dribble, kick, catch, overhand throw, and underhand roll). The TGDM-3 has been administered in approximately 20 minutes. The assessment of complex motor skills has been carried out through the employment of one or more Inertial Measurement Units (IMUs) positioned in specific participants' body locations, depending upon the specific task to analyse, namely locomotor or ballistic skills (Masci et al, 2012 and 2013; Grimpampi et al, 2016) and fixed by means of ad hoc designed elastic bands.

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). Namely, this assessment was performed on 24 Down Syndrome (DS) participants that were compared to 21 Typically Developed (TD) participants.

What reported below, thus, refers to 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).

PHYSICAL TESTS

1.1 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).

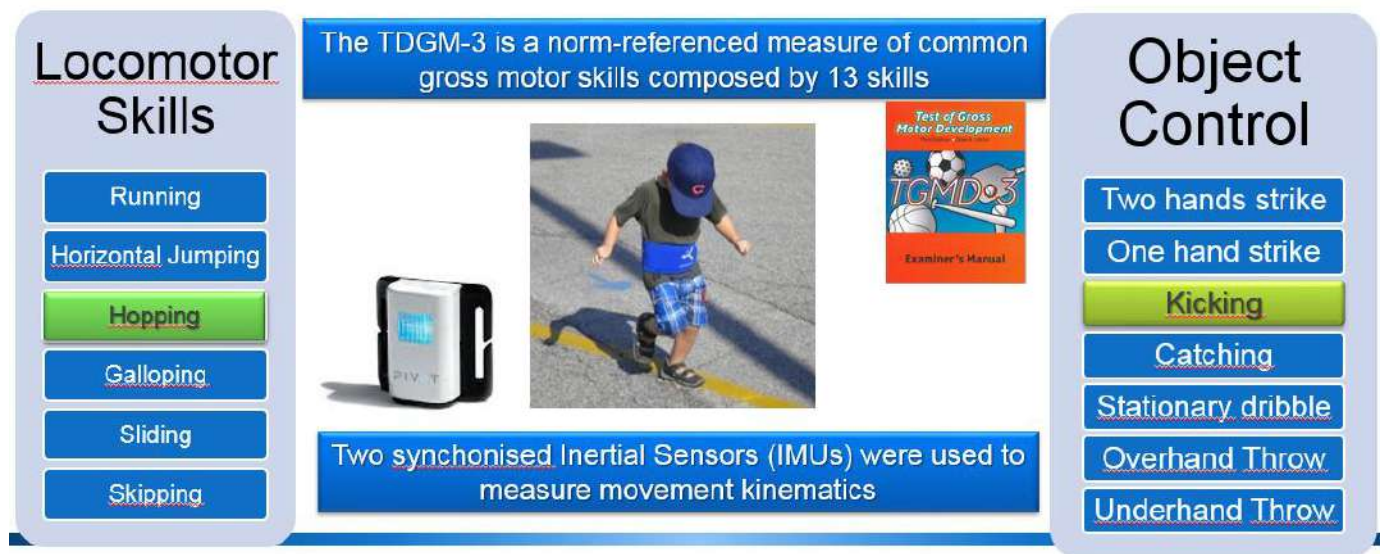


Fig. 1 ECSS 2021 Invited Symposia – Session ID- IS-MH03

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 K_v (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).

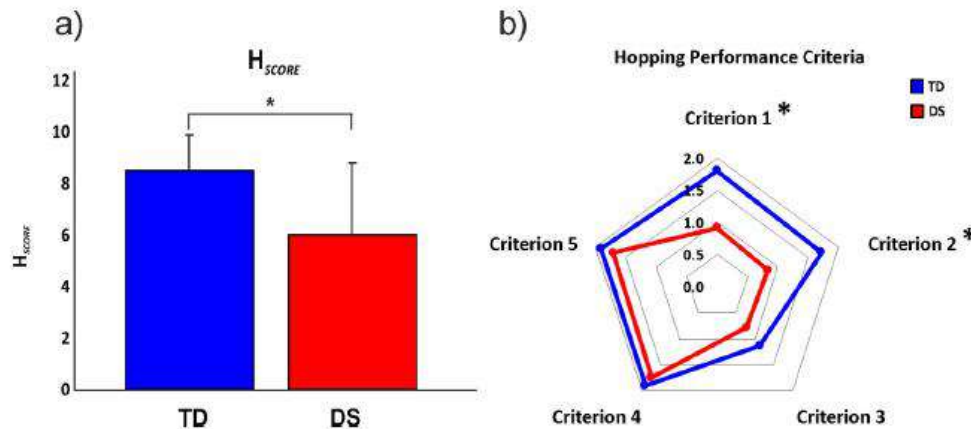


Fig. 2. a) Total hopping score obtained using the performance criteria of theTGMD-3 (H_{SCORE}). b) Individual performance criteria score – Criterion 1: Non-support leg swings forward in pendular fashion to produce force; Criterion 2: Foot of the non-support leg remains behind the body; Criterion 3: 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.

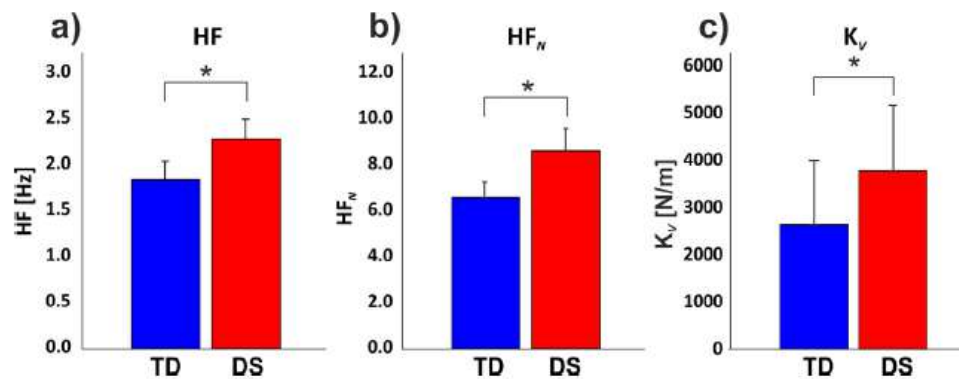


Fig. 3. a) Hopping frequency (HF) and b) normalized hopping frequency (HF_N) for DS (red columns) and TD individuals (blue columns).c) Vertical stiffness (K_v) reported for DS (red) and TD (blue) individuals during the hopping skill. *Denotes significant differences between the two groups. (For interpretation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

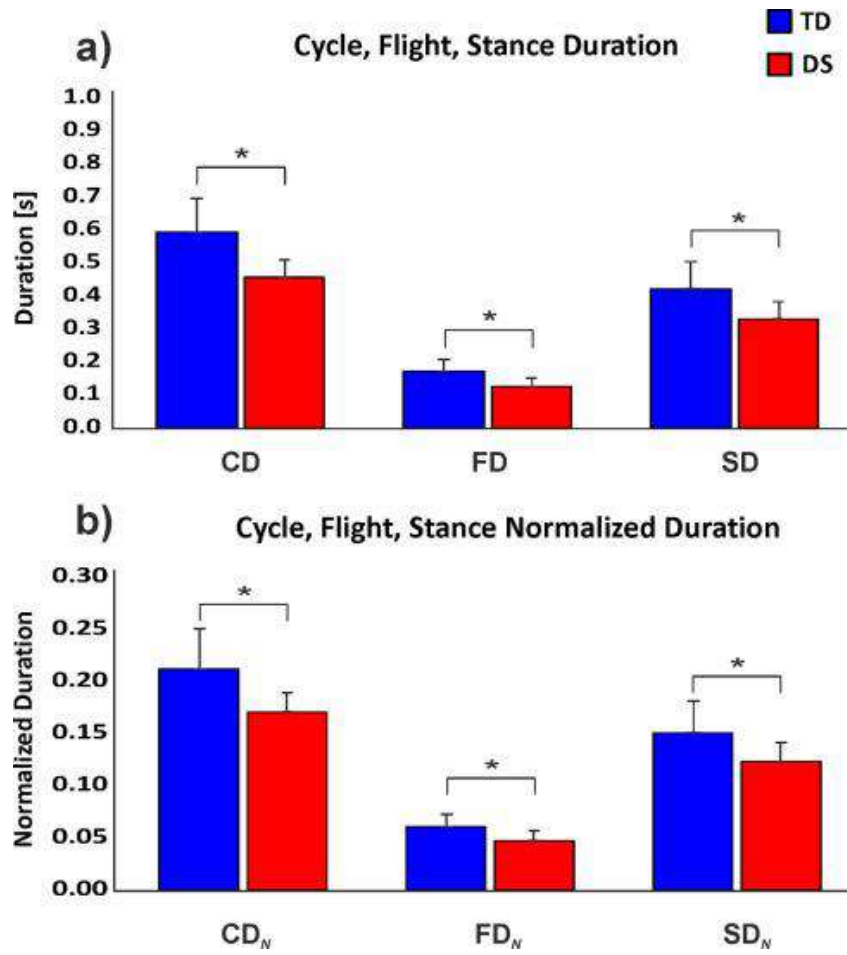


Fig. 4 a) Cycle (CD), Flight (FD) and Stance duration (SD) and b) normalized Cycle (CD_N), Flight (FD_N) and Stance duration (SD_N) for DS (red) and TD (blue) individuals. *Denotes significant differences between the two groups. (For interpretation of the references to color in this figure legend, the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

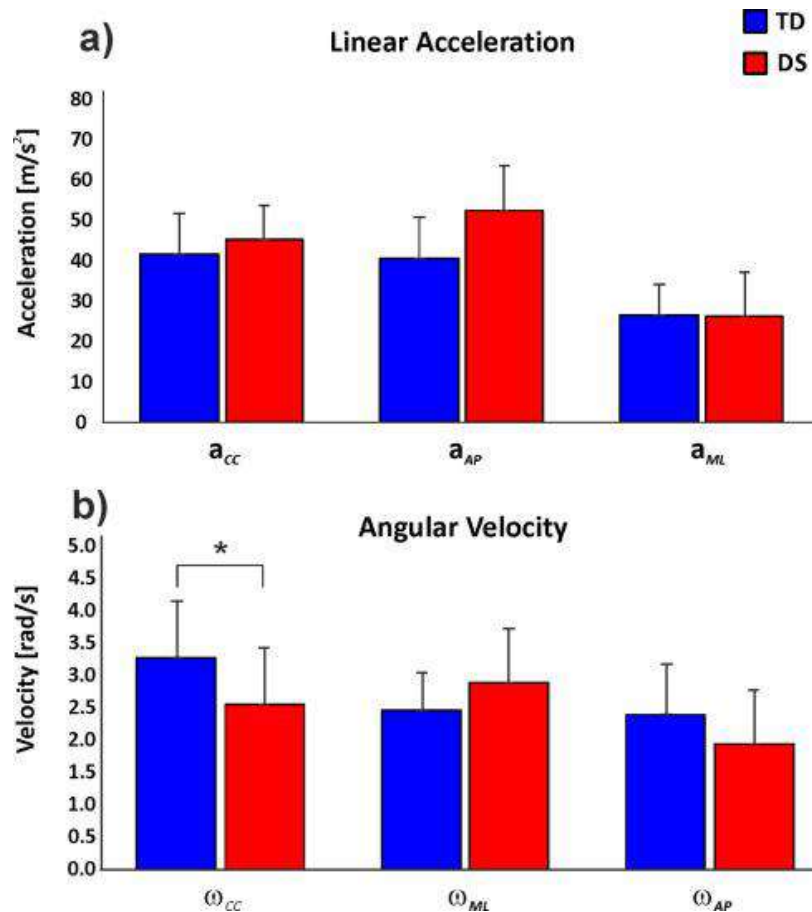


Fig. 5 a) Peak to peak linear acceleration on the cranio-caudal (a_{CC}), medio-lateral (a_{ML}) and antero-posterior (a_{AP}) axes reported for DS (red) and TD (blue) individuals b) Peak to peak angular velocity on the cranio-caudal (ω_{CC}), medio-lateral (ω_{ML}) and antero-posterior (ω_{AP}) axes reported for DS (red) and TD (blue) individuals. (For interpretation of the references to color 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.

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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.

1.2 Pre-Training assessment Results - KICKING

The following figures report the main results obtained as regards the Kicking ability compared between DS and TD individuals before and after 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?

Contents lists available at ScienceDirect
Journal of Science and Medicine in Sport
journal homepage: www.elsevier.com/locate/jams

Test of Gross Motor Development
Third Edition - Dale A. Ulrich
TGMD-3

Review
A hitchhiker's guide to assessing young people's motor competence:
Deciding what method to use
Farid Bardid^{a,b,*}, Giuseppe Vannozzi^c, Samuel W. Logan^d, Louise L. Hardy^e,
Lisa M. Barnett^f

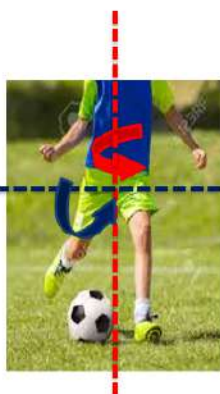
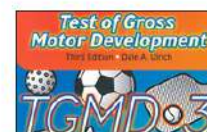


The example of kicking

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

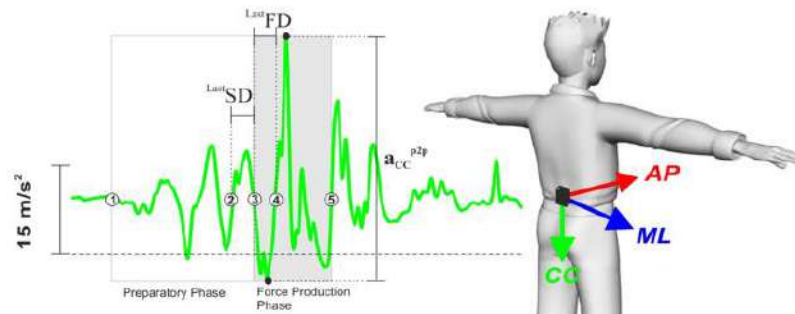
 *Quinzi et al, 2021, Human Mov Sci*
Quinzi et al, J Intellect Disabil, submitted

	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/m ²]*	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

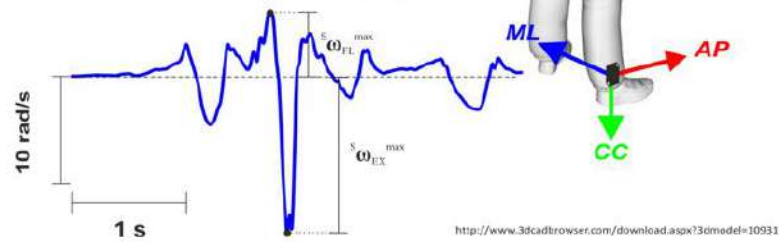
- Two trials for each locomotor and object control skills following TGMD-3 procedures

Kicking biomechanical parameters

Lumbar Cranio-Caudal Linear Acceleration



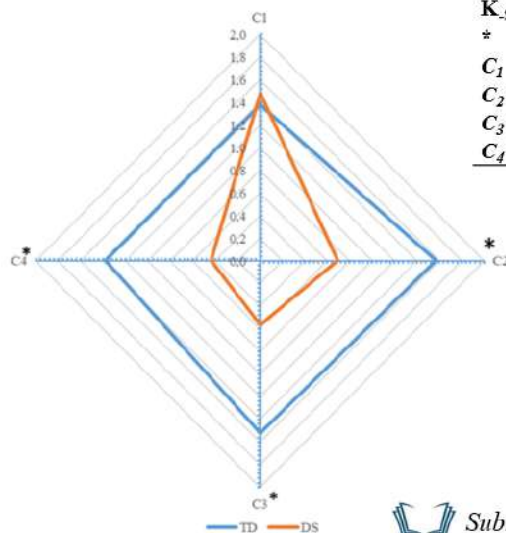
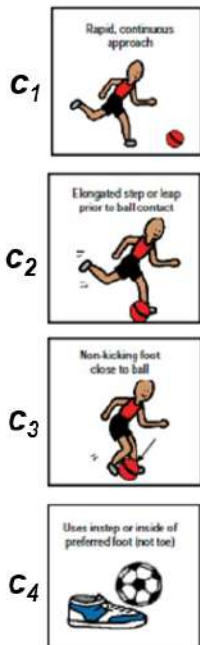
Malleolus Medio-Lateral Angular Velocity



<http://www.3dcadbrowser.com/download.aspx?3dmodel=10931>

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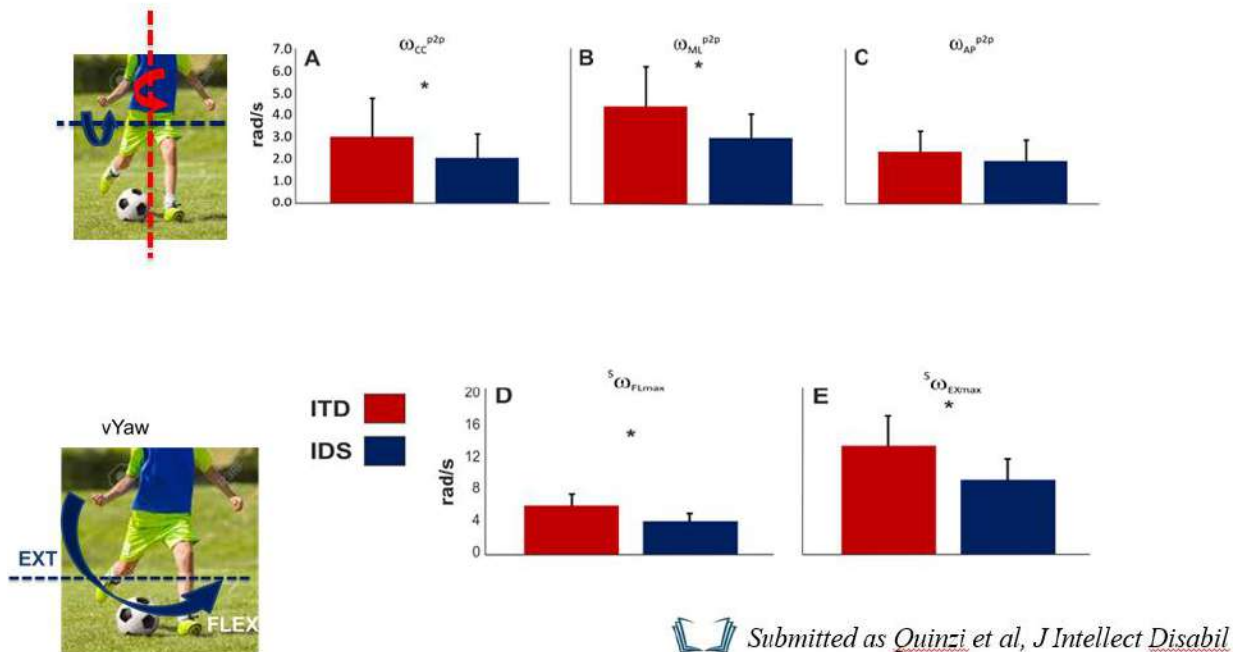
Results



	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



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.

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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.

1.3 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 (<i>n</i> = 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 6).

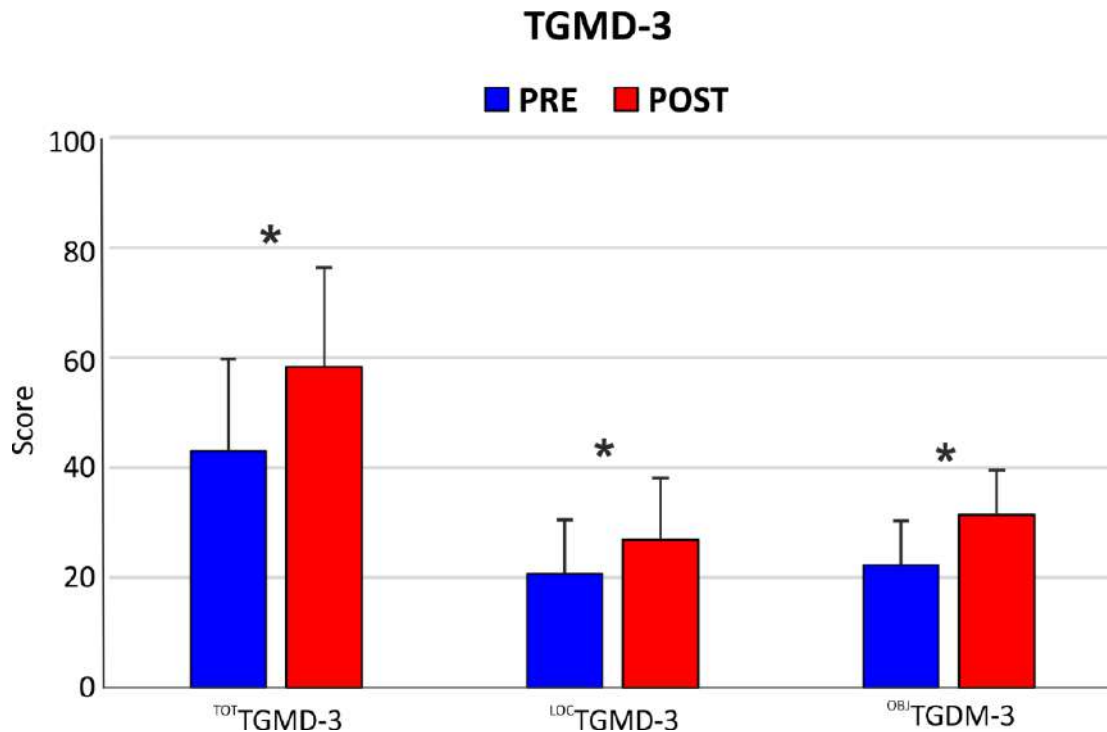


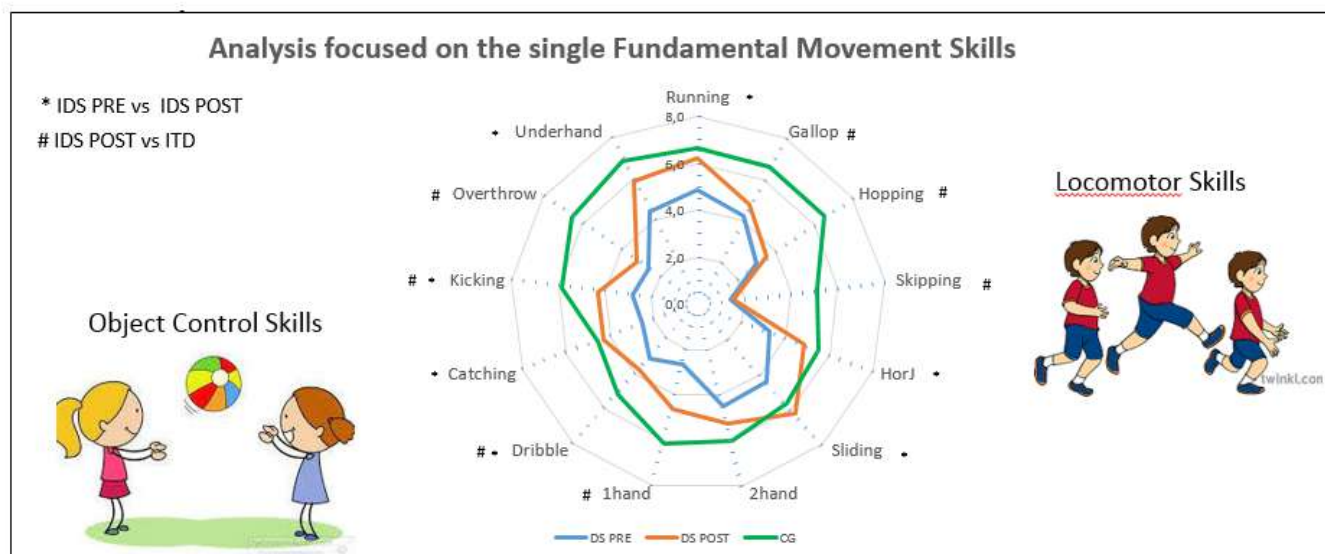
Fig 6. TGMD-3 Total, Locomotor, and Object control scores before (blue bars) and after (red bars) the adapted karate physical intervention. Data are reported as mean and SD. The significance level was set to $\alpha = 0.05$. Bonferroni corrected significance level was 0.016.

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%).

	DS-PRE (<i>n</i> = 37; 10F)	DS-POST (<i>n</i> = 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

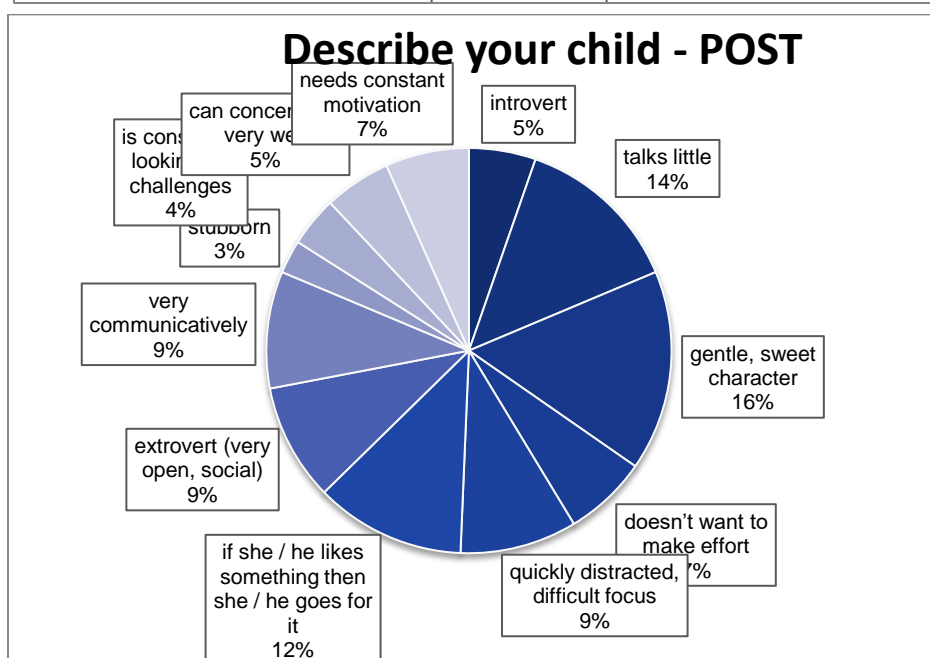
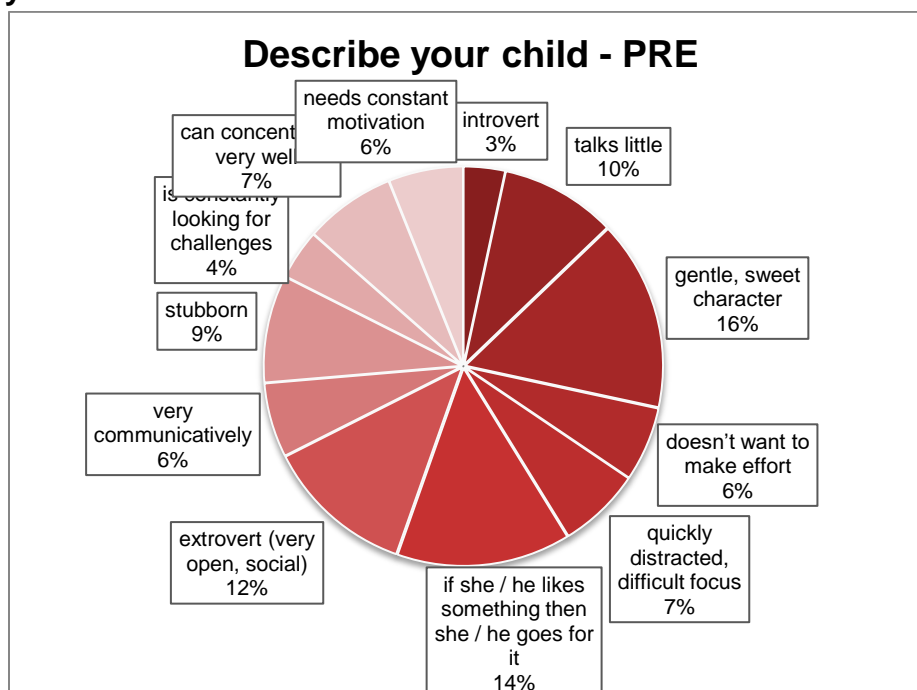
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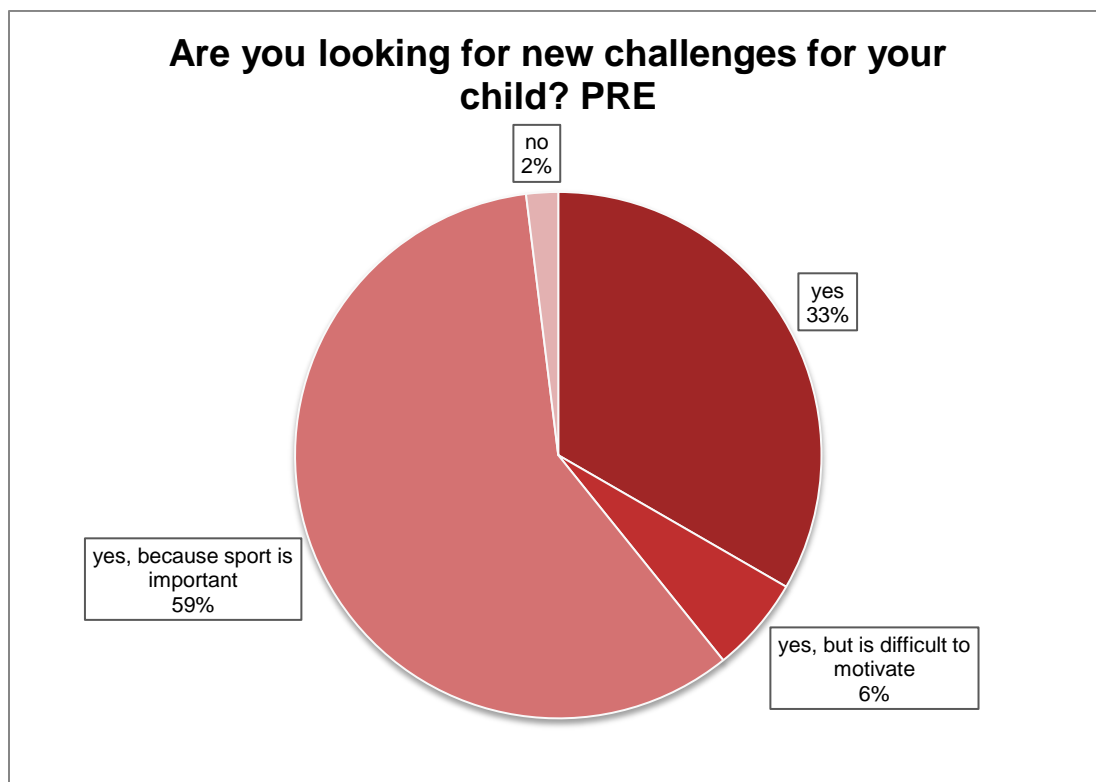
PARENTS' QUESTIONNAIRE

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

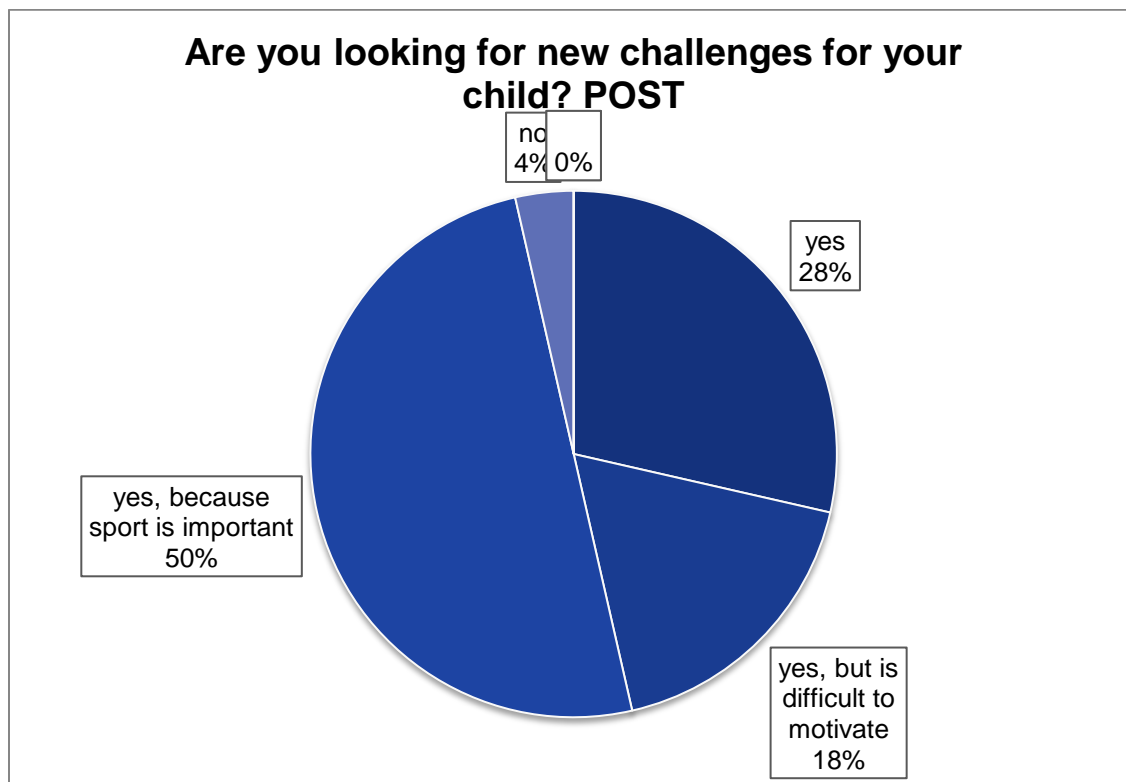
Q1 - Describe your child



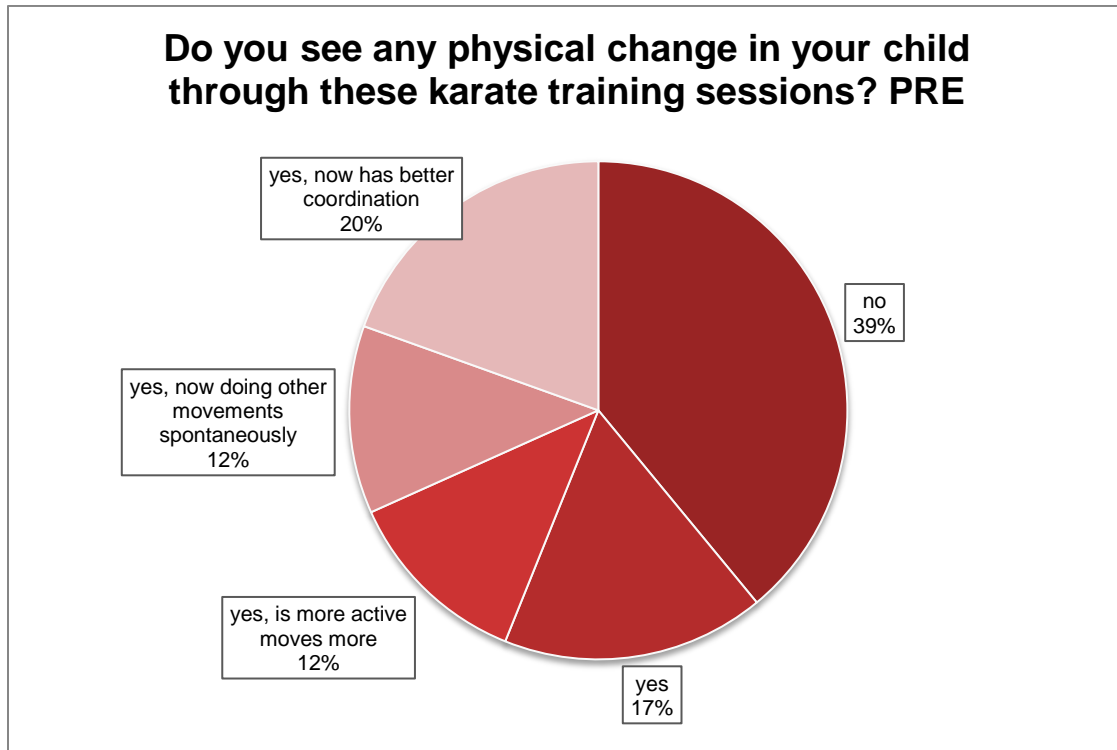
Q2- Are you looking for new challenges for your child?



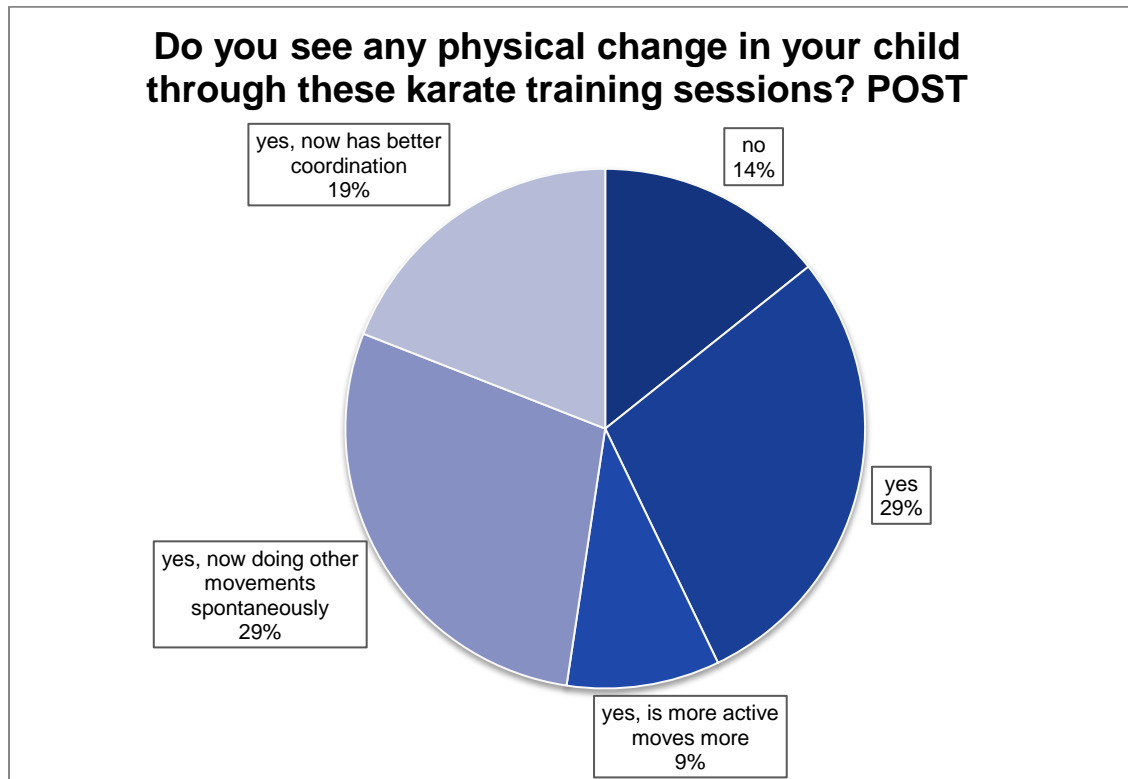
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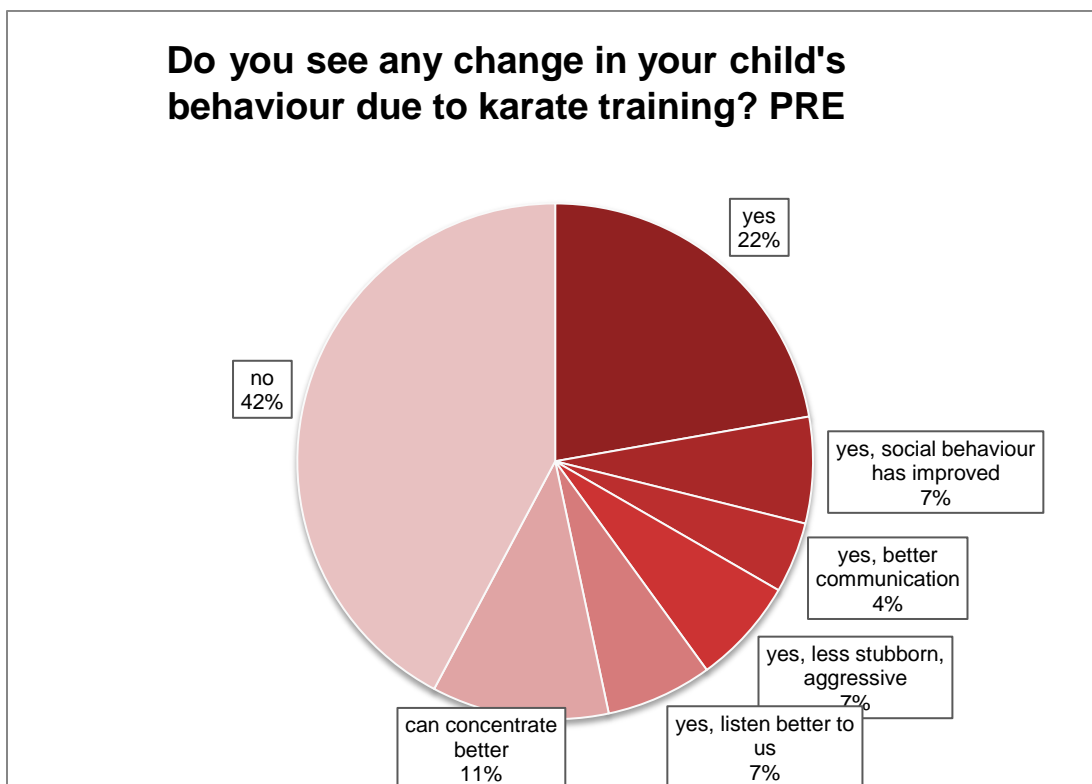
Q3 – Do you see any physical change in your child through these karate training sessions?



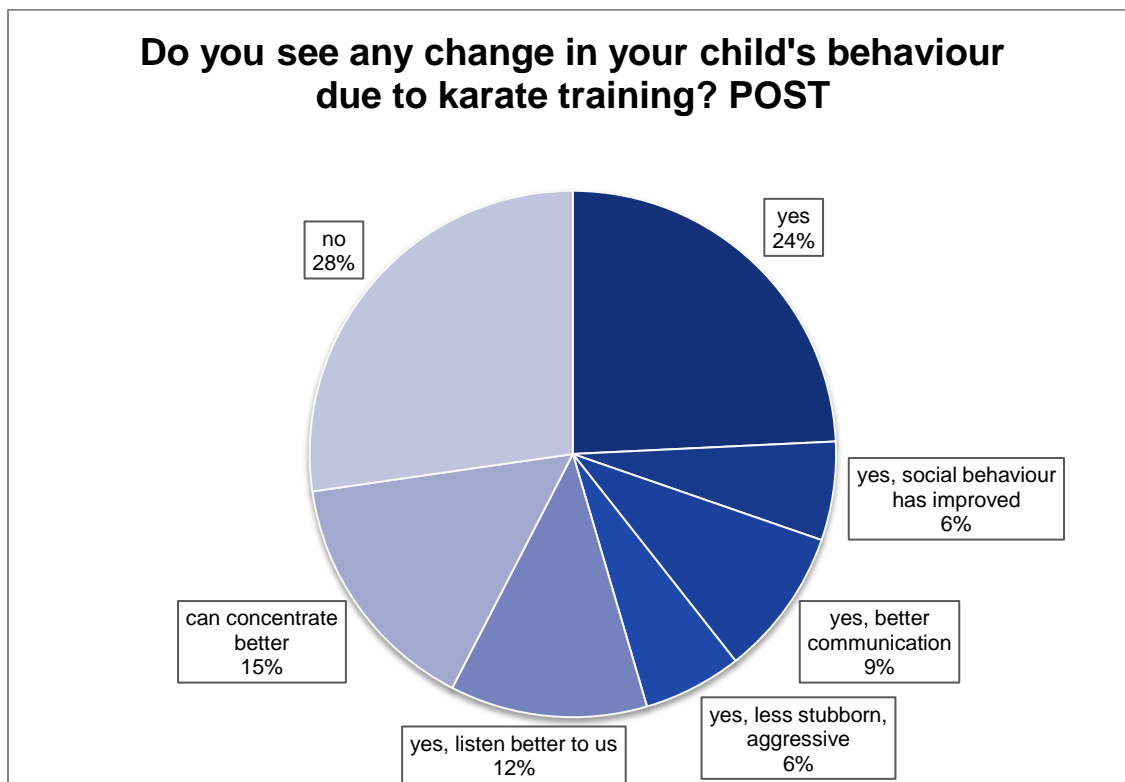
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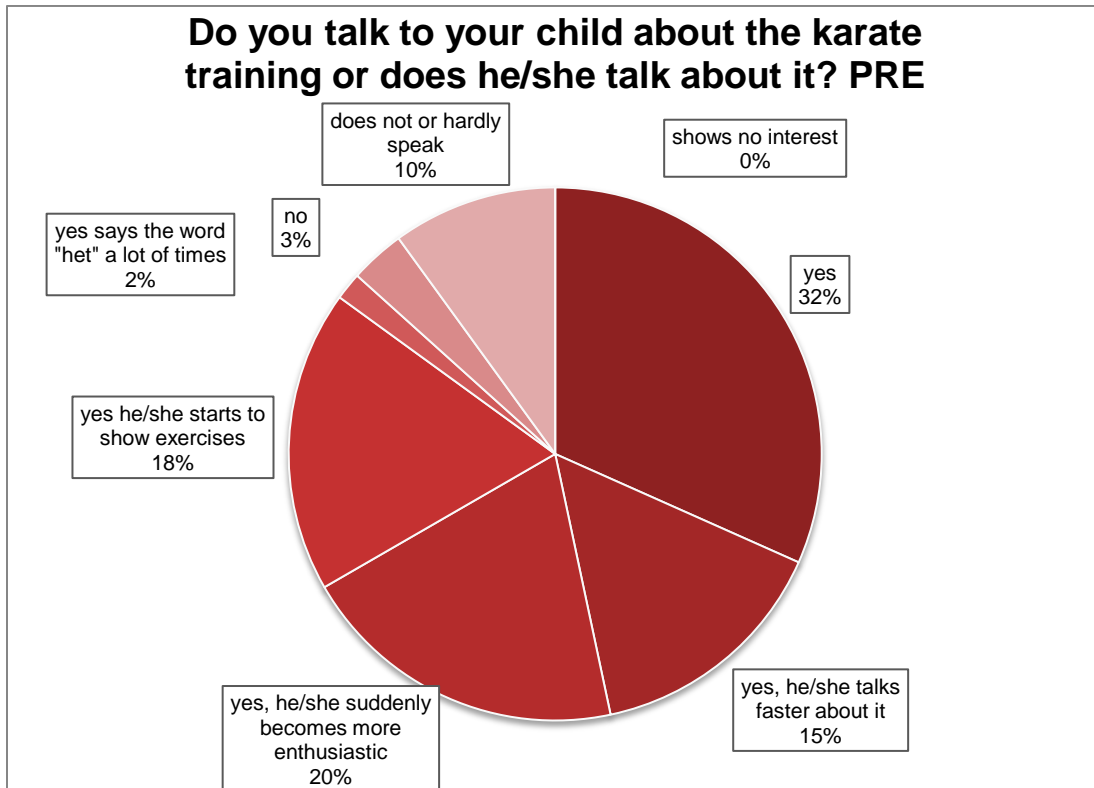
Q4 - Do you see any change in your child's behavior due to karate training?



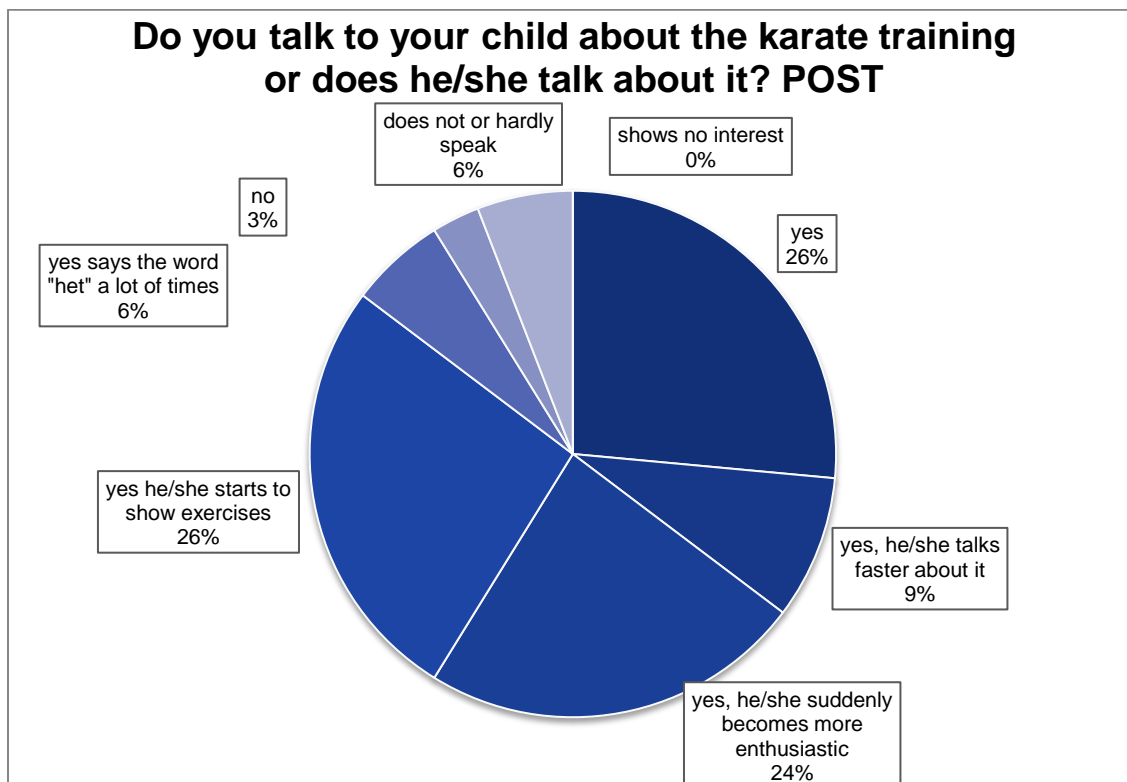
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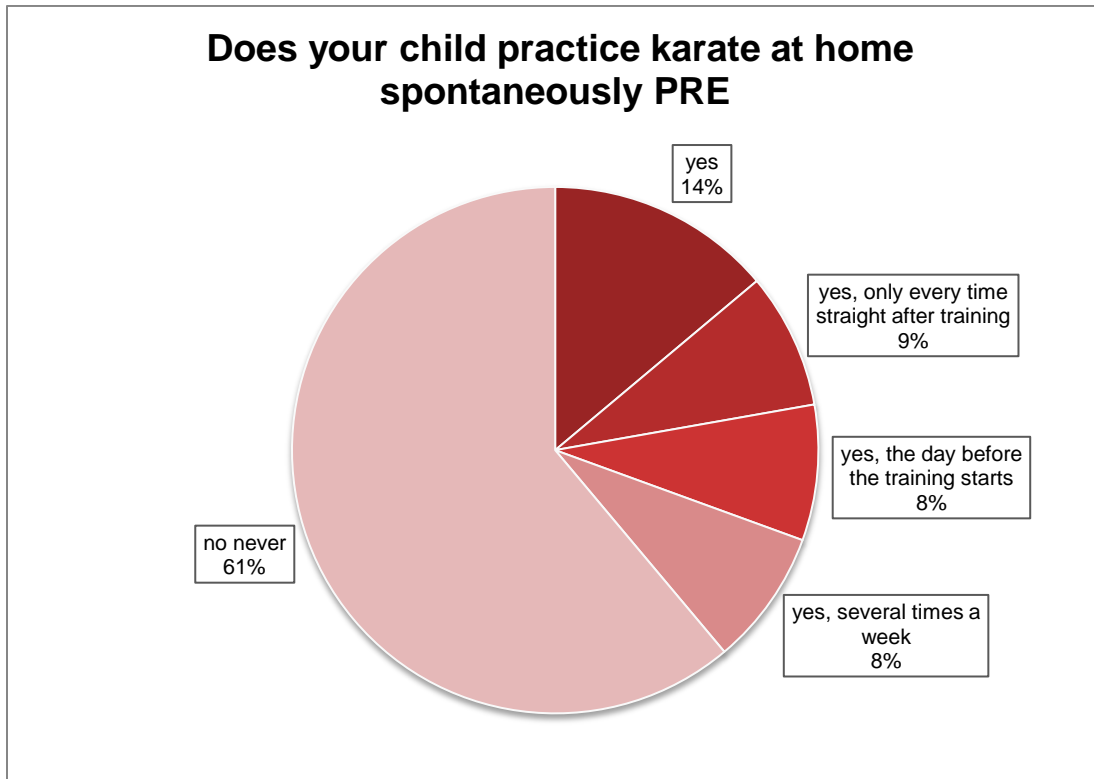
Q5 – Do you talk to your child about the karate training or does he/she talk about it?



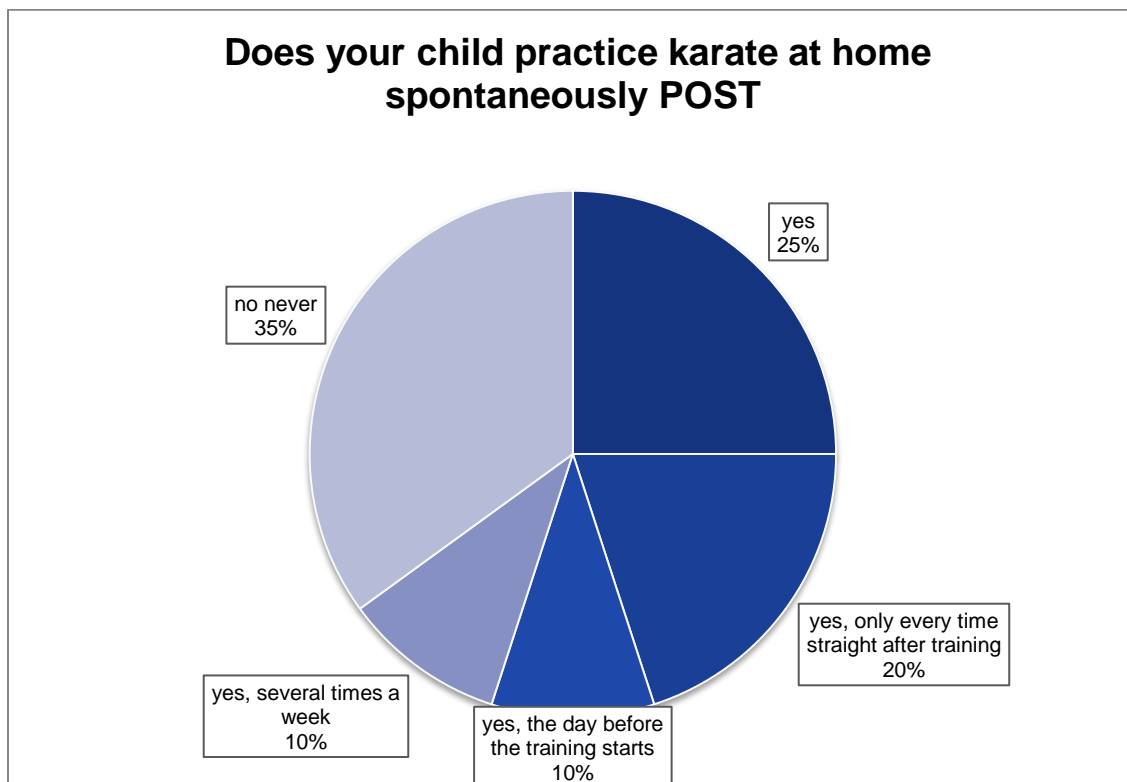
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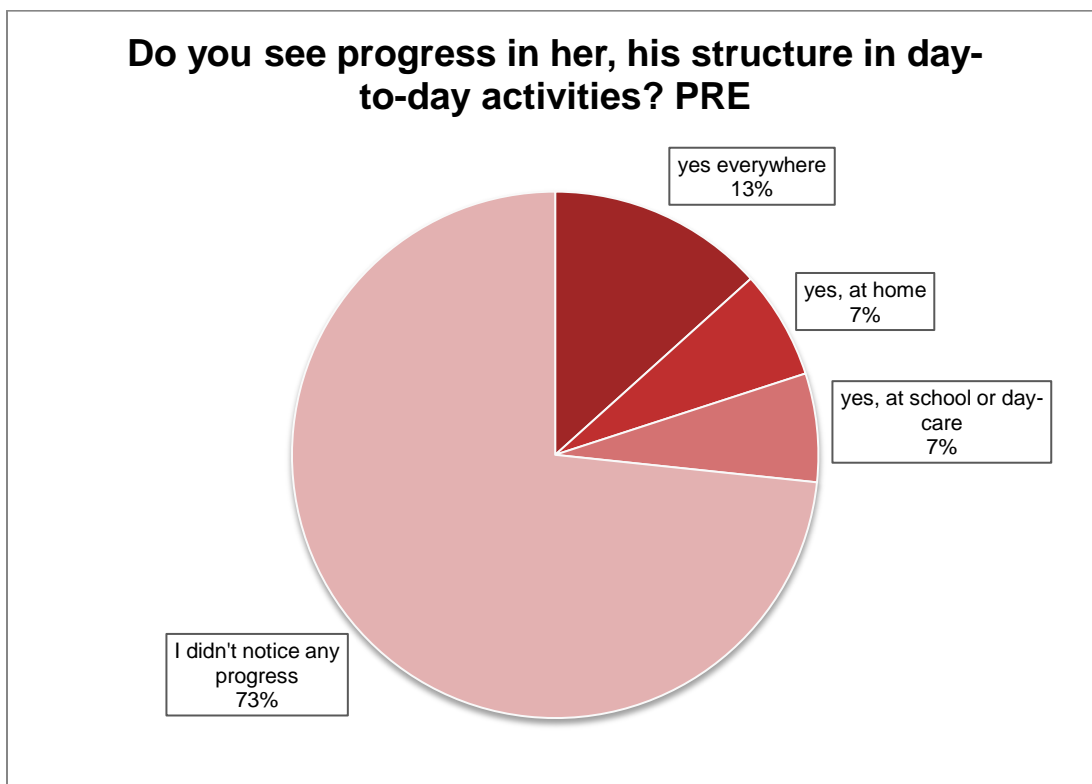
Q6 – Does your child practice karate at home spontaneously?



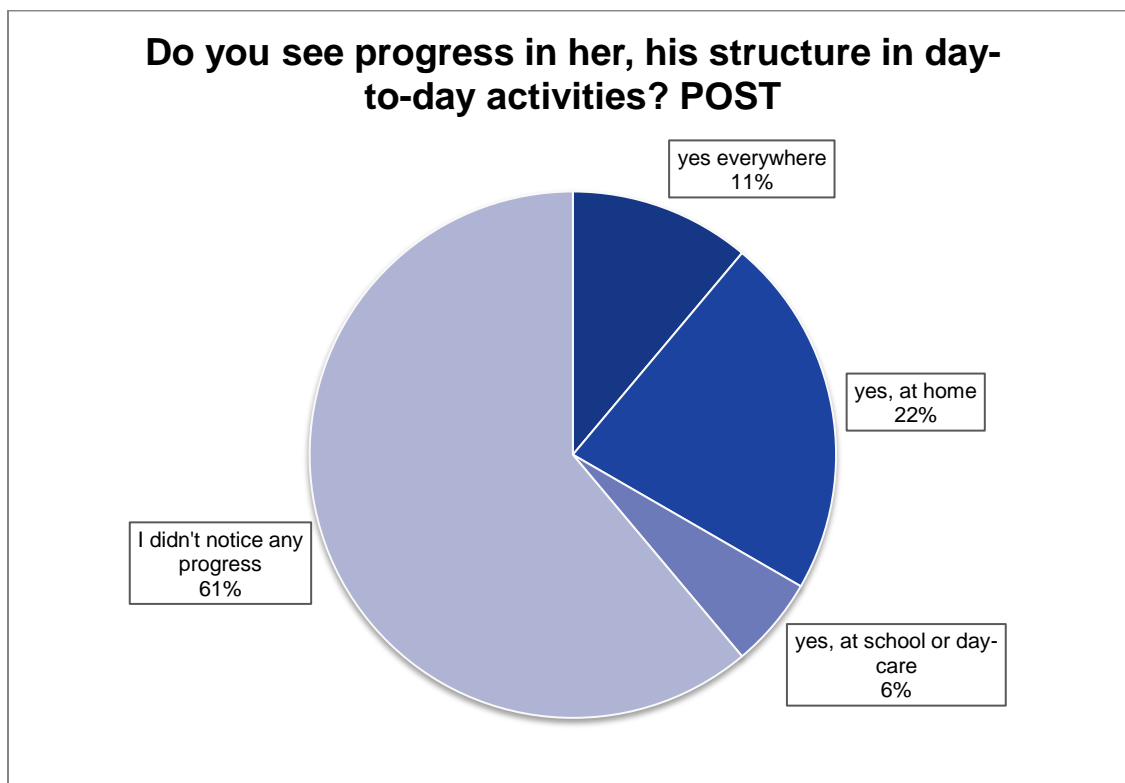
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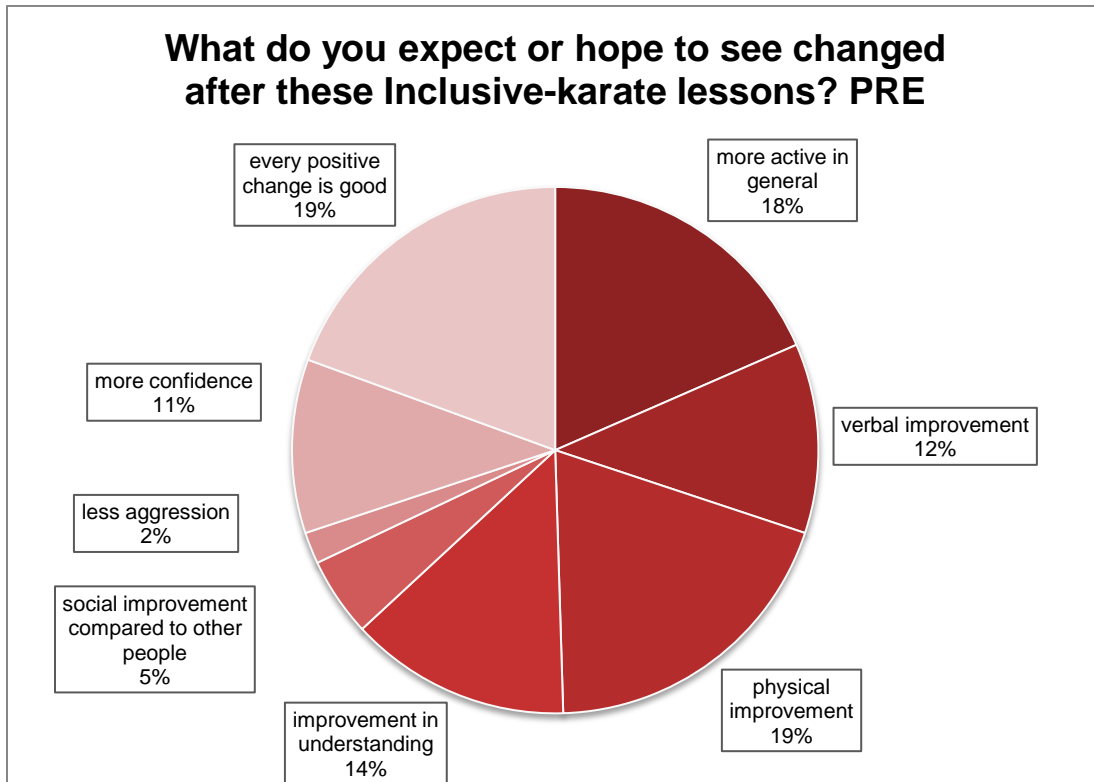
Q7 – Do you see progress in her/his structure in day-to-day activities?



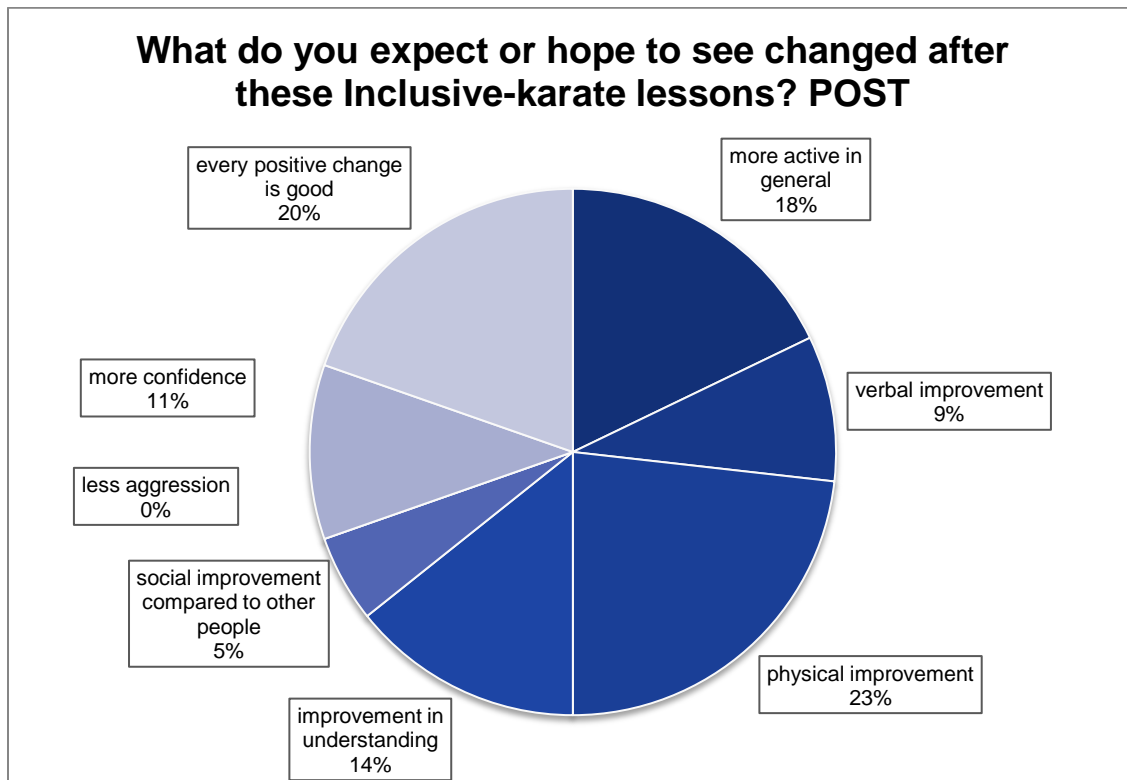
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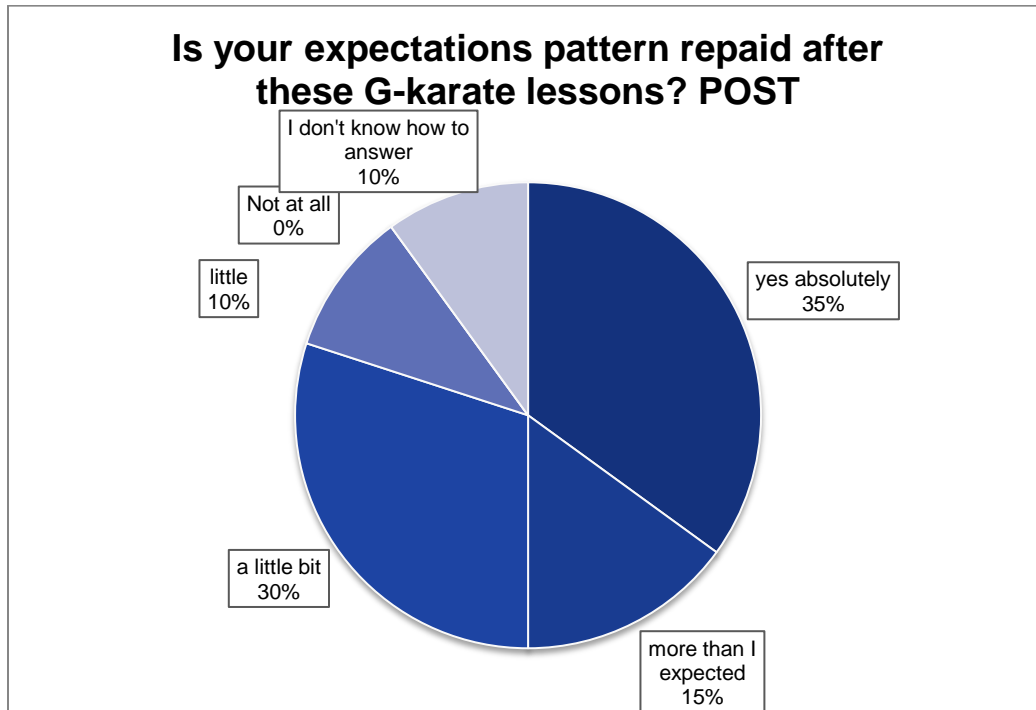
Q8 – What do you expect or hope to see changed after these inclusive karate lessons?



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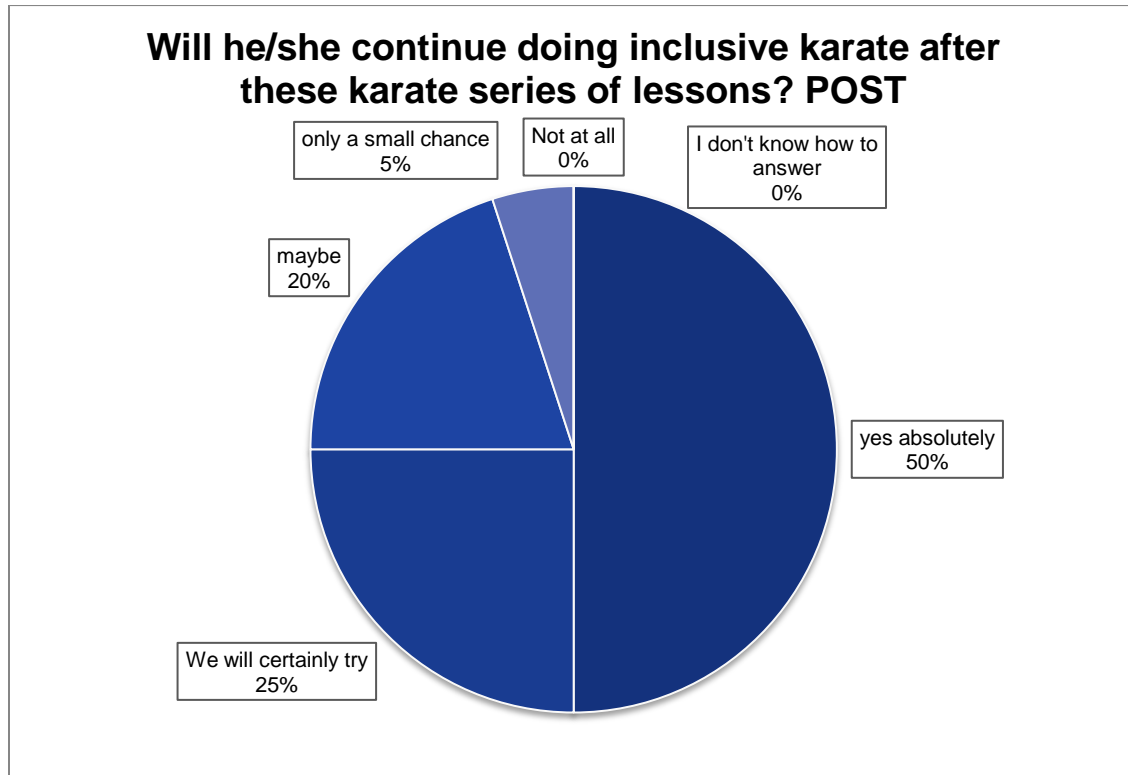


Q9 – Is your expectations repaid after these G-karate lessons?



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

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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.

Project partners have coaches have also collected some testimonies from participants' parents about the project training:

AUSTRIA

- I never thought that karate training would have such a big impact on my son Philipp. After only a short time, he began to speak much more, and now he even speaks in complete sentences, something he hasn't done for many years. Since then, he is much easier to understand and participates more in social life. His movement behavior has also improved significantly! This is really great! *Pia, mom of a participant.*
- Due to the worldwide Corona lockdowns, the training was unceremoniously switched to online, which worked great for most participants and made us very happy. Since then, my daughter has also become more independent in the digital world. She gets into the online training on her own and now writes emails, which is just great! Anina even took part in a world championship online and was able to impressively demonstrate her skills by winning 2 medals. *Gabriela Meusburger, chairwoman of the Vorarlberg Down syndrome working group.*

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BELGIUM

- Kris' swimming coach has put us in touch with this project. At first we were absolutely not convinced to participate in this project. Karate? We have already done so much for Kris his development, and a lot was a failure, what can he still learn was my question, Kris was 39 years old then? A conversation with Eric Bortels from IKFI brought clarity. The goal of the project was not only sports and exercise. The development of the whole personality was the ultimate goal. Both intellectual, social, and emotional skills could improve. We did not want to let this pass us by. We decided to participate in this project. Driving to the training place 2 times a week was the assignment. After a few weeks of training we saw no noticeable improvement. We did notice that Kris always was ready on time for every training and was happy that he could go to the karategroup. This was already the motivation for us to persevere. But eventually it didn't stop there. The first improvement we saw with Kris after months of training was his balance. Standing on one leg had never been possible, not even after all the exercises we had done with

Kris by ourselves. Now Kris can stand on his left or right leg without any help. (Chris demonstrates) Congratulations Kris.

A second improvement was concentration. In the beginning, during class, you saw his attention decrease after 15 minutes. The switch to digital classes was initially a test of concentration. Now Kris can perform and focus on the exercises correctly during the entire karate session of 50 minutes.

A third improvement : Due to the system of the red and blue straps on the wrist, kris has improved his feeling for right and left. Applying red and blue straps to his bicycle has made cycling with the family simplified and safer. It is now clear for Kris witch side to turn.

Also the social enviroment, practicing in group, feels very nice for Kris. The group dynamics give him energy to persevere.

In summary, as a parent, I can say that we are happy that we accepted the invitation to participate in this Erasmus Project IKONS. The most important thing is that Kris has taken another step forward in his development. Thanks to the trainers and all the staff. Participants give yourselves a tremendous applause. *Father of Kris.*

- Niels then 17, is a boy with not only Down syndrome, but also with a half-sided paralysis (hemiplegia) after a stroke at the age of 7 years. Niels did not do many sports, had been given physiotherapy 2 to 3 times a week for years.

I let him participate in the Erasmus project in the hope that he might do some more sports.

He himself was only moderately enthusiastic. After the first training, the enthusiasm was already a bit bigger with him, I thought he would never be able to practice this sport, that it would be too difficult for him with his disability. But his enthusiasm grew week after week, and I too began to see changes in the movement of his left arm. Sticking his arm in the air and stretching was otherwise very difficult and only with the help of the physiotherapist.

After a few weeks of karate training, we suddenly saw that this went much smoother and that he also spontaneously started to do so during other activities. The physiotherapist was also impressed. Slowly on, we saw more and more positive changes such as his seriously improvement of the balance. Then, before he started the training, he could hardly maintain a balancing act with the physiotherapist for 5 counts, after a few months of karate he could already keep the same exercise for 60 counts. A physiotherapist, who had not seen him for a while and did not know that he was doing karate, was very surprised.

The only thing that had changed were the karate training that Niels followed. After this we saw small improvements in his movements again and again, his motivation to practice also got bigger and bigger. It was also very good to see that he really made an effort to stretch his arm while practicing. He also started practicing movements spontaneously, more and more and asked regularly to set up training videos so that he could train more.

After the holidays, and therefore no training sessions, we clearly saw that it took much more effort to stretch his arm. After the completion of the project, Niels' motivation was so big that he now continues to practice this sport.

Since this year he has started training even more often, on the one hand because he likes it very much, on the other hand because the physiotherapist advised this because this is clearly an added value for his motor skills and his self-confidence. For us, this Erasmus project was a great success, both in terms of sports, motor development skills and social level. *Mother of Niels.*

HUNGARY

Because of karate training, the family's schedule had to be reorganized, but because of the positive return on lessons, it was much more profitable than giving up.

The very good, familiar, relaxed atmosphere of the classes made it very easy for both Máté and ourselves to attend. So far, this was the first exercise that he even went to sleep voluntarily, dutifully, with joy at first, although I was afraid of it at first because Máté du used to be tired and fell asleep regularly in the car. The trainings greatly increased his self-esteem, giving him a sense of success every hour, to which a lot of praise, motivation, a positive attitude and patience during the lessons contributed a lot. His self-discipline and sense of duty developed a lot, for whatever day he had before, he always got up on the carpet and tried to give his best. He has increased self-confidence (he regularly looks at his muscles biceps, abdominal muscles).

The workouts were also affected by my ability to concentrate and remember, although I can't prove these things, but I feel like I had to learn so many complex and different exercises that we wouldn't have even dared to think about during the first workouts. Proud of you, leave karatézik, it's a good influence on the self-confidence and good to the rest of karate is such an enthusiastic and pulled each other up, which I'm glad separately because Matthew's school , most children - I'm sorry, it's really no harm in to them - worse capabilities has, which slowed down its development greatly as the curriculum was adapted to them . We are especially happy that you work with full effort and concentration during almost every workout, sweat well, the physiological effects of which you will be better able to describe and how much the complex, crossed, complicated large movements help to coordinate the hemispheres and develop memory, movement coordination. (Strong exercise, sweating strengthens the immune system, has a good effect on circulation, detoxification, sorry, the naturopath got out of me a little bit) except for chickenpox since then . I am also very happy that he started to dissolve, open to the other children as well, a couple of bad effects for him before, but now he feels that he belongs here, part of the community! And the race before Christmas was as good as the enthusiasm and joy the kids had at the time. It was good that he had to overcome his excitement and received positive feedback, "won" clothes and medals, so he would start challenging tasks more boldly. But this also applies to workouts in general, because of the many positive feedback, he starts to do new things much more boldly, now I notice when studying at home and I don't mind if I have to repeat things over and over again, try to perfect the tasks again and

again. . Increased endurance and ability to concentrate for longer. (We almost always press 1.5 hours of learning at a time, which we admit wouldn't be easy for adults either)

And super, really every parent and companion turns to every child with so much love and help, it feels really good for everyone. It is good that they are also involved in the training, I think it is also very good for their souls. It feels good to be able to do something for the kids and They also get positive feedback. (Thank you so much!). *Mom of Máté.*

ITALY

- Fabrizio participates in the lessons with pleasure and seriousness. He is satisfied with what he learns because he realises that he has mastered his movements and therefore, feels more confident in everyday life. He proudly enjoys talking and showing what he learns at lesson to family and friends. We, as parents, are very happy with the improvements he has made so far and we hope that the project can continue also in the future. *Mom of Fabrizio.*
- Filippo loves taking his Karate classes. He is committed to follow the coach's instructions and he tries to copy the movements with passion and joy. We believe that these exercises help him to increase his listening and attention skills. *Agnese and Fabrizio, parents of Filippo.*
- I just want to share Jacopo's words first: „What a great experience! I had a lot of fun also with the zoom lessons where I met a lot of nice people. A very positive balance. I learned Kata and I also do it on my own and I learned how to say HET and also to jump!“. This karate course has been a real surprise for Jacopo, it has helped him a lot in the coordination of his movements, to be more dynamic and less lazy in doing things and also to be less shy and to have more confidence in himself. A very, very positive experience. *Mom of Jacopo.*

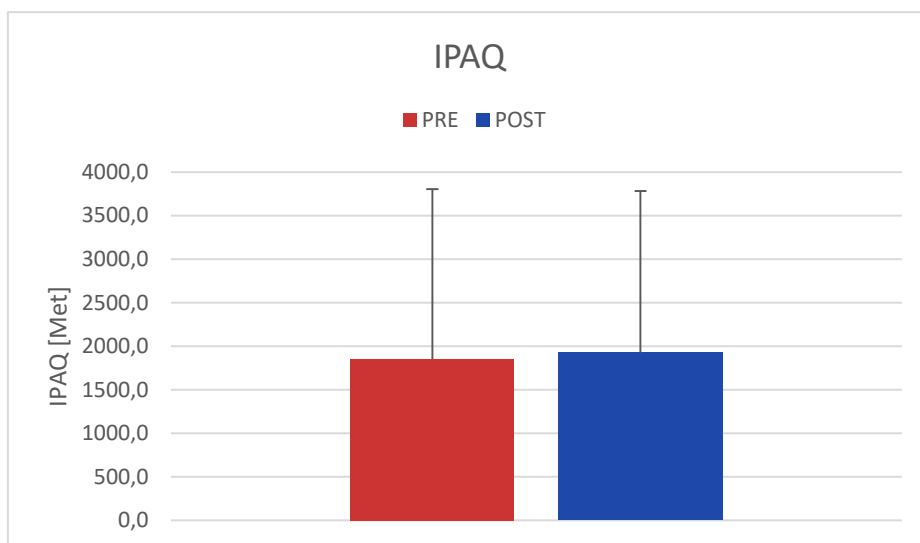
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ROMANIA

- Karate classes excited Kati (Ecaterina) and helped her a lot emotionally. Unfortunately, due to the pandemic of the Corona virus, the classes were held online, which made our access a little more difficult. However, Kati is excited when she talks about karate classes and she really wants to continue. *Mom of Ecaterina.*
- Albinel has wanted to do karate for many years and now with this project his dream has come true. He loves karate training and course interaction and wanted to train more and more. Since doing karate, the flexibility of the articulations has increased considerably, it feels good, it has a wonderful tone. Sometimes he repeats at home, using the learned movements, which helps him a lot. We can't wait for the pandemic measures to relax so that Albinel can meet with his colleagues and be able to resume your training. *Cousin of Albinel.*

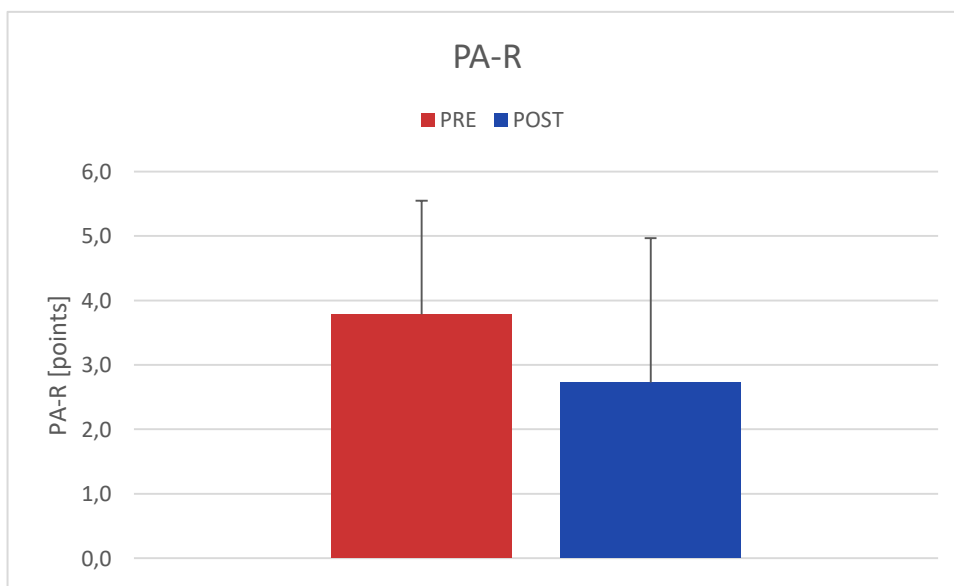
PHYSICAL ACTIVITY QUESTIONNAIRES (IPAQ, PA-R)

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.



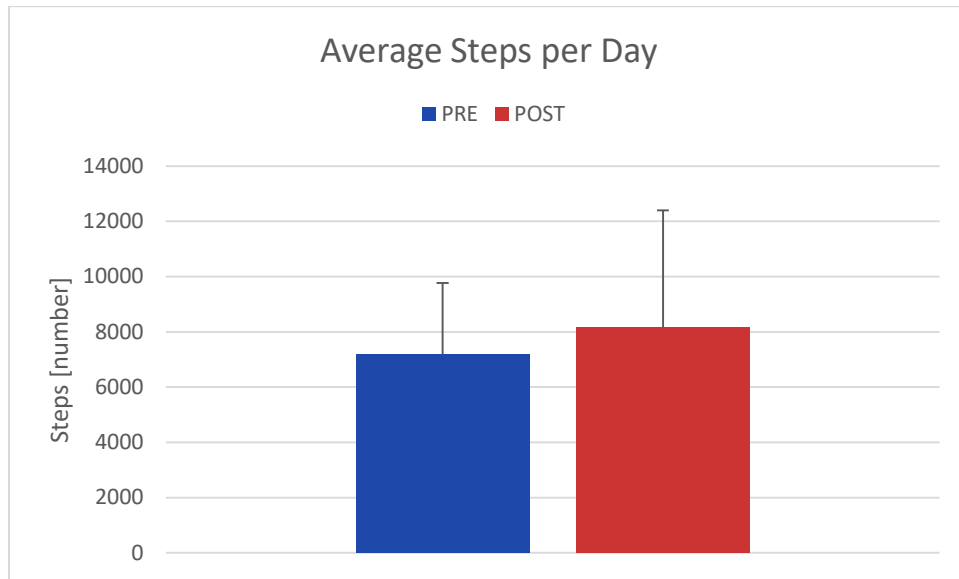
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The statistical analysis performed on the international physical activity questionnaire showed no significant results of the training program on the amount of physical activity of the participants. Student T-test $p = 0.92$)



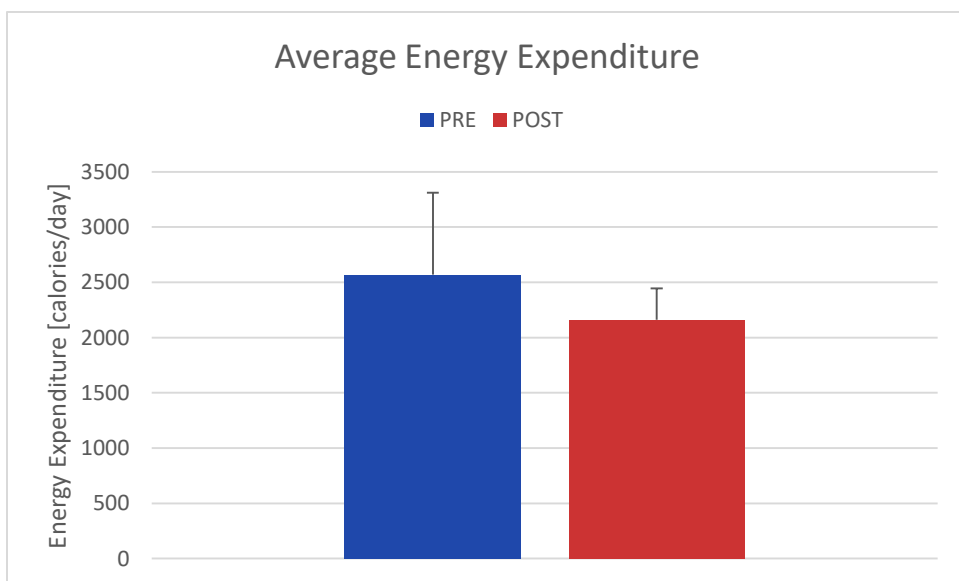
PHYSICAL ACTIVITY MONITORS (Fitbit watches)

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



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



PUBLICATIONS & INTERNATIONAL CONFERENCES LIST

FULL PAPERS

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. 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.

