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Estado nutricional y equilibrio motriz en estudiantes con síndrome de Down para la inclusión a la clase de educación física

Nutritional status and motor balance in students with Down syndrome for inclusion in physical education class

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Palabras claves:
inclusión, test ktk, síndrome de down, estado nutricional, gasto energético, equilibrio, psicomotricidad.

Resumen

Introducción: el síndrome de Down es un desorden genético atribuido a una anormalidad cromosómica, que muestra una serie de síntomas físicos y cognitivos que surgen como efecto del síndrome específicamente, uno de los principales efectos es la falta de equilibrio que se genera en los sujetos que presentan esta condición, así como, condiciones de obesidad o sobrepeso. **Objetivos:** para el presente estudio se plantea como objetivo determinar el estado nutricional y el equilibrio motriz en estudiantes con síndrome de Down. **Metodología:** la metodología del caso de estudio de una estudiante del décimo año básica de una institución educativa. Es un estudio descriptivo tomando en consideración la recopilación de ingesta energética nutrimental y gasto energético por recordatorio de 24 horas y la aplicación del test KTK para la medición del equilibrio. **Resultados:** como resultados se obtiene un grado de sobrepeso del sujeto de investigación según la tabla de curva del IMC para niños con Síndrome de Down, y falta de equilibrio según los resultados presentados por el test aplicado. Se establece una propuesta de un sistema de ejercicios físicos y talleres de "escuela para padres" para inducir una adecuada nutrición para el sujeto de investigación. **Conclusiones:** el análisis de gasto energético y gasto calórico está modificado por el condicionamiento del síndrome que presenta el sujeto de investigación, lo que implica que su esquema corporal específicamente el desarrollo de su equilibrio se vea afectado significativamente; sin embargo, dentro de las características del síndrome de Down se pueden generar un margen de afectación en el equilibrio a partir del grado de sobrepeso que presenta el sujeto. **Área de estudio general:** Ciencias sociales-Pedagogía de la Cultura Física. **Área de estudio específica:** Educación Física Inclusiva **Tipo de estudio:** Estudio de Caso.

Keywords:
inclusion, down's syndrome, nutritional condition, energy expenditure,

Abstract

Introduction: Down syndrome is a genetic disorder attributed to a chromosomal abnormality, which shows a series of physical and cognitive symptoms that arise as an effect of the syndrome specifically, one of the main effects is the lack of balance that is generated in the subjects who present this

balance, psychomotor skills.

condition, as well as obesity or overweight conditions.**Objectives:**The objective of this study was to determine the nutritional status and motor balance of students with Down syndrome.**Methodology:**the methodology of the case study of a tenth-grade student of an educational institution. It is a descriptive study taking into consideration the compilation of nutritional energy intake and energy expenditure per 24-hour reminder and the application of the KTK test for the measurement of balance.**Results:**The results show a degree of overweight of the research subject according to the BMI curve table for children with Down Syndrome, and lack of balance according to the results presented by the applied test. A proposal for a system of physical exercises and "school for parents" workshops is established to induce adequate nutrition for the research subject.**Conclusions:**The analysis of energy expenditure and caloric expenditure is modified by the conditioning of the syndrome presented by the research subject, which implies that his body schema, specifically the development of his balance, is significantly affected; However, within the characteristics of Down syndrome, a margin of affectation in balance can be generated from the degree of overweight that the subject presents.

Introduction

Down syndrome is a genetic disorder attributed to a chromosomal abnormality(1). That is, the presence of all or part of an extra chromosome in the 21st pair of these; it also shows a series of physical and cognitive symptoms that arise as an effect of the above. According to the National Institutes of Health (2), there are three types of Down Syndrome based on the distribution of this extra chromosome: Complete trisomy 21, mosaic trisomy 21 or "mosaicism" and trisomy 21 by translocation.

Diet and physical activity in people with Down syndrome play a fundamental role in their health status. From birth, people with Down syndrome have certain characteristics and barriers that hinder their path to proper nutritional status and beyond their visual, cognitive and auditory needs, hormonal and nutritional disorders caused by anomalies in the digestive system, their growth and development differs from that of children with a specific chromosomal distribution for the species, characterized by short stature, weak

muscle tone and a prevalence of overweight and obesity more marked in adolescence and adulthood.(2,3,4).

Obesity is a chronic disease that, according to the World Health Organization, can be defined as an abnormal or excessive accumulation of body fat due to a positive energy balance, which particularly affects children and adolescents with Down syndrome, in whom there is a marked decrease in the speed of growth and development, which manifests itself in a shorter stature than their peers, which, together with a sedentary lifestyle due to personal, family and/or social conditions, increases the predisposition to being overweight, in addition to genetic factors that determine a decrease in the metabolic rate and a tendency to suffer from hypothyroidism.(5.3).

In recent decades, obesity has been increasing alarmingly in the child and adolescent population, compromising health and well-being and currently constituting one of the main public health problems. However, this pandemic is poorly studied in specific populations, such as people with Down syndrome (5,7).

Overweight and obesity in adolescents with Down syndrome affects approximately half of the population and can lead to other concomitant health problems such as cardiovascular disease, dyslipidemia, systemic arterial hypertension (SAH), obstructive sleep apnea syndrome (OSA), among others. In addition, overweight and obese children have a higher risk of becoming obese adults.

However, obesity is avoidable and it is important to adopt good habits at home, such as not eating foods saturated with fat, chocolates, fizzy drinks, sausages, sweets, etc. and increasing physical activity. Remember that children learn from the example of adults, and it is advisable not to have unhealthy foods at home.(6).

Methodology

A specific quantitative case study of a 13-year-old girl with Down syndrome is presented.(7), who is in the 8th grade at the La Pradera Educational Unit located in the city of Manta. Information is collected on nutritional energy intake, daily energy expenditure and anthropometric measurements, height and weight, with which the BMI was determined and its evaluation was carried out according to the growth tables for children with Down Syndrome from birth to 18 years of age in Sweden. 2002. established by the National Institute of Food and Nutrition.(8).

Regarding the Energy-Nutritional Assessment, the contribution of macronutrients and food energy is considered, which is determined by a 24-hour recall of the Daily Food Ration (RDA), on three alternate days, two during the week and one on the weekend.(9), and its subsequent assessment using the automated Ceres+ system(10).

Total Energy Expenditure (TEE) is detailed from the 24-hour activity diary, with the same regularity as the nutritional energy assessment. To process the information obtained, the calculation of the energy expenditure per activity is carried out, multiplied by the weight (kg) by the factor corresponding to it and the number of minutes spent in each activity developed, generating the result from the sum of the values obtained. (11).

In addition, the TMB was determined according to the formula proposed by the WHO, FAO(12).

$$TMB= (12.2*P) + 746$$

Which also allowed us to calculate the Physical Activity Level (NAF)

$$NAF=GET/TMB$$

The KTK test is used as a reference for the assessment of the balance of the case. It is standardized and allows for quantitative data collection, as well as control of variables in defined situations and comparison of results defined at different times of its application. The test was used to assess the balance of the subject of the study at the same time as taking anthropometric measurements.

The test uses the same coordination tasks for all ages. However, the content of these tasks has different levels of difficulty, i.e. the older the participants, the more demanding they are. Thus, age differentiation is established according to criteria such as: increased height or distance; increased speed; better precision in the performance measured, for example, the ratio of attempts/successes.(13).

Data analysis

Statistical analysis was performed using the Excel program, determining the arithmetic mean (M) as descriptive statistics of central tendency, and the standard deviation (SD) as variation, presented as M(SD), and the coefficient of variation (CV%).

Validation

A theoretical validation of the proposal of the system of activities for the inclusion of the student with Down syndrome was carried out by expert criteria using the techniqueDelphi (14), it was determined for this purpose:

- Competence Coefficient (k) through self-assessment and the formula:

$$(k= ½ (kc + ka),$$

- Knowledge Coefficient, using the formula:

$$Kc = ni (0,1)$$

$$ni = (n1 + n2 + n3 + n4 + n5 + n6) \quad (14, 15)$$

- Coefficient of Argumentation with the formula

$$Ka = a$$

Expert agreement was determined using Aiken's V(16).

Results

The subject of the study is 13 years old, a student of the Fiscal Educational Unit "La Pradera", in the eighth (8th) Year of Basic General Education, which will be the starting point for the analysis of the results obtained.

For the anthropometric evaluation of the research subject as a specific case diagnosed with Down Syndrome, we start from a general assessment for each oneFrom the anthropometric parameters, the determination of height and weight allowed us to assess their body measurements with respect to chronological age and characteristics of the syndrome, in addition to their percentile location according to the Weight for Height Index (WTI) and the Body Mass Index (BMI).

The anthropometric assessment of the research subject's height showed a value of 1.37 m, which is within the parameters in accordance with the chronological age p25 and the physical condition according to the height-for-age curves... However, the weight provided a value of 51.51 kg, which for the age is located in the 95th percentile and is classified as obese.

Table 1.*Anthropometric measurements*

Code	*Sex*	*Age*	*Size (in meters)*	*Current weight (in kg)*	*BMI*
Student	Female	13.00	1.37	51.50	27.44

According to the results obtained from the weight and height measurement, the Body Mass Index (Quetelec Index) was calculated, which gave usa value of 27.44and classifies the student with an obesity condition according to the growth curve for children with Down Syndrome (figure 1), specifically it is considered that she would be in the 2DE curve range (figure 1).

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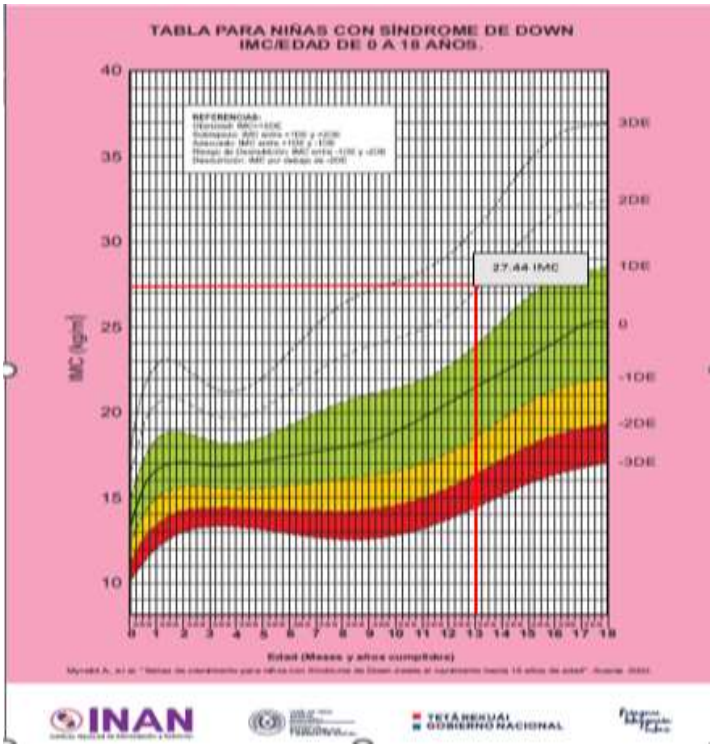

Figure 1.BMI curves in girls with Down syndrome

Likewise, it is necessary to mention that, regarding the anthropometric variable weight, it is emphasized that it depends on the skeleton and changes in body composition (gain of fat and muscles).(17), which is why it is influenced by both the nutritional aspect and the physical exercise developed and the height achieved.

In Table 2,describesthe dietary energy intake of the study subject by day of the week based on the24-hour recall survey and total energy expenditure according to the activities carried out in the same period, as well as the mean values obtained, the standard deviation and the coefficient of variation, which reflect that the incorporation of food energy by the Daily Food Ration (RDA) is greater than the total daily energy expenditure.This variation indicates a positive energy balance (18, 19), and therefore a gain in body weight.

Total energy expenditure. According to activity diary

When determining the daily energy expenditure (GET) according to the 24-hour Activity Diary survey, an average caloric expenditure of 2268.40±95.14 Kcal was obtained, with a coefficient of variation (CV) of 41.9%, these results being the determining factor for the analysis of the nutritional process and its impact on the balance of the research subject (Table 2).

Table 2.*Incorporation of food energy*

Subject of study	Embodied energy according to the RDA (Kcal)	Total energy expenditure according to physical activities performed in 24h
	2642.71	2213.47
	2484.82	2213.47
	1992,48	2378.27
Average	2373.34±410.03	2268.40±95.14
CV	18,86675032	4.19

In accordance with the above, it is not uncommon to consider the influenceof the energy balanceon the final results that reflect the nutritional status and that influence their quality of life and motor balance.

Resting metabolic rate

The resting metabolic rate, for its part, provided a value of 1389.75 Kcal determined from body weight and for the age range.

Physical Activity Level

To calculate the Physical Activity Level (NAF), the data corresponding to the GET obtained in the manner already described and the values of the Resting Metabolic Rate (TMR) determined were used, obtaining a NAF of 1.6, which is classified as moderate for female individuals.

Balance

The Kiphard and Schilling (1974) Children's Body Coordination Test (KTK) was developed by Kiphard and Schilling in 1970, later revised in 1974. The purpose of this test is to identify and diagnose children with movement and coordination difficulties, who are between the ages of 5 and 14 years.(19); In the present study, the essential indicators of the KTK test were considered from the balance for a girl with Down Syndrome, giving as results that the girl; its application was given in a partial space of a minimum area of 4 x 5 cm. The tests that were initially measured include: balance moving backwards, jumping on one leg (unipodal), jumping and lateral displacement; as well as, walking on a line drawn in the selected space in such a way that the gross motor development and therefore the balance that is the object of study can be identified.

For the application of the test, the reference that it considers for the population with intellectual disabilities was considered, having a reliability of 98%, the following coefficients were taken (table 3).

Table 3. Classification of motor coefficients of the KTK test

Mark	Classification	Deviation	Percentage
131 – 145	Very good coordination	3	99 to 100%
116 – 130	Good coordination	2	85 to 98%
86 – 115	Normal coordination	1	17 to 84%
71 – 85	Disturbance in coordination	-2	3 to 16%
56 – 70	Insufficient coordination	-3	0 to 2%

Fountain: Arm(20)

In order to achieve the results, the tests were carried out based on what the test manual considers or suggests; however, the development time varied depending on the condition of the research subject to ensure the understanding of the activities to be developed. It should be noted that it was necessary to make adaptations in the application, such as, for example, offering an additional opportunity in the development of the tests in the event that fatigue or loss of attention or "control" by the subject in the execution of the proposed activities was evident.

It is necessary to mention that for the present study only the balance test was considered since it is the object of study of the present investigation, the objective is to verify the stability of the balance on the bar in backwards motion, where three bars of 3 meters long, 3 cm high and of different width are used as a resource to graduate the difficulty of the same; however, as previously mentioned, an adaptation to the task was made which consisted of placing a line on the floor that acts as a bar to graduate the degree of difficulty of the test considering the physical background of the research subject.

The task consisted of walking forward one foot after the other to initially calculate the balance that one has, however, after 10 steps it was possible to see the difficulty that was presented when carrying out the activity; after that, the time was given to resume the activity again obtaining the same result.

The test was alternated with what the manual indicates by performing the activity backwards. No results were obtained for this one since several attempts were made and it was difficult to perform it. It should be noted that for the execution of the task, an example exercise was carried out by the evaluator so that the exercise could be made more effective.

The scores of each attempt were recorded on the results sheet used for said evaluation. Based on the sum of the attempts made, the value achieved with the age of the research subject is verified, as well as the motor coefficient is determined.

In the EQ task, the values of the three balance attempts are added and compared with the reference table, Figure 1. The value of the crossing indicated in the table will be the value of motor coefficient 1 (CM1).

Discussion

According to the above comparative data, it is evident that the research subject, at least in terms of body weight and BMI, is not within the normal range if we consider the syndrome he suffers from; however, it is necessary to consider that the possession of a body weight is not a sufficient condition for the manifestation of obesity, in consideration of this, if the weight is linked to excessive adipose behavior, which influences the increase in body mass, without contributing to the production of muscle strength and therefore to balance from the analysis of the body scheme and the reference table of the KTK test.

For its part, height has individual characteristics as an anthropometric parameter, and is a characteristic component of the research subject that is identified in the linearity of the skeleton, as a support against gravity; however, its height and bone structure are a determining factor for managing balance that can be considered as the starting point of the results obtained when applying the test.

The dietary energy intake by the research subject according to the RDA in a 24-hour period and its comparison with the GETD reflects a positive energy balance, which indicates a possible gain in body mass.

In this regard, it is noted that energy balance is the equilibrium between the intake of dietary energy according to the Daily Food Ration (RDA) and the use or expenditure of the same according to the individual's lifestyle in a 24-hour period, understood to include basal metabolism, food-induced thermogenesis and energy expenditure according to physical activities performed, and this balance between dietary energy needs and daily caloric intake is the fundamental determinant of body weight. "When there is a positive balance and the diet provides more energy than necessary, the excess is stored in the form of fat, leading to overweight and obesity" (18, 21).

In this regard, it has been determined that Down syndrome is significantly associated with overweight and obesity in children and adolescents of both sexes, which also enables the development of cardiovascular diseases and dyslipidemias, affecting the health and quality of life of the individual (22, 23).

However, energy expenditure according to physical activities performed shows that sedentary activities significantly exceed leisure, sports or work activities (school); in itself, this indicates that the lack of physical activity and the reported overweight is causing the balance and management of the body scheme to be minimal and that there is difficulty when performing the exercises.

Regarding the results obtained on motor balance, the results coincide with those obtained by other authors for children and adolescents with Down Syndrome, where it is highlighted that this genetic disorder implies, in addition to the pathological disorders characterized by physical and mental alterations, a decrease in muscle tone and with it a decrease in muscle strength, poor muscle contraction, laxity of the ligaments, inadequate postural control, altered proprioception, which affects their motor development and within this, balance is the most severely affected physical capacity (24, 25, 26).

In this regard, Perdiguero (2018) (27) points out: "children with Down syndrome have balance problems and deficits in the postural control system. Thus, their postural responses when they lose balance are insufficient to maintain stability, and they are also usually slow… These postural dysfunctions are the most common problem found in them, and are associated with poor motor coordination and proprioception, a decrease in the reaction time of anticipatory postural adjustments, and problems in sensory-motor integration."

Proposal

Once the results have been analyzed, it is necessary to consider implementing an exercise system based on the appropriate methodology that allows the correct inclusion of the research subject in physical and school activities for their good emotional and physical development, thus improving their quality of life, but also contributing to the development of motor balance.

Williamson, quoted by(24)It outlines the general model of adaptation to sports participation by means of the representation of a triangle, in the center of which it places the objectives of participation and in each of the vertices the three basic aspects that will condition said objectives, these are: the personal profile of the student, the implications of the deficiency and the specific needs of the activity.

According to this author, the objectives for adapted physical programs should aim to:

- Help the student achieve the adaptation and psychological balance required by his or her disability.
- To train him/her to understand such an impediment, as well as the possibilities of movement and action derived from it.
- Enable the child to adapt to his or her limitations and compensate for them.
- Facilitate the independence and autonomy of children with special educational needs.
- Help the child in the process of identification and inclusion in his social group.

In addition, according to Fernandez (24) there are five fundamental factors that influence the gross motor development of children with Down Syndrome, among which we find: hypotonia or decreased muscle tone, which makes it difficult to maintain balance in certain activities; ligamentous laxity, this characteristic makes joints less stable and makes it difficult to maintain balance on them; reduced strength, when performing easy exercises they do not increase strength which also affects balance; short limbs in relation to the trunk, which makes different motor activities difficult and last but not least cardio-respiratory disorders that indirectly limit any physical activity.

For the application of this system of exercises, it is necessary to consider that the inclusive model will guide the dynamics during the execution of this system of exercises, strengthening the presence, active participation and performance of the subjects. The proposed exercises aim to offer playful teaching methods, where the possibilities and limitations of the exercise for each subject can be known and assumed, and work on them.

Based on the exercises developed, problematic situations will be analyzed, and based on these results, the exercises can be modified to adapt them from the UDL methodology and innovative strategies from the inclusive perspective, in such a way that it leads to the effective development of participation, presence and performance of all subjects under equal conditions.

Based on this background, it is necessary to propose that in the case study, a comprehensive system of exercises be generated that promote the effective development of gross motor skills, body schema and mainly what corresponds to balance, the latter being one of the fundamental factors to work on; Likewise, it is necessary to establish workshops as a "parents' school" that allow the induction of parents in general and specifically the parents of the research subject to interrelate physical activities with the appropriate nutrition scheme that allows students to improve their quality of life.

In this last point we can find the difficulty of the socioeconomic conditions of the non-direct and direct population of the research subject, this being an impediment, in the first instance, for the implementation of the proposal; however, it is necessary to have a contingency plan that allows the achievement of the objective, this being the improvement of the quality of life of the students and specifically of the research subject.

Likewise, in relation to the physical exercise system, it is necessary to consider activities that arise from what is established in the physical education curriculum and that can be adjusted with inclusive activities as proposed by the UDL methodology. These can be generalized as:

- Rhythmic activities, which focus on fundamental movements, specific steps, and actual body expression.

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- Games, in which sensory and motor skills must be considered in the areas of running, jumping, balance, among others.
- Basic gymnastics is being linked with games in order to include the proposed exercises more effectively.

It is worth mentioning that the proposed exercises must be linked to the game system as a support methodology, taking into account the results obtained in the KTK test, it is extremely difficult for the research subject to execute linear activities that feel obligatory, generating discomfort in the subject.

In addition, the activities presented must be in accordance with the motor movements that the adolescent can perform and that he or she understands clearly, so a verbal explanation is not enough; the teacher's example is essential and, if necessary, in the first executions, the teacher or other students help him or her, promoting inclusion and for each activity and each class, motivation and corresponding recognition are essential, which will give him or her confidence and raise his or her self-perception.(25).

Table 4.*Example of class activities. Rhythmic activities: Balance (works on spatial location and recognition of body scheme-initial balance management) 40-minute classes*

Initial Part

It begins with the planned regulatory process regarding the greeting, the basic instructions of the activity explaining the process to be developed and the objective that has been set for it.

	Activity low impact	Time	Series	Rest	Muscles who work	Materials for exercises
INITIAL	Stretching movements.				Upper and lower extremities, head	
	Walking on heel and toe.				calves and hip flexors	
	Arm stretch with lateral extensions.	6´	1	2´	Deltoid, upper trapezius, and supraspinatus	
	Exercises based on music instructions.				Hips, waist, knees, elbow	
		4´	3-6	2´		Rods
MAJOR -	Rhythmic movements introducing the previous exercises.	4´	23		Body scheme	Weights Bottles Tapes
	Starting dance steps from good posture	4`	3-10	2´	Body scheme	Hulas Radio
	Posture exercises to strengthen balance.	3´	3- 10		Body scheme	CD Pendrive
				2´		

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END	Walking posture from one foot to the other with the rhythm of the music Breathing exercises while doing the previous activity. Lateral posture change exercises. Relaxation posture with open arms and circular frontal rotation Stretching exercise to improve posture.	3´	1-10	3´	Body scheme Body scheme Dorsal and lumbar	Radio Pendrive Music

Weekly time distribution for students with Down Syndrome: 10 minutes of theoretical work and between 15 and 30 minutes of daily work on adapted exercises. The time dedicated to physical exercise will depend on the adaptive response of the students in general, considering the ideal integration of children with Down Syndrome and the rest of the group of students, controlled by personalized attention from the teacher.

Likewise, 6 workshops were scheduled with the family to discuss food and healthy diet, to which all parents of the course are invited, the topics to be discussed are:

1. Diet and healthy diet.
2. Body weight and its relationship with quality of life and health.
3. Foods and their functions in the body.
4. Daily menu examples
5. Physical activity and health.
6. Presentation of healthy dishes.

The workshops were scheduled for 40 minutes, one per week, and were conducted with personnel specialized in nutrition and dietetics.

Validation of the proposal

The validation of the proposal was carried out by expert criteria using the Delphi technique (14, 15). In the first phase, experts were selected and questionnaires were prepared. In the second phase, the questionnaire was sent to the experts and the responses were analyzed looking for coincidences and divergences with the corresponding feedback. In the third and final phase, a consensus was reached and the final report was written.

For the selection of experts, the criteria adopted are third and fourth level qualifications and experience, both in the area of Physical Culture (Physical Education, Sport and Recreation).

A total of 5 experts with more than five years of experience in the area of Physical Culture were selected, determining the K competence coefficient,Knowledge/Information Quotient (kc) and the coefficient of argumentation (table 5).

Table 5.*Behavior of the coefficient of competence of experts*

Experts	kc	ka	K	Assessment
Expert 1	0.9	0.7	0.8	High
Expert 2	0.8	0.8	0.8	High
Expert 3	0.9	0.9	0.9	High
Expert 4	0.8	0.8	0.8	High
Expert 5	1	0.8	0.9	High

The analysis of the experts' responses provided a mean of 4.86 for all the established items, validating the proposal for the system of activities for the inclusion and improvement of motor balance in adolescent students with Down syndrome. Aiken's V concordance in all cases exceeded 0.80, which qualifies the proposal as valid.

Conclusions

- The nutritional status of the student with Down syndrome determined that she is obese due to a positive energy balance that indicates a greater nutritional energy intake than the daily energy expenditure; likewise, the motor balance is deficient, which is considered characteristic of this condition, which can also be affected by the condition of being overweight.
- The proposed system of inclusive activities to improve motor balance is validated by expert criteria according to the Delphi technique.
- Currently, several investigations consider that everything that triggers an imbalance between food intake and energy consumption with positive energy balance, is determined as one of the causes of obesity, considering the interrelation between intake and obesity; in this specific case, subjects with Down syndrome, this is more notable, based on their own physical condition and the lack of it causes obesity to worsen, affecting the balance of this and the nutritional imbalance that causes inactivity.
- The execution of physical activities adapted for effective execution by the research subject must be applied by teachers and family members, considering that it is appropriate to take into account that the results of the KTK test and the energy values give as results a degree of obesity of the research subject, corrective measures must be taken from a constant process of recreational physical activity that allows the voluntary execution of the same and the improvement of their quality of life.

Conflict of interest

The authors declare that there is no conflict of interest in relation to the submitted article.

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