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Psychometric properties of the dizziness handicap inventory-child/adolescent (DHI-CA) – short form

Propriedades psicométricas do *dizziness handicap inventory-child/adolescent* – versão reduzida

Maria da Glória Canto de Sousa¹, Cristina Freitas Ganança², Laíse dos Santos Lobo³, Melka de Almeida Souza³, Eduardo Pondé de Sena⁴

ABSTRACT

Introduction: Dizziness during childhood and adolescence interferes with psychological behavior, and can lead to consequences such as poor academic performance and language disorders. **Purpose:** To develop and verify the applicability of the short version of the Dizziness Handicap Inventory-Child/Adolescent (DHI-CA) in school-going children and adolescents. **Methods:** A methodological validation study developed in municipal public network teaching units of Cabula Sanitary District/Beiru de Salvador, Bahia. Data were collected by means of the Dizziness Handicap Inventory Child/Adolescent (DHI-CA) and proposed short version denominated Dizziness Handicap Inventory Child/Adolescent-short form (DHI-CA/SF). The DHI-CA/SF is composed of 15 objective questions divided into subscales corresponding to emotional, physical and functional aspects. **Results:** The sample of 97 children and adolescents was composed of 69 girls (71.1%) and 28 (28.9%), boys. The age-range was from 7 to 15 years with mean age of 11 years. Internal consistency relative to the total scale was $\alpha=0.84$; and $\alpha=0.66$ for the functional; $\alpha=0.61$, emotional, and $\alpha=0.65$ for the physical subscale. Relative to agreement between the two applications of DHI-CA/SF, the authors verified that the intra-examiner intraclass correlation coefficients demonstrated satisfactory agreement, and satisfactory to excellent agreement for the items in the second application. Agreement values in the second application were: - emotional: 0.70; - Functional: 0.93, and Physical: 0.80. **Conclusion:** By means of the Dizziness Handicap Inventory Child/Adolescent DHI-CA it was possible to obtain a short version denominated Dizziness Handicap Inventory Child/Adolescent-short form (DHI-CA-SF) applicable in children or adolescents with complaints of dizziness.

Keywords: Dizziness; Child; Surveys and questionnaires; Quality of life; Validity of tests

RESUMO

Introdução: A tontura na infância e adolescência interfere no comportamento psicológico e pode levar a consequências, como mau rendimento escolar e distúrbios de linguagem. **Objetivo:** Desenvolver e verificar a aplicabilidade da versão reduzida do *Dizziness Handicap Inventory-Child/Adolescent* (DHI-CA) em crianças e adolescentes em fase escolar. **Métodos:** Estudo metodológico de validação, desenvolvido nas unidades de ensino da rede pública municipal do Distrito Sanitário Cabula/Beiru de Salvador, Bahia. Os dados foram coletados por meio do *Dizziness Handicap Inventory Child/Adolescent* (DHI-CA) e da proposta reduzida, denominada *Dizziness Handicap Inventory Child/Adolescent-short form* (DHI-CA/SF). O DHI-CA/SF é composto de 15 questões objetivas, divididas em subescalas correspondentes aos aspectos emocionais, físicos e funcionais. **Resultados:** A amostra foi composta por 97 crianças e adolescentes. Destas, 69 eram do sexo feminino (71,1%) e 28 (28,9%) eram do sexo masculino. A faixa etária esteve entre 7 e 15 anos, com média de 11 anos. A consistência interna referente à escala total foi de $\alpha=0,84$ e $\alpha=0,66$, para a subescala funcional, $\alpha=0,61$ para a emocional e $\alpha=0,65$ para a física. Quanto à concordância das duas aplicações do DHI-CA/SF, foi verificado que os coeficientes de correlação intraclasse, intraexaminadores, demonstraram concordância satisfatória e de satisfatória a excelente para os itens, na segunda aplicação. Os valores de concordância na segunda aplicação foram os seguintes: emocional: 0,70; funcional: 0,93 e física: 0,80. **Conclusão:** A partir do *Dizziness Handicap Inventory Child/Adolescent* DHI-CA, foi possível obter uma versão reduzida, denominada *Dizziness Handicap Inventory Child/Adolescent-short form* (DHI-CA-SF), aplicável em crianças ou adolescentes com queixas de tontura.

Palavras-chave: Tontura; Criança; Inquéritos e Questionários; Qualidade de vida; Validade dos testes

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INTRODUCTION

Imbalance and vertigo are the symptoms that most negatively affect the well-being of patients of both genders and different age-ranges⁽¹⁾.

Vestibulopathy is a disorder that causes a series of signs and symptoms, and may affect children and adolescents⁽²⁾, interfering in their psychological behavior and performance at school⁽³⁾.

The episodes of vertigo reported by the children must almost always indicate the presence of vestibular dysfunction. Vertigo in children is manifested in various forms and their complaints are similar to those of adults. Therefore, as in adults, children may also present progressive or chronic loss of vestibular function that affects the development of postural control⁽²⁾. However, there is difficulty in diagnosing vestibular dysfunction in childhood, due to the variety of symptoms presented, and by the difficulty with reporting them⁽⁴⁾.

Researchers⁽²⁾ have made reference to Epidemiological studies with school-age children, which have shown that around 15% had experienced at least one episode of dizziness during the period of one year. These same authors pointed out innumerable studies about the most common disturbances that cause vertigo and imbalance in children. These publications have shown the extent to which the suffering of children that have vertigo and imbalance has been neglected, when compared with the publications about dizziness in adults, revealing a certain failure to observe the suffering dizziness causes in the child population.

The incapacity caused by dizziness, whether from the emotional, functional, or physical aspects, is most important in the social and personal context of individuals, irrespective of its etiology, since it considerably affects their quality of life⁽⁵⁾.

Concerned about quantifying the interference of dizziness in the day-to-day life of children, researchers elaborated the Dizziness Handicap Inventory Child/Adolescent (DHI-CA)⁽⁶⁾, from the Dizziness Handicap Inventory (DHI). The DHI is an inventory designed to measure the incapacitating effect imposed by dizziness on the quality of life of adult subjects. The purpose of using it is not only to diagnose, but also to evaluate the effects of treatment⁽⁷⁾.

At present, there are few studies that make reference to the DHI as a tool for evaluating the impact of dizziness in pediatric patients, namely: the DHI-PC, which evaluates children's dizziness from the perspective of care-givers⁽⁸⁾ and the DHI-CA⁽⁶⁾, which measures the impact of dizziness on the quality of life of children and adolescents, for the purpose of quantifying the effects imposed on daily life functions. These tools may be incorporated in the evaluation of children who suffer from vertigo.

Vestibulopathy in childhood is capable of compromising children's performance in the school environment, affecting their ability to communicate and their psychological state.

The changes resulting from this disturbance in children lead to the lack of balance, compromised body posture and motor coordination, lack of aptness to practice physical exercises, distorted feelings about their own bodies and surrounding objects, because they have the greatest difficulty in maintaining postural stability during readouts. In view of the need to perform complex tasks, the development of communicative skills requires linguistic and semantic capacities, in addition to skills such as perception and eye movements. Symptoms such as nausea, emesis (vomiting), and frequent falls during activities that involve movement also form part of the day-to-day life of children with vestibular disturbance⁽¹⁾.

Considering the subjective nature of dizziness, and assuring the metric properties of the self-report instruments, these may be useful in the evaluation of and intervention in dizziness in children and adolescents who are in the process of learning at school.

In this context, it is important to point out that because the issue concerns children and adolescents, an instrument with a smaller quantity of questions would possibly obtain their most faithful responses, considering that the attention span in this age group is limited/reduced. Furthermore, the authors emphasize that in addition to the DHI/CA-SF being quicker to apply, it may be used for triage in schools and/or health services, when there are reports of symptoms of dizziness by children and adolescents, bearing in mind that this symptom presents elevated prevalence in this age group, according to the national and international literature.

In view of the foregoing, the aim of this study was to develop and verify the applicability of the short version of the Dizziness Handicap Inventory-Child/Adolescent (DHI-CA) in school-going children and adolescents.

METHODS

This was a methodological validation study, developed in municipal public network teaching units of Cabula Beiru District, in the municipality of Salvador, Bahia, after being approved by the Research Ethics Committee of the *Universidade do Estado da Bahia*, protocol No.179.799/2013. The authors committed themselves to using the information collected for scientific purposes only, keeping the patients' data confidential, in accordance with the rules of Resolution 466/12.

Based on consultation of the database of the Municipal Secretary of Education (SMED) of the city of Salvador/BA, 47 school units registered in the District of Cabula-Beiru were identified, with schoolchildren in the age range from 7 to 15 years.

Of the 17 schools that effectively participated in this research, 253 classes were visited, however, for the reason of age group, only 5,999 schoolchildren were approached. Of these, 112 complained of dizziness and 97 handed in the Term of Free and Informed Consent (TFIC), duly signed.

To compose the study, the schoolchildren had to present a report of dizziness of any type, whether it was a sensation of rotary movement, or not, irrespective of the frequency and intensity of episodes. For this purpose, the diagnosis of vestibular change was not necessary, but self-report of the complaint was required. During the visits to the classrooms, the schoolchildren were asked about their knowledge of the symptom of dizziness, and explanations were given about its various possible manifestations and presence. The authors point out that reports of isolated episodes of dizziness were not considered.

The children were submitted to application of the proposed reduced version of the Dizziness Handicap Inventory-Child/Adolescent (DHI-CA)⁽⁶⁾. The time spent on application of the instrument was an average of 10 minutes. Data collection lasted for period of 12 months. Retest of the short version of DHI/CA was carried out approximately 20 days after the first application. The schoolchildren who presented elevated scores during the application of the instrument (DHI-CA) short version, were instructed to consult a specialist, for due investigation and treatment.

The methodological procedure predicted the following stages:

1. Application of the proposed short version of the DHI-CA in children and adolescents with reports of dizziness, for adequate evaluation of the internal consistency.
2. Reapplication of the proposed short version of the DHI-CA to evaluate the stability of the scores by means of test-retest.
3. Evaluation of the degree of agreement between the two applications of the proposed short version of the DHI-CA.

For the choice of the items to be extracted from the original instrument, the DHI-CA, the researchers decided that only the result of the second application would be considered for statistical analysis. For this purpose, the researchers evaluated the degree of intraexaminer agreement and agreement between the items, relative to both the total value of the score and for each domain of the instrument, in addition to performing the test-retest. Thus, the DHI-CA short version was obtained, now denominated DHI/CA-SF, consisting of a total of 15 items

The instrument Dizziness Handicap Inventory-Child/Adolescent (DHI-CA)

The DHI is an instrument composed of 25 questions, organized into three subscales: Functional (nine items); Emotional (nine items); and Physical (seven items). The response scale varies between 0 ("no") and 4 ("yes"), in addition, contemplating the intermediate value 2 ("sometimes"). The maximum score for the physical subscale is 28 points; for Emotional, 36 points; and for Functional, 36 points, totaling 100 points⁽⁷⁾. Considering the total score, the degree of incapacity may be slight (0 to 30 points); moderate (30 to 60 points); or severe (over 60 points)⁽⁹⁾. Considering the emotional

and functional subscales, the degree of incapacity may be nonexistent (0-14 points), reveal moderate deficiency (15 to 24 points), or severe deficiency (over 25 points). Considering the physical subscale, the degree of incapacity may be nonexistent (0-9 points), reveal moderate deficiency (10 to 16 points), or severe deficiency (over 17 points)⁽¹⁰⁾. Application of the instrument takes about 10 to 15 minutes⁽⁷⁾.

The proposal of the short version of the DHI/CA comprised items extracted from the original scale, and was composed of 15 questions. These were organized into three subscales, which were seven items with reference to the functional domain, three items in the emotional domain, and five items with reference to the physical domain. The proposal had the same purpose as that of the DHI/CA, which evaluated the impact of dizziness on the quality of life of children and adolescents with symptom, with the aim of quantifying its effects on the functions of daily life, and to help with the choice of treatment and evaluation. The responses were recorded by means of items in the forms of "no", "yes" and "sometimes". Each item was scored on a scale that varied between 0 ("no") and 4 ("yes"), in addition to contemplating the intermediate value 2 ("sometimes"). The maximum score for the physical subscale was 16 points; 16 points for the emotional, and 28 for the functional subscale, in which the measurement of incapacity of the symptoms was obtained by the some of the scores of the items, ranging from 0 to 60. Higher scores indicated greater disadvantage; that is, the higher the score, the more compromised was the quality of life of the child and adolescent (Appendix 1).

Statistical analysis

The characteristics of the participants were described by means of the median, interquartile interval, minimum and maximum.

The internal consistency of the questions was measure by means of the Cronbach alpha statistics.

For the following analyses, in case of disagreement or low consistency of the evaluator, the criterion was adopted, item by item, by the second measurement, considering the phenomenon of regression of the mean. For this purpose, the Kappa pondered index was used⁽¹¹⁾.

For evaluating the degree of intraexaminer agreement in the two applications - DHI-CA and short version - and to measure the consistency of the responses, total scores, per domain, of the second application of the two instruments, the Intraclass Correlation Coefficient (ICC) was used^(11,12). The reproducibility of the instrument was analyzed by means of the test-retest for the items, using pondered Kappa calculation of the index. To measure the reproducibility with reference to the total score of the domains, the Intraclass Correlation Coefficient was used⁽¹¹⁾.

The statistical procedures were performed by means of descriptive statistics with R, using the statistical program with R for analysis of the results.

Table 1. Distribution of the scores of the Dizziness Handicap Inventory Child/Adolescent-short form, considering sex and the domains

Domains	Female (n=69)				Male (n=28)			
	Median	IIQ	Min	Max	Median	IIQ	Min	Max
Emotional	20	12	0	36	22	14	0	34
Functional	24	12	0	36	20	12	0	34
Physical	18	12	0	28	16	14	0	28
Total Score	62	36	0	100	57	30	6	28

Subtitle: IIQ = interquartile interval; Min = minimum; Max = maximum

RESULTS

The sample was composed of 97 schoolchildren from the Municipal school teaching units of the Cabula-Beiru District. Of the 97 subjects, 69 were girls (71.1%) and 28 (28.9%), were boys. The age-range was from 7 to 15 years with a mean age of 11 years.

The scores attributed in DHI/CA-SF, per domain, considering the sex of the children and adolescents, obtained by means of the median, interquartile interval, minimum and maximum are presented in Table 1.

The internal consistency data of the DHI/CA-SF data, evaluated by means of the Cronbach alpha, demonstrated that the indices obtained were adequate, in terms of both the alpha for the total scale ($\alpha=0.84$); and for each of the three subscales: ($\alpha=0.66$ for the functional, $\alpha=0.61$ for the emotional and $\alpha=0.65$ for the physical subscale).

The DHI/CA-SF values per item are demonstrated in Table 2.

Table 2. Distribution of the reproducibility values, per domain, of the Dizziness Handicap Inventory Child/Adolescent-short form

Subscales	ICC rest (n=97)
Emotional	0.56
Functional	0.60
Physical	0.61

Subtitle: ICC = intraclass correlation coefficient; rest = test-retest

Distribution of the agreement indices of DHI/CA and DHI/CA-SF are presented in Table 3, and for better visualization of the data, the Bland Altman graph, represented in Figure 1, demonstrates the distribution of agreement between the total scores of DHI/CA-SF and DHI-CA.

The indices of intraexaminer agreement between the two time intervals of application - DHI/CA-SF short version and DHI-CA - are demonstrated in Table 4.

DISCUSSION

This study consisted of developing and verifying the applicability of the Dizziness Handicap Inventory-Child-Adolescent/short

Table 3. Distribution of the indices of agreement of the Dizziness Handicap Inventory Child/Adolescent and those of the Dizziness Handicap Inventory Child/Adolescent-short form, per domain

Subscales	1 st Application ICC rest (n=97)	2 nd Application ICC rest (n=97)
Emotional	0.69	0.70
Functional	0.91	0.93
Physical	0.80	0.80

Subtitle: ICC = intraclass correlation coefficient; rest = test-retest

form (DHI/CA-SF). Therefore, statistical tests were performed to verify the internal consistency, estimate the reproducibility and measure the degree of agreement between DHI-CA and DHI/CA-SF, considering the measurement of the second application.

Internal consistency

The internal consistency of the DHI/CA-SF, measured by the Cronbach alpha coefficient presented similar, although lower but adequate values when compared with the original version of the DHI-CA⁽⁶⁾. This similarity occurred for both the total scale and for the three subscales (physical, functional and emotional domains). This reduction may be related to exclusion of some items from the DHI-CA, because children have a certain difficulty of being precise about the symptoms of dizziness, particularly with respect to the emotional questions.

This study revealed that the children and adolescents of the female sex presented higher scores in the three subscales and total scale, when compared with the male sex, except in the emotional subscale. These data are partially in agreement with those of other studies with adult individuals, in which the patients of the female gender had higher scores in all the subscales⁽¹³⁾. When the scores of the DHI-CA and those of DHI/CA-SF were compared, the researchers found that both the three subscale values and the total value of scores were higher in the short version of the DHI/CA-SF.

Analysis of the functional and emotional domains of DHI/CA-SF showed they presented higher scores when compared with the analysis of the same subscales in the original version of the DHI-CA and when the DHI was applied in patients in the age-range from 11 to 30 years^(5,6). This datum reflects the greater limitation of children with regard to restriction of the activities

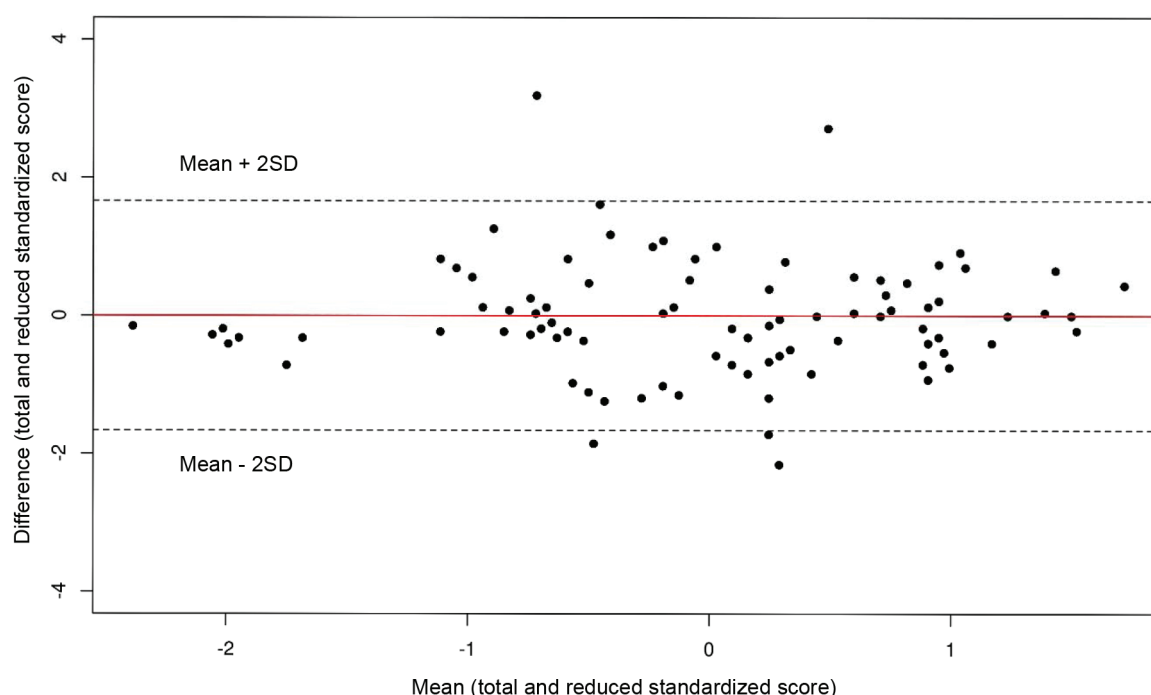


Figure 1. Distribution of agreement between the total score of the Dizziness Handicap Inventory Child/Adolescent-short form and that of the Dizziness Handicap Inventory Child/Adolescent

Table 4. Distribution of the indices of intraexaminer agreement in the two time intervals of application: short version Dizziness Handicap Inventory Child/Adolescent-short form and the Dizziness Handicap Inventory Child/Adolescent

Subscales	DHI/CA-SF rest (n=97) ICC	DHI-CA rest (n=97) ICC
Emotional	0.58	0.55
Functional	0.63	0.60
Physical	0.61	0.44

Subtitle: DHI/CA-SF = Dizziness Handicap Inventory Child/Adolescent-short form; DHI-CA = Dizziness Handicap Inventory Child/Adolescent; ICC= intraclass correlation coefficient; rest = test-retest

evaluated by the functional subscale, because the limitation of certain activities lead to children being less exposed to the risk of the appearance of dizziness. Similarly, when the aspects investigated in the emotional scale were compromised, they demonstrated possible harm to the children's quality of life, particularly relative to concerns about changes in concentration, feelings of incapacity, and depression, among other aspects. These data relative to the emotional domain, which was the domain most affected in this study, were compatible with those of the original version of the DHI-CA.

The physical subscale is evaluated by means of the relationship between the appearance and/or aggravation of dizziness, when bodily movements are made⁽⁵⁾. In the present study, the score was lower when compared with the other subscales, and the scores of the original version of the DHI-CA. This datum was contradictory to studies^(14,15) that made reference to the physical aspects as being those that were most compromised.

When analyzing the degree of incapacity presented by the children and adolescents, the mean score of the total scale of the DHI/CA-SF corresponded to a moderate degree for children and adolescents of the female sex, and severe for those of the male sex. These data were in disagreement with those found in the DHI-CA, which presented a moderate degree for both sexes. In the analysis of the subscales, the schoolchildren of the male sex had a moderate degree in all of them, and those of the female sex presented a severe degree for the physical subscale, and moderate for the emotional and functional subscales⁽⁵⁾.

The results obtained in the second application of the short version of the DHI-CA demonstrated adequate reliability of the items, per domain, which confirmed the stability of the instrument. This finding was in agreement with those found in the DHI-CA and DHI-S^(6,7).

Reproducibility

When comparing the results of the test-retest by items and by total scores per domain, with the original version of the DHI-CA, the researchers observed that the DI-CA-SF values were similar. In this same analysis, when comparison was made with the short form of the original version of DHI (American version), the results also demonstrated a good level of reproducibility, although it had been tested in adults^(2,16). A study⁽⁸⁾ that developed an instrument that evaluated the impact of dizziness on children presented strong test-retest reliability, but the responses reflected only the perspective of the caregiver and not of the child.

Degree of agreement

With regard to the agreement between the two applications - DHI-CA/SF and DHI-CA -, the researchers verified that the intraclass correlation coefficients for the intraexaminer measurements demonstrated satisfactory agreement⁽¹⁴⁾. For analysis of consistency between the two instruments (DHI-CA and its short version), the intraclass coefficient was also used for the three subscales (physical, functional and emotional domains), and the result ranged from satisfactory to excellent with regard to consistency for the second application. Bearing in mind the use of the instruments DHI-CA and its short version, which were the only instruments for the proposed purpose, it was not possible to compare the results with reference to the above-mentioned aspects with those of other studies.

The present study presented three main limitations. The first was with respect to the non-existence of criteria for evaluating the degree of incapacity due to dizziness in the age-range studied, because the criteria for adults were used in the study for elaborating the DHI-CA⁽⁶⁾. It is important to point out the need for making use of the script, to facilitate the application of the instrument in younger children, because the questionnaire was better understood by the children in the older age group. The second limitation was the absence of a measure that would allow the external validity of the DHI-CA to be taken as the gold standard. Lastly, the third limitation was with respect to the sample size, a number still insufficient to enable reference to be made to this age-range, with different sociodemographic profiles.

The researchers hope that future studies, based on the present study, will be able to overcome these limitations and at the same time succeed in using a more robust sample of children and adolescents to evaluate the wider applicability of the instrument.

CONCLUSION

By means of the Dizziness Handicap Inventory Child/Adolescent DHI-CA it was possible to obtain a short version denominated Dizziness Handicap Inventory Child/Adolescent-short form (DHI/CA-SF) applicable in children or adolescents with complaints of dizziness.

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Appendix 1. Dizziness Handicap Inventory Child/Adolescent-Short Form

Domains	Questions	Replies		
		Yes	Sometimes	No
3 - Functional	Because of the dizziness, do you stay away from school?			
6 - Functional	Do you stay away from birthdays, parties, movies, video game arcades because of the dizziness?			
7 - Functional	Because of the dizziness, do you have difficulty with reading?			
8 - Physical	Do games, sports, riding a bicycle, riding on roundabouts/merry-go-rounds worsen the dizziness?			
9 - Emotional	Because of the dizziness, are you afraid to leave the house?			
11 - Physical	Do fast movements of the head worsen your dizziness?			
12 - Functional	Because of the dizziness, do you stay away high places?			
14 - Functional	Because of the dizziness, do you find it difficult to jump, run, play ball games, ride a bicycle?			
17 - Physical	Does walking on the sidewalk, passing or going over a ground full of holes worsen the dizziness?			
18 - Emotional	Because of the dizziness, do you have difficulty with concentrating on your school activities?			
19 - Functional	Because of the dizziness, are you unable to walk about in the dark?			
20 - Emotional	Because of the dizziness, are you afraid to stay at home alone?			
23 - Emotional	Because of the dizziness, do you feel sad, without wanting to do anything?			
24 - Functional	Does your dizziness hamper, interfere in your studies?			
25 - Physical	If you lower your head or body, does the dizziness worsen?			

Examiner_____

Score: _____