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Ceiling and Floor Effect of the Brazilian Version of Geriatric Psychomotor Examination

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ABSTRACT*: PURPOSE: to verify if the items of the Brazilian version of EGP (EGP-Br) and the total score exhibit ceiling or floor effect, and if the results differ between according to gender, the occurrence of falls, cognition and physical activity. METHODS: The study included 215 volunteers with a mean age of 70.22 (+ 6.59) years, 84.7% were women, 61.2% were physically active, 8.1% were diagnosed with cognitive impairment, and 22.8 % reported falls during the past12 months. All were assessed using the EGP-Br and the Mini-Mental State Examination. Comparisons between groups used the Student's t-test, as the data presented normal distribution. Ceiling and floor effects occur when, respectively, more than 15% of the sample has the maximum and minimum score in the evaluated item. RESULTS: The ceiling effect occurred in all 17 items, but the floor effect was not observed in any item. The total EGP-Br score had no ceiling or floor effect. The group that reported falling had worse performance in gait assessment and lower limb fine motor coordination in comparison to the group with no falling. Women had better scores in fine motor coordination as opposed to men. In the Cognition subscale, the physically active group showed better results compared to the sedentary group. The EGP-Br was useful in the assessment of cognition and balance. However, due to the observed ceiling effect, the individual results for each item should be used with caution when evaluating performance improvement.*

Keywords*: Balance, Cognition, Memory, Motor Coordination, Aging.*

I. INTRODUCTION

In aging people, the health status may be revealed by the ability to keep active, physically independent, and cognitively autonomous. It is, therefore, fundamental to keep track of performance of elderly using instruments that have satisfactory psychometric parameters. Having a reliable tool in all areas of healthcare to adequately evaluate cognition and motor aspects is very important. The results may allow identifying and potentializing the abilities needed to maintain functionality during aging[1].

In France, where the study of Psychomotricity originated, the Examen Géronto-Psychomoteur (EGP)[2] was developed to provide information on the capacities of elderly and on the compensatory mechanisms of the cognitive-motor structure. Its utility is based on the possibility of (1) carrying out an initial assessment that allows the establishment of capacities and difficulties, determining both diagnosis and prognosis; (2) drawing either a prophylactic or a therapeutic intervention, which enables the recommendation of the most adequate body mediation for each situation; and (3) establishing the efficacy and the effects of the interventions[3].

Besides France, the EGP has translated versions used in Brazil[4], Lebanon[5], Uruguay[6] and Portugal[7], which have shown evidence of validity. This instrument aids the diagnosis of cognitive impairment, such as in Alzheimer's[8] and Parkinson's[9] disorder. It also differentiates the abilities of elderly, according to their age group[2,5].

Studies carried out in Brazil have shown content validity[1], construct validity, discriminating and converging validities for the factors, and reliabilty[10]. The objective of the present study is to verify if the items of the Brazilian version of the EPG and the total score present ceiling or floor effect, and if the results differ between groups with different profiles concerning gender, occurrence of falls, cognition, and physical activity.

II. METHOD

Ethical aspects

This study is part of a research project that is in accordance with the resolution CNS 466/2012, publicada em 13/06/2013, of the National Health Board (Conselho Nacional de Saúde), which regulates all research involving human subjects. This project was submitted to approval by the Ethics Committee of the Faculty of Health of The University of Brasilia (Comitê de Ética da Faculdade de Saúde da Universidade de Brasília – CEP / FS – UnB. CAAE: 47735015.3.0000.0030) and was approved (parecer: 1.430.179)

The expected results, the evaluation conditions and the relevance of the study were all informed to the volunteers, and those who agreed to participate signed the informed consent term.

Subjects

The sample was composed of 215 volunteers from the community. The inclusion criteria were being 60 years or older and being available for approximately 1 hour to complete the evaluation. The only exclusion criterion was being bed or wheelchair ridden. All volunteers answered a questionnaire about personal characteristics, medical diagnoses, physical activity, pain, falls and fear of falling.

Instruments

- Clinical history – questions concerning sample descriptors: age, gender, and education, as well as criteria variables: physical activity, medical diagnosis, the occurrence of falls during the previous 12 months.

- Geriatric Psychomotor Examination – the Brazilianversion of the EGP (EGO-Br)[10]was used. It is composed of 17 items: 1 – Static coordination, 2 – Static balance, 3 – Gait, 4 – Dynamic balance, 5 – Passive mobility of upper limbs, 6 – Passive mobility of lower limbs, 7 – Fine motor coordination of upper limbs, 8 - Fine motor coordination of lower limbs, 9 – Praxis, 10 – Body awareness, 11 – Attention, 12 – Perceptual memory, 13 – Spatial awareness, 14 – Verbal memory, 15 – Perception, 16 – Temporal awareness, 17 – Communication. The total score ranges from a minimum of 0 to a maximum of 102 and is obtained by adding the score of each of the 17 items. For each item, the minimum score is 0 and the maximum is 6; the lower the score, the worse the performance is.

- Mini-Mental State Examination (MMSE) – cognitive characterization: it consists of a simple rapidly-applied test which aids the diagnosis of cognitive impairment, with 84% sensitivity for Alzheimer's disorder, rendering it a satisfactory cognitive screening tool, despite its 60% specificity. It is composed of 30 items divided into temporal and spatial orientation, memory, attention and calculation, language, comprehension, reading and writing and visuo-spatial ability. Cut-off scores are established by

education: illiterate – 20, 4 years of education and under – 25, 5-8 years of education – 26, 9-11 years of education – 28, and 11 years of education or more – 29.

Analysis of data

The descriptive data was analyzed using measures of central tendency and dispersion, simple and percentual frequencies. Ceiling and floor effects occur when, respectively, more than 15% of the sample has the maximum and minimum score in the evaluated item. The normal distribution of the sample was confirmed by the Shapiro-Wilk test. For independent samples, the Student's t-test was used to compare groups. All the analyses were carried out with the use of the SPSS program, and $p<0,05$ was considered statistically significant.

III. RESULTS

Two hundred and fifteen volunteers participated in the study, with mean age 70,22 (+ 6.59), 84,7% being women, 61,2% were physically active and 8,1% were diagnosed with cognitive impairment. Concerning marital status, 17,9% declared themselves as single, 46,3% married, 22% widowed and 13,8% divorced. Regarding education, the number of years of formal education was enquired and the mean answer was 9.56 (+ 7,23) years.

The value of the standard deviation reflects the heterogeneity of the volunteers; while some had no formal education, others had PhDs. 33,1% of the sample scored below the cut-off in the MMSE, 62% declared themselves as physically active, 22,8% had had the occurrence of falls during the previous 12 months. The results of the analyses are shown in Table 1.

Ceiling effect was observed in all items, although none of the volunteers attained the maximum total score, which corresponds to 102 points. The total score did not show ceiling effect. Floor effect did not occur in any item nor in the total score. In items 1, 5, 6 8, 9, 11, 13, 16, none of the participants scored the minimum of 0 points.

All the 10 items of the Cognition subscale exhibit difference between the group that scored below and the group that scored above the cut-off of the MMSE. Only item 12, perceptive memory, did not show difference between the physically active and sedentary groups. Regarding all the other items, the physically active group performed better than the sedentary group. Item 7, fine motor coordination of upper limbs, revealed better performance amongst women than men.

Comparisons between groups regarding the Balance subscale, constituted by items 1, 2, 3, 4 and 7, showed no differences between groups regarding item 1. Items 2, 3 and 4 showed differences between the groups above and below the cut-off score for MMSE, and item 3 and 8 revealed differences between the group which reported fall and that group which did not.

Items 5 and 6 which are part of the Mobility sub scale showed no difference between groups. The total score of the EGP-Br was statistically different when comparing physically active and sedentary groups as well as when comparing the groups that scores below and above the cut-off score of the MMSE

Table1. Percentual of maximum and minimum scores

Item	Mean (SD)	p < 0,05	Ceiling	Floor
EGP 1 – Static coordination	5,97 (0,30)	-	98,1%	-
EGP 2 – Static Balance	4,46 (1,29)	MMB	16,3%	2,3%
EGP 3 – Gait	5,93 (0,48)	MMB/ RF	96,3%	0,5%
EGP 4 – Dynamic balance	5,69 (1,04)	MMB	90,2%	1,4%
EGP 5 – Mobility of upper limbs	5,39 (0,85)	-	52,1%	-
EGP 6 – Mobility of lower limbs	5,21 (1,11)	-	50,2%	-
EGP 7 – Fine coordination of upper limbs	4,64 (1,35)	MMB/ PA / SX	36,3%	5%
EGP 8 – Fine coordination of lower limbs	5,24 (0,81)	RF	40%	-
EGP 9 – Praxis	4,64 (1,04)	MMB/ PA	15,3%	-
EGP 10 – Body awareness	5,37 (0,80)	MMB/ PA	39,5%	0,5%
EGP 11 – Attention	5,19 (1,03)	MMB/ PA	48,4	-
EGP 12 – Perceptual memory	4,46 (1,42)	MMB	25,6%	0,9%
EGP 13 – Spatial awareness	4,97 (1,17)	MMB/ PA	40%	-
EGP 14 – Verbal memory	4,65 (1,13)	MMB/ PA	27,4%	0,5%
EGP 15 – Perception	4,74 (0,95)	MMB/ PA	21,4%	-
EGP 16 – Temporal awareness	5,23 (1,01)	MMB/ PA	46%	-
EGP 17 - Communication	5,55 (0,95)	MMB/ PA	74%	0,5%
EGP Total	78,35 (9,03)	MMB/ PA	1%	-

Mini-Mental State Examinatiom below cut-off score (MMB)	33,1%
Physically active (PA)	61,2%

Reported fall (RF)	22,8%
Gender (SX)	84,7%

IV. DISCUSSION

The results of this study have shown that it is possible to obtain multi-dimensional data to understand the global functioning of subjects with the use of only one instrument. The relevance of multi-dimensional evaluation has been confirmed.

Recent studies point to the integration of physical tasks and cognition, as the activation of motor functions leads to recruitment of cognitive abilities and vice-versa[14,15,16]. This phenomenon is confirmed in the present study in which the volunteers that were physically active performed better in the Cognition subscale when compared to the sedentary group.

Surprisingly, the physically active group did not have a better performance in the Balance subscale when compared to the inactive group. However, the group that scored above the cut-off for the MMSE exhibited better balance when compared to the group that score below the cut-off.

Both gait and balance are multimodal tasks that require cognitive abilities, especially executive functions and attention[1,17]. The improvement of cognitive functions such as attention and reasoning speed will consequently benefit gait and balance[1]. This is also seen with the amelioration of memory and mood in physically active elderly[22]. This generalization and transfer of functions occur whenever the executed tasks include interactions of systems involved in general aspects of the aimed abilities.

For example, motor actions include cognitive functions or tasks that are more satisfactorily performed with better physical conditioning. Some of the reasons include augmentation of blood flow and changes in the synthesis and degradation of neurotransmitters[18].Another example would be the decline in the capacity to carry out tasks involving simultaneous and competing stimuli. Maintenance of balance involves proprioception, visual accuracy and the vestibular system[19].

To improve comprehension of such mechanism, one can infer that physical exercise and cognitive stimulation convey intermittent stressors which lead to adaptive responses that activate neurotransmitter post-synaptic receptors, triggering neuroprotective mechanisms[22]. This phenomenon involves the activation of intracellular signaling cascades, promoting the transcription of factors that bring about the expression of neuroprotective proteins such as the brain-derived neurotrophic factor (BDNF), coupling mitochondrial proteins and anti-apoptotic proteins[21].

As for the ceiling effect observed in all items of the scale, it is conceived that the EPG-Br is useful to verify the overall progress of motor and cognitive aspects. However, the evolution of specific abilities evaluated by each item must be considered with caution as it would be unsuitable to assess subjects with ceiling scores. And as the floor effect was not observed in any of the items, the EGP-Br may be considered an option to pursue the progression of symptoms of degenerative disorders in Brazilian elderly, as it is in studies from other countries[5,8,9].

CONCLUSION

The Brazilian version of the Geriatric Psychomotor Examination has shown to be a useful aid for healthcare when approaching the 2 main functional complaints of older age, decline of memory and balance. It is being established as a multidisciplinary instrument for motor and cognitive assessment of the elderly in Brazil,

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