Model-based reliability indexes: an application to rehabilitation

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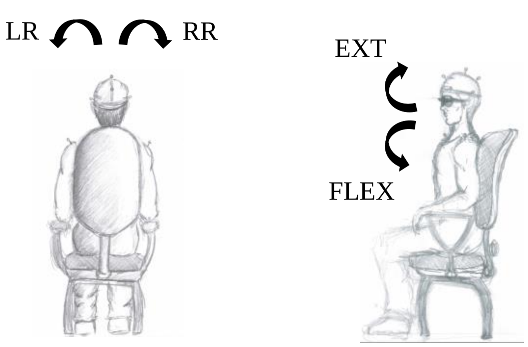
Introduction

The generalizability (G) theory can be used to estimate the reliability of rehabilitation measurements addressing the fact that measurements evaluated on persons vary not only due to individual differences in the personality, behaviors, symptoms, abilities, or skills measured, but also due to various sources of measurement error associated with "facets" of the measurement (e.g., different raters, time of recording) [1]. The reliability is quantified by the dependability coefficient based on the variance components estimated by linear mixed models [2]. Aim of this study was to estimate the dependability coefficient of cervical Joint Position Error (JPE) measurements.

Methods

During period 2020-2021, 26 healthy adults (both genders and range age 18 to 50 years) were recruited to perform, while sitting blindfolded, 4 exercises: the head was passively rotated, by one operator, about 30° to the right and left (right and left axial rotation movements of the cervical spine, RR and, LR tests, respectively) and tilted about 25° back and forth (extension and flexion, EXT and FLEX tests, respectively). After each passive movement, the head was repositioned to neutral, and subjects were requested to reproduce actively the passive displacement. An optoelectronic system recorded the 3D displacements of the midsagittal head axis. For each movement the JPE was calculated as absolute difference in degrees, between the passive and the actively reproduced positions. All subjects (s) were evaluated in two sessions (T0 and T1), with a 2-week time (t) interval, in which the four passive movements were repeated by two operators (o). Data from this fully crossed design (s x o x t) was analyzed by means of a linear mixed model including subject, operators, time and their pairwise interactions as random effects, separately for each of the four exercises.



Results

Subjects had a mean age of 33 years (± 6) and 50% were male. For each movement the highest variance component was related to subjects, and ranged from 1.93 to 8.86 for movements EXT and RR, respectively. Similar results were found for the residual variance component. The variance component related to time, operator and interaction were generally low. The dependability index, that is, the ratio of the variance components related to patients to the sum of all variance components, ranged from 0.76 to 0.90 for movement EXT and RR, respectively.

	Movement			
Source of variance	RR	LR	EXT	FLEX
Subject	8.856	3.817	1.927	2.209
Time	0.038	0.154	0.035	0.000
Operator	0.185	0.049	0.000	0.036
Subject*Time	0.449	0.456	0.756	0.003
Subject*Operator	0.170	0.446	0.449	0.063
Time*Operator	0.000	0.000	0.023	0.000
Residual	2.621	2.448	0.716	1.292
Dependability index	0.902	0.784	0.756	0.855

Conclusions

Values of obtained dependability indexes suggested quite a negligible "bias" due to facets in this test. Linear mixed models seem to be a feasible approach to estimate variance components needed to measure reliability in complex designs. Unbiased estimates of variance components are the main prerequisite to obtain informative minimal detectable change (MDC) values that is the minimal amount of change exceeding the one expected by chance, in single individuals [3]. This is a crucial information in clinical practice and research.

References

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