



## THEORY OF THE RESPONSE TO THE ITEM IN RESEARCH IN PUBLIC HEALTH TEORIA DA RESPOSTA AO ITEM NAS PESQUISAS EM SAÚDE PÚBLICA

### TEORÍA DE LA RESPUESTA AL ITEM EN LAS INVESTIGACIONES EN SALUD PÚBLICA

Diego Eller Gomes<sup>1</sup>, José Luís Guedes dos Santos<sup>2</sup>, José Wicto Pereira Borges<sup>3</sup>, Murilo Pedroso Alves<sup>4</sup>, Dalton Francisco de Andrade<sup>5</sup>, Alacoque Lorenzini Erdmann<sup>6</sup>

#### ABSTRACT

**Objective:** to analyze the use of Item Response Theory (IRT) in public health research. **Method:** integrative review, without temporal delimitation, in the databases LILACS, SCOPUS, MEDLINE / PUBMED and in the SCIELO virtual library. We adopted the steps of reading, counting of occurrence of characteristics of the publications and organization in thematic categories in the process of analysis. Results: 56 studies met the inclusion criteria that sought to evaluate the validity and reliability of measurement instruments and to make psychometric adjustments. The quality of life, the health of the elderly and the health literacy were highlighted as more evaluated latent traits. Conclusion: the possibilities of using IRT for the evaluation of a diversity of traits previously related to public health are evidenced by allowing the transformation of subjective results into probabilities. The development of new instruments may consider the evaluation of latent traits relevant to public health, such as the integrality of care in basic care, the user's link to health services and perspectives on vulnerabilities, contributing to the advancement of scientific knowledge. **Descriptors:** Statistical Methods and Procedures; Surveys and Questionnaires; Quantitative Analysis; Public Health; Nursing; Nursing Assessment.

#### RESUMO

**Objetivo:** analisar a utilização da Teoria da Resposta ao Item (TRI) nas pesquisas em saúde pública. **Método:** revisão integrativa, sem delimitação temporal, nas bases de dados LILACS, SCOPUS, MEDLINE/PUBMED e na biblioteca virtual SCIELO. Adotaram-se as etapas de leitura, contagem de ocorrência de características das publicações e organização em categorias temáticas no processo de análise. **Resultados:** 56 estudos atenderam aos critérios de inclusão que buscaram avaliar a validade e a confiabilidade de instrumentos de mensuração e realizar ajustes psicométricos. Destacaram-se, como traços latentes mais avaliados, a qualidade de vida, a saúde de idosos e o letramento em saúde. **Conclusão:** evidenciam-se as possibilidades de utilização da TRI para a avaliação de uma diversidade de traços antes relacionados à saúde pública ao permitir a transformação de resultados subjetivos em probabilidades. O desenvolvimento de novos instrumentos pode considerar a avaliação de traços latentes relevantes para a saúde pública, como a integralidade da assistência na atenção básica, o vínculo do usuário aos serviços de saúde e perspectivas sobre vulnerabilidades, contribuindo para o avanço do conhecimento científico. **Descritores:** Métodos e Procedimentos Estatísticos; Inquéritos e Questionários; Análise Quantitativa; Saúde Pública; Enfermagem; Avaliação em Enfermagem.

#### RESUMEN

**Objetivo:** analizar la utilización de la Teoría de la Respuesta al Ítem (TRI) en las investigaciones en salud pública. **Método:** revisión integrativa, sin delimitación temporal, en las bases de datos LILACS, SCOPUS, MEDLINE / PUBMED y en la biblioteca virtual SCIELO. Se adoptaron las etapas de lectura, conteo de ocurrencia de características de las publicaciones y organización en categorías temáticas en el proceso de análisis. **Resultados:** 56 estudios atendieron a los criterios de inclusión, que buscaron evaluar la validez y la confiabilidad de instrumentos de medición y realizar ajustes psicométricos. Se destacaron como rasgos latentes más evaluados, la calidad de vida, la salud de ancianos y el letramiento en salud. **Conclusión:** se evidencian las posibilidades de utilización de la TRI para la evaluación de una diversidad de rasgos latentes relacionados a la salud pública, al permitir la transformación de resultados subjetivos en probabilidades. El desarrollo de nuevos instrumentos puede considerar la evaluación de rasgos latentes relevantes para la salud pública, como la integralidad de la asistencia en la atención básica, el vínculo del usuario a los servicios de salud y perspectivas sobre vulnerabilidades, contribuyendo al avance del conocimiento científico. **Descriptores:** Métodos y Procedimientos Estadísticos; Encuestas y Questionarios; Análisis Cuantitativo; Salud Pública; Enfermería; Evaluación em Enfermería.

<sup>1</sup>PhD in Production Engineering, Postgraduate Program in Production Engineering, Federal University of Santa Catarina / UFSC, Florianópolis (SC), Brazil. E-mail: [diego.eller@ufsc.br](mailto:diego.eller@ufsc.br) ORCID iD: <https://orcid.org/0000-0003-4434-5492>; <sup>2</sup>PhD, PostGraduate Program in Nursing, Federal University of Santa Catarina / UFSC, Florianópolis (SC), Brazil. E-mail: [joseenfermagem@gmail.com](mailto:joseenfermagem@gmail.com) ORCID iD: <https://orcid.org/0000-0003-3186-8286>; <sup>3</sup>PhD, Post-Graduation Program in Health and Community, Federal University of Piauí / UFPI, Floriano (PI), Brazil. E-mail: [josewictoborges@gmail.com](mailto:josewictoborges@gmail.com) ORCID iD: <https://orcid.org/0000-0002-3292-1942>; <sup>4</sup>Doctorate student, Postgraduate Program in Nursing, Federal University of Santa Catarina / UFSC, Florianópolis (SC), Brazil. E-mail: [murilopedrosoalves@gmail.com](mailto:murilopedrosoalves@gmail.com) RCID iD: <https://orcid.org/0000-0002-2704-6848>; <sup>5</sup>PhD, Postgraduate Program in Production Engineering, Federal University of Santa Catarina / UFSC, Florianópolis (SC), Brazil. E-mail: [dalton.andrade@ufsc.br](mailto:dalton.andrade@ufsc.br) ORCID iD: <https://orcid.org/0000-0002-4403-980X>; <sup>6</sup>PhD, Postgraduate Program in Nursing, Federal University of Santa Catarina / UFSC, Florianópolis (SC), Brazil. E-mail: [alacoque@newsite.com.br](mailto:alacoque@newsite.com.br) ORCID iD: <https://orcid.org/0000-0003-3964-1115>

## INTRODUCTION

The use of psychometric instruments and tests is considered as an important advance in the area of health evaluation because it allows the investigation of several phenomena.<sup>1</sup> This is due to the fact that the tests allow the establishment of a referential and, consequently, reduce the subjective biases of the evaluations.<sup>2</sup>

In the nineteenth century, the development of instruments for psychological evaluation, parallel to the advance of positivist science and the identification of the importance of objective and valid measures for clinical research, was started.<sup>1</sup> The need for theories to assess the psychometric properties of measuring instruments emerged.<sup>1,3</sup>

In this context, two main theoretical lines of psychometry are identified: Classical Test Theory (CTT) and Item Response Theory (IRT). As a focus of the TCT, the instrument itself is used to determine the properties or metric parameters of the test.<sup>4</sup> The focus of the IRT focuses on the individualized study of the component items of a test group or bank of items - unlike its predecessor.<sup>3</sup>

IRT, an expression of modern psychometry, is a group of mathematical models that allow advances in the validity and reliability studies of instruments based on robust analyzes applied to the different types of measurement instruments. Among the IRT models, the following are included: nominal response model; modified standard model; multiple choice model; model of scale of estimation; partial credit model; generalized partial credit model; model of gradual response and continuous model.<sup>5</sup>

In many countries, as well as in Brazil, IRT was widely disseminated and used in the evaluation of educational tests,<sup>6-7</sup> of quality management,<sup>8</sup> marketing,<sup>9</sup> among others.<sup>10</sup> In the health area, some of the IRT models for construction,<sup>11</sup> validation<sup>12-3</sup> and evaluation of instruments and programs.<sup>14</sup> The importance of public health as a science that fosters the development of strategies and tools to improve the quality of life of the population through management is emphasized care and health services, the prevention of diseases and diseases to the health of the disease, health promotion and the education of the patient, family and community. It contributes to the practice of the various health professionals, especially Nursing.

When considering the possibilities of using IRT, the development of a study aiming at the

identification of which are and are being used the mathematical models of the IRT in the area of public health presents itself as a contribution to researchers interested in using it in investigations. So far, there is no synthesis of knowledge that makes it possible to analyze the panorama and the perspectives of the use of IRT in the area of public health. Therefore, an advance in the scientific knowledge related to the subject is presented. In addition, an analysis in this sense may show perspectives for advances in health behavior measurement studies. Thus, the question is: how has IRT been used in public health research?

## OBJECTIVE

- To analyze the use of Item Response Theory (IRT) in public health research.

## METHOD

Integrative review using an intervention tool called Knowledge Development Process - Constructivist (Proknow-C).<sup>15</sup> This instrument subsidized the process of formation of the bibliographic portfolio (BP) referring to the fragment of the literature: use of IRT in health research public.

There is the first stage of Proknow-C with the objective of identifying the scientific publications related to the theme defined by the researchers. This stage consists of three substeps: (1) selection of the gross articles bank; (2) filtering the articles bank and (3) performing the representativeness test of the articles. In each substep, researchers need to make choices resulting in portfolio selection, which is a restricted and relevant set of scientific articles representative of the literature fragment under investigation.

The following criteria were adopted for the inclusion of the studies in the review: to explain the use of IRT in research in the public health area from the "item response theory" AND "public health" in the title, abstract or keywords, key; be in Portuguese, English or Spanish; be available online. It was decided not to establish a time limit in view of the small number of studies published until the year 2010. These criteria were applied to the LILACS and SCOPUS databases, to the Scientific Electronic Library Online (SCIELO) and to the Online System Research and Analysis of Medical Literature and Retrieval System Online via PUBMED.

Figure 1 shows the process of application of Proknow-C for the selection of the portfolio of articles representative of the fragment of the literature.

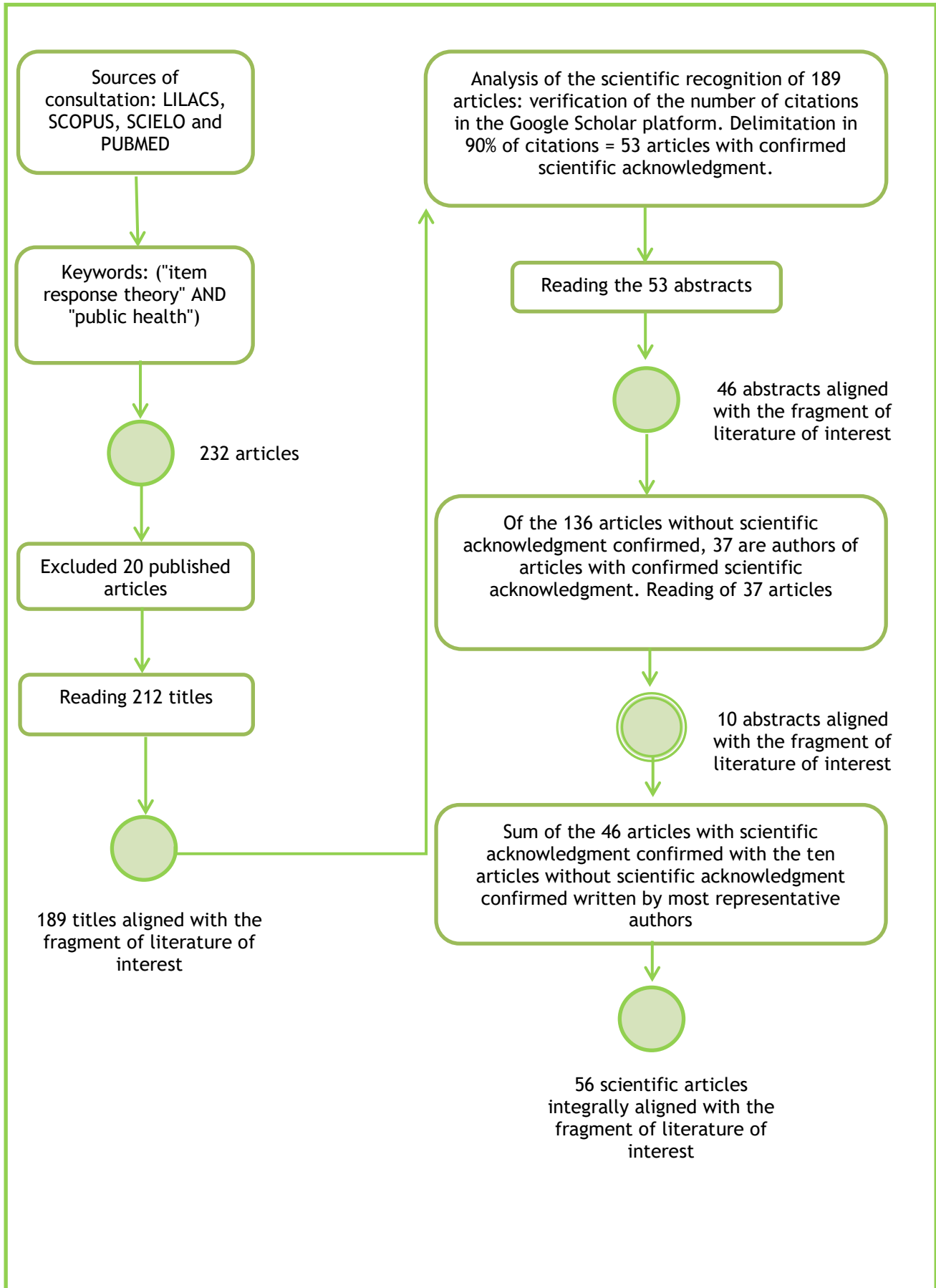


Figura 1. Etapas do processo de formação do portfólio bibliográfico. Florianópolis (SC), Brasil, 2018.

The bibliographic portfolio was composed with 56 scientific articles available online and fully aligned with the research theme.

After the formation of the portfolio of scientific articles, some characteristics of the publications of the fragment of the investigated literature were counted in order to build knowledge in the researchers and, later, in the scientific community.<sup>15-6</sup> They were defined as characteristics to be analyzed: (1) who are the researchers with trajectory in the area of knowledge; (2) which

are the journals that have dedicated space for the publication of the subject and (3) which are the articles most quoted by the scientific community, by counting citations on the Google Scholar platform, on August 25, 2017.

In the last step, regarding content analysis, a critical analysis of the selected BP was performed, describing the data and grouping them by similarity. For that, a priori categories were established, such as: study objectives, latent traits evaluated and IRT models used. At the end of the three stages,

it was identified where and how it is possible to intervene scientifically in relation to the subject investigated and to justify these choices.

## RESULTS

Two authors were highlighted by the highest number of scientific publications using IRT in public health research, both with 11 publications. One of these authors is Professor of Law, Policy and Health Management at the Medical University of Shanghai, China. Another prominent author is Professor of Health Policy and Management at the Boston University School of Public Health in the United States, whose research focuses on disability, physiotherapy, and gerontology.

Quality of Life Research (seven articles), Archives of Physical Medicine and Rehabilitation (six publications) and Journal of Clinical Epidemiology (three publications) stood out as the three journals with more space for publications using IRT in health research public. Quality of Life Research is a multidisciplinary journal dedicated to the

communication of original research, theoretical articles and methodological reports related to the field of quality of life in all health sciences, with an impact factor of 2,344. The journal Archives of Physical Medicine and Rehabilitation focuses on the creation and use of knowledge in the rehabilitation process, through original research and clinical reports on trends in medical rehabilitation, whose impact factor is 3,289. The third journal that has devoted more space to publications using IRT in the field of public health - Journal of Clinical Epidemiology - aims to promote the quality of clinical health care research through the promotion and application of innovative methods, with special attention the formation of new scientists and leaders of clinical practice, and its impact factor is 4,978.

With regard to the articles in focus, figure 2 presents the ten articles most cited by the scientific community, with emphasis on the study Development of an easy-to-use Spanish Health Literacy Test,<sup>17</sup> with 170 citations.

Title	Journal	Year	First author	Num. of quotes
Development of an easy-to-use Spanish Health Literacy test	Health Services Research	2006	Lee <sup>17</sup>	170
The grounded psychometric development and initial validation of the Health Literacy Questionnaire (HLQ)	BMC Public Health	2013	Osborne <sup>18</sup>	156
A two-tier full-information item model analysis model with applications	Psychometrika	2010	Cai <sup>19</sup>	131
Development of a Japanese version of the Epworth Sleepiness Scale (JESS) based on item response theory	Sleep Medicine	2009	Takegami <sup>20</sup>	110
The European KIDSCREEN approach to measure quality of life and well-being in children: development, current application, and future advances	Quality of Life Research	2014	Ravens-Sieberer <sup>21</sup>	100
Short Assessment of Health Literacy- Spanish and English: a comparable test of health literacy for Spanish and English speakers	Health Services Research	2010	Lee <sup>22</sup>	73
Mokken scale analysis of mental health and well-being questionnaire item responses: a non-parametric IRT method in empirical research for applied health researchers	BMC Medical Research Methodology	2012	Stochl <sup>23</sup>	65
Unidimensionality and bandwidth in the Center for Epidemiologic Studies Depression (CES-D) Scale	Journal of Personality Assessment	2006	Stansbury <sup>24</sup>	63
The development of the S-QoL 18: a shortened quality of life questionnaire for patients with schizophrenia	Schizophrenia Research	2010	Boyer <sup>25</sup>	57
Can item response theory reduce patient burden when measuring health status in neurological disorders? Results from Rasch analysis of the SF-36 physical functioning scale (PF-10)	Journal of Neurology, Neurosurgery and Psychiatry	2001	Jenkinson <sup>26</sup>	48

Figure 2. Articles most cited by the scientific community that used TRI in the area of public health. Florianópolis (SC), Brazil, 2018.



It is noted that an article published in 2006 obtained the largest number of citations. However, articles published in 2013 and 2014, are also among the most cited, with 156 and 100 citations, respectively. The articles presented in table 1 are important sources of research because they show greater scientific

recognition about the application of TRI in public health research.

Diversified objectives were presented, however, one can observe greater occurrence of verbs to evaluate, develop and validate. Figure 3 shows the characteristics of the studies regarding the objectives, latent traits and TRI models used.

Firstauthor	Year	Objective	Latent trace	TRI Models
Jenkinson <sup>26</sup>	2001	Validate a construct	Physical function in neurological motor disease and Parkinson's disease	ML1P <sup>b</sup>
Gulliford <sup>27</sup>	2004	Assess reliability and validity	Family food safety	ML2P <sup>c</sup>
Lee <sup>17</sup>	2006	Develop a measure	Literacy in health for adults	ML1P, ML2P, ML3P <sup>d</sup>
Metz <sup>28</sup>	2006	Evaluate a psychometric adjustment	Quality of life of patients with asthma	MCPG <sup>e</sup>
Stansbury <sup>24</sup>	2006	Evaluate a psychometric adjustment	Depression	ML1P
Filiatrault <sup>29</sup>	2007	Assess reliability and validity	Balance for activities in the elderly	MRG <sup>f</sup>
Jette <sup>30</sup>	2008	Develop a measure	Use of research on aging	DIF <sup>g</sup>
Tao <sup>31</sup>	2008	Develop a measure	Mobility, daily activities and cognitive abilities	Não especifica
Allen <sup>32</sup>	2009	Validate a construct	Pediatric outcomes	ML1P
Forjaz <sup>33</sup>	2009	Assess reliability and validity	Autonomic symptoms in Parkinson's disease	ML1P; DIF
Forjaz <sup>34</sup>	2010	Evaluate a psychometric adjustment	Anxiety and hospital depression	ML1P; DIF
Haley <sup>35</sup>	2009	Evaluate an item bank	Physical function in children with cerebral palsy	ML1P; DIF
Haley <sup>36</sup>	2009	Evaluate a psychometric adjustment	Physical function in children with cerebral palsy	ML2P; DIF
Jette <sup>37</sup>	2009	Develop a measure	Physical function in people with osteoarthritis	ML2P
Takegami <sup>20</sup>	2009	Assess reliability and validity	Somnolence	MCPG
Boyer <sup>25</sup>	2010	Evaluate a psychometric adjustment	Quality of life	MCPG; DIF
Brodersen <sup>38</sup>	2010	Evaluate a psychometric adjustment	Consequences of screening for lung cancer	MCPG
Cai <sup>19</sup>	2010	Validate a construct	Quality of life	ML2P
Cherepanov <sup>39</sup>	2010	Evaluate a psychometric adjustment	Quality of life	ML2P
Conrad <sup>40</sup>	2010	Assess reliability and validity	Crime and violence	ML1P
Perron <sup>41</sup>	2010	Validate a construct	Inhalant use / abuse disorders	ML2P
Villaveces <sup>42</sup>	2010	Develop a measure	Prevention of injuries and violence	ML1P, ML2P, ML3P
Conrad <sup>43</sup>	2011	Assess reliability and validity	Psychological abuse in the elderly	ML1P; DIF
Dregan <sup>44</sup>	2011	Develop a measure	Medical Codes	ML2P
Fang <sup>45</sup>	2011	Evaluate a psychometric adjustment	Quality of life of people with disabilities	DIF
Riley <sup>46</sup>	2011	Evaluate a psychometric adjustment	Mental health	MRG; DIF
Bann <sup>47</sup>	2012	Develop a measure	Public health surveillance of well-being	DIF
Chan <sup>48</sup>	2012	Evaluate item equivalence	Aging	ML2P
Fang <sup>49</sup>	2012	Evaluate a psychometric adjustment	Quality of life of the elderly	MCPG; DIF
Jette <sup>50</sup>	2012	Calibrate a bank of items	Functional spinal cord injury	MRG; DIF
Stochl <sup>23</sup>	2012	Develop an instrument	Health and wellness	Mokken
Lee <sup>51</sup>	2013	Develop an instrument	Oral health literacy	DIF

Lee <sup>22</sup>	2010	Develop a measure	Literacy in oral health for adults	ML1P, ML2P, ML3P
Marfeo <sup>52</sup>	2013	Evaluate a psychometric adjustment	Behavioral health	MRG; DIF
Marfeo <sup>53</sup>	2013	Validate a construct	Health behavior at work	ML1P, ML2P, ML3P
Mcdonough <sup>54</sup>	2013	Evaluate a psychometric adjustment	Ambulatory Rehabilitation	CAT <sup>h</sup>
Osborne <sup>18</sup>	2013	Develop a measure	Health literacy	MRG
Parsons <sup>55</sup>	2013	Assess reliability and validity	Hypersexual disorder	MRG
Waller <sup>56</sup>	2013	Develop a measure	Knowledge about HPV	ML1P, ML2P, ML3P
Bevans <sup>57</sup>	2014	Calibrate a bank of items	Quality of life	CAT
Hahn <sup>58</sup>	2014	Develop a measure	Social health in chronic diseases	ML2P; DIF
Onishi <sup>59</sup>	2014	Develop a measure	Symptoms of ascites in cirrhosis	MCPG
Ravens-Sieberer <sup>21</sup>	2014	Develop an adaptive test	Quality of life related to child health	MCPG
Rose <sup>60</sup>	2014	Calibrate a bank of items	Physical function	MRG
Spiegel <sup>61</sup>	2014	Develop a measure	Gastrointestinal symptoms	MRG
Zhong <sup>62</sup>	2014	Assess reliability and validity	Depression scale	DIF
Chan <sup>63</sup>	2015	Evaluate a psychometric adjustment	Cognitive performance in aging	MRG
Epstein <sup>64</sup>	2015	Assess reliability and validity	Impact of health education	MRG; ML2P; DIF
Gerrard <sup>65</sup>	2015	Assess reliability and validity	Integration of adults injured by burns	Não especificado
Honda <sup>66</sup>	2015	Develop a measure	Quality of life in gastrointestinal surgery	MCPG
Michel <sup>67</sup>	2015	Develop a measure	Quality of life in patients with multiple sclerosis	DIF
Schalet <sup>68</sup>	2015	Develop a measure	Physical and mental health	MRG
Teicher <sup>69</sup>	2015	Develop a measure	Exposure to maltreatment and abuse	ML1P
Coster <sup>70</sup>	2016	Evaluate a psychometric adjustment	Mobility, fatigue and pain in children with cerebral palsy	MRG; DIF
Mcdonough <sup>71</sup>	2016	Evaluate a psychometric adjustment	Cognitive function in outpatient rehabilitation	CAT
Marino <sup>72</sup>	2017	Develop a set of items	Social impact of burns in adults	CAT

Figure 3. Objectives, latent traits and TRI models used in studies in the area of public health. Florianópolis (SC), Brazil, 2018.

b: Logistic model of a parameter

c: Logistic model of two parameters

d: Logistic model of three parameters

e: Generalized partial credit model

f: Gradual response model

g: Differential operation of the item

h: Computerized adaptive test

## DISCUSSION

Among the most representative journals, it was found that the Journal of Clinical Epidemiology seeks to highlight the application of innovative methods in the health area, while the journal Quality of Life Research has been dedicating space for publications related to the quality of life being this the latent trait more evaluated in public health research using IRT.<sup>19,28,32,35,41,45,56,59,66-7</sup> Therefore, the evaluation of the quality of life, through the use of mathematical and statistical models of IRT, has been gaining more space in scientific publications and can be considered an innovative combination.

Regarding the objectives of the articles, it was verified that the IRT has been used with three main purposes: to evaluate instruments,<sup>27-9,32-3,35,39,41-2,44-5,51-2,62,65,70</sup> validate constructs<sup>28,31,40,54,37</sup> and develop instruments.<sup>51,62,75</sup> These findings confirm the possibilities and benefits of using IRT indicated in classic studies.<sup>4,5,73</sup> It was identified as well as diversified goals such as: developing the Japanese version of a drowsiness scale,<sup>20</sup> measuring gastrointestinal symptoms reported by patients,<sup>61</sup> exploring the feasibility of a functional adaptation system in mobility, daily activities and cognitive abilities<sup>31</sup> and describing the process of calibration of the functional spinal cord injury index.<sup>49</sup> Four scientific studies sought to

harmonize, together, the results of other research.<sup>44,63,68</sup>

With the purpose of developing or evaluating instruments as well as evaluating latent traits, the one-dimensional, one-, two- or three-parameter model was the most recurrent and used in<sup>17</sup> studies analyzed. The logistic model of three parameters (ML3)<sup>74</sup> is the most complete because, in addition to the parameters of difficulty and discrimination of the items, it also considers the likelihood of success at random when the respondent has a low level of fitness or latent trait.<sup>73</sup> However, only five studies adore ML3, generally in comparison to the one- and two-parameter models,<sup>17,38,48,51,55</sup> because randomization seems to make less sense when compared to its application in the educational area, which seeks to represent the probability of a student with low ability to respond correctly to the item, at random, or kick.

By ML3, the one-dimensional logistic model of two parameters (ML2) is easily obtained,<sup>75</sup> for example, when there is no possibility of chance matching. Thus, this model stands out as the most used in public health research,<sup>19,28,30,35,37-38,40,44,48,51,55,57,64</sup> because, besides the difficulty of the item, contemplates the item discrimination parameter that refers to the ability of the item to discriminate respondents with different levels of fitness or latent trait.<sup>73</sup>

Among the unidimensional IRT models for dichotomous items, those corrected as right or wrong, belong or do not belong, satisfied or dissatisfied, among others, the logistic model of a parameter (ML1) or Rasch model is the simplest, considering that all items have the same power of discrimination and includes, in its formula, only the difficulty parameter of the items. After the two-parameter model of IRT, ML1 was identified as the most used.<sup>17,26-8,31-4,36,38-9,48,51,55,69</sup>

Regarding the models for polytomic items, the GRM assumes that the response categories of an item can be ordered among themselves.<sup>76</sup> In these cases, multiple choice items are evaluated in a graduated way, elaborated with intermediate categories in order to obtain more information about the individuals' responses and not only to identify if they gave correct or incorrect answers. It was identified the adoption of this model in 11 studies that applied IRT in public health research.<sup>29,42,46,50,55,60-1,63-4,68,70</sup>

Another finding evidenced in this study refers to the use of the generalized partial credit IRT (GPCM) model for polytomic items in public health research.<sup>77</sup> The model is related to items with IRT's gradual polytomic

responses and considers the probabilities of choice for each of the response categories as adopted in eight scientific studies related to public health.<sup>28,33,45,58-9,66</sup> In the model, the respondent earns more credit (would have a higher value for his latent trait) as measured that your answer is closer to the more complete answer.<sup>78</sup>

Among the selected studies, 19 of them performed the analysis of the differential function of the item (DFI) in order to verify if the probability of agreement or agreement with the item varied among groups of respondents by sex, age, educational level, geographical location and/ or level of disease severity.<sup>28-9,32,34,39,41-3,45-6,48,50,57,62,64,67,70</sup> The use of DFI in public health and, consequently, by Nursing professionals, may allow the investigation of variables that influence the health assessments, allowing to highlight the vulnerabilities or social determinants of health.

The DFI analysis aims at the detection of items whose probability of success differs between distinct groups whose respondents have the same level of latent trait in the measured variable. A good model of measurement should require that the most capable person, or with a higher level of a latent trait, is always more likely to hit an item than a less able person. Every person should be more likely to hit an easy (or common) item than a difficult one (or rare), and finally, these conditions should be product of the person and the position of the item in the dash or skill and not based on the race, sex or other characteristics of the respondents.<sup>79</sup>

In the studies, benefits derived from the use of IRT in public health research have been identified, such as: creation of evaluation tools that can be applied to populations of different languages in the case of cross-cultural research;<sup>57</sup> response of the items;<sup>33</sup> identification of bias among the groups of respondents due to their characteristics, through the analysis of DFI;<sup>33-4,44,70</sup> elaboration of tests that do not need many items, because the analysis of its parameters allows the identification of the items with greater power of discrimination, which can reduce the error and the size of the sample;<sup>39-40-1,56</sup> iterative change or replacement of items, made possible by the methodology of computerized adaptive tests (CAT), in which the presentation of an item is based on the information obtained from the answers to previously applied items.<sup>29,42,60</sup>

More specifically, some studies have presented, as benefits of IRT, the possibility

of validation of measures such as self-report of psychological abuse in the elderly,<sup>36</sup> the evaluation and comparison between the level of health literacy of Spanish and English speakers, aspect positive, and also to subsidize the process of awareness of Nursing professionals in relation to the needs of patients with low level of health literacy, which can help reduce the linguistic complexity used in communication between professionals and patients.<sup>49</sup>

Some care is taken to develop tools for evaluating latent traits related to public health, such as the calibration of the parameters of the items from the application of the instrument to people with different levels of latent trait and the elaboration of items with different levels difficulty of reiterating the indication presented in classic studies about the use of IRT.<sup>5,73</sup>

This review has as limitation the use of a descriptive design in relation to the studies that applied the IRT in public health research, without incurring in an in depth analysis of the latent traits most explored in public health as quality of life, health of the elderly and literacy in health. In addition, some articles did not show the IRT model used, which made it difficult to analyze these studies.

## CONCLUSION

Using IRT, it is possible to evaluate several constructs relevant to public health by mathematical means, transforming the subjective results of evaluations into probabilities. For this passage, a variety of models were used, mainly the one and two parameter models, in order to determine the validity and reliability qualities of the instruments that sought to evaluate, mainly, the latent traits quality of life, health of the elderly and literacy in health.

The latent traits were also worked out, from the differential functioning of items, to observe if certain characteristics can influence the responses of individuals. Thus, when answering the question: how has IRT been used in public health research, new possibilities are presented to analyze the reliability and validity of public health measurement instruments. Such perspectives could be used in the establishment of new instruments considering latent traits relevant to public health, such as the integrality of basic health care, vulnerability perspectives, health promotion behavior, user bonding and equity in access to health services. contributing to future research in the area of public health and Nursing..

As a fruitful field for future investigations, the theoretical-analytical panorama presented, especially, in the area of Nursing is evidenced. The importance of Nursing professionals in the search for emancipation of users in the context of the discussions about the social determinants of health conditioning for the process of living healthy related to the socioeconomic, cultural and environmental vulnerabilities.

## REFERENCES

1. Sartes LMA, Souza-Formigoni MLO. Advances in psychometrics: from Classical Test Theory to Item Response Theory. *Psicol Reflex Crit.* 2013;26(2):241-50. Doi: <http://dx.doi.org/10.1590/S0102-79722013000200004>
2. DeMars C. Item response theory: understanding statistics measurement. New York: Oxford University Press; 2010.
3. Andriola WB. *Psicometria Moderna: características e tendências.* Est Aval Educ. 2009 May/Aug;20(43):319-40. Doi: <http://dx.doi.org/10.18222/ae204320092052>
4. Pasquali L, Primi R. Basic theory of Item Response Theory - IRT. *Aval Psicol [Internet].* 2003 Dec [cited 2018 Feb 12];2(2):99-110. Available from: <http://pepsic.bvsalud.org/pdf/avp/v2n2/v2n2a02.pdf>
5. Embretson S, Reise S. Item response theory. Hoboken: Taylor and Francis; 2013.
6. Klein R. Use of Item Response Theory at the Brazilian Assessment System for Basic Education. *Rev Meta.* 2009;1(2):125-40. Doi: <http://dx.doi.org/10.22347/2175-2753v1i2.38>
7. Chen CM, Lee HM, Chen YH. Personalized e-learning system using item response theory. *Comput Educ.* 2005 Apr;44(3):237-55. Doi: <https://doi.org/10.1016/j.compedu.2004.01.006>
8. Alexandre JWC, Andrade DF, Vasconcelos AP, Araújo AMS. A construct analysis proposal for measuring the total quality management critical factors through the item response theory. *Gest Prod.* 2002 Aug;9(2):129-41. Doi: <http://dx.doi.org/10.1590/S0104-530X2002000200003>
9. Jong MG, Steenkamp JBEM, Fox JP, Baumgartner H. Using item response theory to measure extreme response style in marketing research: a global investigation. *J Mark Res.* 2008 Feb;45(1):104-15. Doi: <https://doi.org/10.1509/jmkr.45.1.104>
10. Pasquali L. *Psicometria.* Petrópolis: Vozes; 2009.



11. Rodrigues MTP, Moreira TMM, Andrade DF. Elaboration and validation of instrument to assess adherence to hypertension treatment. *Rev Saúde Pública.* 2014 Apr;48(2):232-9. Doi: <http://dx.doi.org/10.1590/S0034-8910.2014048005044>
12. César CC, Mambrini JVM, Ferreira FR, Lima-Costa MF. Functional capacity in the elderly: analyzing questions on mobility and basic and instrumental activities of daily living using Item Response Theory. *Cad Saúde Pública.* 2015 May;31(5):931-45. Doi: <http://dx.doi.org/10.1590/0102-311X00093214>
13. Gomes RRFM, Batista JR, Ceccato MGB, Kerr LRF, Guimarães MDC. HIV/AIDS knowledge among men who have sex with men: applying the item response theory. *Rev Saúde Pública.* 2014 Apr;48(2):206-15. Doi: <https://doi.org/10.1590/S0034-8910.2014048004911>
14. Souza MF, Santos AFD, Reis IA, Santos MADC, Jorge AO, Machado ATGDM, et al. Care coordination in PMAQ-AB: an item response theory-based analysis. *Rev Saúde Pública.* 2017;51:87. Doi: [10.11606/S1518-8787.2017051007024](https://doi.org/10.11606/S1518-8787.2017051007024)
15. Ensslin L, Ensslin SR, Pacheco GC. A study about safety in football stadiums based on bibliometric analysis of international literature. *Perspect Ciênc Inf.* 2012 Apr/June;17(2):71-91. Doi: <http://dx.doi.org/10.1590/S1413-99362012000200006>.
16. Lacerda RT, Ensslin L, Ensslin SR. A bibliometric analysis of strategy and performance measurement. *Gest Prod.* 2012;19(1):59-78. Doi: <http://dx.doi.org/10.1590/S0104-530X2012000100005>
17. Lee SY, Bender DE, Ruiz RE, Cho YI. Development of an Easy-to-Use Spanish Health Literacy Test. *Health Serv Res.* 2006 Aug;41(4 pt 1):1392-412. Doi: [10.1111/j.1475-6773.2006.00532.x](https://doi.org/10.1111/j.1475-6773.2006.00532.x)
18. Osborne RH, Batterham RW, Elsworth GR, Hawkins M, Buchbinder R. The grounded psychometric development and initial validation of the Health Literacy Questionnaire (HLQ). *BMC Public Health.* 2013 July;13(1):658. Doi: [10.1186/1471-2458-13-658](https://doi.org/10.1186/1471-2458-13-658)
19. Cai L. A Two-Tier Full-Information Item Factor Analysis Model with Applications. *Psychometrika.* 2010 Dec;75(4):581-612. Doi: [10.1007/S11336-010-9178-0](https://doi.org/10.1007/S11336-010-9178-0)
20. Takegami M, Suzukamo Y, Wakita T, Noguchi H, Chin K, Kadotani H, et al. Development of a Japanese version of the Epworth Sleepiness Scale (JESS) based on item response theory. *Sleep Med.* 2009 May;10(5):556-65. Doi: [10.1016/j.sleep.2008.04.015](https://doi.org/10.1016/j.sleep.2008.04.015)
21. Ravens-Sieberer U, Herdman M, Devine J, Otto C, Bullinger M, Rose M, et al. The European KIDSCREEN approach to measure quality of life and well-being in children: development, current application, and future advances. *Qual Life Res.* 2014 Apr;23(3):791-803. Doi: [10.1007/s11136-013-0428-3](https://doi.org/10.1007/s11136-013-0428-3)
22. Lee SYD, Stucky B, Lee J, Rozier R, Bender D. Short assessment of health literacy-spanish and english: a comparable test of health literacy for spanish and english speakers. *Health Serv Res.* 2010 Aug;45(4):1105-20. Doi: [10.1111/j.1475-6773.2010.01119.x](https://doi.org/10.1111/j.1475-6773.2010.01119.x)
23. Stochl J, Jones PB, Croudace TJ. Mokken scale analysis of mental health and well-being questionnaire item responses: a non-parametric IRT method in empirical research for applied health researchers. *BMC Med Res Methodol.* 2012 June;12(1):74. Doi: [10.1186/1471-2288-12-74](https://doi.org/10.1186/1471-2288-12-74)
24. Stansbury JP, Ried LD, Velozo CA. Unidimensionality and Bandwidth in the Center for Epidemiologic Studies Depression (CES-D) Scale. *J Pers Assess.* 2006 Feb;76(1):10-22. Doi: [10.1207/s15327752jpa8601\\_03](https://doi.org/10.1207/s15327752jpa8601_03)
25. Boyer L, Simeoni MC, Loundou A, D'Amato T, Reine G, Lancon C, et al. The development of the S-QoL 18: A shortened quality of life questionnaire for patients with schizophrenia. *Schizophr Res.* 2010 Aug;121(1-3):241-50. Doi: [10.1016/j.schres.2010.05.019](https://doi.org/10.1016/j.schres.2010.05.019)
26. Jenkinson C, Fitzpatrick R, Garratt A, Peto V, Stewart-Brown S. Can item response theory reduce patient burden when measuring health status in neurological disorders? Results from Rasch analysis of the SF-36 physical functioning scale (PF-10). *J Neurol Neurosurg Psychiatry.* 2001 Aug;71(2):220-4. Doi: [10.1136/jnnp.71.2.220](https://doi.org/10.1136/jnnp.71.2.220)
27. Gulliford MC, Mahabir D, Rocke B. Reliability and validity of a short form household food security scale in a Caribbean community. *BMC Public Health.* 2004 June;4:22. Doi: [10.1186/1471-2458-4-22](https://doi.org/10.1186/1471-2458-4-22)
28. Metz SM, Wyrwich KW, Babu AN, Kroenke K, Tierney WM, Wolinsky FD. A comparison of traditional and Rasch cut points for assessing clinically important change in health-related quality of life among patients with asthma. *Qual Life Res.* 2006 Dec;15(10):1639-49. Doi: [10.1007/s11136-006-0036-6](https://doi.org/10.1007/s11136-006-0036-6)

29. Filiatrault J, Gauvin L, Fournier M, Parisien M, Robitaille Y, Laforest S, et al. Evidence of the psychometric qualities of a simplified version of the activities-specific balance confidence scale for community-dwelling seniors. *Arch Phys Med Rehabil*. 2007 May;88(5):664-72. Doi: [10.1016/j.apmr.2007.02.003](https://doi.org/10.1016/j.apmr.2007.02.003)
30. Jette AM, Haley SM, Ni P, Olarsch S, Moed R. Creating a computer adaptive test version of the late-life function and disability instrument. *J Gerontol A Biol Sci Med Sci*. 2008 Nov;63(11):1246-56. PMID: [19038841](https://pubmed.ncbi.nlm.nih.gov/19038841/)
31. Tao W, Haley SM, Coster WJ, Ni P, Jette AM. An exploratory analysis of functional staging using an item response theory approach. *Arch Phys Med Rehabil*. 2008 June;89(6):1046-53. Doi: [10.1016/j.apmr.2007.11.036](https://doi.org/10.1016/j.apmr.2007.11.036)
32. Allen DD, Gorton GE, Oeffinger DJ, Tytkowski C, Tucker CA, Haley SM. Analysis of the pediatric outcomes data collection instrument in ambulatory children with cerebral palsy using confirmatory factor analysis and item response theory methods. *J Pediatr Orthop*. 2008 Mar;28(2):192-8. Doi: [10.1097/BPO.0b013e3181652185](https://doi.org/10.1097/BPO.0b013e3181652185)
33. Forjaz MJ, Ayala A, Rodriguez-Blazquez C, Frades-Payo B, Martinez-Martin P, Longitudinal Parkinson's Disease Patient Study, et al.. Assessing autonomic symptoms of parkinson's disease with the scopa-aut: a new perspective from rasch analysis. *Eur J Neurol*. 2010 Feb;17(2):273-9. Doi: [10.1111/j.1468-1331.2009.02835.x](https://doi.org/10.1111/j.1468-1331.2009.02835.x)
34. Forjaz MJ, Rodriguez-Blázquez C, Martinez-Martin P, Longitudinal Parkinson's Disease Patient Study Group. Rasch analysis of the hospital anxiety and depression scale in Parkinson's disease. *Mov Disord*. 2009;24(4):526-32. Doi: [10.1002/mds.22409](https://doi.org/10.1002/mds.22409)
35. Haley SM, Fragala-Pinkham MA, Dumas HM, Ni P, Gorton GE, Watson K, et al. Evaluation of an item bank for a computerized adaptive test of activity in children with cerebral palsy. *Phys Ther*. 2009;89(6):589-600. Doi: [10.2522/ptj.20090007](https://doi.org/10.2522/ptj.20090007)
36. Haley SM, Ni P, Jette AM, Tao W, Moed R, Meyers D, et al. Replenishing a computerized adaptive test of patient-reported daily activity functioning. *Qual Life Res*. 2009;18(4):461-71. Doi: [10.1007/s11136-009-9463-5](https://doi.org/10.1007/s11136-009-9463-5)
37. Jette AM, McDonough CM, Ni P, Haley SM, Hambleton RK, Olarsch S, et al. A functional difficulty and functional pain instrument for hip and knee osteoarthritis. *Arthritis Res Ther*. 2009 July;11(4):107-18. Doi: [10.1186/ar2760](https://doi.org/10.1186/ar2760)
38. Brodersen J, Thorsen H, Kreiner S. Consequences of screening in lung cancer: development and dimensionality of a questionnaire. *Value Health*. 2010 Aug;13(5):601-12. Doi: [10.1111/j.1524-4733.2010.00697.x](https://doi.org/10.1111/j.1524-4733.2010.00697.x)
39. Cherepanov D, Palta M, Fryback DG. Underlying dimensions of the five health-related quality-of-life measures used in utility assessment. *Med Care*. 2010 Aug;48(8):718-25. Doi: [10.1097/MLR.0b013e3181e35871](https://doi.org/10.1097/MLR.0b013e3181e35871)
40. Conrad K, Riley B, Conrad K, Chan Y, Dennis M. Validation of the Crime and Violence Scale (CVS) against the rasch measurement model including differences by gender, race, and age. *Eval Rev*. 2010 Apr;34(2):83-115. Doi: [10.1177/0193841X10362162](https://doi.org/10.1177/0193841X10362162)
41. Perron BE, Vaughn MG, Howard MO, Bohnert A, Guerrero E. Item response theory analysis of DMS-IV criteria for inhalant-use disorders in adolescents. *J Stud Alcohol Drugs*. 2010 July;71(4):607-14. PMID: 20553671
42. Villaveces A, Stucky BD, Runyan CW, Moore KS, Berlin SP. The development of an instrument for evaluating core competencies in violence and injury prevention. *J Public Health Manag Pract*. 2010 July/Aug;16(4):337-44. Doi: [10.1097/PHH.0b013e3181bede2a](https://doi.org/10.1097/PHH.0b013e3181bede2a)
43. Conrad KJ, Iris M, Ridings JW, Langley K, Anetzberger GJ. Self-report measure of psychological abuse of older adults. *Gerontologist*. 2011 June;51(3):354-66. Doi: [10.1093/geront/gnq103](https://doi.org/10.1093/geront/gnq103)
44. Dregan A, Grieve A, Van Staa T, Gulliford MC. Potential application of item-response theory to interpretation of medical codes in electronic patient records. *BMC Med Res Methodol*. 2011 Dec;11(1):168. Doi: <https://doi.org/10.1186/1471-2288-11-168>
45. Fang J, Fleck MP, Green A, McVilly K, Hao Y, Tan W, et al. The response scale for the intellectual disability module of the WHOQOL: 5-point or 3-point? *J Intellect Disabil Res*. 2011 June;55(6):537-49. Doi: [10.1111/j.1365-2788.2011.01401.x](https://doi.org/10.1111/j.1365-2788.2011.01401.x)
46. Riley WT, Pilkonis P, Cella D. Application of the National Institutes of Health patient-reported outcomes measurement information system (PROMIS®) to mental health research. *J Ment Health Policy Econ*. 2011 Dec;14(4):201-8. PMID: 22345362
47. Bann CM, Kobau R, Lewis MA, Zack MM, Luncheon C, Thompson WW. Development and psychometric evaluation of the public health surveillance well-being scale. *Qual Life Res*. 2012 Aug;21(6):1031-43. Doi: [10.1007/s11136-011-0002-9](https://doi.org/10.1007/s11136-011-0002-9)

48. Chan KS, Kasper JD, Brandt J, Pezzin LE. Measurement equivalence in ADL and IADL difficulty across international surveys of aging: findings from the HRS, SHARE, and ELSA. *J Gerontol B Psychol Sci Soc Sci*. 2012 Jan;67B(1):121-32. Doi: [10.1093/geronb/gbr133](https://doi.org/10.1093/geronb/gbr133)
49. Fang J, Power M, Lin Y, Zhang J, Hao Y, Chatterji S. Development of short versions for the WHOQOL-OLD Module. *Gerontologist*. 2012 Feb;52(1):66-78. Doi: [10.1093/geront/gnr085](https://doi.org/10.1093/geront/gnr085)
50. Jette AM, Tulskey DS, Ni P, Kisala PA, Slavin MD, Dijkers MP, et al. Development and initial evaluation of the spinal cord injury-functional index. *Arch Phys Med Rehabil*. 2012 Oct; 93(10):1733-50. Doi: [10.1016/j.apmr.2012.05.008](https://doi.org/10.1016/j.apmr.2012.05.008)
51. Lee J, Stucky B, Rozier G, Lee SY, Zeldin LP. Oral health literacy assessment: development of an oral health literacy instrument for spanish speakers. *J Public Health Dent*. 2013;73(1):1-8. Doi: [10.1111/jphd.12000](https://doi.org/10.1111/jphd.12000)
52. Marfeo EE, Ni P, Haley SM, Bogusz K, Meterko M, McDonough CM, et al. Scale refinement and initial evaluation of a behavioral health function measurement tool for work disability evaluation. *Arch Phys Med Rehabil*. 2013 Sept;94(9):1679-86. Doi: [10.1016/j.apmr.2013.03.012](https://doi.org/10.1016/j.apmr.2013.03.012)
53. Marfeo EE, Ni P, Haley SM, Jette AM, Bugosz K, Meterko M, et al. Development of an instrument to measure behavioral health function for work disability: item pool construction and factor analysis. *Arch Phys Med Rehabil*. 2013 Sept;94(9):1670-8. Doi: [10.1016/j.apmr.2013.03.013](https://doi.org/10.1016/j.apmr.2013.03.013)
54. McDonough CM, Jette AM, Ni P, Bogusz K, Marfeo EE, Brandt DE, et al. Development of a self-report physical function instrument for disability assessment: item pool construction and factor analysis. *Arch Phys Med Rehabil*. 2013 Sept;94(9):1653-60. Doi: [10.1016/j.apmr.2013.03.011](https://doi.org/10.1016/j.apmr.2013.03.011)
55. Parsons JT, Rendina HJ, Ventuneac A, Cook KF, Grov C, Mustanski B. A psychometric investigation of the hypersexual disorder screening inventory among highly sexually active gay and bisexual men: an item response theory analysis. *J Sex Med*. 2013 Dec;10(12):3088-101. Doi: [10.1111/jsm.12117](https://doi.org/10.1111/jsm.12117)
56. Waller J, Ostini R, Marlow LAV, McCaffery K, Zimet G. Validation of a measure of knowledge about human papillomavirus (HPV) using item response theory and classical test theory. *Prev Med*. 2013 Jan;56(1):35-40. Doi: <https://doi.org/10.1016/j.ypmed.2012.10.028>
57. Bevans M, Ross A, Cella D. Patient-Reported Outcomes Measurement Information System (PROMIS): Efficient, standardized tools to measure self-reported health and quality of life. *Nurs Outlook*. 2014 Sept/Oct;62(5):339-45. Doi: [10.1016/j.outlook.2014.05.009](https://doi.org/10.1016/j.outlook.2014.05.009)
58. Hahn EA, DeWalt DA, Bode RK, Garcia SF, DeVellis RF, Correia H, et al. New English and Spanish social health measures will facilitate evaluating health determinants. *Health Psychol*. 2014 May;33(5):490-9. Doi: [10.1037/hea0000055](https://doi.org/10.1037/hea0000055)
59. Onishi Y, Wakita T, Fukuhara S, Noguchi Y, Okada M, Sakaida I, et al. Development and validation of a symptom scale specific for ascites accompanied with cirrhosis: the ASI-7. *Clin Transl Gastroenterol*. 2014 Feb;5(2):e48. Doi: [10.1038/ctg.2013.20](https://doi.org/10.1038/ctg.2013.20)
60. Rose M, Bjorner JB, Gandek B, Bruce B, Fries JF, Ware Jr JE. The PROMIS Physical Function item bank was calibrated to a standardized metric and shown to improve measurement efficiency. *J Clin Epidemiol*. 2014 May;67(5):516-26. Doi: [10.1016/j.jclinepi.2013.10.024](https://doi.org/10.1016/j.jclinepi.2013.10.024)
61. Spiegel B, Hays R, Bolus R, Melmed G, Chang L, Whitman C et al. Development of the NIH Patient-Reported Outcomes Measurement Information System (PROMIS) Gastrointestinal Symptom Scales. *Am J Gastroenterol*. 2014 Nov;109(11):1804-14. Doi: [10.1038/ajg.2014.237](https://doi.org/10.1038/ajg.2014.237)
62. Zhong Q, Gelaye B, Fann JR, Sanchez SE, Williams MA. Cross-cultural validity of the spanish version of PHQ-9 among pregnant peruvian women: a raschitem response theory analysis. *J Affect Disord*. 2014;158:148-53. Doi: [10.1016/j.jad.2014.02.012](https://doi.org/10.1016/j.jad.2014.02.012)
63. Chan KS, Gross AL, Pezzin LE, Brandt J, Kasper JD. Harmonizing measures of cognitive performance across international surveys of aging using item response theory. *J Aging Health*. 2015 Dec;27(8):1392-414. Doi: [10.1177/0898264315583054](https://doi.org/10.1177/0898264315583054)
64. Epstein J, Osborne RH, Elsworth GR, Beaton DE, Guillemin F. Cross-cultural adaptation of the Health Education Impact Questionnaire: experimental study showed expert committee, not back-translation, added value. *J Clin Epidemiol*. 2015 Apr;68(4):360-9. Doi: [10.1016/j.jclinepi.2013.07.013](https://doi.org/10.1016/j.jclinepi.2013.07.013)
65. Gerrard P, Kazis LE, Ryan CM, Shie VL, Holavanahalli R, Lee A, et al. Validation of the Community Integration Questionnaire in the adult burn injury population. *Qual Life Res*. 2015 Nov;24(11):2651-5. Doi: [10.1007/s11136-015-0997-4](https://doi.org/10.1007/s11136-015-0997-4)
66. Honda M, Wakita T, Onishi Y, Nunobe S, Miura A, Nishigori T, et al. Development and validation of a disease-specific instrument to

measure diet-targeted quality of life for postoperative patients with esophagogastric cancer. *Ann Surg Oncol*. 2015 Dec;22(S3):848-54. Doi: <https://doi.org/10.1245/s10434-015-4696-8>

67. Michel P, Auquier P, Baumstarck K, Pelletier J, Loundou A, Ghattas B, et al. Development of a cross-cultural item bank for measuring quality of life related to mental health in multiple sclerosis patients. *Qual Life Res*. 2015 Sept;24(9):2261-71. Doi: [10.1007/s11136-015-0948-0](https://doi.org/10.1007/s11136-015-0948-0)

68. Schalet BD, Rothrock NE, Hays RD, Kazis LE, Cook KF, Rutsohn JP, et al. Linking Physical and Mental Health Summary Scores from the Veterans RAND 12-Item Health Survey (VR-12) to the PROMIS® Global Health Scale. *J Gen Intern Med*. 2015 Oct;30(10):1524-30. Doi: [10.1007/s11606-015-3453-9](https://doi.org/10.1007/s11606-015-3453-9)

69. Teicher MH, Parigger A. The 'Maltreatment and Abuse Chronology of Exposure' (MACE) Scale for the Retrospective Assessment of Abuse and Neglect During Development. *PLoS One*. 2015 Feb;10(2):e0117423. Doi: [10.1371/journal.pone.0117423](https://doi.org/10.1371/journal.pone.0117423)

70. Coster WJ, Ni P, Slavin MD, Kisala PA, Nandakumar R, Mulcahey MJ, Tulsy DS, Jette AM. Differential item functioning in the Patient Reported Outcomes Measurement Information System Pediatric Short Forms in a sample of children and adolescents with cerebral palsy. *Dev Med Child Neurol*. 2016 Nov;58(11):1132-8. Doi: [10.1111/dmcn.13138](https://doi.org/10.1111/dmcn.13138)

71. McDonough CM, Ni P, Coster WJ, Haley SM, Jette AM. Development of an IRT-Based short form to assess applied cognitive function in outpatient rehabilitation. *Am J Phys Med Rehabil*. 2016 Jan;95(1):62-71. Doi: [10.1097/PHM.0000000000000340](https://doi.org/10.1097/PHM.0000000000000340)

72. Marino M, Soley-Bori M, Jette AM, Slavin MD, Ryan CM, Schneider JC, et al. Measuring the social impact of burns on survivors. *J Burn Care Res*. 2017 Jan/Feb;38(1):377-83. Doi: [10.1097/BCR.0000000000000398](https://doi.org/10.1097/BCR.0000000000000398)

73. Andrade D, Tavares H, Valle R. Teoria da Resposta ao Item: conceitos e aplicações. São Paulo: ABE; 2000.

74. Lord F. Applications of item response theory to practical testing problems. New York: Routledge; 1980.

75. Birnbaum A. Some latent trait models and their use in inferring and examinee's ability. In: Lord FM, Novick MR. Statistical theories of mental test scores. Menlo Park: Addison-Wesley; 1968.

76. Samejima F. A new family of models for the multiple-choice item. Knoxville: University of Tennessee; 1979.

77. Muraki E. A generalized partial credit model: application of an EM algorithm. *Applied Psychological Measurement*. 1992 June;16(2):159-76. Doi: <https://doi.org/10.1177/014662169201600206>

78. Ferreira EV, Azevedo CLN. Contribuições ao estudo do Modelo de Crédito Parcial Generalizado. *Est aval educ*. 2017 Jan/Apr; 28(67):236-54. Doi: [http://dx.doi.org/10.18222/ae.v0ix.3385](https://dx.doi.org/10.18222/ae.v0ix.3385)

79. Sisto FF. Differential item functioning. *Psico-USF* [Internet]. 2006 Jan/June [cited 2017 Nov 15];11(1):35-43. Available from: <http://www.scielo.br/pdf/pusf/v11n1/v11n1a05.pdf>

80. Dalcin CB, Backes DS, Dotto JI, Souza MHT, Moreschi C, Büscher A. Social determinants of health that influence the healthy living process in a vulnerable community. *J Nurs UFPE on line*. 2016 June;10(6):1963-70. Doi: 10.5205/reuol.9199-80250-1-SM1006201608



Submission: 2018/02/15

Accepted: 2018/03/19

Publishing: 2018/06/01

**Corresponding Address**

Diego Eller Gomes

Rua Professor Milton Sullivan, 28 / Ap. 103

Bairro Carvoeira

CEP: 88040-620 – Florianópolis (SC), Brazil