



Work constraints leads to accident: Questionnaire validity and a qualitative interpretation of the cutoff point

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ABSTRACT

French-speaking ergonomists conceive constraint as a work situation in which the worker has his power to act, think and decide reduced or hampered, which can facilitate the occurrence of work accidents. A questionnaire with five items was elaborated to measure constraint addressed to nursing staff members. From February to September 2013, a census was carried out at Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo, Brazil, one of the biggest hospital complexes in the world. The census response rate was approximately 92%. The construct validity and criterion's of the questionnaire was checked. After the former, four items remained, two of these measured time constraint and the other two Personal Protection Equipment constraint. The gold standards of the criterion validity were work accident involving exposure to biological fluid (WABIF) caused by sharp objects, WABIF through patient's body fluid contact and work incident (or almost accident) involving these two kinds of WABIF. Criterion validity was performed with both Item Response Theory (IRT) and Classical Test Theory (CTT) paradigms using logistic regression. Only WABIF by contact and incident got criterion validity. The results of the IRT paradigm showed that it is possible to go beyond the CTT cutoff point and reach a more qualitative interpretation when a relationship is established between the cutoff point value and the b parameter value of the category of each item. Hence, we find the intensity of the item (represented by its category) sufficient to him/her being at that risk.

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1. Introduction

French-speaking ergonomics comprehend this subject as the specific study of human labour in real work situations (Tersac and Maggi, 2004), or work activities (Guérin et al., 2001), with their real working conditions – the resources the worker has to perform his work – and its effective results, which are associated directly with three aspects of the employer institution: prescribed work; working conditions determined by the company; expected results. Usually people who define prescribed work do not consider the laborers in real work situations. They are also responsible for dictating the working conditions and the expected results. All of these results have as consequences demands or constraints to which the worker is exposed in order to carry out his work activities (Falzon and Sauvagnac, 2007; Guérin et al., 2001). Consequently, the worker exposed to constraint has his power to act, think or decide

reduced or hampered. Constraint can be in different forms, such as the time expected by the institution for the worker to do his job, the means provided to reach the expected results and the unusual variability – at least, initially – in the work situation. Tersac and Maggi (2004) call attention to the fact that variability can also be a consequence of features inherent to the organization of the work itself. Another phenomenon of French-speaking ergonomics is regulation, defined as the action through an operative mode which the worker does to attain results, after realizing that his actual results were insufficient (Falzon, 2007). When the regulation is not achieved, there is an imbalance between constraints to which the worker is exposed and the resources available to him in order to carry out his work activity (Falzon and Sauvagnac, 2007; Guérin et al., 2001). Work overload occurs when this imbalance is caused by high constraints and low worker resources, which can lead to situations that contribute both to worker illness and to work accidents as well as the almost accident.

The Brazilian Ministry of Labour and Employment (2005), of the Brazilian government annex II of Regulatory Standard number 32

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(NR32), defines biological agents as bacteria, prions, parasites, fungi and viruses, among which human immunodeficiency virus (HIV) and hepatitis B virus (HBV) and C (HBC) are highlighted due to their level of mortality and morbidity. In Brazil, the most common work injury among health workers, especially among nursing staff, is work accidents caused by exposure to biological fluid (WABIF) which could contain these biological agents (Assunção et al., 2012; Balsamo et al., 2006). WABIF can be characterized by the contact of any patient body fluid with an injury on the worker's body caused by a contaminated sharp object with biological fluid, or when a patient's biological fluid comes into contact with the worker's skin or his/her mucosa. WABIF damages often go beyond worker physiological trauma, as HIV seroconversion, or its threat which affects the emotional balance of the worker, his relatives and friends (CDC, 2008). The World Health Organization (WHO) reports that WABIF among health workers has global relevance (Prüss-Üstün and Corvalán, 2006; Prüss-Üstün et al., 2003; World Health Organization, 2002), mainly due to the occupational component of exposure to HIV, HBV and HCV and the fact that health professionals represent approximately 0.6% of the world population.

This study aims to validate a constraint questionnaire addressed to nursing staff to check if constraint leads to work accident. For this, we use construct validity and criterion's. Specifically in the latter, we apply a crossover between the cutoff point and b parameter from the Item Response Theory (IRT) intending to reach not only a point on the construct specter as a whole that indicates a severe or unsafe construct level to the worker, but also the level of each item that indicates this unsafe condition. This will enable us to perform a qualitative interpretation about the cutoff point.

2. Method

The Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo (HCFMUSP), Brazil, is one of the biggest complex hospitals in the world. The Instituto Central (ICH) is one of the principal buildings of this complex and it can be considered the main one if the criterion is the quantity of different clinical areas reunited only in one building. From February to September 2013, a nursing staff census was carried out at the ICH. The ICH is considered the pioneer building of the complex, which was opened in 1944 and was extended in 1981. Today this complex has more than five specialized institutes, two auxiliary hospitals, a rehabilitation division, an associated hospital as well as other units, such as a management building and an institute for Aids patients (Almeida and Moraes, 2012; HCFMUSP, 1997). About 46% (N = 1003) of patient beds at the complex belong to the ICH, which physically corresponds to more than one third of the total complex area (352 mil m²). Monthly, approximately 100 thousand people are attended at the ICH and it offers to the population an emergency room, outpatient clinics, infirmaries, intensive care units and operating theatres. The ICH also offers medical care specialized in the digestive system and liver transplants, renal and kidney transplants, hematology and bone marrow transplants, gynecology and obstetrics and burns. The population attended at the ICH come not only from São Paulo capital or São Paulo state as a whole, but also from other Brazilian states and foreign countries. The ICH clients reflect the reality faced day-to-day at the hospital complex.

We applied a standard training to form instructors and another to interviewers intending to minimize response biases of the study's participants, who were ICH nursing staff members working directly with the hospital's patient. Both instructors and interviewers were aware about the study's aims. Instructors trained all interviewers at the field research. They were present in at least five

interviews realized by each trainee interviewer because the instructors needed to warrant that trainee were administered very well the questionnaire, e.g., preventing suggestions to the participants answers. The project is part of a study which was presented and accepted by two Ethics committees of research on human beings, one at the School of Public Health, University of São Paulo, and another which belongs to HCFMUSP. Interviewers only performed the data collection with workers who consented to it. EPI-DATA software was used to record interviewee answers.

2.1. Variables

Below are the constraint items with their respective response categories:

- Item 1: If in an emergency situation the nursing staff member can carry out his/her tasks according to the technical guidelines (1-Yes; 0-No).
- Item 2: If nursing staff production is delayed when he/she executes the assigned tasks with the necessary care according to the technical guidelines (4-Always; 3-Often; 2-Sometimes; 1-Rarely; 0-Never).
- Item 3: If the nursing staff member was required to work in another job sector (5-More than once a week; 4-Weekly; 3-Monthly, more than once; 2-Monthly, once at least; 1-Less than once a month; 0-No).
- Item 4: If Personal Protection Equipment (PPE) hampers the execution of a good job (4-Always; 3-Often; 2-Sometimes; 1-Rarely; 0-Never).
- Item 5: How often did the nursing staff member not use PPE (4-Always; 3-Often; 2-Sometimes; 1-Rarely; 0-Never).

These items were written as questions, which were asked to the participants at the interviews. This questionnaire is cumulative in that the higher its intensity, the higher the constraint. Therefore, we inverted the first item to perform the analysis.

Items 1 and 2 measure constraint caused by time pressure. This constraint form is typical for hospital workers who deal constantly with emergency situations (Martin and Gadbois, 2007). In addition, nursing staff in Brazil must follow standard operational procedures (procedimentos operacionais padrões – POP) to carry out their respective functions in health institutions (Guerrero et al., 2008). Each POP strictly determines how nursing staff tasks should be done, how each stage of the task is to be carried out and the sequence to be followed. One of the essential POP targets is to guarantee the expected result for each task for the team. Thereby, item 1 was elaborated to determine whether the nursing staff member can achieve the POP even if he/she is faced with an urgent situation under the pressure of the hospital system. Item 2 aimed to determine if accomplishing POP delays the expected results.

Item 3 considers management constraint form (Tersac and Maggi, 2004), specifically the nursing staff turnover in several ICH sectors. We can characterize constraint as the case when a nursing staff member is removed from his/her usual sector where he/she performs his/her day-to-day work activity, i.e., the place where he/she masters his/her tasks, to another where he/she has less experience. In this environment, the worker has fewer skills and resources to draw upon when faced with situations considered trivial for experienced workers in that sector. Then, his/her regulation capacity is impaired.

This constraint situation of item 3 was one finding of the dissertation developed using qualitative methodology and French-speaking ergonomics (Donatelli, 2013). This dissertation aimed to comprehend ICH nursing staff members through the analysis of two WABIF, which occurred in this worker population. This study

was performed simultaneously with the present study. One of its results is that this displacement of nursing staff members throughout ICHC sectors was commonplace in the day-to-day at the ICHC. In fact, this event is known colloquially as "being lent out" and the nursing staff members themselves realize that it is caused by an insufficient number of staff to meet the labour demand.

Constraint form can also be in the materials provided by the institution to the worker for the expected results to be achieved (Falzon and Sauvagnac, 2007; Guérin et al., 2001). Items 4 and 5 fit into this sort of constraint as they measure how much PPE can be a source of constraint. These items listed to the interviewees were the most common among the nursing staff: gloves; glasses; masks; aprons. Although PPE is designed to ensure greater work safety, it can hinder some work situations but it is legally required by Brazilian employers (Veiga et al., 2007). Agricultural work is one area where difficulties caused by PPE have already been observed, e.g., where workers must wear specific clothes (PPE) to apply pesticides. Research results showed that those who wore this PPE presented a higher concentration of pesticide in their body than those who did not wear it. Furthermore, PPE as specific protective clothing can work as a physical constraint factor, in this case, causing thermal discomfort (Crockford, 1999; Veiga et al., 2007). ICHC nursing staff also claim that PPE hamper his/her ability to perform his/her work (Donatelli, 2013). If protection barriers conflict with task demands, the worker is expected to bypass the protective devices (Apfeld, 2011), even though their use is determined by procedures and laws.

Other variables were used in this study such as nursing staff function, job sector, WABIF and its incident, which represents in this study the almost accident. These are explained more precisely in the analysis description where they were applied. All information was collected with a 12-month recall.

2.2. Analysis

All study analysis was run with R software and its specific functions and packages are described in each analysis.

2.2.1. Construct validity

Construct validity was performed in stages as described below. After their completion, the descriptive statistics of the construct scale were estimated and its internal consistency also, which was assessed by Cronbach alpha with ltm package (Rizopoulos, 2006).

2.2.1.1. Principal component analysis and exploratory factor analysis. The data bank was randomly split into four smaller sets. A principal component analysis (PCA) was carried out in three of these in order to check how many factors would be extracted through the exploratory factor analysis (EFA). Psych was the R package used in both analyses (Revelle, 2012). EFA performed extractions from one general factor to the quantity of factors found in PCA results. The cutoff point of the factor load was 0.300. Promax rotation was used when EFA extracted more than one factor.

EFA was performed using Weighted Least Square (WLS) as its estimation method. Only item 1 is dichotomous. The others have ordinal level measurement, and WLS is the most appropriate in this situation as it ensures a more robust analysis, mainly with small sample sizes (Kline, 2011). Polycor package (Fox, 2013) was used to obtain a polychoric correlation matrix as WLS demands.

2.2.1.2. Confirmatory factor analysis. Confirmatory factor analysis (CFA) was applied to the final EFA model in one of the four data banks, which was not used in PCA or in EFA. Lavaan package (Rossel, 2012) was used with WLS, and the model was prepared according to the estimated process with fix factor variance to a

constant, value equal to one, which is called unit variance identification (Kline, 2011).

The model was assessed using the goodness-of-fit statistics of chi-square p value, comparative fit index (CFI), Tucker-Lewis index (TLI) and the root mean square error of approximation (RMSEA) with a 90% confidence interval (CI90%) (Byrne, 2010; Kline, 2011). CFA checked all models approved by EFA.

2.2.1.3. Item response theory. Every case available in the data bank was used in the Item Response Theory (IRT) analysis, which was performed using Graded Response Model (GRM) (Samejima, 1969) with the ltm package (Rizopoulos, 2006). The GRM model estimates the discrimination parameter (a) of each item and its thresholds (b) for each response category. GRM also estimates the latent trait for each participant or case called theta, which is expressed in scale (0,1), where 0 represents the mean and 1 the standard deviation. The estimates of the b parameters are also given in this scale. In this study, discrimination (a) and difficulty (b) parameters and the latent trait value (theta) for each case were estimated. IRT was applied to the same models checked by CFA.

2.2.1.4. Differential item functioning. Differential item functioning (DIF) analysis verified bias existence in each item from the CFA final models. Uniform and non-uniform DIF was checked with the questionnaire in both measurement paradigms, CTT and IRT. Questionnaire general performance is a variable used in DIF analysis. Then, CTT paradigm used as general performance the variable measured by the global sum of the questionnaire items per each case, which is commonly called score. On the other hand, DIF IRT handled the latent trait standard deviations of theta, which were outputted by the IRT analysis. Although this one can also be referred to as score, in this study we decided to use specifically standard deviations of theta aimed to prevent confusion between the construct intensity computed by CTT paradigm with IRT's.

DIF was performed using logistic regression (Osterlind and Everson, 2009; Zumbo, 1999). This DIF method treats each item as an outcome. Thereby, in this study, item 1 was a dichotomous outcome. So, logistic regression function glm from the stats package (R Core Team, 2012) was sufficient to run the analysis. However, the other items were polytomous, which determined the use of ordinal logistic regression (OLR) performed by polr function from the MASS package (Venables and Ripley, 2002).

Logistic regression as a DIF method involves a three-stage analysis (Osterlind and Everson, 2009; Zumbo, 1999). First, the association between outcome (item) and exposition (questionnaire general performance) is checked. Next, group variable is added to the regression and the third stage consists of the addition of the variable resulting from the interaction between questionnaire general performance and group variable. Uniform DIF is found if the difference between the second and first stages is significant (p value), and the non-uniform one is characterized by the significant difference between the third and second stages.

This study performed DIF analysis with two groups who came from the nursing staff function variable: nursing assistant and nursing technician versus nurse graduated from nursing school. Nursing assistant and technician were defined as the worker who ICHC hired requiring nursing assistant and technician expertise, which is equivalent to high school technical education (BRASIL, 1986). Brazilian laws differentiate between nursing technicians and assistants, as nursing technicians can contribute to the elaboration of nursing staff work planning. However, observation of the ICHC nursing staff work activity showed that both nursing assistants and technicians performed very similar tasks (Donatelli, 2013), such as medicine preparation and its administration, patient observation, recognition and description, as well as referring the patient for tests, to surgical centers or clinics. Brazilian laws also

define nursing staff member with a degree as having more nursing expertise than nursing assistants and technicians in the health institution hierarchy (BRASIL, 1986). These nurses are responsible for team management and are required to provide constant support to other members of the nursing staff.

The objective of this DIF analysis was to check if the probability of the two groups from the nursing staff function were equal to answer each questionnaire item, taking into account that the members of the two groups were on the same construct level on the constraint questionnaire. This hypothesis originated from the existence of different tasks expected of each nursing staff member.

2.2.2. Criterion validity

The questionnaire applied to criterion validity composed the items which remained after construct validity. Three gold standards were used for this analysis, namely WABIF caused by sharp objects, WABIF caused by patient body fluid contact and work incidents (almost accidents) caused by these two sorts of WABIF. These three gold standards were used because work incidents or accidents can be a constraint consequence (Falzon and Sauvagnac, 2007; Guérin et al., 2001).

The first gold standard question asked if the worker suffered WABIF caused by sharp injury (1-Yes; 0-No) and then if WABIF was caused by contact. Finally, the following question was asked: "how often did you **almost** suffer at least one of these two WABIF?". The response categories were: always, often, sometimes, rarely or never. The answers were dichotomized into zero value (rarely and never categories) and one (the other categories) in order to perform the analysis.

Criterion validity was assessed using logistic regression by *glm* R function. The aim was to test the association between gold standards and questionnaire general performance, which estimated both CTT and IRT paradigms. After, we tested in these associations the interference of the function variable categories and job sectors. The job sector consisted of outpatient clinic (OC), infirmary, intensive care unit (ICU), surgical center (SC) and emergency room (ER). The predict function from the Stats package (R Core Team, 2012) was applied only to the associations with *p* value <0.05 to estimate the cutoff point, sensitivity and specificity and the probability of each case.

2.2.3. Cutoff point, IRT threshold (b) and probabilistic curve

After reaching the cutoff points through criterion validity using IRT paradigm, this information was put together with the IRT threshold (b) of each item to find which item categories were closer to the right side of the cutoff point. This crossover between IRT b parameter and criterion validity information enabled us to identify the category of each item which would have at least a 50% chance of reaching the gold standard if the respondent endorsed it. This was possible because b parameter represents item category and it is on the same scale as theta. In other words, this technique could help us to know from which category each item exposes the worker to a severe or unsafe situation.

Each item category was placed according to its respective b parameter value on a probabilistic curve graph, which was outputted from logistic regression that analyzed criterion validity by IRT. We elaborated probabilistic curve graphs of the criterion validity in order to compare didactically the difference between the cutoff point of the CTT paradigm and the b parameters found by the IRT paradigm.

3. Results

The response rate census was approximately 92% (*N* = 1648). In 80 ICHC sectors there were nursing staff members who directly

interacted with patients. One of these sectors reached a 75% response rate and the other reached at least 80%. The majority of participants were female and their average age was 42 years old (Table 1).

Questionnaire item responses are shown in Table 2. Specifically, in item 1, 61% (CI95%: 59%–64%; *N* = 1013) of the interviewees answered that they can carry out their tasks according to the technical guidelines facing emergency situations, while 39% (CI95%: 36%–41%; *N* = 635) of them reported that they cannot. Therefore, there was a significant difference of CI95% between those who answered positively and those who answered negatively. This difference was true in the function and sector variables but not for the ER.

Table 1

Descriptive statistics of the age, sex, function and sector variables in nursing staff, São Paulo, Brazil, 2013. Goodness-of-fit statistics of the confirmatory factor analysis (CFA) from construct validity of the constraint questionnaire. Prevalence of the gold standards from criterion validity of the constraint questionnaire.

Descriptive statistics		
Variable	Categories	Values
Age	–	Average 42 years (CI95%: 41–43), minimum 20 years and maximum 75 years
Sex	Female	<i>N</i> = 1483 (89.98%)
	Male	<i>N</i> = 0165 (10.02%)
Function	Nurse graduated from nursing school	<i>N</i> = 0400 (24.27%)
	Nursing assistant and nursing technician	<i>N</i> = 1248 (75.73%)
Sector	Outpatient clinic (OC)	<i>N</i> = 0217 (13.17%)
	Infirmary	<i>N</i> = 0787 (47.75%)
	Intensive care unit (ICU)	<i>N</i> = 0311 (18.87%)
	Surgical center (SC)	<i>N</i> = 0173 (10.50%)
	Emergency room (ER)	<i>N</i> = 0160 (09.71%)

Confirmatory factor analysis (CFA) - Construct validity

Model	Goodness-of-fit statistics	Values
First	Chi-square p value Comparative fit index (CFI) Tucker-Lewis index (TLI) RMSEA(CI90%)	0.060 0.917 0.834 0.051(0.000–0.094)
Second	Chi-square p value Comparative fit index (CFI) Tucker-Lewis index (TLI) RMSEA(CI90%)	0.009 0.893 0.679 0.093(0.040–0.156)

Prevalence of gold standards - Criterion validity

Gold standards	–	Values
WABIF ^a by contact	–	42.23%(CI95%: 39.84%–44.62%)
WABIF ^a by sharp object	–	10.50%(CI95%: 09.06%–12.08%)
Incident (almost WABIF ^a)	–	35.07%(CI95%: 32.76%–37.43%)

^a WABIF: Work accident involving biological fluid.

Table 2

Distribution of absolute values and relative frequencies (N(%)) of the response categories of the five constraint items answered by nursing staff, and the estimates of their parameters, discriminant (a) and thresholds (b), which remained after the construct validity, analyzed by Item Response Theory (IRT) performed using Graded Response Model (GRM). São Paulo, Brazil, 2013.

Item	Item category						Missing	Estimates of the item parameters				
		0 ^a	1 ^b	2 ^c	3 ^d	4 ^e		a ^g	b2 ^b	b3 ^c	b4 ^d	b5 ^e
1	635(38.53)	1013(61.47)	–	–	–	–	0.765	0.696	–	–	–	–
2	715(43.39)	248(15.05)	443(26.88)	126(07.65)	116(07.04)	–	0.886	–0.353	0.447	2.27	3.27	–
3	775(47.03)	459(27.85)	146(08.86)	144(08.74)	66(04.00)	58(03.52)	–	–	–	–	–	–
4	1053(63.90)	205(12.44)	281(17.05)	50(03.03)	59(03.58)	–	0.748	0.855	1.743	3.852	4.741	–
5	597(36.23)	607(36.83)	370(22.45)	42(02.55)	30(01.82)	–	2(00.12)	0.972	–0.686	1.234	3.599	4.558

^a Item category: items 1 and 3, no; items 2, 4 and 5, never.

^b Item category or threshold (b): item 1, yes; items 2, 4 and 5, rarely; item 3, less than once a month.

^c Item category or threshold (b): items 2, 4 and 5, sometimes; item 3, monthly, once at least.

^d Item category or threshold (b): items 2, 4 and 5, often; item 3, monthly, more than once.

^e Item category or threshold (b): items 2, 4 and 5, always; item 3, weekly.

^f Item category: item 3, more than once a week.

^g Discrimant parameter (a).

3.1. Construct validity

3.1.1. PCA and EFA

PCA throughout the three data banks ($N_1 = 421$, $N_2 = 403$, $N_3 = 390$) indicated the extraction of two factors. EFA factor loadings were more stable for one general factor than for two. Factor load of item 1 and 4 were insufficient once in different data banks and item 3 was insufficient in all data banks.

The CFA had two models with one general factor. Although item 3 showed an insufficient factor load throughout the EFA, the first CFA model was composed by the five items due to the exploratory character of this study. We tested a second model without item 3. Despite the insufficient factor load of item 1 and 4, both items were maintained in the CFA models because these evidences of EFA occurred in the proportion of one data bank to two.

3.1.2. CFA

The CFA data bank consisted of 434 cases. Both models had satisfactory fitted values (Table 1). However, the item 3 factor load in model 1 was 0.033, whereas in the other items this reached between 0.382 and 0.498. Item 3 is the essential difference between the models. Therefore, this evidence enables us to relativize the values of the goodness-of-fit statistics of the first model or to reinforce the second model (Table 1). Both models remained for analysis as it is inappropriate to perform an exclusion comparison between them given that they are neither nested nor equivalent (Kline, 2011).

3.1.3. IRT

Parameters from item 3 ($a = 0.063$; b parameters specter began in $b2 = -1.880$ and finished $b6 = 52.421$) showed that it belongs possibly to another constraint construct different to the constraint measured by the other questionnaire items. On the other hand, parameters of the scale composed by the four remained items obtained good values (Table 2).

3.1.4. DIF

About function variable, the category of nursing assistants and technicians were the majority of the participants (Table 1). DIF analysis applied to the scale composed by the four items (1, 2, 4 and 5) did not resulted any bias by function for both measurement paradigms, CTT and IRT.

3.1.5. Construct validity assessment

At the end of the construct validity analysis, the evidence indicated that the questionnaire needs to be composed of four items

(item 1, 2, 4 and 5). Item 3, since EFA, showed inconsistency in measuring the same construct as the other ones.

The questionnaire with four items performed on CTT had an average of 3.25 (CI95%: 3.14–3.36) scores, with a minimum value of zero and maximum of 12 scores. On the IRT paradigm, the average was 0.018 (CI95%: -0.012 – 0.049) theta standard deviation, minimum of -1.029 and maximum 2.072 theta standard deviations. Internal consistency was lower than we expected, Cronbach alpha 0.40.

3.2. Criterion validity

The prevalence of three gold standards were different and their 95% confidence interval (CI95%) did not overlap (Table 1). Infirmary was the sector with the majority of study's participants followed by ICU, OC, SC and ER (Table 1).

When gold standard was incident (Table 3), the general odds ratio (OR) association by CTT was 1.20 (CI95%: 1.15–1.26), i.e., to each score that the worker feels more constraint, he/she has 20% chance of suffering an incident. For IRT the general OR was 1.08 (CI95%: 1.06–1.09). Therefore, for each theta 0.1 standard deviation which raises the worker to feel more constraint, he/she has an eight per cent chance of reaching the outcome.

The general association of the incident and constraint was not affected by the function variable and OC sector. This was observed in the cutoff points (Table 3). Although in the IRT paradigm the values of the variable function and OC sector compared with the general association were not exactly the same, the closeness among them allows us to consider that these variables did not interfere effectively in the general association.

On the other hand, a nursing staff member who works in an infirmary must have his/her constraint intensity higher (9 scores or 1.404 theta standard deviations) than in the general association, for he/she to have at least a 50% chance of suffering an incident (Table 3). Nevertheless, the opposite was observed in the ICU and SC (6 and 5 scores or 0.556 e 0.342 theta standard deviations, respectively).

In the WABIF caused by contact, general OR performed on CTT was 1.18 (CI95%: 1.13–1.24), i.e., to each score that the worker feels more constraint, he/she has an 18% chance of suffering this outcome (Table 3). On IRT paradigm, OR was 1.07 (CI95%: 1.05–1.08), for each theta 0.1 standard deviation which the worker feels constraint, his/her chance to suffer a WABIF by contact raises seven per cent.

Both function and sector affected the association between WABIF caused by contact and the constraint (Table 3). For the worker who is a nurse to achieve at least a 50% chance of suffering

Table 3

Criterion validity of the constraint questionnaire against the gold standards work incident (almost accident) involving exposure to biological fluids from patients and work accidents involving exposure to biological fluid (WABIF) caused by contact from patients body fluids in nursing staff, São Paulo, Brazil, 2013. This was performed using Classical Test Theory (CTT) and Item Response Theory (IRT) paradigms to output the Odds Ratio (OR) with a 95% confidence interval (CI95%), sensitivity and specificity and cutoff points to the general association and each category from function variable and sector's.

Gold standard	Measurement paradigm	Variable/category	OR (CI95%) ^a	Sensitivity	Specificity	Cutoff point ^b
Incident						
CTT						
General association						
		Function/Nurse	1.20(1.15–1.26)	14.01	93.27	7
		Function/Assistant-technician	1.17(1.06–1.29)	09.22	94.98	7
		Sector/OC	1.21(1.15–1.28)	15.56	92.73	7
		Sector/Infirmary	1.22(1.08–1.38)	10.14	93.24	7
		Sector/ICU	1.18(1.10–1.27)	02.54	98.73	9
		Sector/SC	1.29(1.16–1.44)	29.51	88.36	6
		Sector/ER	1.26(1.10–1.43)	37.50	82.18	5
		Sector/ER	1.09(0.96–1.24)	–	–	–
IRT						
General association						
		Function/Nurse	1.08(1.06–1.09)	14.88	94.77	0.899
		Function/Assistant-technician	1.07(1.03–1.10)	12.06	96.53	0.939
		Sector/OC	1.08(1.06–1.10)	16.02	93.83	0.887
		Sector/Infirmary	1.08(1.03–1.13)	11.59	96.62	0.848
		Sector/ICU	1.07(1.04–1.10)	02.54	98.55	1.404
		Sector/SC	1.11(1.07–1.16)	35.25	85.71	0.556
		Sector/ER	1.09(1.03–1.14)	37.50	80.20	0.342
		Sector/ER	1.05(1.00–1.10)	–	–	–
WABIF by contact						
CTT						
General association						
		Function/Nurse	1.18(1.13–1.24)	22.13	86.66	6
		Function/Assistant-technician	1.21(1.09–1.33)	32.93	82.83	5
		Sector/OC	1.18(1.12–1.24)	22.31	85.40	6
		Sector/Infirmary	1.18(1.04–1.33)	04.69	98.69	9
		Sector/ICU	1.20(1.12–1.28)	37.91	79.20	5
		Sector/SC	1.28(1.15–1.42)	38.73	78.70	5
		Sector/ER	1.15(1.02–1.31)	15.38	95.37	7
		Sector/ER	1.00(0.88–1.14)	–	–	–
IRT						
General association						
		Function/Nurse	1.07(1.05–1.08)	28.45	83.93	0.533
		Function/Assistant-technician	1.07(1.03–1.11)	27.54	87.12	0.503
		Sector/OC	1.06(1.05–1.08)	28.73	83.17	0.550
		Sector/Infirmary	1.07(1.02–1.12)	04.69	98.04	1.163
		Sector/ICU	1.07(1.04–1.09)	45.05	70.21	0.285
		Sector/SC	1.09(1.05–1.14)	47.18	73.37	0.335
		Sector/ER	1.05(1.02–1.10)	07.69	97.22	1.135
		Sector/ER	1.01(0.96–1.06)	–	–	–

^a CTT: OR interpretation is for each score that raises the constraint level. IRT: OR interpretation is for each 0.1 theta standard deviation that raises the constraint level.

^b CTT: the unit of measurement was score. IRT: the unit of measurement was theta standard deviations.

this outcome, he/she must have his/her constraint intensity lower (5 scores or 0.503 theta standard deviations) than the general association (6 scores or 0.550 theta standard deviations). Less constraint intensity is also required on the infirmary nursing staff and ICU's (5 scores or 0.285 e 0.335 theta standard deviations, respectively). On the other hand, OC and SC are sectors which demand of the worker a higher constraint (9 and 7 scores or 1.163 and 1.135 theta standard deviations, respectively) for he/she to reach at least a 50% chance of getting the outcome compared with the general association.

The ER sector did not reach significant OR or WABIF caused by contact or incident (Table 3). In these two gold standards, the constraint questionnaire presented more accuracy to identify the nursing staff member who reported low constraint than the contrary because the specificity was better than sensitivity as a whole. WABIF caused by sharp objects did not achieve criterion validity.

3.3. Cutoff point, IRT difficulty (b) parameter and probabilistic curve

Item categories placed on the probabilistic curve graph according to their respective b parameter (Figs. 1a2–g2 and 2a2–g2), which were estimated by IRT (Table 2), made it possible to go beyond the cutoff points typical from the CTT paradigms

(Figs. 1a1–g1 and 2a1–g1). This information crossover enabled us to identify which response categories of the items were sufficient for the worker to have at least a 50% chance to reach the gold standard.

We can use the general associations as an example. The cutoff point of the general association estimated by IRT for the gold standard incident (Fig. 1a2) was 0.889 theta standard deviations (Table 3). After checking the b parameter of each item, in order to recognize which categories were closest to the right side of the cutoff point, the worker who responded to **sometimes** to items 4 and 5 (Table 2, b3 parameter = 1.743 e 1.234 theta standard deviations, respectively), or **often** to item 2 (Table 2, b4 parameter = 2.270 theta standard deviations), had at least a 50% chance of suffering an incident. The b parameter from item 1 (**no**) (b2 parameter = 0.696 theta standard deviations) was not higher than the cutoff point.

On the other hand, for the gold standard WABIF caused by contact (Fig. 2a2), cutoff point 0.533 theta standard deviations (Table 3), the worker who answered **no** to item 1 had at least a 50% chance of achieving the outcome. This probability was the same for the nursing staff member who answered **often** to item 2 (b4 parameter = 2.270 theta standard deviations), **rarely** to item 4 (b2 parameter = 0.855 theta standard deviations) and **sometimes** to item 5 (b3 parameter = 1.234 theta standard deviations).

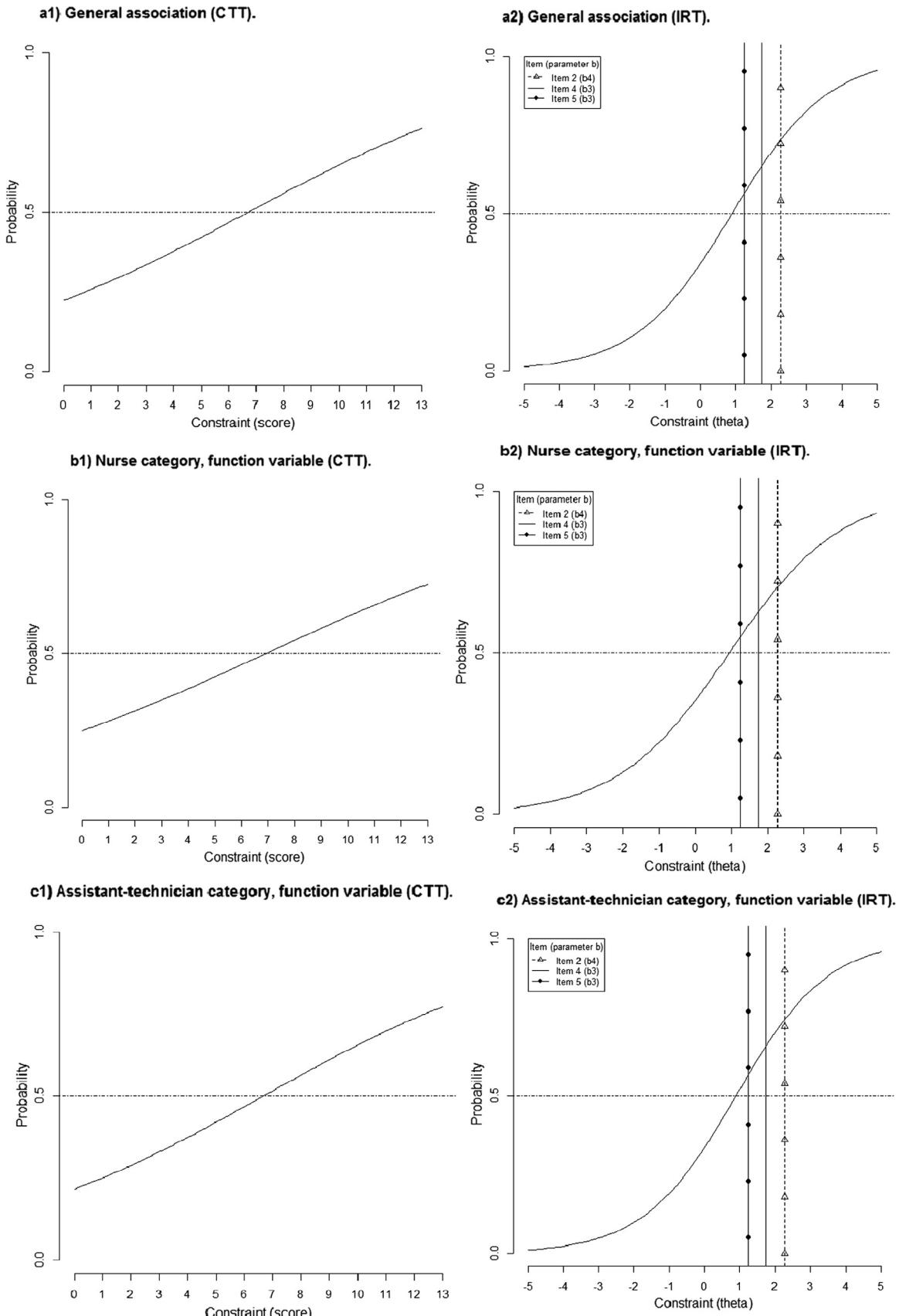
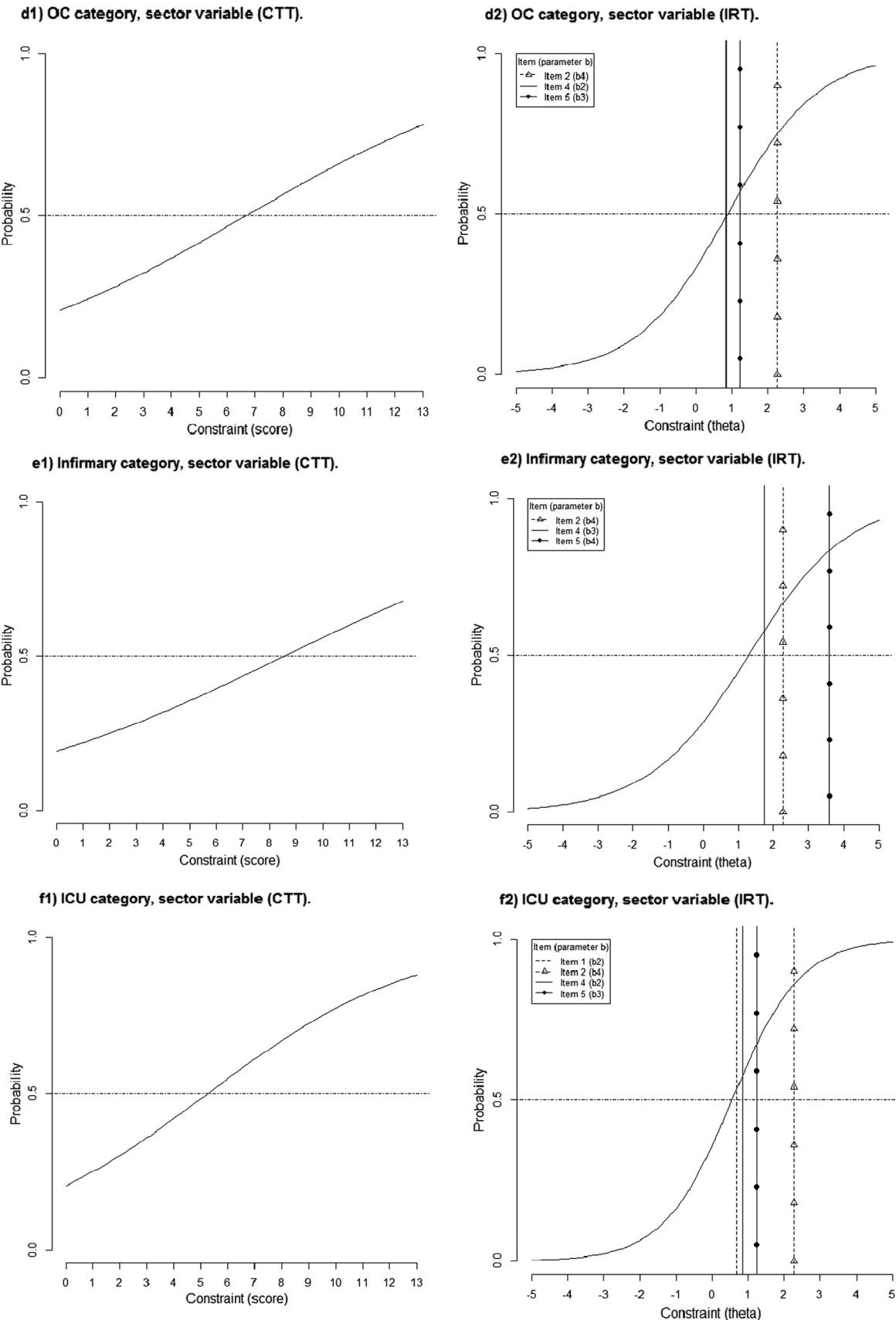


Fig. 1. Probabilistic curves from the criterion validity of the constraint questionnaire against the work incident involving exposure to biological fluids from patients, estimated by Classical Test Theory (CTT) (a1, b1, c1, d1, e1, f1, g1) and Item Response Theory (IRT) (a2, b2, c2, d2, e2, f2, g2) to the general association and the categories from function variable and sector's (Table 3) in nursing staff, São Paulo, Brazil, 2013. **Table 2**, b parameters, which are after the cutoff point (Table 3) were placed on the IRT curves.

**Fig. 1 (continued)**

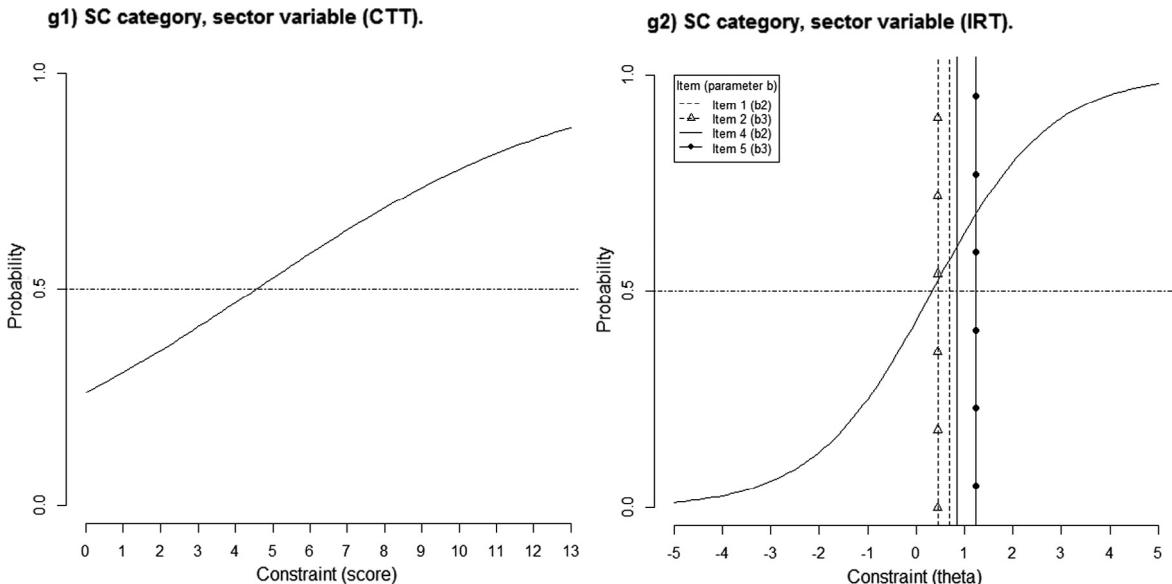


Fig. 1 (continued)

These interpretations of the crossover information from the general associations can be applied to the other curves (Figs. 1 and 2) estimated using IRT.

4. Discussion

This constraint questionnaire applied to the ICHC FMUSP nursing staff reaches construct validity for items 1, 2, 4 and 5, which achieved criterion validity against incident and WABIF caused by contact, performed using CTT and IRT (Table 2). Function and sector variables affected the criterion validity association between outcomes and constraint, except in the ER sector (Table 3). This questionnaire was more accurate in identifying low constraint rather than high. In this study, the healthy worker effect bias was prevented by the return of the interviewers to the job sectors, who in their first interviewees were identified workers absence due to, e.g., sickness-absenteeism or vacation.

4.1. Generalization and the study as a national and an abroad reference

This census with a response rate of over 90% of all nursing staff members who directly interacted with hospital's patient, as well as a good response rate into each ICHC sector, allows us to generalize about the results of this study on the ICHC nursing staff population. The category of workers selected to participate of this study, who working directly with the hospital's patient, represent the absolute majority of the ICHC nursing staff.

In respect of the WABIF prevalence throughout the HCFMUSP institutes, a survey about it was elaborated between June 2010 and May 2011 taking into account the accidents registered at the Specialized Service of Safety Engineering and Occupational Medicine ("Serviço Especializado em Engenharia de Segurança e em Medicina do Trabalho" - SESMT) from HCFMUSP (Pustiglione, 2011; Santos, 2015). There was no significant contrast among the ICHC and the others equivalents institutes. The result can us settle that probably the almost accident involving exposure to biological fluid, i.e., the incident, was also no contrasting among the HCFMUSP institutes. The plausibility of this hypothesis is sustained by the rationale into work accidents's literature about a relation-

ship between work accident and its incident, in the sense of where there is one, there is the other.

The imbalance between sex's categories found in this study (Table 1) represents the distribution of this variable into the nursing staff population from HCFMUSP and of the Brazilian hospitals as whole. Specifically about the contribution of this sex imbalance for the occurrence of WABIF or its incident, there was no evidence about such association among six epidemiological analysis performed at the thesis (Santos, 2015), which use the same databank and variables of this study basically to identify the factors associated with those outcomes. On the other hand, the relationship of work constraint and sex was not one of the study's focus. Then, we cannot at least conjecture, e.g., that the internal resources to the fact of the worker to be male or female interfere considerably in the way of the nursing staff member faces the kinds of constraint we measured in this questionnaire. This relationship is something interesting to explore in futures researches.

The present study can be also used as a reference to the Brazilian nursing staff and abroad. It is known that ICHC concentrates a large technological resource of middle and high complexity and the majority of hospital specialties and people attendance inside one of the biggest hospital complexes in the world, HCFMUSP (Almeida and Moraes, 2012). Consequently, ICHC is an essential institution in the health system of São Paulo city and state, as well as in Brazil and, sometimes, in foreign countries.

4.2. "Being lent out": another constraint's dimension

It is a mistake to think item 3 does not measure the constraint phenomenon because the results of the construct validity indicated its removal from the questionnaire. We can conjecture that item 3 possibly measures another dimension of the constraint phenomenon different to the one measured by the items of this questionnaire, which remained after the construct validity. This hypothesis is based, firstly, about essential issue of unidimensionality (Embretson and Reise, 2000; Reckase, 2009). Its discrimination parameter (a) was much lower than the value (0.700) generally used as reference to check if the item respects the essential unidimensionality of IRT.

In addition to these empirical evidences, a theoretical explanation exists about the constraint form of item 3. French-speaking

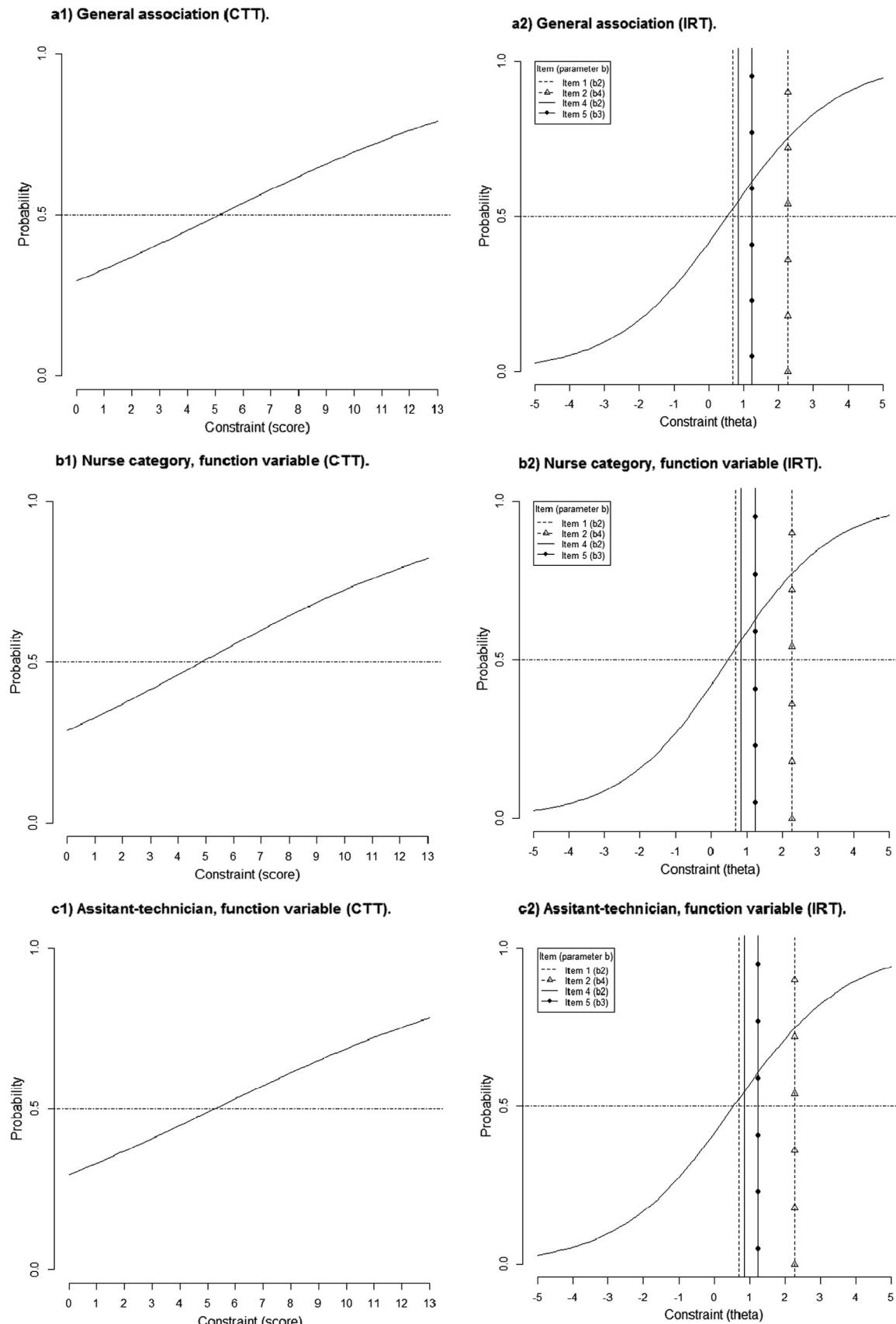


Fig. 2. Probabilistic curves from the criterion validity of the constraint questionnaire against the work accident involving exposure to biological fluids (WABIF) from patients caused by contact, estimated by Classical Test Theory (CTT) (a1, b1, c1, d1, e1, f1, g1) and Item Response Theory (IRT) (a2, b2, c2, d2, e2, f2, g2) to the general association and the categories from function variable and sector's (Table 3) in nursing staff, São Paulo, Brazil, 2013. **Table 2**, b parameters, which are after the cutoff point (Table 3) were placed on the IRT curves.

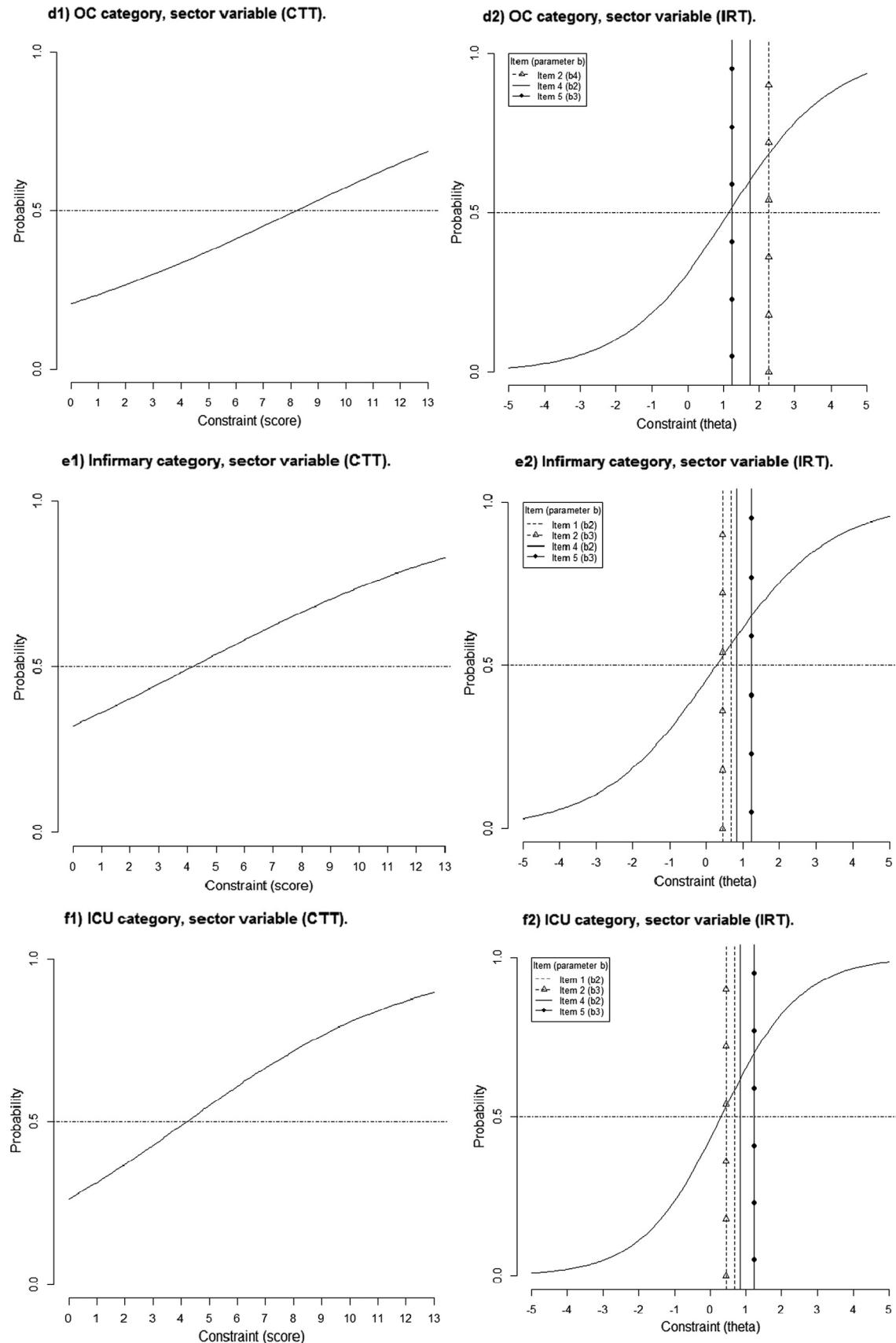


Fig. 2 (continued)

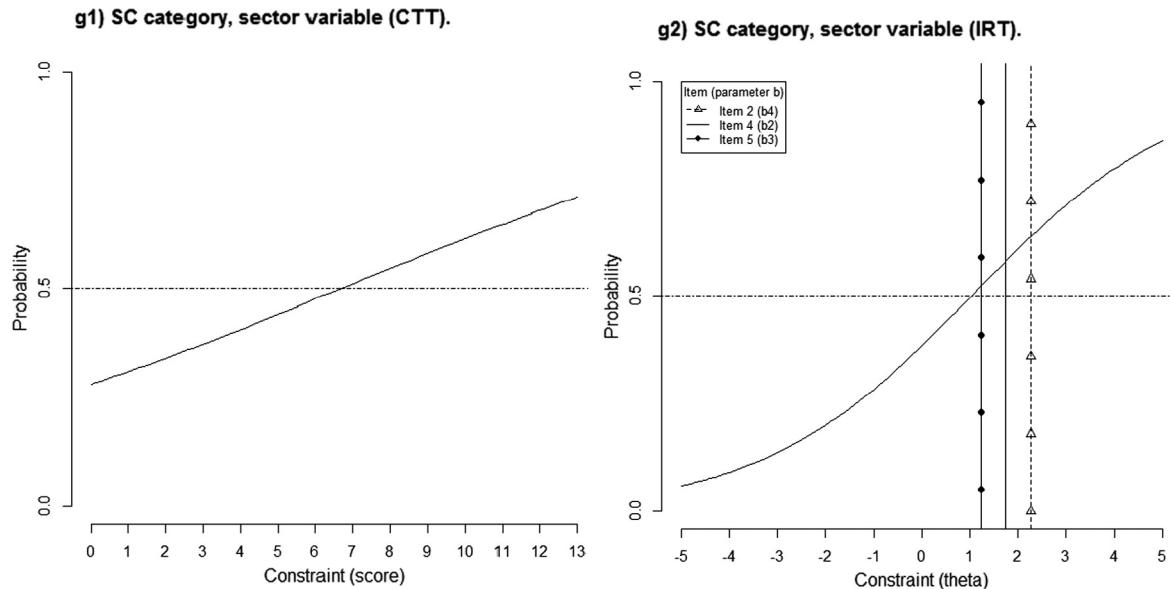


Fig. 2 (continued)

Ergonomics considers this item's content, colloquially called “being lent out” into the ICHC nursing staff culture, a management constraint (Tersac and Maggi, 2004) due to it indicates an event of changing the worker from the job sector where he/she is accustomed to. The variable of this item can be understood as localized on an upper level of the institution compared with the other ones of this constraint questionnaire, because the content of item 3 touches the management organization of the institution as a whole (Reason, 2009). ICHC presents insufficient contingency of nursing staff members (Donatelli, 2013), which requires its workers to move to work in another job sector than the one they are adapted to. Management organization is responsible for the problem of lack of workers. Further, we can conjecture the existence of an interaction between this issue and the real work, as comprehended by the French-speaking Ergonomics (Guérin et al., 2001). Item 3 can be meant as a proxy of a management constraint (Tersac and Maggi, 2004) which influences the real work represented by items which measure time and materials (PPE) constraint. For example, the lack of contingency simultaneously intervenes in the situation of the worker changing to another sector and in the fact of the he/she to move faster to accomplish his/her task (items 1 and 2), i.e., a time pressure constraint.

4.3. Low internal consistency

The internal consistency of the instrument was lower than we expected, Cronbach alpha ≥ 0.70 (Nunnally and Bernstien, 1994). This is an example of inconsistency among the items, possibly originated from some random bias or systematic's (Urbina, 2007). The latter was analyzed, firstly, for the heterogeneities from function and sector variables, but the variability of Cronbach alpha was in the expected range. This result held when the difference among the interviewees was checked. Such findings can be used to disregard the time influence as a systematic bias, because more than one interviewer began to work and left at different periods of time during the seven months of data collection.

4.4. Searching for constraints instruments in databases

Pubmed, Web of Science and Scopus were used to research similar studies like this one. A search strategy was elaborated, which encompassed occupational health, constraint according to

French-speaking ergonomic's definition and the method of psychometric validation of the instruments. This search strategy was adapted for each database and the subject descriptor was applied whenever possible. Otherwise, specific words were used in the search of title, abstracts and key-words. A period of time was not used in the search. Four studies stood out among the data base results, three of which were French and one American (Bonneterre et al., 2011; Gonon et al., 2004; Spector and Jex, 1998; Trichard et al., 2009).

However, none of the instruments used in the four studies maintained a close approximation to the items elaborated in this study to measure the constraint construct. This scale can be useful as a predictive assessment and a preventive intervention in work situations involving constraint, which could facilitate the occurrence of harmful events to the workers. Thus, the hospital managers responsible for the work safety can use this questionnaire to obtain a previous diagnosis of the constraint work situations.

4.5. Time pressure and PPE operating as sources of constraints

Since the beginning, item 1 was dichotomized intending to offer the worker two clear response options. Our intention was to check if the nursing staff member could perform or not the POP in emergency situations, i.e., if the prescribed work can be performed in a typical hospital situation (Martin and Gadbois, 2007). Comparing CI95% of the two response categories for item 1, we observed that the difference between both was significant, independently of function and sector variables, except in the ER. This evidence was previously found in the same context and work category (Donatelli, 2013). Time pressure among healthcare workers was also found as a reducer of hand hygiene compliance by Australian nurses (Jimmieson et al., 2016) and a guide to diminish safety conditions in a Norwegian surgical team (Høyland et al., 2014). However, the lack of significance between item 1 categories in the ER sector can be explained by the frenetic pace, which determines the work activity performance of the ER nursing staff. The health of the ER patient is in fact in a critical condition, often a matter of life and death. The ICHC's ER sector is complex because its contingency of nursing staff members experiences a chronic and permanent lack of staff, which would be the minimum number of nurses required to effectively keep the ER running. These factors contribute to the frenetic pace of this sector.

Despite the result for the significant difference of item1 categories, we do not make an apology for the extinction of the prescribed work or the POP. However, such evidence indicates that both can represent an idealization of nursing staff management, without taking into account the influence of the context and the countless variables presented in a real work situation. Therefore, it is necessary to think about a solution which considers the work situation where the nursing staff need to perform their work activity at the ICHC (Guérin et al., 2001), even if these workers participate in the group which will devise and undertake this solution.

A similar consideration we address to the result of the PPE hampers the work performance becoming a constraint, and yet the Brazilian workers (not only those belonging to nursing staff) are obligated to use PPE due to their law (Veiga et al., 2007). Of course, PPE generally is necessary and important for safety, but a PPE redesign is required by the real work situation (Guérin et al., 2001). This redesigning must consider comfort and good handling for its user during the performance of his/her work activity in order to prevent the worker bypassing the protective device (Apfeld, 2011). This material innovation will diminish the worker exposure to an accident or another undesirable event.

4.6. Gold standards: hierarchy among them and their relationship with the constraint

Gold standards used in this study do not represent per se the phenomenon which the questionnaire aimed to measure, but they can be a constraint consequence (Falzon and Sauvagnac, 2007; Guérin et al., 2001). When the gold standard is the phenomenon itself, the values of the results tend to be lower than its consequence or some effect of the phenomenon brought by another one. Otherwise, the intensity of the phenomenon measured by the questionnaire must reach a plateau where the supposed effect is produced. Following this rationale, Table 3 values would possibly achieve low values if the gold standard of this study was the constraint itself. In addition to cutoff point relativization, if the procedure to dichotomize incident response categories was changed, most likely the association between this outcome and the constraint scale would output different results compared with Table 3.

Regarding the relevance that ICHC nursing staff attributed to the two kinds of WABIF used in this study, we expected that both would be close to each other and their incident relevance lower than them. We can use gold standard prevalence as an indicator of this WABIF relevance hierarchy. Hence, we expected the incident prevalence higher than two WABIF and CI95% of these last ones were overlapped or closest at least. However, the results were different (Table 1). WABIF by contact was the highest prevalence, followed by the incident and WABIF by sharp objects, respectively, and no CI95% overlapped. This evidence helps us to hypothesize that among ICHC nursing staff there is a hierarchy between WABIF and it by sharp objects to be the highest one. This can be extended to WABIF incidents, possibly workers noticed as an almost accident when the situation involves sharp objects than patient's body fluids. This conjecture of WABIF hierarchy among ICHC nursing staff can find plausibility in the risk perception theory (Douglas and Wildavsky, 1982), which argues that risks are a cultural product because they are socially selected and the social context influence their construction as a perception.

The rationale about the overestimation of the WABIF by sharp objects and possibly its incident can also help us to conjecture an explanation about the cause of the incident cutoff points being often higher than WABIF by contact (Table 3). Theoretically, a proportionally inverse relationship exists between the prevalence values of an outcome and the intensity of its cutoff point, i.e., the lower the prevalence, the higher the cutoff point and vice versa. Then, following the previous expectation in this study about its

three outcomes, we expected that both WABIF cutoff points for both paradigms would be higher than their incidents. However, we found the opposite (Table 3), incident cutoff points were higher than WABIF by contact, except in the OC and SC sectors, where the nursing staff procedures with the patients are quite different to the other sectors, which could influence the worker to notice this outcome more accurately. On the OC attendance, the work activity exposes the worker more to the WABIF by contact than in other hospital sectors because the nursing staff member is routinely involved in small surgeries, bandage maintenance and tests in which the worker deals with the patients' body fluids. Possibly SC nursing staff perceived WABIF by contact easier than workers from other sectors because exposure to body fluids is constant when the patient is undergoing a surgical procedure.

This questionnaire would possibly achieve criterion validity to WABIF by sharp objects if more items were elaborated in order to measure the constraint forms in a specter wider than the one used here. The four items which remained after construct validity were insufficient to sharply discriminate the constraint from workers who suffered this kind of WABIF from workers who did not. The same can explain the evidence of better specificity than sensitivity and the ER lack of validity (Table 3), which, as we saw previously, is the hospital sector where the workers often work at a frenetic pace night and day. However, this questionnaire intended to be an initial and exploratory instrument to check the nursing staff constraint and its unsafe consequences to the workers.

4.7. More quality to interpret construct's severe levels for each item by its category

Once more, databases were searched, but now to look for studies which applied to IRT b parameter as a cutoff point. Pubmed, Web of Science, Scopus and PsycNet were used, the latter being added due to the creation of IRT and is still in development as a subject of the psychometric field. A time period was not fixed and the search strategy embraced the methods to analyze IRT, sensitivity and specificity, criterion validity and gold standard. The same criteria used to search for publications about constraint, as described before, on the databases was applied here. At the end of the search, we do not find study using IRT b parameter as a cutoff parameter.

The fact of crossover the estimation of the IRT b parameters (Table 2) and IRT cutoff points (Table 3) enabled us to get a detailed and a more qualitative interpretation about the cutoff point, which fell beyond the CTT paradigm results (Figs. 1 and 2). The usual information produced by CTT paradigm's cutoff point, which can be applied to IRT paradigm also to find just one cutoff point, informs us how much of the construct a person needs to achieve the gold standard with at least 50% chance (remembering the researcher can change this value deliberately) for he/she to be in a severe level of this phenomenon. Then, from this point of the construct to the highest one, they will reach a no longer safe condition. On the other hand, to apply IRT b parameter to criterion validity found important values of the construct level closest to the cutoff point estimated by the IRT paradigm (Figs. 1 and 2). We can identify the level of each item, which surrounded that value by its right side. This helped us to find the intensity degree of each item, represented by the item category due to its b parameter, sufficient to demand from the instrument's respondent to reach, with at least 50% chance, the plateau considered as severe or unsafe by the gold standard. So, we can comprehend from which item level (represented by its category) there will be an exposition to an unsafe work condition.

The example of the general association of the gold standard incident (Table 3), specifically item 2 (Table 2) (Fig. 1.a2), depicts the nursing staff member as being on a constraint level considered

severe and unsafe (to experience an almost accident), when he/she noticed his/her production **often** delayed because he/she executes his/her tasks with the necessary care according to the technical guidelines. The **always** response category of item 2 also keeps the same construct level as the previous category. The same rationale that the worker achieves an unsafe level of the construct to suffer an incident can be applied to the category **sometimes** of the items 4 and 5 and to the next ones. However, it is possible to find items for which none of their categories will be sufficient to achieve that plateau. This was observed in item 1 on the association of the example above (Fig. 1.a2). This situation about item 1 exemplifies other important issues finding a match between the cutoff point estimated by IRT and the item's b parameters. We can also find which item matters, or does not matter (by itself in this qualitative interpretation) to the worker to be in an unsafe condition of the gold standard variable. However, although item 1 categories does not matter by itself to expose the worker to an unsafe condition, it really is as important as the other items (2, 4 and 5) to the constraint scale because they together form the base of the latent trait previously validated as a construct, which contemplated the criterion validity.

Work accidents can be analyzed by the bow-tie model (Almeida et al., 2014; Hale et al., 2007). At the center of the bow-tie is the core event which, in our case, is the accident and on the left are the risks present in the context where the events involved in the accident occurred. On the right side are the accident consequences. This rationale allows using the bow-tie model to arrange the variables associated with the accident. They can be classified as near or distant (or latent) from the accident, independent of the bow-tie side. Usually it is easier to find, measure and analyze variables near the center of the bow-tie than those which are distant. The questionnaire of our study fits this premise because time pressure (items 1 and 2) and PPE (items 4 and 5) constraint aspects are near and on the left of the accident. Distant variables are not so present at the event and they are more difficult to assess. There is a parallel between this and what Reason (1990) writes about latent errors and distant disasters. In this study, item 3 is an example of the challenge of assessing a distant or latent variable at that Reason rationale applied to the bow-tie model perspective. Further, the comparison of the variable near or distant from the accident on the bow-tie perspective can strengthen what we propose above of item 3 measures another dimension of the constraint construct than those four items remained after the construct validity. This also supports our hypothesis, elaborated at the end of the study, that those constructs, which can spread their specter as near or as distant from the accident, as the constraint study here, have at least two dimensions: one for the construct aspects near to the accident and another for the accident distant to it.

5. Conclusion

A new constraint indicator caused by time pressure or personal protection equipment (PPE), was validated, which is addressed to nursing staff workers and it is conceptualized on the French-speaking Ergonomics. When nursing staff members face constraint situations at work, they are exposed to suffer accidents with biological fluid and its almost accident. Further, a new way was found to interpret unsafe conditions using cutoff points. Criterion validity analysis found the work constraints level that indicates the construct's place where nursing staff workers experience an unsafe condition to suffer a biological fluid accident by contact, or the almost biological fluid accidents can be achieved. However, the boundaries of that unsafe construct's place was not delimited by just one cutoff point value on the construct's scale, as is the standard procedure in the literature. We found a delimitation yielded

by each level of the constraint action measured by each item of the questionnaire, which is represented by IRT b parameter and its respective item category. Therefore, we can understand by a detailed and more qualitative way which item category guides the worker to an unsafe work condition.

We wanted to assess the phenomenon among a relevant population of nursing staff workers. Therefore, we selected our participants at the main institute of the Hospital das Clínicas da Faculdade de Medicina de São Paulo, which reflects the core issues faced by the nursing staff of this hospital complex, one of the biggest in the world. This study could be used as a source for elaborating constraint instruments also addressed to other worker categories, always using the French-speaking Ergonomics conception.

Complementary information

The present study is the first article of the doctoral thesis entitled "Accidents to biological fluid and its relationship with factors' from inside and outside work: a multilevel study with nursing staff of a public hospital". Its authorship belongs to the first author of this article, who attended as a student at the Public Health Graduation PhD Program from Public Health School, University of São Paulo (USP), Brazil, and he defended the thesis on 31 October 2015. It won the Santander Thesis Acknowledgement Award ("Editorial 02/2016: Prêmio Reconhecimento Tese Santander"), specific from USP. The method applied to the thesis was conceptualised as an epidemiological study that intended to embrace the relationship between the outcomes and exposition variables. One of the latter it was the work constraint indicator. Hence, previously, as an essential condition, we needed to validate this indicator, as it was presented in this article.

Acknowledgments

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