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Research report

Evidence of Validity for the Brazilian Burnout Assessment Tool (BAT-Brazil)

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ABSTRACT

This study aimed to evaluate the psychometric properties of the Brazilian version of the Burnout Assessment Tool (BAT-Brazil), a new measure of burnout. To assess validity evidence, the BAT-23 was administered to a sample of 2,223 Brazilian participants, while the BAT-12 was completed by 4,022 participants. Both samples included workers from the five regions of the country. The factorial validity and the reliability of the BAT-Brazil were examined through confirmatory factor analyses, which supported a hierarchical structure with four first-order factors and one second-order factor as the best-fitting model. Both versions of the scale demonstrated satisfactory internal consistency. Additionally, the external discriminant validity of the BAT-Brazil aligned with the Job Demands-Resources model. These findings provide initial evidence for the reliability and construct validity of the BAT-Brazil.

Keywords: burnout; Job Demands–Resources model; positive psychology; occupational health.

RESUMO – Evidências de Validade da Escala de Avaliação de Burnout (BAT-Brasil)

Buscou-se avaliar as propriedades psicométricas da versão brasileira do Burnout Assessment Tool (BAT-Brasil), uma nova medida de burnout. A amostra para análise das evidências de validade do BAT-23 foi constituída por 2.223 participantes brasileiros e para o BAT-12 por 4.022 participantes brasileiros. Ambas as amostras incluíram trabalhadores das cinco regiões do país. Examinamos a validade fatorial do BAT-Brasil e sua confiabilidade. As análises fatoriais confirmatórias demonstraram que a estrutura hierárquica de quatro fatores de primeira ordem e um fator de segunda ordem foi a melhor solução para o BAT-Brasil. A consistência interna das duas versões da escala foi satisfatória. A validade discriminante externa do BAT-Brasil esteve em consonância com o Modelo de Recursos e Demandas do Trabalho. Os resultados do presente estudo fornecem evidências da confiabilidade e validade de construto do BAT-Brasil.

Palavras-chave: *Burnout*; Modelo de Recursos e Demandas do Trabalho; Psicologia Positiva; Saúde Ocupacional.

RESUMEN – Evidencias de Validez de la Escala de Evaluación de Burnout (BAT-Brasil)

Buscamos evaluar las propiedades psicométricas de la versión brasileña del Burnout Assessment Tool (BAT-Brasil), una nueva medida de burnout. La muestra para el análisis de evidencias de validez del BAT-23 estuvo compuesta por 2.223 participantes brasileños y para el BAT-12, por 4.022 participantes brasileños. Ambas muestras incluyeron trabajadores de las cinco regiones del país. Examinamos la validez factorial de BAT-Brasil y su confiabilidad. Los análisis factoriales confirmatorios mostraron que la estructura jerárquica de cuatro factores de primer orden y un factor de segundo orden fue la mejor solución para el BAT-Brasil. La consistencia interna de las dos versiones de la escala fue satisfactoria. La validez discriminante externa del BAT-Brasil estuvo en consonancia con el Modelo de Recursos y Demandas Laborales. Los resultados proporcionaron evidencias de confiabilidad y validez de constructo del BAT-Brasil.

Palabras clave: *Burnout*; Modelo de Recursos y Demandas Laborales; Psicología Positiva; Salud Ocupacional.

In the recent 11th revision of the International Classification of Diseases burnout was included as an occupational phenomenon that influences health (World Health Organization, WHO, 2019). Schaufeli et al. (2019) argues that the burnout concept must be tested in a comprehensive model instead of the pragmatic or minimalistic view. Altogether, the authors stand out that burnout must be understood as a state of being severely fatigued, feeling an intolerance to put their energy on the work, and also an unwillingness to perform. Note that

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a theoretical concept of burnout cannot be reduced to exhaustion as a symptom because it is not sufficient to explain neither the nature nor the stressor process.

Secondly, scholars are questioning the psychometric basis to assess burnout, and their practical applicability. In this line, the gold standard of the Maslach Burnout inventory (MBI, Maslach & Jackson, 1981), which is used in about 90% of all empirical papers on the subject, is being criticized as it needs updating because of its limitations to measure burnout by the three constituting elements that are tapped by the MBI (De Beer et al, 2020; Redelinghuys & Morgan, 2023; Sakakibara et al, 2020; Schaufeli et al., 2019).

The earlier contributions of the MBI were to be an instrument that identified the burnout phenomenon preliminary by empirical data. In fact, there is a large range of evidence that burnout syndrome predict many negative consequences to individuals and organizations. Among them are life and job dissatisfaction, hypercholesterolemia, type 2 diabetes, musculoskeletal disorders, prolonged fatigue, headaches, gastrointestinal issues, mood disturbance, absenteeism, cardiovascular and coronary heart diseases, insomnia and depression (Alessandri et al., 2018; Bakusic et al., 2020; Engelbrecht et al., 2019; Vazquez et al., 2019). Furthermore, nowadays burnout became even more prominent because of the pandemic. Recent studies show that the infection of COVID-19 has also posed strain and increased workload and job stress, and especially healthcare workers have been related to higher risk of burnout than others (Denning et al., 2021; Sharma et al., 2020). These findings corroborate the need for a reliable, sensitive and innovative tool to evaluate and identify the burnout impacts on workers' mental health.

Even if we consider the relevant contributions to the knowledge we obtained so far, the evidence on burnout presents intriguing points for the need to develop an accurate instrument to advance deeper into a more comprehensive theory (De Beer et al., 2020; Sakakibara et al., 2020). Schaufeli et al. (2019) developed the Burnout Assessment Tool (BAT), a new self-report questionnaire to measure burnout, supported by the Job Demand Resources Model to explain the stressor and energetic process. First, they introduced a new definition using a dialectical approach as a "*work-related state of exhaustion that occurs among workers, characterized by extreme tiredness, reduced ability to regulate cognitive and emotional processes, and mental distancing*" (p.3). The nature of the work-related state is not restricted to paid employment or specific occupational groups but refers to all structured activities that require effort to reach the goal directed. Second, BAT assumes that the stressor process is supported by the Thorndike definition of extreme fatigue as the intolerance of any effort, which is reflected by the inability and the unwillingness to spend energy at work or to perform (Schaufeli et al., 2019).

The development of the BAT (Burnout Assessment Tool) was grounded in established scientific procedures, emphasizing the utilization of existing scientific knowledge on burnout. To the development of BAT scale, Schaufeli et al. (2019) initially conducted 49 in-depth interviews with healthcare practitioners. Based on these interviews and an extensively review on existing burnout assessment tools, they proposed the first version of BAT with 90 items. After removing the duplicated and overlapped items, a comprehensive discussion took place to scrutinize the remaining items, ultimately leading to the final version of the BAT with 23 items referring to the core symptoms of burnout.

In order to allow a screening on main burnout symptoms and avoid unnecessary burden on respondents, Schaufeli et al. (2019) developed a brief version of BAT with 12 items. The shortening process of BAT-23 to BAT-12 considered the reliability, validity and contribution of each item, as well as the psychometric proprieties of the brief scale.

Finally, the BAT-23 and BAT-12 assesses burnout as a multidimensional concept with four core dimensions (Schaufeli et al., 2020): 1. Exhaustion, as a severe loss of energy in feeling used-up and inability to make more efforts after a working day, 2. Mental Distance, as a defensive and dysfunctional psychological reaction to cope with the unwillingness to perform, with a strong aversion for the work, and the wish to avoid contact with others acting by a cynical attitude, 3. Cognitive Impairment indicated by memory problems, attention and concentration deficits and poor cognitive performance; 4. Emotional Impairment evidenced in intense emotional reactions and feeling overwhelmed by one's emotions. Comorbidities and secondary symptoms (e.g., psychosomatic complaints, symptoms of depression) are the often the reason to seek help or to be away from work, but the process of burnout starts even before. This novel comprehension of burnout contributes to scientific and practical advances in its treatment and for planning more effective policies for prevention, promotion, and protection of workers' health.

The present paper aims to demonstrate evidence of validity for the Brazilian version of the Burnout Assessment Tool, comparing the complete and short version, focused only on the four core dimensions. Its psychometric properties have been assessed in Austria, Belgium, Equator, Finland, Germany, Ireland, Italy, Japan and Netherlands (De Beer et al., 2020; Mazzetti et al., 2022; Sakakibara et al., 2020; Schaufeli et al., 2020; Vinueza-Solórzano et al., 2021). Based on theoretical and empirical findings, Schaufeli et al. (2019) proposed a hierarchical solution of four first order factors (exhaustion, mental distance, emotional impairment and cognitive impairment) that load on a second order factor that assesses burnout. The hierarchical structure observed in other versions of BAT-23 (De Beer et al., 2020; Schaufeli

et al., 2020; Vinueza-Solórzano et al., 2021) and BAT-12 (Schaufeli et al., 2020; Vinueza-Solórzano et al., 2021). In the Japanese version of BAT-23, it showed a bifactorial structure, in which general score of burnout was assessed through a general factor and a burnout core dimensions were evaluated trhough four oblique first order dimensions (Sakakibara et al., 2020).

In this study, we assessed if the hierarchical solution of four first order factors (exhaustion, mental distance, emotional impairment and cognitive impairment) that load on a second order factor that assesses burnout showed the best fit for BAT-23 and BAT-12 (*Hypothesis* 1). Also, we evaluated the invariance for gender (*Hypothesis* 2) and educational level (*Hypothesis* 3) on the two versions of the BAT-Brazil.

To demonstrate evidence of the nomological network of Brazilian BAT-23 and BAT-12, we examined the relations of burnout with job demands, job resources, work engagement and life satisfaction. Job demands refer to job activities that require continued levels of physical, emotional or mental effort to ensure their achievement. Because of the efforts associated to job demands, they are associated to different levels of physiological and psychological costs. Instances of job demands encompass quantitative factors like excessive workload, insufficient workload, and the rate of change, as well as qualitative job demands associated with the nature of tasks and job characteristics, including mental (e.g., pressure on decision-making), emotional (e.g., patient suffering), and physical (e.g., standing for long hours) demands. Due the physiological and psychological costs, high levels of job demands are positively associated with the development of burnout (Bakker et al., 2023; Schaufeli et al., 2020; Vinueza-Solórzano et al., 2021). On the other hand, job resources are conceptualized as factors of the job that have a potential to contribute to workers achieve their occupational goals, pursue professional and personal development, and act as a protective factor against the physiological and psychological costs associated with job demands. Examples of social job resources in the workplace encompass factors such as job clarity (e.g., clear communication of job responsibilities and tasks), team support (e.g., helpful interactions among team members to provide support in work activities), supervisor support (e.g., support provided by a supervisor), perception of team spirit and teamwork (e.g., feeling a sense of collaboration within a team). On the other hand, job content resources include elements such as job control (e.g., having autonomy to manage their own job tasks) and perception of decision-making (e.g., being involved in decision-making processes that affect one's job) (Bakker et al., 2023; Schaufeli et al., 2020). Based on this, we expected a positive relationship between burnout and its dimensions with job demands, like work overload, conflict of roles and interpersonal conflicts (*Hypothesis 4*), and a negative relationship with job resources, such as job control, role clarity and support of the team (*Hypothesis 5*).

Furthermore, we evaluate the relationships of burnout and its dimensions with opposite states of well-being by investigating the associations with work engagement and life satisfaction. In opposition to workers suffering from burnout, engaged workers exhibit high levels of energy and dedication and are usually highly involved and feel absorbed in their work (Kassandrinou et al., 2023, Schaufeli et al., 2019; Sullivan et al., 2023). Life satisfaction is a positive state of well-being that refers to the evaluation that individuals make of their level of satisfaction with relevant life domains (Hutz et al., 2014). Life satisfaction may act as a protective factor in the prevention of the burnout syndrome (Vazquez et al., 2019). We expect that burnout, and its dimensions will be negatively related with work engagement (*Hypothesis 6*) and with life satisfaction (*Hypothesis* 7).

Method

Participants

The inclusion criteria in this study were being over 18 years old, having been employed for at least 12 months, and working a minimum of 20 hours per week. The only exclusion criterion utilized was that the professionals were on work leave due to health reasons. The convenience sample of BAT-23 consisted of 2,223 workers, 25.3% male and 74.7% female, aged between 18 and 90 years (M=37 years, SD=11.4), 48% were aged between 35 and 49 years old. The majority (50.4%) had a postgraduate degree, with 24.9% having a college degree or ongoing and 24.7% having completed high school. The participants lived in the four Brazilian macroeconomic regions, with 78.5% in the Center-South, 17.6% in the Northeast, 2.7% in the Legal Amazon, and 1.2% in the administrative region (Federal District). At the time of the survey, the sample was composed of 11% white collars workers and 48.4% blue collars, and 26.5% were health workers. The predominant salary range was between three to six salaries (40%). All participants in this data collection answered the instruments before the COVID-19 pandemic.

The BAT-12 sample was constituted by 4,022 professionals, because an independent sample of 1,799 professionals who answered only the BAT-12 was added to the BAT-23 sample ($n_{BAT\text{-}23}$=2,223). This second independent sample was constituted of 28% male and 72% female, mean age was 35,5 years (SD=9, between 19 and 58), 53% were aged between 35 and 49 years old. In relation to educational level, most participants (71%) had a postgraduate degree, with 24% having a college degree or ongoing and 23% having completed high school. The majority (57%) salary range was between four to seven salaries. All participants of this second sample were from

Center-South Brazilian macroeconomic regions. Most of the sample (77%) worked as health workers and 23% are blue collars workers. In the total sample of BAT-12, 55% of professionals responded to the scale before the COVID-19 pandemic and 45% responded during the pandemic. The decision to integrate the samples was a strategy to mitigate limitations associated to convenience sampling, enhance response variability, and strengthen the ecological validity of the data.

Instruments

The Burnout Assessment Tool (BAT) was used to assess burnout. This instrument assesses the dimensions of exhaustion, mental distance, emotional impairment and cognitive impairment, as well as measuring burnout levels as a general score. Both BAT-23 and its short version of BAT-12. In BAT-23, exhaustion is measured through 8 items and all other dimensions (mental distance, cognitive impairment and emotional impairment) by 5 items in BAT-12, all dimensions are evaluated through 3 items each (Schaufeli et al., 2020).

Job resources refer to job control (7 items), role clarity (3 items) and support of the team (3 items). The job demands refer to work overload (4 items), role conflict (3 items) and interpersonal conflicts (4 items). All job characteristics were assessed with the Job Demand Resource Questionnaire (JDR-Q). The subscales total 31 items (Schaufeli, 2015). In the present study, the scale showed satisfactory goodness-of-fit indexes (CFI= .94, TLI = .93 and RMSEA= .087 [90%, .083 - .090]) and reliability (work overload, α=.87, $\overline{\omega}$=.85, and C. R.=.88, role conflict, α=.81, $\overline{\omega}$=.78, and C. R.=.81, interpersonal conflicts, α=.86, $\overline{\omega}$=.84, and C. R.=.88, role clarity, α=.87, $\overline{\omega}$=.83, and C. R.=.87, support of the team, α=.87, $\overline{\omega}$=.84, and C. R.=.87, and job control, α=.93, $\overline{\omega}$=.92, and C. R.=.93). The JDR-Q is currently undergoing adaptation to the Brazilian context, under the responsibility of the first author of this study. In the process of adapting the instrument to Brazilian Portuguese, the steps of cross-cultural adaptation were followed (American Educational Research Association, AERA, et al., 2014). The items were translated by independent judges, evaluated by a panel of judges, piloted with a pilot group, and then translated back to English. The author of the original version of the scale approved the Brazilian version of the instrument, allowing for the continuation of the development of the JDR-Q adaptation to Brazilian context.

Engagement levels were assessed using the Utrecht Work Engagement Scale through 9 items. The internal consistency index of the scale is .95 (Vazquez et al., 2015). UWES showed satisfactory goodness-of-fit indexes (CFI=.98, TLI=.97 and RMSEA= .237 [90%, .227 - .248]) and reliability (α=.97, $\overline{\omega}$=.97, and C. R.=.88) in the present sample.

Life Satisfaction Scale (Hutz et al., 2014) consists of five items that measure the cognitive component of subjective well-being in terms of the level of happiness that the person perceives in his life, in general. The scale's internal consistency level is .90. Goodness-of-fit indexes (CFI= .99, TLI = .99 and RMSEA= .214 [90%, .205-.130]) and reliability (α=.92, $\overline{\omega}$=.90, and C. R. = .92) were satisfactory in the present sample.

Translation and validation

The BAT-23 and BAT-12 scales were adapted to Brazilian Portuguese by three Brazilian evaluators, fluent in English, with specialization in psychometrics or in Organizational and Work Psychology. The synthesis of the three translated versions gave rise to the first version in Portuguese (AERA et al., 2014).

Content validity was assessed through three focus groups, by level of education: high school professionals (n=3); higher education professionals (n=3) and elementary education professionals (n=3). The focus groups were carried out to the point of theoretical saturation. Based on the participants' suggestions, adaptations were made in the wording of items, but there was no inclusion of new items or dimensions in the Brazilian version of the scale. Before sending the scale to the authors of the original version of the BAT, a reverse translation of the version was carried out by a bilingual researcher with knowledge of the construct. The BAT authors considered the version adapted to Brazilian Portuguese. It is pointed out that the participation of the test authors was essential for BAT's translation and back-analysis processes.

Ethical Considerations and Data Collection

This study was approved by the Research Ethics Committee (CAAE 78617617.8.0000.5345) and followed the ethical Resolution 466/2012 of the Brazilian National Health Council.

The collected data were carried out through an online survey published on the researchers' social networks by the SurveyMonkey tool. When indicating their interest in participating in the study, the participants had access to the Consent Form.

Data Analysis

To confirm the most adequate structure of the BAT-23 and BAT-12, three Confirmatory Factor Analyses (CFA) were carried out using the Weighted Least Squares Mean and Variance-Adjusted (WLSMV) estimation method, as this is a robust estimation method for ordinal data (Muthén & Muthén, 2010). The first model evaluated the unifactorial structure of BAT-23 and BAT-12; in this model all items constitute a general factor of burnout. The second model investigated was a hierarchical solution of four first order factors (exhaustion, mental distance, emotional impairment and cognitive impairment) that load on a second-order factor that assesses burnout,

as proposed by Schaufeli et al. (2019). The third assessed a four oblique first order factor (exhaustion, mental distance, emotional impairment and cognitive impairment), to evidence the high correlation between factors that justify the existence of a higher order factor. The fit indices were the Comparative Fit Index (CFI), the Tucker-Lewis Index (TLI), and the root mean square error of approximation (RMSEA) with its confidence intervals (CI). The fit indices to indicate adequate and excellent model were CFI (>.90), TLI (>.90), and RMSEA (<.08, with a 90% confidence interval not exceeding .10) (Brown, 2015).

In this study, confirmatory factor analysis (CFA) was selected as the preferred method of analysis, because it allows to investigate a pre-specified theoretical and empirical evidence. Considering the evidence showed the hierarchical structure of four first-order factors and one second-order factor as the best solution for the BAT-23 and BAT-12 (De Beer et al., 2020; Schaufeli et al., 2019; Schaufeli et al., 2020; Vinueza-Solórzano et al., 2021), this model was evaluated. Additionally, CFA is also more efficient, requiring a smaller sample size compared to Exploratory Factor Analysis (EFA), as it tests a specific model without exploring multiple models (Hoyle & Duvall, 2004).

After defining the final structure of BAT-23 and BAT-12, multigroup confirmatory factor analysis (MGCFA) was performed to test the measurement invariance of the scale for gender (male and female) and educational level (high school, college degree and postgraduate degree). The measurement invariance was evaluated by testing the configural, threshold, metric, scalar and uniqueness invariances in a hierarchical way, which meant that a more restricted model was compared to a less restricted model. The measurement invariance was assessed based on the CFI difference values (ΔCFI) and the RMSEA difference values between the models (ΔRMSEA). Measurement invariance is achieved if ΔCFI is lower than .01 (ΔCFI <.01) and ΔRMSEA is lower than .015 (ΔRMSEA <.015). The internal consistency of the factors was assessed using Cronbach's alpha (α), omega (ω) and composite reliability (C.R.) indices. Values of Cronbach's alpha higher than .70 were considered acceptable.

The content validity was assessed through the association of burnout and its dimensions (exhaustion, mental distance, cognitive impairment and emotional impairment) with job demands, including work overload, role conflict and interpersonal conflicts; job resources such as job control, role clarity, support of the team, and with the indicators of well-being (i.e., engagement and satisfaction with life). Evidence of validity with external variables of BAT-23 and BAT-12 was investigated through Pearson correlations.

The discriminant validity of BAT-23 and BAT-12 was investigated through the calculation of the Average Variance Extracted (AVE) of burnout, exhaustion, mental distance, cognitive impairment, emotional impairment, work overload, role conflict, interpersonal conflicts, job control, role clarity, support of the team, work engagement and satisfaction with life. To observe the discriminant validity of BAT-23 and BAT-12, it was expected that the AVE of each construct was superior to the square correlations of the constructs with each other.

A *t* test was performed to investigate the differences in burnout levels and its dimensions (exhaustion, mental distance, cognitive impairment and emotional impairment) between professionals who answered BAT-12 before and during the COVID-19 pandemic. The effect size of group differences was investigated using Cohen's *d*.

All analysis described in this study were carried out through software R Studio version 1.4.1717 (R Core Team, 2021). The structural equation modeling was investigated using the package lavaan (Rossel, 2012), the reliability indices were investigated using package MBESS (Kelley, 2020), and the t test was performed using the package stats (R Core Team, 2021).

Results

The results of the first CFA that evaluated the unifactorial solution showed that all items showed a high factor loading on the BAT-23 and BAT-12 factors. However, the unifactorial solution for BAT-23 and BAT-12 showed mediocre goodness-of-fit indices for the BAT-23 and BAT-12 (Table 1). The second model showed adequate goodness-of-fit indexes for BAT-23 and excellent goodness-of-fit indexes for BAT-12 (Table 1). In BAT-23, all items showed a high factor loading on the four first-order factor, and in their turn, the four factors showed high loading factors on the second-order burnout factor (exhaustion, β=.82, mental distance, β=.91, cognitive impairment, β=.77, and emotional impairment, β=.83) (Table 1). In BAT-12, the items showed factor loadings higher than .75, and the dimensions showed high factor loadings on the second-order burnout factor (exhaustion, β=.79, mental distance, β=.92, cognitive impairment, β=.74, and emotional impairment, β=.81) (Table 1). The third model evidence that all items obtained high factor loadings on the four first-order factor in BAT-23 and BAT-23, all factors showed strong magnitude associations among them (BAT-23, exhaustion with mental distance, *r*=.761, exhaustion with cognitive impairment, *r*=.636, exhaustion with emotional impairment, *r*=.689, mental distance with cognitive impairment, *r*=.703, mental distance with emotional impairment, *r*=.740, cognitive impairment with emotional impairment, *r*=.703, BAT-12, exhaustion with mental distance, *r*=.713, exhaustion with cognitive impairment, *r*=.561, exhaustion with emotional impairment, *r*=.586, mental distance with cognitive impairment, *r*=.677, mental distance with emotional impairment, *r*=.690, cognitive impairment with emotional impairment, *r*=.647) (Table 1).

In both versions of BAT, results evidenced that the item difficulty for endorsement was greater when the response option of the same item was closer to the "Always" alternative, indicating a gradual increase in the response difficulty along the interval scale. In the BAT-23 and BAT-12, the item 'I'm cynical about what my work means to others' (item 13 in BAT-23 and item 6 in BAT-12) of the mental distance dimension showed greater difficulty of endorsement, as this item showed the highest threshold (respectively, BAT-23, τ=2.31, BAT-12, τ=2.04) (Table 1).

To evaluate if the goodness-of-fit indexes of model 1, model 2 and model 3 were significantly different for the BAT-23 and BAT-12, chi-square difference test analyses ($\Delta\chi^2$) were conducted to compare the models of each BAT version. A comparison of model 1 of BAT-23 with model 2 of BAT-23 showed that model 2 had significantly better goodness-of-fit indexes than model 1($\Delta\chi^2$=2,464.6 (4), p<.001). Model 3 was also obtained better goodness-of-fit indexes than model 1 ($\Delta\chi^2$=1,605.3 (3), p<.001). The comparison of model 2 with model 3 evidence that models were statistically different ($\Delta\chi^2$=23.3 (2), p<.001), however the goodness-of-fit indexes of models suggested that they were equivalent. Based on the strong association between factors on model 3, the model 2 was considered a best fit for BAT-23. Comparing model 1 with model 2 of BAT-12, showed that model 2 and model 3 had a significantly better goodness-of-fit index than model 1 (respectively $\Delta\chi^2$=3,710.3 (4), p<.001, $\Delta\chi^2$=1,315.1 (6), p<.001). Results suggested that model 3 obtained slightly better goodness-of-fit indexes than model 2 ($\Delta\chi^2$=20.1 (2), p<.001), however, the burnout factors were highly correlated between them. Based on these results and on theoretical propositions (De Beer et al., 2020; Mazzetti et al., 2022; Schaufeli et al., 2020; Schaufeli et al., 2019; Vinueza-Solórzano et al., 2021), we can conclude that model 2 represents the best solution for the BAT-23 and BAT-12 (Table 1).

The results of MGCFA of BAT-23 and BAT-12 evaluated if the hierarchical solution of four oblique first order factors and a second-order factor of burnout was invariant for gender and educational level. Although outstanding that our sample is more representative of the higher educational levels, our findings pointed that the goodness-of-fit indexes of the configural model showed that the hierarchical structure was acceptable in the two versions of the BAT according to gender (female and male) and educational level (high school, college degree and postgraduate degree). According to the ΔCFI and ΔRMSEA results of the MGCFA, for the BAT-23 and BAT-12, both versions of the scale achieved threshold, metric, scalar, and uniqueness invariance for gender (female and male) and educational level (high school, college degree and postgraduate degree) (Table 2).

The internal consistency of the scale was excellent, both for the long and short versions of BAT. The values of the reliability indices for BAT-23 and BAT-12 are shown in Table 3.

Evidence of validity with external variables demonstrates that BAT-23 and BAT-12 adequately assess burnout in the Brazilian context. The results show that the burnout scores and their dimensions (exhaustion, mental distance, emotional impairment and cognitive impairment), assessed by BAT-23 and BAT-12, are positively associated with job demands, including work overload, role conflict and interpersonal conflicts. Only mental distance, evaluated with BAT-23 or BAT-12, did not show a statistically significant relation with work overload. The job resources measured via role clarity, support of the team and job control, and well-being indicators (work engagement and satisfaction with life) presented negative relationships with the burnout score and its dimensions as assessed by BAT-23 and BAT-12, as expected (Table 4).

Results showed evidence of discriminant validity for the BAT-23 and BAT-12, given that AVE's values of all variables were greater than their squared correlations, demonstrating that there was discriminant validity between them. Based on these results, it was observed that BAT-23 and BAT-12 differ from the scales that assess work overload, role conflict, interpersonal conflicts, job control, role clarity, support of the team, work engagement and satisfaction with life (Table 4).

Table 1
Confirmatory Factor Analysis of BAT-23 and BAT-12

I	BAT-23												
	M1	M2				Items Thresholds (τ) of Model 2				M3			
	B	E	MD	CI	EI	τ1	τ2	τ3	τ4	E	MD	CI	EI
1	.73	.79				-1.71	-.89	.22	1.25	.73			
2	.50	.55				-1.73	-.74	.38	1.37	.49			
3	.77	.82				-1.26	-.34	.52	1.32	.80			
4	.77	.82				-1.22	-.30	.68	1.53	.81			
5	.73	.79				-.98	-.06	.76	1.46	.75			
6	.78	.86				-.67	.30	1.10	1.83	.86			
7	.74	.79				-.87	.05	.91	1.61	.80			
8	.79	.85				-1.53	-.61	.26	1.12	.84			

Table 1 (continuation)
Confirmatory Factor Analysis of BAT-23 and BAT-12

	BAT-23												
I	M1	M2				Items Thresholds (τ) of Model 2				M3			
	B	E	MD	CI	EI	τ1	τ2	τ3	τ4	E	MD	CI	EI
9	.76		.86			-.66	.36	1.24	1.97		.86		
10	.72		.80			-.64	.20	.83	1.33		.79		
11	.78		.85			-.51	.68	1.47	2.10		.82		
12	.77		.84			-.64	.48	1.37	2.05		.87		
13	.66		.74			-.42	.82	1.75	2.31		.79		
14	.77			.88		-.36	.77	1.59	2.22			.75	
15	.57			.67		.11	.95	1.66	2.10			.83	
16	.71			.82		-.76	.25	1.12	1.82			.70	
17	.78			.88		-.16	.60	1.28	1.93			.94	
18	.68			.79		-.15	.81	1.53	2.08			.80	
19	.68				.77	-.56	.18	.76	1.41				.84
20	.77				.86	-.27	.54	1.28	1.91				.80
21	.62				.71	.21	.80	1.44	1.90				.86
22	.81				.94	.22	.87	1.53	2.07				.84
23	.71				.80	.28	.86	1.45	1.90				.78

M2 - Burnout	τ
Exhaustion	.82
Mental Distance	.91
Cognitive Impairment	.78
Emotional Impairment	.83

BAT-23	$\chi^2(gl)$	CFI	TLI
M1 –Unifactorial Model	14,092.1 (230)	.800	.780
M2 – Hierarchical Mode	4,898.3 (226)	.933	.925
M3 – Four First Order Oblique Model	3,079.7 (224)	.933	.925

	BAT-12												
I	M1	M2				Items Thresholds (τ) of Model 2				Model 3			
	B	E	MD	CI	EI	τ1	τ2	τ3	τ4	E	MD	CI	EI
1	.78	.86				-1.84	-1.07	-.07	.87	.76			
2	.73	.82				-1.44	-.28	.22	1.06	.83			
3	.80	.90				-1.41	-.57	.34	1.13	.85			
4	.74		.83			-.84	.48	.97	1.66		.88		
5	.77		.91			-.82	.17	1.06	1.72		.88		
6	.68		.84			-.58	.56	1.44	2.04		.79		
7	.77			.85		-.62	.37	1.24	1.89			.80	
8	.82			.93		-.22	.57	1.35	1.88			.88	
9	.69			.80		-.40	.50	1.31	1.91			.83	
10	.77				.85	-.83	-.16	.47	1.19				.81
11	.83				.86	-.11	.45	1.15	1.67				.86
12	.76				.77	-.10	.43	1.07	1.65				.78

M2 - Burnout	τ
Exhaustion	.79
Mental Distance	.91
Emotional Impairment	.76
Cognitive Impairment	.82

RMSEA (90 CI)	BAT-12	$\chi^2(gl)$	CFI	TLI	RMSEA (90 CI)
.160 (.157 - .162)	M1 –Unifactorial Model	10,464.5 (54)	.849	.816	.219 (.215 - .223)
.093 (.091 - .096)	M2 – Hierarchical Model	1,139.4 (50)	.984	.979	.074 (.070 - .077)
.095 (.092 - .098)	M3 – Four First Order Oblique Model	351.3 (48)	.984	.978	.067 (.060 - .073)

Note. All items are statically significant (p<.001). I=Items, M1=Model 1, M2=Model 2, B=Burnout, E=Exhaustion, MD=Mental Distance, EI=Emotional Impairment, and CI=Cognitive Impairment

Table 2
Gender (Male x Female) and Educational Level (high school, college degree and postgraduate degree) Measurement Invariance for BAT-23 and BAT-12

	Gender Measurement Invariance	χ2(gl)	CFI	ΔCFI	TLI	RMSEA (90 C.I.)	ΔRMSEA
BAT-23	Unconstrained Model	4,882.4* (452)	0.935	-	.928	.091 (.089 -0.094)	-
	Threshold Invariance	5,042.7* (516)	0.934	.001	.935	.086 (.084 -0.088)	.005
	Metric Invariance	4,678.3* (538)	0.940	.006	.943	.081 (.079 -0.083)	.005
	Scalar Invariance	4,678.3* (538)	0.940	0	.943	.081 (.079 -0.083)	0
	Uniqueness Invariance	4,678.3* (538)	0.940	0	.943	.081 (.079 -0.083)	0
	Educational Level Measurement Invariance	χ2(gl)	CFI	ΔCFI	TLI	RMSEA (90 C.I.)	ΔRMSEA
	Unconstrained Model	5,063.0* (678)	.934	-	.926	.094 (.091 - .096)	-
	Threshold Invariance	5,384.4* (806)	.931	.003	.935	.088 (.086 - .090)	0.006
	Metric Invariance	4,921.5* (850)	.939	.008	.945	.081 (.078 -.083)	0.007
	Scalar Invariance	4,921.5* (850)	.939	0	.945	.081 (.078 -.083)	0
	Uniqueness Invariance	4,921.5* (850)	.939	0	.945	.081 (.078 -.083)	0
BAT-12	Gender Measurement Invariance	χ2(gl)	CFI	ΔCFI	TLI	RMSEA (90 C.I.)	ΔRMSEA
	Unconstrained Model	742.1* (100)	.979	-	0.972	.074 (.069 - .079)	-
	Threshold Invariance	830.9* (131)	.977	.002	0.977	.067 (.063 - .072)	0.006
	Metric Invariance	754.5* (142)	.980	.003	0.982	.061 (.056 - .065)	0.007
	Scalar Invariance	754.5* (142)	.980	0	0.982	.061 (.056 - .065)	0
	Uniqueness Invariance	754.5* (142)	.980	0	0.982	.061 (.056 - .065)	0
	Educational Level Measurement Invariance	χ2(gl)	CFI	ΔCFI	TLI	RMSEA (90 C.I.)	ΔRMSEA
	Unconstrained Model	717.8* (150)	.981	-	.975	.072 (.066 -.077)	-
	Threshold Invariance	829.3* (212)	.980	.001	.981	.063 (.058 - .067)	.006
	Metric Invariance	754.5* (142)	.980	0.003	.982	.061 (.056 - .065)	.006
	Scalar Invariance	792.7* (234)	.982	0.002	.985	.057 (.053 - .061)	.004
	Uniqueness Invariance	792.7* (234)	.982	0	.985	.057 (.053 - .061)	0

Note. *p<.001

Table 3
Reliability indices of general factor of burnout and S-factors exhaustion, mental distance, emotional impairment and cognitive impairment

	BAT-23			BAT-12		
	α (95% CI)	θ (95% CI)	C.R.	α (95% CI)	θ (95% CI)	C.R.
Burnout	.94 (.94 - .95)	.94 (.94 - .95)	.94	.91 (.90 - .91)	.91 (.90 - .92)	.90
Exhaustion	.90 (.90 - .91)	.91 (.90 - .91)	.77	.86 (.85 - .87)	.86 (.85 - .87)	.90
Mental Distance	.84 (.83 - .85)	.84 (.83 - .86)	.86	.80 (.79 - .82)	.81 (.79 - .82)	.89
Cognitive Impairment	.86 (.85 - .87)	.86 (.85 - .87)	.84	.85 (.83 - .86)	.85 (.85 - .87)	.88
Emotional Impairment	.87 (.86 - .88)	.87 (.86 - .88)	.96	.87 (.86 - .88)	.87 (.86 - .88)	.86

Table 4
Relationships between burnout, job demands, job resources, work engagement and life satisfaction

	M		SD		AVE		1	2	3	4	5	6	7	8	9	10	11	12	13
	BAT-23		BAT-12		B23	B12													
1. B	2.3	.6	2.3	.7	.97	.98		.81*	.84*	.83*	.82*	.24*	.51*	.40*	-.45*	-.35*	-.37*	-.74*	-.50*
2. Ex	2.3	.8	3.3	.8	.62	.74	.90*		.53*	.57*	.55*	.40*	.51*	.39*	-.30*	-.37*	-.30*	-.51*	-.30*
3. MD	1.8	.8	2.0	.9	.67	.67	.84*	.64*		.58*	.53*	-.04	.37*	.39*	-.44*	-.34*	-.41*	-.83*	-.57*
4. EI	2.2	.8	2.3	.8	.67	.75	.83*	.65*	.59*		.59*	.18*	.40*	.26*	-.32*	-.20*	-.16*	-.54*	-.37*
5. CI	1.8	.6	1.7	.7	.65	.74	.81*	.62*	.65*	.61*		.26*	.42*	.33*	-.40*	-.30*	-.28*	-.56*	-.39*
6. WO	3.8		.8		.82	.82	.23*	.33*	-.05	.24*	.17*		.45*	.23*	-.06	-.15*	-.01	.10	.13
7. RCon	3.0		.8		.77	.77	.51*	.51*	.37*	.41*	.41*	.45*		.55*	-.35*	-.38*	-.24*	-.36*	-.15*
8. InC	2.5		.7		.76	.76	.42*	.42*	.36*	.25*	.37*	.23*	.55*		-.48*	-.61*	-.33*	-.38*	-.17*
9. RCla	4.0		.7		.87	.87	-.45*	-.37*	-.46*	-.33*	-.37*	-.06	-.35*	-.48*		.43*	.38*	.51*	.36*
10. ST	3.8		.8		.85	.85	-.35*	-.35*	-.31*	-.18*	-.31*	-.15*	-.38*	-.61*	.43*		.31*	.38*	.15*
11. JC	3.5		.7		.72	.72	-.36*	-.34*	-.43*	-.18*	-.27*	-.01	-.24*	-.33*	.38*	.31*		.45*	.34*

Table 4 (continuation)
Relationships between burnout, job demands, job resources, work engagement and life satisfaction

	M		SD		1	2	3	4	5	6	7	8	9	10	11	12	13
	BAT-23	BAT-12	B23	B12													
12.UWES	5.0	1.3	.91	.91	-.75*	-.60*	-.82*	-.57*	-.57*	.10	-.36*	-.38*	.51*	.38*	.45*		.68*
13. SWL	5.1	1.4	.91	.91	-.52*	-.41*	-.58*	-.40*	-.41*	.13	-.15*	-.17*	.36*	.15*	.34*	.68*	

Note. *$p<.01$; M=Mean, SD=Standard Deviation, AVE=Average Variance Extracted, B=Burnout, E=Exhaustion, MD=Mental Distance, CI=Cognitive Impairment, EI=Emotional Impairment, WO=Work Overload, RCon=Role Conflict, InC=Interpersonal Conflicts, RCla=Role Clarity, ST=Support of the Team, JC=Job Control, UWES=Work Engagement, SWL=Life Satisfaction. Values in square brackets indicate the 95% confidence interval for each correlation. Bottom diagonol are relations of BAT-23 with external variables. Upper diagonol are relations of BAT-12 with external variables

Discussion

The current study aimed to analyze the validity evidence of the Brazilian version of the Burnout Assessment Tool (BAT-Brazil), a new burnout measure. Our results, supporting Hypothesis 1, show that the hierarchical structure of four first order dimensions (exhaustion, mental distance, emotional impairment and cognitive impairment) that load on a second order factor that assesses burnout is the most adequate model for BAT-Brazil-23 and BAT-Brazil-12. This finding is aligned with the previous studies about BAT in different countries (De Beer et al., 2020; Mazzetti et al., 2022; Schaufeli et al., 2020; Schaufeli et al., 2019; Vinueza-Solórzano et al., 2021).

Secondly, there is evidence that BAT is a reliable scale to investigate burnout. All items of the BAT-Brazil-23 and BAT-Brazil-12 presented high factorial loadings and adequate threshold variability, even in the mental distance item that demonstrated more difficulties and need to be interpreted with parsimony. It is important to enlighten that the item 'I'm cynical about what my work means to others' of mental distance dimension (item 13 on BAT-23 and item 3 on BAT-12) showed the higher difficulty threshold, but there is evidence that mental distance is one of the core-symptoms of burnout (Schaufeli et al., 2019). In a way that high levels on mental distance may indicate that one is experiencing a process of energy wear, facing difficulties to cope with their work-related stressors and to perform their work activities. The items 'At work, I feel mentally exhausted' (item 1 on BAT-23 and BAT-12) and 'At the end of my working day, I feel mentally exhausted and drained' (item 8 on BAT-23) of exhaustion dimension showed the lower difficulty threshold. These results support that exhaustion is characterized as one of the first core-symptoms observed among professionals who develop burnout syndrome (Schaufeli et al., 2019).

Taken together, these findings indicate that both versions of the scale measure a wide range of symptoms related to the burnout syndrome, making it possible to differentiate one with low and high levels of burnout and its dimensions. Furthermore, the reliability indices of the four dimensions and the total burnout score were satisfactory. Moreover, there is evidence in the results of the invariance in gender and educational level in the Brazilian BAT assessment, supporting the second and third hypothesis of the present study, respectively.

About the nomological network of the Brazilian version of BAT-23 and BAT-12, as expected, the evidence of convergent validity showed that burnout is positively related to job demands (*Hypothesis 4*) and negatively associated to job resources (*Hypothesis 5*), work engagement (*Hypothesis 6*) and life satisfaction (*Hypothesis* 7). In addition, discriminant validity of both versions of BAT-Brazil showed identified burnout and each of its dimensions (exhaustion, mental distance, emotional impairment and cognitive impairment) as a unique construct. These findings indicate that burnout and its dimensions are associated with these variables (Schaufeli et al., 2019; Vazquez et al., 2019; Vinueza-Solórzano et al., 2021), yet they constitute distinctive constructs, supporting our fourth, fifth, sixth and seventh hypothesis, respectively.

The positive relationship between burnout levels and its dimensions with job demands contributes to the understanding that high levels of demand, such as work overload, personal conflicts, and role conflict, can have detrimental effects on professionals, leading to their illness (Schaufeli et al., 2019). On the other hand, the negative relationships between burnout and its dimensions with job resources demonstrate how these resources can act as protective factors and mitigate the development of burnout, highlighting the importance of strengthening job resources in organizations as a strategy to prevent burnout.

Furthermore, this study evidence that burnout and work engagement can be understood as opposite well-being states, as the associations of burnout and its dimensions with engagement were strongly negative (Schaufeli et al., 2019). The levels of burnout refer to a state of low energy and lack of pleasure, while engagement is characterized by high levels of energy and enjoyment in work (Engelbrecht et al., 2019; Kassandrinou et al., 2023; Schaufeli et al., 2019). In addition to the observed negative relationship between burnout, its dimensions and engagement, it was noted

that all the relationships among the variables assessed in the present study (life satisfaction, work resources and demands) showed an opposite pattern in their association with burnout and its dimensions compared to engagement, supporting the notion that these well-being states are opposed in terms of how workers relate to their work (Kassandrinou et al., 2023; Schaufeli et al., 2019; Sullivan et al., 2023).

The levels of burnout were also negatively associated to life satisfaction, suggesting its important role in the prevention of burnout, in line with findings that demonstrated high levels of life satisfaction usually are relevant dimensions in a positive manner to work satisfaction, professional career and interpersonal relations (Hutz et al., 2014). The negative relationship between burnout, its dimensions and life satisfaction highlight that work overload, excessive demands, and low levels of resources can contribute to the development of burnout among professionals, while also undermining their levels of life satisfaction (Hodkinson et al., 2022; Schaufeli et al., 2019; Vazquez et al., 2019).

Strengths and weaknesses

The main strengths of the study include the use of two independent samples to assess the adaptation of the Brazilian version of BAT-23 and BAT-12. Both samples analyzed in this study were large, involving professionals with different occupations and educational levels. The use of these samples allowed to increase the variability of the relations of professionals with their work. Furthermore, all analyses were performed with corrections for the characteristics of ordinal and non-scalar variables, increasing the robustness of the results presented.

Despite the contributions showed in the study, some limitations should be pointed out. First, the use of exclusively self-reported measures may narrow the robustness of the data, due to a common method effect. Second, the data collection at one point only does not allow us to make causal inferences and we cannot investigate in depth the relations of burnout and the external variables assessed. The third limitation of our study is the sample, that may increase the probability that individuals who experience lower levels of burnout will be more prone to voluntarily collaborate on the research. Thus, it will be relevant researches on clinical validity of BAT, with participants that are representative and include patients in different levels of burnout.

Future research should investigate the relations between burnout and its dimensions through item response theory, analyzing the stability and difficulty of items, including to test an improvement on mental distance assessing. Also, studies should explore if the best structure for burnout is the hierarchical model, in line with the conceptual definition as a syndrome (Schaufeli et al., 2020), or if burnout should be evaluated through a bifactor model, in which burnout would present a general factor and a set of dimensions that comprise the core-symptoms of burnout (Sakakibara et al., 2020). Furthermore, research should also investigate the causal relationships between burnout and its dimensions with possible antecedents (e.g., job demands and job resources) and their impact on health (e.g., depression) and organizational outcomes (e.g., performance).

Final Considerations

Burnout refers to a negative state of well-being, which potentially has a negative impact on the life of employees (e.g., depression, gastrointestinal issues, and prolonged fatigue) as well as the organization (e.g., absenteeism) (Alessandri et al., 2018; Bakusic et al., 2020; Engelbrecht et al., 2019; Vazquez et al., 2019). The present study contributes to the literature by showing that both Brazilian versions of the BAT are robust and reliable scales. Furthermore, BAT-Brazil is a viable alternative tool for the assessment and screening of burnout and its dimensions in employees with diverse characteristics (e.g., educational level and occupation). In addition, the free availability of both versions of BAT-Brazil may stimulate the development of studies to evaluate a validated a clinical cut-off and the effectiveness of interventions on occupational and work health.

The psychometric performance of BAT-12 in comparison to BAT-23 suggests that the brief version of BAT may be a best tool to assess burnout as a global measure, especially considering the goodness-of-fit indexes of the hierarchical model of burnout, and the results of the discriminant and convergent analyses. The BAT-12 may also be a preferable tool in evaluations that aim to cover additional constructs. Based on these findings, researchers assessing Brazilian professionals are encouraged to use BAT-12 as a general burnout screening tool, and BAT-23 whenever the focus is on the evaluation of the separate burnout dimensions.

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Authors' contributions

We declare that all the authors participated in the elaboration of the manuscript.

Availability of data and materials

All data and syntax generated and analyzed during this research will be treated with complete confidentiality due to the Ethics Committee for Research in Human Beings requirements. However, the dataset and syntax that support the conclusions of this article are available upon reasonable request to the principal author of the study.

Competing interests

The authors declare that there are no conflicts of interest.

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