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ORIGINAL ARTICLE

Information and communication technology demands and resources: Validity evidence of a measure

Demandas e recursos de tecnologias de informação e comunicação: evidências de validade de um instrumento

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Abstract

Background: The Demands-Resources Model in Information and Communication Technologies (ICT) suggests that technology can act as a facilitating resource or add demands, influencing occupational stress and health. **Objective**: To adapt and validate the ICT Demands and Resources Scales in the Brazilian context, exploring their psychometric properties. **Methods**: The study involved 213 Brazilian workers who used ICT in their job tasks, mostly male (64.8%), with an average age of 35.5 and higher education (92.5%). The measure was administered online, and the data were analyzed using Confirmatory Factor Analysis (CFA) and the Omega reliability coefficient. **Results**: The CFA revealed a structure similar to the original, with eight factors for the Demands Scale and two for the Resources Scale, both with satisfactory Omega coefficients and adequate fit indices. **Conclusion**: The measure shows adequate psychometric validity for investigating demands and resources in ICT work environments, offering a useful tool for managers seeking to assess and balance these aspects in the workplace, thereby helping prevent occupational stress.

Keywords: Demands; Resources; Communication and Information Technologies; Psychological Assessment; Validation.

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Resumo

Contexto: O modelo Demandas-Recursos em Tecnologias de Informação e Comunicação (TIC) propõe que a tecnologia pode atuar como recurso facilitador ou demanda adicional, influenciando o estresse e saúde ocupacional. **Objetivo**: Adaptar e validar as Escalas sobre Demandas e Recursos de TIC para o contexto brasileiro, explorando suas propriedades psicométricas. **Métodos**: Participaram 213 trabalhadores brasileiros que utilizavam TIC no desempenho laboral, a maioria do sexo masculino (64,8%) com média de idade de 35,5 anos e formação superior (92,5%). O instrumento foi administrado *online*, e os dados foram analisados através de Análise Fatorial Confirmatória (AFC) e coeficiente de fidedignidade Ômega. **Resultados**: A AFC revelou uma estrutura idêntica à original, com oito fatores para a escala de Demandas e dois para a escala de Recursos, ambos com coeficientes Ômega satisfatórios e índices de ajuste adequados. **Conclusão**: O instrumento apresenta validade psicométrica adequada para investigar demandas e recursos em ambientes de trabalho com TIC, oferecendo uma ferramenta útil para gestores que busquem avaliar e equilibrar esses aspectos no contexto laboral, prevenindo o estresse ocupacional.

Palavras-Chave: Demandas; Recursos; Tecnologias de Comunicação e Informação; Avaliação Psicológica; Validação.

Introduction

The information and communication technology (ICT) era began in the 1990s, with a gradual transformation that has significantly affected education, business, social activities, and the environment (Ahmed et al., 2021). This era is attributed to major technological progress, the growth of globalization, internet communication, and evolving norms and legislation (Ahmad, 2024). Ultimately, the ICT revolution resulted in a work environment that is increasingly digitalized and virtual (Parts, 2024).

The COVID-19 pandemic has accelerated the growth of flexible work arrangements, including teleworking and remote working, facilitated by technological advancements that have proliferated over the last decade (Hajal, 2022). This trend is seen by many individuals as a beneficial change, enabling workers to have flexible schedules and work locations, as well as providing opportunities for individuals in low-income nations, people with disabilities, and those with caregiving obligations. However, this process also leads to a substantial amount of labor force workers being assigned tasks through online platforms that utilize algorithmic design and resources to assign, monitor, and assess tasks (Rani & Furrer, 2021).

In this way, the distinctive characteristics of digital platforms impact working conditions by influencing access to tasks, remuneration, and flexible working hours (Rani & Furrer, 2021), in addition to affecting workers' mental health and well-being (Parts, 2024). However, ICT tools can enrich work experiences and positively impact workers and organizations when strategically planned and applied (Pansini et al., 2023).

Day et al. (2010) introduced the Demands-Resources model in the field of ICT, suggesting that employees view ICT as both a tool that facilitates task completion and an added workload that exacerbates work-related stress. The authors argue that ICT can impact workplace accessibility and colleague interactions; it also affects information availability; shapes interpersonal communication; serves as a means for tracking employee performance and providing feedback; and influences control

over work-life balance. Furthermore, the authors have also pinpointed frequent issues associated with ICT, which include system malfunctions, the implementation of conflicting technologies, heightened demands, and the continuous necessity to upgrade one's professional skills.

Work demands are characterized by the physical and mental exertion they entail, resulting in both physiological and psychological consequences. In contrast, job resources encompass the positive aspects of work that can aid in achieving work objectives, decrease the physical and mental costs linked to work requirements, and foster individual growth and advancement (Bakker et al., 2023; Demerouti et al., 2001). Day et al. (2010) identified eight distinct ICT-related demands: 1) the frequency at which employees encounter issues with ICT functionality; 2) the amount of data that ICT provides; 3) the expanded availability of employees for work outside regular office hours; 4) work overload; 5) employees' limited control over ICT usage; 6) the necessity for employees to learn and become proficient in new ICT skills; 7) ICT's impact on communication among colleagues; and 8) the use of ICT to monitor employees. The authors also emphasize two fundamental resources: 1) personal assistance and resource support and 2) ICT updates.

Recognizing the job demands and resources involved makes examining their effects on workers' occupational well-being essential. Research has found that job demands are the primary predictors of burnout and psychosomatic health issues (Bakker et al., 2003; Hakanen et al., 2006). According to research, demands can hinder an organization's efficiency (Stich et al., 2015), negatively impact workers' occupational well-being (Day et al., 2012; Pansini et al., 2023), and lead to technostress (Salanova et al., 2012; Stadin et al., 2021; Vieira & Carlotto, 2021).

Furthermore, ICT demands have been linked to heightened workload strain, stress, and emotional exhaustion, even when accounting for demographic data, work conditions, and other job demands. In contrast, both types of ICT resources were associated with lower stress, strain, and burnout levels. Resource/update support moderated the relationship between learning expectations and most strain indicators. Similarly, technical support moderated the relationship between ICT problems and strain (Day et al., 2012). In general, resources are predictors of job satisfaction, motivation, and engagement (Bakker et al., 2023; Bakker et al., 2010) and act as mediators between technological demands and stressors (Day et al., 2012).

Although the use of ICT in the workplace is growing, few studies have explored how these technologies influence workers' well-being, likely because of the scarcity of validated instruments to assess the factors involved in their use. To address this gap, Day et al. (2012) developed and validated the ICT Demands and Support Scales, designed to assess specific demands and resources for ICT workers. Two theoretical models—the Demands-Resources at Work (Demerouti et al., 2001) and the Conservation of Resources (Hobfoll, 1989)—were the foundation for this instrument. It consists of two scales: the ICT Demands Scale, which encompasses the subscales of Availability, Communication, Control, Difficulties, Monitoring, Learning, Response Expectations, and Workload, and the ICT Resources Scale, which includes the subscales of Resource Support/Updates

and Technical Support. Exploratory factor analysis was used to identify the underlying factors for the first validation. This analysis was followed by structural equation modeling to confirm the proposed structure. Reliability coefficients were greater than .70 in all subscales (Day et al., 2012). A comprehensive search of the Virtual Health Library, Pepsic, Pubmed, and Scielo databases uncovered a shortage of tailored tools to measure ICT demands and resources in Brazil. Terms such as "ICT demands" and "ICT resources" were used, focusing on articles published within the last 20 years and written in Portuguese, English, or Spanish as the basis for inclusion. Thus, this study sought to adapt and assess the validity of the Information and Communication Technology Demands and Resources Scales (ICT-DR Scales) for use with Brazilian workers engaged in professional ICT activities.

Method

Participants

The sample comprised 213 non-random employees, all experienced in using ICT in their job tasks. The majority were men (n = 138; 64.8%), had a long-term partner (n = 109; 51.2%), and were childless (n = 117; 54.9%). Participants' ages ranged from 18 to 65 years (M = 35.53; SD = 9.42). Nearly all participants had higher education (n = 197; 92.5%). Most participants held technical roles (n =101; 47.4%), followed by systems and data analysts (n = 65; 30.5%) and management positions (n = 47; 22.1%). The duration of employment in the current workplace ranged from 1 to 35 years (M = 6.68; DP = 6.49). Daily ICT use at work ranged between 1 and 14 hours (M = 7.60; DP =2.24). Most employees (n = 152; 71.4%) worked morning and afternoon shifts, and 79.3% of the sample ((n = 169) used their smartphones during working hours.

Instruments

Sociodemographic Questionnaire

A questionnaire was developed to gather sociodemographic and employment information. The variables encompassed gender, marital status, age, the number of children, and education level. Employment data examined included job title, salary, length of service at the current institution, type of ICT equipment utilized at work (such as a smartphone, notebook, tablet, and computer), and daily working hours using ICTs.

Information and Communication Technologies—Demands and Resources Scales (ICT-DRs)

Day et al. (2012) developed the ICT-DRs, which comprise 35 items distributed across two scales: the ICT Demands scale, which has eight factors and 27 items, and the ICT Support/Resources scale, which includes two factors and eight items. The Demands scale assesses eight factors associated with the requirements for ICT use in the workplace. The Availability factor (five items; α = .71) measures the expectation that workers will be continuously accessible, usually through devices such as smartphones. Poor Communication (three items; α = .76) assesses problems of interpretation in

messages sent via ICT, such as misunderstandings in emails. The Lack of Control factor (three items; α = .76) reflects the perception of limited autonomy in using ICT, such as the feeling that the worker does not control how and when they use the technology at work. Response Expectations (two items; α = .76) assesses the perceived pressure to respond immediately to messages due to the constant accessibility provided by ICT. The Hassles factor (five items; α = .70) examines frustration arising from recurring technical problems, such as system failures. Employee Monitoring (four items; α = .79) captures the perception of surveillance, considering the organization's use of ICT to monitor and evaluate performance. Learning Expectations (three items; α = .73) assesses the continuous requirement for updating technological skills to keep up with changes in ICT, while Workload (three items; α = .73) measures the perception of increased tasks and responsibilities due to ICT use. The Resources scale measures the support available for ICT use, divided into two factors: Personal Assistance (four items, α = .86), which assesses the support offered for technological updates, and Technological Resources (four items, α = .87), which measures the availability of technical support. All items are assessed on a five-point frequency scale, ranging from zero (*never*) to four (*almost always*).

Technostress Scale (RED/TIC)

The RED/TIC, developed by Salanova et al. (2007) and adapted for Brazil by Carlotto e Câmara (2010), incorporates two specific subscales of technostress: Fatigue and Anxiety. The Fatigue subscale (four items, α = .89; in this study, α = .93) measures exhaustion resulting from the use of ICT, while the Anxiety subscale (four items, α = .77; in this study, α = .81) assesses feelings of tension and discomfort when working with technologies. All RED-TIC items were evaluated on a seven-point scale, ranging from zero (*never*) to six (*daily*), with higher means indicating greater fatigue and anxiety levels.

Data Collection Procedures

The researcher and the Occupational Health Psychology research group members distributed an electronic form to participants via social media platforms and institutional emails. Data were collected between March and June 2019 using Google Forms, which included the research instruments and the Free and Informed Consent Form (FICF). Participants gained access to the instruments after agreeing to the FICF. The Universidade do Vale do Rio dos Sinos Research Ethics Committee approved the study (CAAE approval number: 03794918.0.0000.5344).

Adaptation Procedures and Content Validity Assessment

The adaptation of the ICT-DR Scales to the Brazilian context followed the guidelines of the International Test Commission (2017). Four translators fluent in English and Brazilian Portuguese performed the translation and back-translation processes after receiving authorization from the original scale's authors. Two psychologists specializing in organizational and work psychology independently analyzed and compared the items in the adapted version, which the translators

validated. Hernández-Nieto (2002) proposed the Content Validity Coefficient (CVC) to measure the content validity of the items. The categories of analysis included understanding the language, along with practical and theoretical relevance (Cassep-Borges et al., 2010). Each item was rated on a five-point Likert scale ranging from 1 (*very little*) to 5 (*very much*). As a criterion, CVC values above .80 were considered indicative of satisfactory validity (Cassep-Borges et al., 2010). Four staff members who employed ICT in their job tasks evaluated the semantic equivalence of the final version in Brazilian Portuguese. This procedure aimed to guarantee that the items were pertinent to the Brazilian context and comprehensible to the respondents. The ultimate goal was to achieve a definitive, consistent version of the ICT-DR Scales, which would then enable the examination of the instrument's internal structure.

Data Analysis Procedures

The analyses were performed using JASP software (version 0.19), except for Confirmatory Factor Analysis (CFA), which was conducted using R software (version 4.2.1) with the lavaan package (Rosseel, 2012) and the WLSMV estimator (Asparouhov & Muthén, 2010).

Initially, exploratory analyses were conducted to evaluate scale dimensionality and factor structure. Specifically, Minimum Rank Factor Analysis (MRFA) with orthogonal rotation was adopted, considering the ICT-DR Scales response system (Day et al., 2012; Timmerman & Lorenzo-Seva, 2011). We applied the Kaiser-Meyer-Olkin (KMO) and Bartlett goodness-of-fit tests to verify the quality of the data for factor analysis.

Considering the independence between the Demands and Resources scales, two CFAs were performed: one to evaluate the factors of the Demands scale and another to evaluate the factors of the Resources scale. Model fit was assessed using the χ^2/df index, Root Mean Squared Error of Approximation (RMSEA), Comparative Fit Index (CFI), and Tucker-Lewis Index (TLI), following reference values for adequate fit (RMSEA < .08, preferably < .06; CFI and TLI > .90, preferably > .95; Hu & Bentler, 1999).

We calculated the internal consistency of the scale factors using Cronbach's alpha and McDonald's omega, with values above .70 indicating adequacy (Cronbach, 1951).

A Pearson correlation analysis was conducted between the factors of the ICT Demands and Resources scales and the Fatigue and Anxiety dimensions of the RED/TIC (Salanova et al., 2007), which had been translated and adapted for Brazil by Carlotto e Câmara (2010). This assessment aimed to evaluate the convergent validity of the ICT-DR Scales.

The skewness and kurtosis values of the items indicated an approximately normal distribution, within the acceptable range of -3 and +3 for skewness and -7 and +7 for kurtosis (Marôco, 2014). Skewness values ranged from -0.08 to 1.02, and kurtosis values from -0.28 to 2.16.

Results

Evidence of Content Validity and Semantic Equivalence

The CVC values were deemed acceptable (CVC > .80; Cassep-Borges et al., 2010). More specifically, values were .95 for language, .97 for practical relevance, .97 for theoretical relevance, and an overall CVC of .96. Workers who used ICT demonstrated a good understanding of the items during the semantic equivalency assessment, indicating that the final version of the ICT-DR was adequate for subsequent analyses.

Factor Structure, Dimensionality, and Reliability

Parallel analyses based on MRFA supported the dimensionality and factorability of the ICT-DR. The results showed an eight-factor structure consistent with the original version of the instrument and accounted for 71% of the total variance. The KMO (.79) and Bartlett tests ($\chi^2_{(595)} = 3860.27$; $p < .001$) confirmed the adequacy of the data for factor analysis. Table 1 presents the fit indices of the final model for the Demands and Resources scales. Both models demonstrated satisfactory fits, suggesting that the proposed theoretical structures were replicated in this study's sample. Although the RMSEA results were within a reasonable range, it is important to acknowledge that this measure can be influenced by sample size and degrees of freedom, resulting in values slightly exceeding the recommended thresholds.

Table 1

Fit Indices of the ICT-DR Models

Model/Scale	χ^2/df	RMSEA	CFI	TLI
Demands	2.16	.07	.91	.90
Resources	2.78	.09	.99	.99

Note. ICT-DRs = Information and Communication Technologies—Demands and Resources Scale; χ^2/df = chi-square/degrees of freedom; RMSEA = Root Mean Square Error of Approximation; CFI = Comparative Fit Index; TLI = Tucker-Lewis Index.

Table 2 presents the CFA factor loadings for the Demands Scale factors and their respective internal consistency indices. The CFA revealed that all items had adequate factor loadings (> .30), indicating strong alignment with the theoretical factors. The internal consistency indices, calculated using Cronbach's alpha and McDonald's Omega coefficients, were satisfactory, except for the Lack of Control factor, which exhibited a value slightly below the recommended threshold (> .70). Hair et al. (2014) stated that coefficients ranging from .60 to .70 are acceptable in contexts where construct validity where the theoretical model confirms construct validity. Items 4 and 10 were considered to assess the internal consistency of factors displaying cross-loadings.

Table 2

Factor Loadings and Internal Consistency of the ICT-DR Demand Scale Factors

Item	HA	RE	RA	WO	LC	LE	MO	PC
1		.70						
2		.95						
3			.86					
4			.63					
5			.84					
6			.72					
7								.79
8								.81
9								.90
10					.51			
11					.74			
12					.70			
13	.65							
14	.82							
15	.87							
16	.83							
17	.53							
18							.75	
19							.85	
20							.90	
21							.85	
22						.72		
23						.71		
24						.74		
25				.62				
26				.85				
27				.92				
McDonald's Omega	.78	.74	.80	.80	.64	.71	.85	.82
Cronbach's Alpha	.79	.75	.80	.79	.63	.72	.85	.81

Note. ICT-DRs = Information and Communication Technologies—Demands and Resources Scale; HA = Hassles; RE = Response Expectations; RA = Response Availability; WO = Work Overload; LC = Lack of Control; LE = Learning Expectation; MO = Monitoring; PC = Poor Communication.

Table 3 presents the CFA factor loadings for the dimensions of the Resources Scale and their internal consistency indices. As with the Demands Scale, all items exhibited adequate factor loadings (> .30). Cronbach's alpha and McDonald's Omega coefficients were excellent (> .80), indicating high internal consistency.

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Table 3

Factor Loadings and Internal Consistency for the ICT-DR Resources Scale

Items	TR	PA
1	.68	
2	.86	
3	.95	
4	.86	
5		.82
6		.95
7		.94
8		.81
McDonald's Omega	.88	.91
Cronbach's Alpha	.88	.90

Note. ICT-DR = Information and Communication Technologies—Demands and Resources Scale; TR = Technological Resources; PA = Personal Assistance.

Convergent Validity

The correlations between the factors of the ICT-DR and RED/TIC scales, along with the descriptive statistics for these factors, are shown in Table 4. The analyses revealed that the ICT-DR demonstrated convergent validity, indicating substantial correlations between the Demands subscales and the Fatigue and Anxiety factors. The Resources subscales showed negative correlations with these same factors, suggesting that the resources assessed may be linked to lower levels of technostress.

Table 4

Correlations between ICT-DR and RED/TIC Factors

Factors	*M* (*SD*)	HA	RE	RA	WO	LC	LE	MO	PC	TR	PA	FA	AN
HA	1.30 (0.86)	—											
RE	2.54 (1.10)	.17**	—										
RA	2.71 (0.96)	.17**	.60***	—									
WO	2.17 (1.19)	.24**	.38***	.53***	—								
LC	2.55 (1.00)	.02	.07	.14	.02	—							
LE	2.66 (0.96)	.17**	.23**	.24**	.39***	.05	—						
MO	1.56 (1.29)	.33***	.17**	.13	.25**	-.13	.22**	—					
PC	0.75 (0.84)	.33***	.25**	.14	.19**	-.02	.16	.09	—				
RTC	2.30 (1.03)	-.15**	-.08	-.09	.06	.09	.22**	.20**	.06	—			
ASP	2.49 (1.09)	-.18**	-.14**	-.05	.23**	.03	.46***	.03	.06	.09	—		
FA	2.49 (1.67)	.16**	.24**	.19**	.38***	.25**	.25**	.14**	.15**	-.15**	-.18**	—	
AN	1.64 (1.36)	.24**	.25**	.23**	.36***	.18**	.08	.14**	.22**	-.08	-.14**	.65***	—

Nota. ICT-DRs = Information and Communication Technologies—Demands and Resources Scale; RED/TIC = Technostress Scale; HA = Hassle; RE = Response Expectations; RA = Response Availability; WO = Work Overload; LC = Lack of Control; LE = Learning Expectations; MO = Monitoring; PC = Poor Communication; TR = Technological Resources; PA = Personal Assistance; FA = Fatigue; AN = Anxiety.

** $p < .01$. *** $p < .001$.

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Discussion

The primary aim of this study was to examine the factorial structure and psychometric properties of the ICT-DR in a sample of ICT workers. We confirmed that the instrument effectively identifies specific ICT-related workplace demands and available resources. The validation of this instrument is particularly important given the increasing adoption of ICTs, ensuring a reliable tool for the Brazilian context and facilitating research on the impact of ICTs in the workplace. The findings provided strong evidence for the validity and reliability of the ICT-DR.

Content Validity and Semantic Coherence

Analyses of the ICT-DR's content validity and semantic equivalence indicated that the items were highly appropriate regarding language, practical relevance, and theoretical relevance (Cassep-Borges et al., 2010). It can be inferred that the items appropriately contribute to the construct's definition, as they are logically structured. Thus, the theoretical soundness of the instrument for assessing the ICT Demands-Resources model is confirmed. Participants' consistent understanding of the items reinforced the adequacy of the ICT-DR's final version for the Brazilian context.

Factor Structure

The study successfully replicated the theoretical model proposed by Day et al. (2010) by obtaining adequate fit indices and appropriate factor loadings for the items within their respective factors. Confirming the original factor structure provides evidence of the model's stability and applicability to the Brazilian context, representing a significant milestone in validating instruments for ICT workers. The eight-factor structure for Demands and the two-factor structure for Resources adequately represents the distinction between the characteristics assessed. The study's findings align with the Job Demands-Resources theory, which posits that demands related to ICT use can lead to occupational stress, whereas available resources can buffer these effects (Bakker et al., 2023; Demerouti et al., 2001). The independence of the factors reinforces the instrument's ability to accurately capture the specific characteristics of demands and resources in the ICT work environment.

Reliability

The subscales showed satisfactory internal consistency, with Cronbach's alpha and McDonald's omega coefficients exceeding .70 for most factors, except for the Lack of Control factor, which slightly fell below this benchmark. However, in contexts where construct validity is theoretically supported, consistency values between .60 and .70 may be acceptable (Hair et al., 2014). These findings suggest that the ICT-DR demonstrates adequate psychometric reliability, as established by Dunn et al. (2014) and Tabachnick & Fidell (2012), reinforcing its suitability for studies examining the effects of ICT in the workplace.

Convergent Validity

The correlations between the ICT-DR factors and the Fatigue and Anxiety dimensions of the RED/TIC indicate patterns consistent with the Job Demands-Resources model, reinforcing the instrument's

convergent validity. Significant associations were observed between demand factors—including Hassles, Response Expectations and Availability, Work Overload, Lack of Control, Learning, Monitoring, and Communication Failures—and the Fatigue and Anxiety dimensions of the RED/TIC, suggesting that these elements of the digital work environment are related to heightened stress and emotional exhaustion (Bakker et al., 2010; Carlotto & Câmara, 2010).

Work overload showed the strongest correlation with Fatigue and Anxiety, suggesting that excessive demands in the digital work environment are linked to heightened symptoms of technostress, a finding supported by previous studies (Carlotto & Câmara, 2010; Kupang et al., 2024; Salanova et al., 2012; Stadin et al., 2021; Yikilmaz et al., 2024).

Further correlations were observed between Response Expectations and Communication Failures and the Fatigue and Anxiety dimensions, suggesting that the pressure to remain constantly available and difficulties in effectively communicating via ICT may contribute to increased stress and emotional exhaustion among workers. The importance of improving communication and reducing excessive response expectations has been highlighted in the literature as a strategy for mitigating technostress (Rahman & Singh, 2024; Stadin et al., 2021).

Other demand-related factors, such as Lack of Control, were also correlated with Fatigue and Anxiety, suggesting that difficulties in managing or regulating technology use may contribute to heightened technostress. These findings highlight the relevance of interventions designed to enhance technological resources and personal support, which may help alleviate stress in digital work environments while fostering greater autonomy and control over tasks (Bakker et al., 2010; Rahman & Singh, 2024; Wang & Kong, 2023).

Moreover, the Learning factor showed significant correlations with Resources, including Personal Assistance and Technological Resources, suggesting that, in ICT environments, opportunities to acquire new skills and technological expertise are also linked to the availability of resources in digital work settings. This finding emphasizes the need to balance learning demands with sufficient support to mitigate fatigue and anxiety (Mahapatra & Pati, 2018). Access to technological resources and support can facilitate workers' adaptation to evolving demands and lessen the impact of learning requirements on well-being.

The analysis revealed weak negative correlations between Resource factors and Fatigue and Anxiety, indicating that these resources may serve a protective function in alleviating technostress symptoms. Personal Assistance exhibited a negative correlation with both Fatigue and Anxiety, suggesting that adequate technical support may enable workers to manage technological demands better, enhance well-being, and mitigate the effects of occupational stress (Bakker et al., 2010; Day et al., 2012; Kumar, 2024; Scholze & Hecker, 2024). Technological Resources also showed a significant negative correlation with Fatigue but a non-significant association with Anxiety, which suggests that workplace technological resources may help reduce exhaustion caused by ICT use but do not directly impact workers' anxiety. This finding reinforces the need to expand technological support infrastructure to prevent burnout among professionals in digital work environments (Kupang et al., 2024).

These findings confirm the reliability of the ICT-DR in assessing both demands and resources in ICT environments. Additionally, this study highlights the benefits of identifying specific stressors and supportive resources in digital work environments.

Limitations

One notable limitation of this study is the participants' educational background, which is predominantly composed of professionals with higher education or postgraduate qualifications. This sample profile may reflect specific characteristics of ICT professionals, such as analysts and managers, thereby limiting the generalizability of the findings to workers with lower educational levels or different occupational roles. Future research should include more diverse and representative samples, encompassing workers with varying academic backgrounds and occupations, such as professionals in digital platforms and application-based sectors, to gain a broader understanding of ICT demands and resources.

Another limitation concerns data collection, which relies exclusively on the Google Forms platform. Although this approach facilitated participant recruitment, it also posed challenges, including difficulties verifying response authenticity and preventing duplicate submissions, which may have compromised data integrity. To mitigate these limitations, future studies should consider utilizing data collection platforms that provide enhanced security and control, such as those that implement single authentication and block duplicate responses. Furthermore, survey tools integrating advanced security features, such as data encryption and IP tracking, can ensure a more controlled and secure response environment. Alternatively, offline tools such as KoboToolbox may offer a viable solution for ensuring consistent and secure data collection.

In addition, self-report measures may introduce social desirability and self-awareness biases, potentially affecting participants' responses regarding perceived demands and resources. Future research should, whenever feasible, incorporate additional assessment methods, such as observations or reports from peers and supervisors, to obtain a more objective perspective and reduce potential reporting biases.

Practical Implications

The ICT-DR Scales serve as a valuable tool for managers to monitor the balance between demands and resources in ICT work, facilitating interventions to promote occupational health and reduce technostress. Evaluating these factors is crucial for reducing the risk of burnout and improving workers' well-being, particularly in environments where ICT is pervasive and connectivity expectations are high.

Conclusion

The findings of this study show that ICT-DR Scales possess appropriate psychometric properties, establishing their reliability as an instrument for assessing demands and resources in ICT work within the Brazilian context. The ICT-DR's factor structure, internal consistency, and convergent validity confirm its suitability for future research on technostress and well-being among ICT workers.

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