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Translation, validation and psychometric properties of Effort-Reward Imbalance questionnaire among nurses in Vietnam

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ABSTRACT

We translated the Effort-Reward imbalance questionnaire, an instrument for measuring work stress, into the Vietnamese language and investigated its psychometric properties among nurses in Vietnam. In a hospital-based cross-sectional study design, we sampled and interviewed 207 nurses working full-time (response rate 83%). We evaluated the internal consistency using standardized Cronbach's alpha coefficients and structural validity using confirmatory factor analysis. Discriminative validity was assessed by comparing the measured scores between age groups, gender, education levels, income groups, and job positions. In addition, we confirmed the criterion validity by investigating its association with self-reported health using simple and multiple logistic regression models. Most of the participants were female (73.3%), young (average 28.5 years old), and had education levels of college or higher (53.5%). We observed sufficient internal consistency in effort, reward, and over-commitment scales (Cronbach's alpha 0.80, 0.76, and 0.68, respectively). Confirmatory factor analysis of the three-factor hierarchical model showed an acceptable fit and fair construct validity with most moderate or stronger (>0.3) factor loading coefficients. Poor self-rated health was more likely in respondents in both Effort-Reward ratio's middle tertile (adjusted Odd-Ratio = 2.80, p-value = 0.031) and highest tertile (adjusted Odd-Ratio = 2.64, p-value = 0.05), adjusting for age, gender, and education levels. The Effort-reward imbalance scale has adequate reliability and validity for assessing work stress among nurses in Vietnam. Its significant association with poor self-rated health warrants further investigation. The validated instrument can help measure the effort-reward imbalance to manage better work-related emotional strains and mental health issues among nurses and ensure human resources' stability in healthcare in Vietnam.

1. Background

Nurses and midwives represent half of the global healthcare workforce, are critical in the success of healthcare systems in health promotion and disease prevention, and play a vital role in achieving health equity (WHO, 2016a). Specifically, during pandemics and epidemics, nurse workforces are at the front line in providing treatment and care, relieving suffering, and saving lives (American Nurses Association (ANA), 2020; WHO, 2016a). However, the World Health Organization (WHO) estimated a global shortage of 18 million healthcare workers and 9 million nurses below the number required to ensure Universal Health Coverage and Sustainable Development Goals in 2030 (WHO, 2016b). Heavy workloads and emotional strains significantly contribute to the low job satisfaction and retention rate among nurses, which are critical issues for maintaining and growing the healthcare workforce (WHO, 2020). Recent studies reported the escalation of mental health issues

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(burnout, fatigue, depression, anxiety, and distress) among healthcare providers due to COVID-19 (De Kock et al., 2021; Pappa et al., 2020) and identified the importance of work stress management among nurses in ensuring progress toward the global target of health for all (Gilmour et al., 2020). Measuring work stress and burnout is thus crucial to properly monitoring and maintaining healthcare workforces.

Among the recent theoretical models of psychosocial work characteristics, the Effort-Reward Imbalance (ERI) questionnaire model is widely used in many studies on work stress and health status among healthcare and nursing professionals (Nguyen Van et al., 2018). The WHO has recognized the significant contribution of high demand, low control, effort-reward imbalance at work to several mental and physical health problems, and barriers to achieving health equity at the workplace (WHO, 2008). The theoretical model of ERI has defined the psychosocial work environment into three main components: efforts, rewards (the situational/structural factors), and over-commitment (personal factors) (Siegrist, 1996). It hypothesized that the imbalance between high effort and low reward (Effort-Reward ratio $>$ 1) could create emotional distress related to adverse health outcomes (Siegrist et al., 2004). On the other hand, over-commitment is a personal trait that might impact the association between job stress and stress-related outcomes among individuals. Specifically, individuals characterized with a high level of over-commitment tend to have an extreme demand for control and esteem at work, overestimate their potentials and expected rewards, and thus are at increased risk of experiencing frustration and exhaustion in the long run (Siegrist et al., 2004). Hence, although the ERI model expected that high Effort-Reward ratio would increase the risk of poor health, the risk would even be higher if over-commitment was simultaneously in higher levels. In contrast, the risk might be moderated or lower among those characterized with lower levels of over-commitment. (Siegrist, 2002). This widely-validated instrument showed strong predictability of psychological risks and significant associations with low retention rate, poor physical and psychological health and self-rated health among nurses, and low quality of care and treatment outcomes among patients (Darboe et al., 2016; Li et al., 2013; Nguyen Van et al., 2018; Padilla Fortunatti and Palmeiro-Silva, 2017).

Vietnam, a low- and middle-income country, also faces a shortage in both the quality and quantity of human resources in healthcare (Nguyen et al., 2015; H. Van Nguyen et al., 2021a). Recent reports showed mental health problems among frontline healthcare workers during the COVID-19 response (Nguyen et al., 2021d; PTL et al., 2021; Than et al., 2020), suggesting the need to improve Vietnam's occupational health conditions. In the Vietnamese healthcare system's specific context with limited resources (Le et al., 2021; P. T. Nguyen et al., 2021c; H. Van Nguyen et al., 2020a), the assessment and control of psychosocial risks are required for protecting staff and maintaining a stable workforce in healthcare. However, there is currently no validated Effort-Reward Imbalance questionnaire for measuring and coping with work stress among Vietnamese healthcare professionals. Given this need, we conducted this study to translate the Effort-Reward Imbalance questionnaire into the Vietnamese language and investigate its internal consistency and psychometric properties. We also evaluated this instrument's factor structure and its association with self-rated health status among the nursing workforce in Vietnam.

2. Methods

2.1. Study design and sample

We conducted a cross-sectional study at a top-public-university hospital in Vietnam, which contained 350 beds and 600 staff and was funded and managed by the central government. We collected a convenience sample of all official nurses working full-time in this hospital during the study period (Oct 2015 to Feb 2016). The response rate was 83% (172/207). Our sample size is considered appropriate for factor analysis according to the rule of thumb of a minimum of five observations per item (Osborne and Costello, 2004).

2.2. Translation

We used the original version of the 22-item Effort-Reward Imbalance (ERI) questionnaire to measure participants' psychosocial work environment (Siegrist et al., 2014). The English version of the ERI questionnaire was forward translated into Vietnamese by two independent translators and reconciled by a third reviewer. After the necessary changes were incorporated into the Vietnamese version, two other translators translated it back into English to ascertain the translation's accuracy. The final version was then produced after all items were rechecked by the researchers (Appendix Table A1).

2.3. Measurement

The 22-item ERI questionnaire used a four-point response scale with no substantial differences in psychometric analyses with a five-point scale but ensuring substantially higher response rates (Msaouel et al., 2012; Siegrist et al., 2009; Tsutsumi et al., 2008). Specifically, the scale ranges from 1 (strongly disagree) to 4 (strongly agree) to measure "extrinsic effort" (6 items), "reward" (10 items), and over-commitment (6 items). Consequently, with such scoring, the effort and over-commitment scales range from 6 to 24, and the reward ranges from 10 to 40. The Effort-Reward ratio was calculated to detect the degree of mismatch between effort and reward, as the ratio of sum scores for efforts and rewards (Siegrist et al., 2014). The formula is as follows:

$$\boldsymbol{Effort-Rewardratio} = \frac{\boldsymbol{E}}{\boldsymbol{R^{*}k}}$$

Where E and R are the values of the sum scores for effort and reward items, respectively. The correction factor k = 0.6 is applied to adjust for the unequal items of the effort (6 items) and reward scales (10 items). In interpretation, an Effort-Reward ratio $>$ 1 means the person reports more efforts for each reward, indicating exposure to Effort-Reward imbalance at work (Siegrist et al., 2014). We then defined the upper tertile scores of the Effort-Reward ratio as a higher risk of ERI at work, which may increase other psychosocial risks (Msaouel et al., 2012).

We measured the self-rated health of participants by using the WHO's single-item measure "In general, how would you rate your health today", with five response options of "very good (1), good (2), moderate (3), bad (4) and very bad (5)" (World Health Organization, 2002). Similar to previous works, we then analyzed poor self-rated health as a dichotomous variable with "moderate, bad or very bad" were coded as 1 and "good or very good" was coded as 0 (Darboe et al., 2016; Subramanian et al., 2010).

2.4. Statistical analysis

We evaluated the internal consistency of the Vietnamese ERI scale by examining the standardized Cronbach's alpha coefficient, Guttman's lambda 6, and the corrected item-total correlations. Values $>$0.7 in Cronbach's alpha and $>$0.3 in corrected item-total correlations were considered appropriate (Taber, 2018). Next, we used the Pearson correlation matrix, which is appropriate for a large sample ($>$100), to examine the magnitude of a correlation between all items. The Pearson correlation coefficient ranges [-1, 1], and an absolute value $>$0.3 could be a good candidate for factor analysis (Lee Rodgers and Alan Nice Wander, 1988). Then, we evaluated the appropriateness of factor analysis by Bartlett's test of sphericity with a p-value $<$0.05. We then applied the Kaiser-Meyer-Olkin measure of sampling adequacy for factor analysis with values $>$0.7.

We applied confirmatory factor analysis (CFA) to establish the structural validity of the three-factor and five-factor with unidimensional and hierarchical structures of the ERI model as suggested by the

original theories and previous studies (Li et al., 2017; H. Van Nguyen et al., 2020b; Siegrist et al., 2014). We evaluated the goodness of fit based on multiple indices, including Chi-square for the overall model, Comparative Fit Index (CFI), Root mean square error of approximation (RMSEA), Standardized root mean square residual (SRMR), Goodness of fit index (GFI), and Bayesian information criterion (BIC). We assessed the discriminative validity using Kruskal-Wallis analysis of variance (for more than two categorical variables) and the Mann-Whitney *U* test (for binomial variables) to compare the Effort-Reward Imbalance scales between age groups, gender, education levels, income groups, and job positions. As previous works confirmed the association between ERI and poor self-rated health (Darboe et al., 2016; Weyers et al., 2006), we evaluated one aspect of criterion validity of the ERI instrument by assuming that Vietnamese nurses who had higher scores in theoretically critical summary measures (ERI ratio) would be at higher risk of having poor self-rated health. Specifically, we used simple and multiple logistic regression models to estimate the unadjusted and adjusted odd-ratios (for gender, age, and education levels) of being poor self-rated health for effort, reward, and overcommitment scores, and Effort-Reward ratio (Li et al., 2005; Msaouel et al., 2012).

2.5. Ethical statemen

The study protocol was approved by the Scientific Panel of the Institute for Preventive Medicine and Public Health, Hanoi Medical University, according to Decision No. 61/QD-YHDP&YTCC dated 16/06/2015. Participants provided verbal consent in addition to information on the voluntary nature of involvement, right to opt-out, data confidentiality, study objectives, and procedures. We confirmed that no identifying information was collected.

3. Results

3.1. Socio-demographic characteristics

Table 1 shows the socio-demographic information of study participants. The majority of the participants were female (73.3%), young (average age of 28.5 years old), and unmarried (72.1%). Regarding socio-economic characteristics, the subjects mostly worked in the clinical field (70.0%), have education levels of college or higher (53.5%), and have median and first and third quartiles [Q1, Q3] of monthly income as 523.8 [464.3, 631.0] US dollars. Furthermore, we observed the median of 5.0 [3.0, 7.0] years of working time at the hospital, with 52.0 [48.0, 60.0] working hours per week and 12 [8.0, 20.0] hours over the regulated time at work. We estimated that the median Effort-Reward ratio was 1.1 [1.0, 1.2], and approximately 76% of participants reported an imbalance of effort and reward at work (Table 1).

Table 1
General characteristics of study participants.

Characteristics	N = 172
Age (years), Median [Q1, Q3]	28.0 [26.0, 31.0]
Gender, n (%)	
Male	46 (26.7%)
Female	126 (73.3%)
Married status, n (%)	
Married	48 (27.9%)
Not married	124 (72.1%)
Education levels, n (%)	
Intermediate	80 (46.5%)
College	32 (18.6%)
University	60 (34.9%)
Income (US Dollars/month), Median [Q1, Q3]	523.8 [464.3, 631.0]
Position, n (%)	
Manager	15 (8.8%)
Clinician	119 (70.0%)
Other	36 (21.2%)
Years of employment (years), Median [Q1, Q3]	5.0 [3.0, 7.0]
Working hours (hours/week), Median [Q1, Q3]	52.0 [48.0, 60.0]
Overtime work (hours/week), Median [Q1, Q3]	12.0 [8.0, 20.0]
Effort-reward ratio, Mean ± SD [Min, Max]	1.1 ± 0.1 [0.7, 1.6]
Imbalance of effort-reward	
Yes	131 (76.2%)
No	41 (23.8%)

Notes: Q1 and Q3 are the 25th and 75th percentiles; n = number of observations, %=Percentage; SD = Standard deviation.

3.2. Internal consistency

The questionnaire's characteristics with means and standard deviation of the scores, corrected item-total correlation, standardized Cronbach's alpha, and Guttman's lambda are in Table 2. We observed the sufficiency of internal consistency in all Effort-Reward Imbalance scales with a Cronbach's Alpha of 0.80, 0.76, and 0.68 and the Guttman's Lambda 6 of 0.79, 0.79, and 0.67 for effort, reward, and over-commitment, respectively. In addition, the values above 0.3 of corrected item-total correlation coefficients among all Effort-Reward Imbalance scales indicated that each item correlates well with the corresponding scale overall, thus confirming acceptable consistency (Table 2).

3.3. Structural validity

The correlation matrix of the 22-item Effort-Reward Imbalance questionnaire is in Appendix Table A2. We observed relatively high correlations among the Effort-Reward Imbalance items suggesting those items are eligible for factor analysis. Bartlett's test of sphericity with a p-value < 0.001 indicates a significant difference between the correlation matrix and identity matrix. The Kaiser-Meyer-Olkin measure of sampling adequacy with an overall value of 0.78 confirmed the Vietnamese Effort-Reward Imbalance items' factorability (Appendix Fig. A1).

Table 3 presents the comparison of fit indices between several proposed theoretical models of ERI. The three-factor hierarchical model of ERI is the most appropriate structure with the smallest value of the Bayesian information criterion (BIC). Additionally, the Comparative Fit Index (CFI) of 0.86, Goodness of fit index (GFI) of 0.88, and Root mean square error of approximation (RMSEA) of 0.06 indicate an acceptable fit of this model. Fig. 1 shows the factorial structure of Vietnamese Effort-Reward Imbalance items in the three-factor hierarchical model. The majority factor loading coefficients are moderate or strong levels (>0.3), excepting ERI9 – " Unfair treatment" and OC3 – "relaxing and switching off work". Detailed values of factor loading are in Appendix Table A3.

3.4. Discriminant validity

We evaluated the discriminative validity between different demographic characteristics (age groups, genders, married status) and socio-economic status (education levels, income groups, and job positions) in Table 4. Generally, we observed no significant difference in the effort, reward, and over-commitment scores between those socio-demographic characteristics with p-values > 0.05. In addition, there is only a difference in the effort scores and Effort-Reward ratio between education levels (p-value $= 0.04$ and < 0.001, respectively).

3.5. Criterion validity

Table 5 describes the Vietnamese Effort-Reward Imbalance instrument's criterion validity in simple and multiple logistic regression models with unadjusted and adjusted odds ratios for age, gender, and education levels. We tested the hypothesis that healthcare providers who have higher scores in the effort, lower scores in reward, higher scores in over-commitment and Effort-Reward ratio would have a higher risk of having poor self-rated health. We observed a statistically significant increase risk of poor self-rated health among respondents in the

Table 2
Mean scores, Corrected item-total correlation, Cronbach alpha, and Guttman's lambda of Effort-Reward Imbalance items

Items	N	Mean ± SD	Item-total correlation	Cronbach's alpha	Guttman's lambda
Effort	172	3.27 ± 0.40		0.80	0.79
ERI1-Time pressure	172	3.38 ± 0.49	0.77	0.75	0.73
ERI2-Interruptions and disturbances	172	3.26 ± 0.51	0.70	0.78	0.76
ERI3-Responsibility	172	3.48 ± 0.55	0.71	0.77	0.76
ERI4-Pressured to work overtime	172	3.10 ± 0.62	0.70	0.77	0.76
ERI5-Physical demand	172	3.10 ± 0.63	0.60	0.80	0.78
ERI6-Increasing demand	172	3.31 ± 0.57	0.77	0.75	0.73
Reward	172	2.97 ± 0.29		0.76	0.79
ERI7-Respective from supervisor	172	3.14 ± 0.46	0.66	0.72	0.75
ERI8-Sufficient support	172	3.20 ± 0.48	0.64	0.73	0.76
ERI9-Unfair treatment	172	3.07 ± 0.62	0.45	0.76	0.78
ERI10-Job promotion prospects	172	2.74 ± 0.59	0.52	0.75	0.77
ERI11-Undesirable change	172	2.97 ± 0.52	0.56	0.74	0.77
ERI12-Poor employment security	172	2.90 ± 0.51	0.58	0.74	0.77
ERI13-Adequate position	172	2.98 ± 0.43	0.36	0.77	0.80
ERI14-Adequate respect and prestige	172	3.02 ± 0.50	0.74	0.71	0.74
ERI15-Adequate promotion prospects	172	2.83 ± 0.51	0.56	0.74	0.77
ERI16-Adequate income	172	2.84 ± 0.53	0.57	0.74	0.77
Over-commitment	172	2.73 ± 0.36		0.68	0.67
OC1-Overwhelmed by time pressure	172	3.32 ± 0.47	0.62	0.64	0.62
OC2-Think about work	172	2.87 ± 0.63	0.69	0.61	0.58
OC3-Relax and 'switch off' work	172	2.40 ± 0.65	0.41	0.72	0.68
OC4-Sacrifice too much for work	172	2.56 ± 0.54	0.59	0.65	0.63
OC5-Work rarely let go	172	2.35 ± 0.62	0.70	0.60	0.58
OC6-Trouble sleeping at night	172	2.89 ± 0.57	0.70	0.60	0.58

Notes: SD = Standard deviation; Cronbach's alpha in single item is the alpha of the scale after omitting this item.

Table 3
Comparisons of fit indices between the unidimensional and hierarchical models of Effort-Reward Imbalance models in Vietnam

Models	df	$\chi 2$	*p-value*	CFI	RMSEA(90% CI)	SRMR	GFI	BIC
3-Uni	206	508.67	<0.001	0.71	0.09 (0.08 to 0.10)	0.10	0.78	5557.89
3-Hie	181	342.46	<0.001	0.86	0.06 (0.05 to 0.07)	0.05	0.88	5520.37
5-Uni	199	475.91	<0.001	0.73	0.09 (0.08 to 0.10)	0.10	0.80	5561.17
5-Hie	203	479.45	<0.001	0.73	0.09 (0.08 to 0.10)	0.10	0.80	5544.12

Notes: 3-Uni = Three-factor unidimensional model, 3-Hie = Three-factor hierarchical model, 5-Uni = Five-factor unidimensional model, 5-Hie = Five-factor hierarchical model; df = degree of freedom, $\chi 2$ = Chi-square, CFI = Comparative fit index, RMSEA = Root mean square error of approximation; SRMR = Standardized root mean square residual, GFI = Goodness of fit index, BIC = Bayesian information criterion.

middle tertile of effort with adjusted Odd-Ratio (aOR) of 3.12 and p-value = 0.017. Similar results were seen in highest tertile of over-commitment (aOR = 5.16; p-value = 0.045), and both middle tertile (aOR = 2.80; p-value = 0.031) and highest tertile (aOR = 2.64; p-value = 0.05) of Effort-Reward ratio. In contrast, there is a reduced risk of having below-average self-rated health among those in the highest tertile of reward (aOR = 0.59). However, it is not statistically significant (p-value = 0.3).

4. Discussion

Our study is the first study describing the psychometric properties of a Vietnamese-translated Effort-Reward Imbalance instrument for measuring work stress in the nursing workforce. It showed satisfactory internal consistency, factor validity, discriminant validity, and criterion validity. The findings suggest that the Vietnamese Effort-Reward Imbalance items could be a reliable and psychometrically valid tool for accessing adverse psychosocial work environments in the healthcare sector. Additionally, we found a statistically significant association between the Effort-Reward ratio and poor self-rated health among nurses.

The present results showed the adequacy of internal consistency reliability in all Vietnamese Effort-Reward Imbalance items, similar to other countries' findings (Griep et al., 2009; Li et al., 2005; Msaouel et al., 2012; Weyers et al., 2006). Our study used standardized Cronbach's alpha based on correlations rather than covariances and was less sensitive to large item varieties than the raw alpha (Falk and Savalei, 2011). The mean scores of Effort-Reward Imbalance items are comparable with previous studies among health professionals. The higher scores in some Effort-Reward Imbalance items suggest differences in job demand and reward among Vietnamese nurses, which may be due to a specific organizational culture (H. Van Nguyen et al., 2020b). The Kaiser-Meyer-Olkin test showed a value <0.5 in item OC3 - "Easily relax and switch off work at home", suggesting this item could be eliminated in the Vietnamese Effort-Reward Imbalance questionnaire (Appendix Fig. A1). The factorial structure supports it with no correlation of OC3 with other items and latent constructs (Fig. 1).

The theoretical ERI model with unidimensional "effort" and "over-commitment" scales and three factorial structures of the "reward" scale (containing three components: esteem rewards, job security, and promotion (financial and career-related) prospects) showed good model fit previous studies in European populations (Siegrist, 1996; Siegrist et al., 2004). In our confirmatory factor analysis, the three-factor hierarchical model has the highest goodness of fit to Vietnamese nursing context, which is comparable with previous work among healthcare workers in Asia (Li et al., 2005; Tsutsumi et al., 2001), and also consistent with the Effort-Reward Imbalance model's assumptions. The adequate model fit indices (Table 3) suggest sufficient reliability of our findings and satisfactory validity and applicability of the Effort-Reward Imbalance instrument for upcoming research in work stress among healthcare workers in Vietnam. Notably, five reserve worded items (ERI9, ERI10, ERI11, ERI12, and OC3) showed the lowest factor loading coefficients. This phenomenon was reported in previous studies as a drawback of the Likert scale for developing a factor structure when using reserve worded items due to its generation of method factors (Zhang et al., 2016).

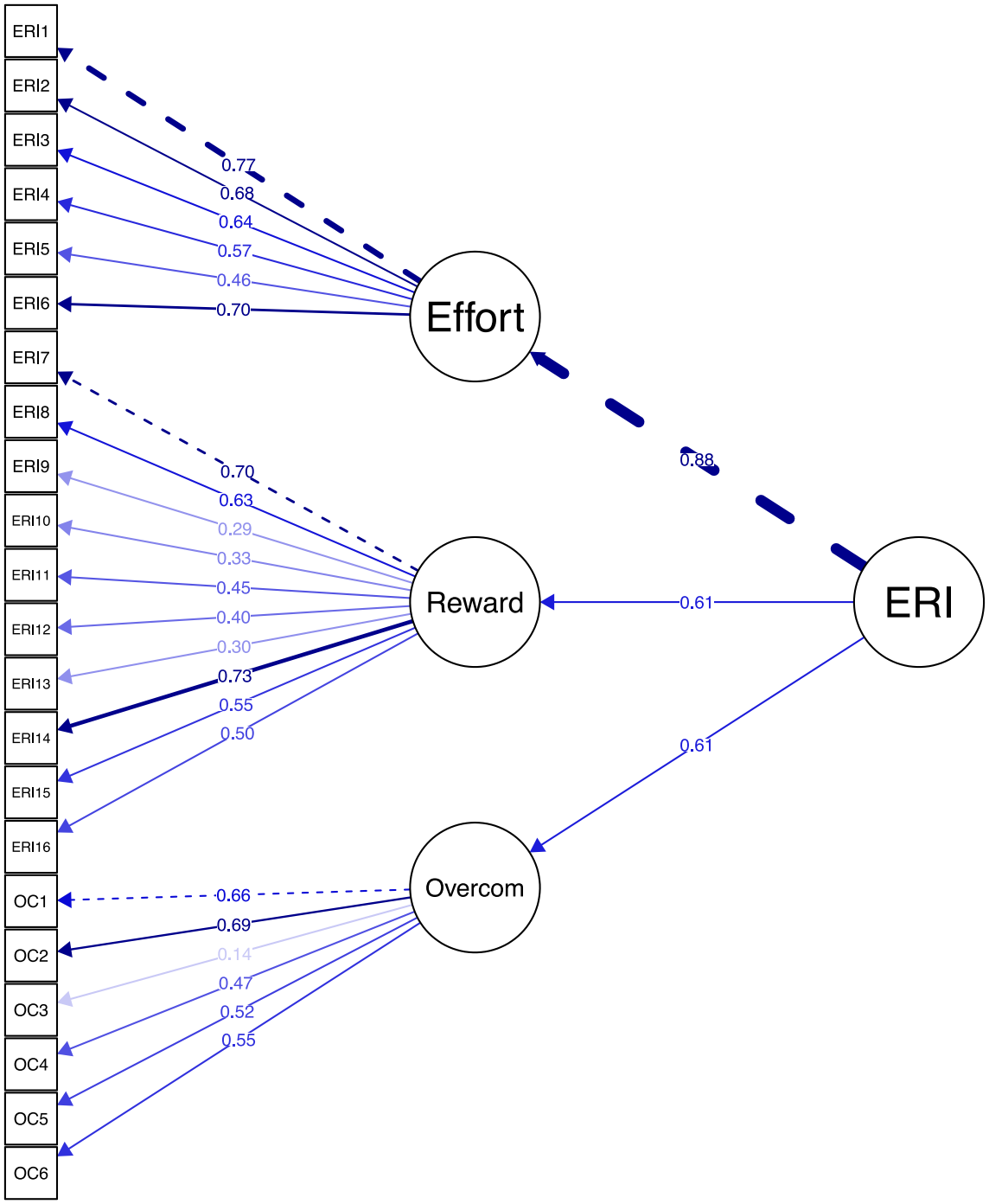

Fig. 1. Factorial structure of the Vietnamese Effort-Reward Imbalance items
Notes: ERI = Effort-Reward Imbalance, Overcom = Overcommitment.

Therefore, we suggest replacing reserve worded items with positive-worded items in future research to have better validity. Furthermore, we recommend using "Expanded Format" to minimize acquiescence bias and eliminate the method effects of reserved worded items (Zhang and Savalei, 2016).

Our findings show no difference in the effort, reward, over-commitment scores, and the Effort-Reward ratio between age groups, gender, married status, income groups, and job positions. In contrast, we observed statistically significant effects of education levels on the effort scores and Effort-Reward ratio. Those results are comparable with previous studies, which reported variant effects of demographic and socio-economic characteristics in nurses' Effort-Reward Imbalance scores among different populations (Griep et al., 2009; Hasselhorn et al., 2004; Li et al., 2005; Msaouel et al., 2012). It suggests the need for further research in investigating the association of gender, age, and occupation and Effort-Reward Imbalance among Vietnamese workers in the specific organizational culture, working environment, and labor system. Regarding the criterion validity, we observed a statistically significant association of self-rated health with Effort-Reward ratio and over-commitment adjusting for age, gender, and education levels. The findings are consistent with previous works and coherent with the original theory that the highest effects of Effort-Reward Imbalance were in the combined measure (Li et al., 2005; Msaouel et al., 2012; Weyers et al., 2006). As self-reported health has been a well-recognized predictor of

Table 4
Comparisons of ERI scores and ER ratios between different demographic characteristics and socio-economic status.

Characteristic	Effort		Reward		Over-commitment		Effort-Reward Ratio	
	Mean ± SD [min, max]	p-value	Mean ± SD [min, max]	p-value	Mean ± SD [min, max]	p-value	Mean ± SD [min, max]	p-value
Age groups								
<25	20.1 ± 2.3 [15.0, 24.0]	0.724	30.6 ± 3.1 [24.0, 38.0]	0.213	16.8 ± 2.3 [14.0, 23.0]	0.710	1.1 ± 0.1 [0.7, 1.4]	0.743
25–29	19.5 ± 2.5 [13.0, 24.0]		29.7 ± 2.9 [22.0, 39.0]		16.5 ± 2.1 [12.0, 21.0]		1.1 ± 0.1 [0.7, 1.5]	
30–34	19.6 ± 2.3 [16.0, 24.0]		29.4 ± 2.5 [20.0, 38.0]		16.1 ± 2.1 [11.0, 20.0]		1.1 ± 0.1 [0.9, 1.6]	
>35	19.5 ± 2.3 [17.0, 24.0]		28.6 ± 3.5 [23.0, 36.0]		16.3 ± 2.3 [14.0, 21.0]		1.1 ± 0.1 [1.0, 1.3]	
Gender								
Male	19.8 ± 2.1 [17.0, 24.0]	0.618	30.0 ± 2.5 [26.0, 37.0]	0.577	16.5 ± 1.9 [13.0, 21.0]	0.382	1.1 ± 0.1 [0.9, 1.4]	0.540
Female	19.6 ± 2.5 [13.0, 24.0]		29.6 ± 3.0 [20.0, 39.0]		16.3 ± 2.2 [11.0, 23.0]		1.1 ± 0.2 [0.7, 1.6]	
Married status								
Married	20.0 ± 2.3 [15.0, 24.0]	0.175	30.1 ± 3.1 [23.0, 38.0]	0.253	16.9 ± 2.1 [13.0, 23.0]	0.151	1.1 ± 0.1 [0.7, 1.4]	0.786
Not married	19.5 ± 2.4 [13.0, 24.0]		29.5 ± 2.8 [20.0, 39.0]		16.2 ± 2.1 [11.0, 21.0]		1.1 ± 0.1 [0.7, 1.6]	
Education levels								
Intermediate	19.2 ± 2.4 [13.0, 24.0]	0.041	30.1 ± 2.8 [24.0, 39.0]	0.384	16.4 ± 2.1 [12.0, 21.0]	0.860	1.1 ± 0.1 [0.7, 1.4]	<0.001
College	19.8 ± 2.3 [16.0, 24.0]		29.4 ± 3.1 [22.0, 37.0]		16.3 ± 2.2 [11.0, 21.0]		1.1 ± 0.1 [0.9, 1.4]	
University	20.2 ± 2.2 [16.0, 24.0]		29.3 ± 2.9 [20.0, 38.0]		16.5 ± 2.3 [12.0, 23.0]		1.2 ± 0.1 [0.9, 1.6]	
Income group								
Lowest	19.5 ± 2.5 [13.0, 24.0]	0.536	29.6 ± 2.7 [22.0, 37.0]	0.948	16.7 ± 2.1 [12.0, 23.0]	0.242	1.1 ± 0.2 [0.7, 1.6]	0.559
Medium	19.6 ± 2.3 [15.0, 24.0]		29.8 ± 3.4 [23.0, 39.0]		16.1 ± 2.0 [12.0, 21.0]		1.1 ± 0.1 [0.9, 1.3]	
Highest	20.0 ± 2.3 [16.0, 24.0]		29.6 ± 2.8 [20.0, 38.0]		16.1 ± 2.3 [11.0, 21.0]		1.1 ± 0.1 [0.9, 1.4]	
Position								
Manager	20.6 ± 2.3 [17.0, 24.0]	0.266	30.9 ± 3.0 [27.0, 38.0]	0.130	16.8 ± 2.0 [13.0, 21.0]	0.740	1.1 ± 0.1 [1.0, 1.3]	0.547
Clinician	19.6 ± 2.3 [14.0, 24.0]		29.3 ± 2.7 [20.0, 38.0]		16.3 ± 2.2 [11.0, 21.0]		1.1 ± 0.1 [0.7, 1.6]	
Other	19.7 ± 2.3 [15.0, 24.0]		30.3 ± 3.2 [25.0, 39.0]		16.4 ± 2.1 [13.0, 23.0]		1.1 ± 0.1 [0.7, 1.4]	

Table 5
Association of Effort-Reward Imbalance scales and Effort-Reward ratio with poor self-rated health from simple and multivariable logistic regression models.

Characteristics	Unadjusted			Adjusted†		
	OR[a]	95% CI[b]	p-value	OR[a]	95% CI[b]	p-value
Effort						
Lowest tertile (<19)	1	—		1	—	
Middle tertile (19–21)	3.26	1.38, 8.38	0.009	3.12	1.26, 8.34	0.017
Highest tertile (>21)	2.33	0.97, 6.08	0.068	2.38	0.91, 6.73	0.086
Reward						
Lowest tertile (<29)	1	—		1	—	
Middle tertile (29–31)	0.91	0.38, 2.10	0.8	0.99	0.39, 2.39	0.9
Highest tertile (>31)	0.49	0.18, 1.34	0.2	0.59	0.20, 1.73	0.3
Over-commitment						
Lowest tertile (<16)	1	—		1	—	
Middle tertile (16–18)	1.28	0.60, 2.71	0.5	1.30	0.57, 2.95	0.5
Highest tertile (>18)	4.84	1.23, 32.4	0.047	5.16	1.23, 35.8	0.045
Effort-Reward ratio						
Lowest tertile (<1.04)	1	—		1	—	
Middle tertile (1.04–1.16)	2.87	1.24, 7.06	0.017	2.80	1.13, 7.39	0.031
Highest tertile (>1.16)	3.26	1.38, 8.26	0.009	2.64	1.02, 7.24	0.050

[a]OR = Odds Ratio, [b]CI = Confidence Interval
†Adjusted for age groups, gender and education levels.

mortality (DeSalvo et al., 2006; Idler and Benyamini, 1997), our findings emphasize the demand for work stress management to protect nurse professionals' health. Additionally, under a "zero-new-case strategy", nurses and other frontline healthcare workers in Vietnam are experiencing burden from additional responsivities of controlling COVID-19 (investigate contact tracing, provide vaccinations, treatments, and cares) (T.-P. Nguyen et al., 2021b). Therefore, results from our study warrant further studies focusing on the ERI among nurses in Vietnam within the context of the COVID-19 pandemic.

One of this study's limitations is a relatively small sample size compared with studies in other countries. However, since our sample satisfied the ratio of five observations per item (Osborne and Costello, 2004), the factor analysis results can reach acceptable reliability (de Winter et al., 2009). As our participants were collected from a single hospital, to a certain extent, our finding's generalizability to the Vietnamese population is reduced. The cross-sectional design also restricts the causal inference from our results. Future studies with representative samples or cohort designs are necessary for investigating the association of ERI scales with other physical and mental health issues among nurses and healthcare workers. Although there is considerable concern about missing information when using the categorical form of continuous scales, prospective studies showed comparable results from an analysis in both measures (Msaouel et al., 2012; Niedhammer et al., 2004). Finally, although we validated the original (22-item) version of the ERI questionnaire to ensure the psychometric quality in the Vietnamese context, further studies on validating the shortened (16-item) version of ERI may also be needed for large-scale epidemiologic investigations.

5. Conclusion

In conclusion, the Vietnamese ERI questionnaire achieves adequate internal consistency, reliability, factorial validity, discriminative validity, and criterion validity and could be an appropriate instrument for accessing Vietnamese nurses' adverse psychosocial work characteristics. Although further adaptions may be necessary for solving the adverse effects of reverse worded items, our validated Vietnamese ERI questionnaire is available for further research in epidemiology, occupational health, and future programs and interventions in mental health at the workplace. Furthermore, the significant association between the disproportion of efforts and rewards at work and poor self-reported health among nurses is a well-recognized predictor of mortality and other health issues, emphasizing the demand for work stress management in Vietnam. Therefore, we recommended Vietnamese policymakers and nursing managers regularly measure work stress in nurses and healthcare workers to ensure the stability of human resources in healthcare, better control global pandemics like COVID-19, and support progress toward Health for All.

6. Article Summary

6.1. Strengths of this study

- First study provides the translation and validation of Effort-Reward Imbalance instrument for measuring work stress in the nursing workforce in Vietnam.
- First study assesses the association between the Effort-Reward ratio and poor self-rated health among nurses in Vietnam.

6.2. Limitations of this study

- Relatively small sample size but can reach acceptable reliability
- The cross-sectional design restricts the causal inference.

CRediT authorship contribution statement

Phuong The Nguyen: Conceptualization, Methodology, Data curation, Formal analysis, Validation, Writing – original draft, Writing – review & editing, Visualization. **Huy Van Nguyen:** Conceptualization, Methodology, Data curation, Writing – review & editing, Supervision. **Phuong Mai Le:** Writing – original draft, Writing – review & editing, Project administration. **Huyen Thi Phung:** Data curation, Writing – review & editing. **An Thi Minh Dao:** Writing – review & editing. **Kuniyoshi Hayashi:** Writing – review & editing. **Stuart Gilmour:** Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Data sharing statement

No additional data available.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pmedr.2021.101692.

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