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RESEARCH ARTICLE

Basic Psychological Needs Satisfaction and Seafarer Well-being: An Investigation of Interaction Effects Through the Lens of the STD Theory

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Abstract

Enhancing employee well-being is a primary goal for enterprise sustainable development. Although seafarers represent a major human resource in the maritime industry, the distinctive demands of their profession often compel them to compromise on certain elements in fulfilling their basic psychological needs, thereby contributing to mental health challenges. Recently, COVID-19 and its associated border control measures have prolonged the voyages of seafarers, drawing public attention to the topic of seafarer well-being. In this study, self-determination theory was used to explore the effects of autonomy, competence, and relatedness as fundamental psychological needs on seafarer well-being. After the independent effects of these needs were examined, their interaction patterns were explored to determine their influence on seafarer well-being. Three types of basic psychological needs satisfaction were identified: interaction, balance, and threshold. A questionnaire survey was conducted on 400 active seafarers in the domestic maritime sector. Regression analysis was performed with well-being as the dependent variable to verify the independent effects of the three aforementioned types of satisfaction. In addition, from the perspectives of interaction, balance, and threshold, the effects of the interactive relationships of these three types of satisfaction on well-being were examined. Data analysis revealed that each type of satisfaction independently influenced well-being. After a certain threshold was reached, the effect of basic psychological needs satisfaction on well-being diminished. However, the interactive effects of the three types of basic psychological needs satisfaction on well-being were nonsignificant.

Keywords: Seafarer, Well-being, Self-determination theory

1. Introduction

Seafarers often compromise on their family life and social interactions because of the unique nature of their profession. Given the distinctive demands of this profession, including prolonged periods at sea and work discipline, seafarers often sacrifice a certain degree of autonomy over their work and life, which increases their difficulty in meeting their basic psychological needs [1]. Nevertheless, despite these drawbacks, seafarers enjoy high job remuneration, and maritime work offers

them opportunities to experience diverse cultures and lifestyles. For some seafarers, engaging in maritime work is perceived as a lifelong adventure [2], rendering the profession inherently attractive.

In recent years, researchers have increasingly investigated problems experienced by seafarers, shifting from materialistic improvements in the work environment to psychological aspects and paying particular attention to phenomena such as stress and emotional exhaustion among seafarers. Thiruvassagam and Rengamani [3] measured levels of fatigue resulting from onboard work

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arrangements. Slišković [1] and Chung and Chung [4] have explored factors influencing psychological stress among seafarers. McVeigh et al. [5] examined the effects of positive psychology interventions on psychological stress among seafarers. In addition, the International Maritime Organization and multiple nongovernmental organizations worldwide have conducted research regarding seafarer well-being and mental health, thereby contributing to improvements in their working conditions and increasing the attractiveness of maritime work [6].

According to the literature, COVID-19 had adverse effects on seafarer well-being [7], with measures such as border control serving as key sources of stress for seafarers. Consequently, since the pandemic, many seafarer welfare organizations have advocated the explicit regulation of seafarer mental health within the Maritime Labour Convention (MLC). Such appeals have included substantial amendments to the convention's content and exerting pressure on countries yet to ratify the MLC.

According to self-determination theory (SDT), work is a key factor in achieving individual well-being. The satisfaction of basic psychological needs in work or life increases an individual's level of well-being [8,9]. SDT posits that well-being stems from the fulfillment of three basic psychological needs: autonomy, competence, and relatedness. Given that the pursuit of well-being is inherent to human nature, a work environment that offers these three characteristics is likely to induce positive behavior and enhance the well-being of the employees present. SDT has been widely applied across multiple domains—including workplace management, education, family, and social psychology—and has garnered considerable empirical support [8,9,11]. However, despite these advancements, the implications and expectations of basic psychological needs satisfaction may differ across diverse occupational backgrounds. For seafarers, factors such as prolonged sea voyages, limited interactions with family and society, and hierarchical work atmospheres on board vessels may lead to varying perceptions related to the satisfaction of these basic psychological needs. Accordingly, further research is required to confirm whether this theoretical perspective is applicable to the domain of maritime work.

Although most empirical studies regarding SDT support the independent positive effects of autonomy, competence, and relatedness on well-being [12], some researchers have argued that the three aforementioned basic psychological needs may exhibit more complex interactive effects beyond their individual effects [13]. Given the unique work characteristics of seafarers, further

research is required to explore the degree of interdependence among these three basic psychological needs and their interaction patterns. In the present study, in addition to the concepts of independent, synergistic, and balanced interactions proposed by Dysvik et al. [13], a threshold viewpoint was introduced to further explore the effects of satisfying these three basic psychological needs on seafarer well-being in the domain of maritime work. The objectives of this study are summarized as follows:

- (1) To apply SDT to examine the effect of satisfying the three basic psychological needs of autonomy, competence, and relatedness on seafarer well-being; and
- (2) To determine how fundamental psychological needs satisfaction influences the well-being of seafarers, extending beyond the individual effects of the three basic psychological needs.

2. Basic psychological needs satisfaction and well-being

Argyle [14] defined well-being as a positive and affirmative psychological state that encompasses life satisfaction and the balancing of positive and negative emotions. According to Ryan and Deci [8], well-being arises from the “freedom to make autonomous decisions in life and work.” From this perspective, SDT identifies three fundamental psychological needs: autonomy, competence, and relatedness. Fulfilling these needs is regarded as a marker of an individual's self-determination capacity. Autonomy refers to spontaneous behavior when individuals perceive their actions as originating from personal free will, enabling them to make choices voluntarily without feeling commanded, coerced, or threatened. Competence refers to an individual's sense of being able to effectively control and influence their environment. In a state of autonomy, individuals perceive both positive and negative experiences as opportunities for self-improvement, which in turn enhances their ability to handle challenging tasks or assignments. Relatedness refers to the emotional connections that individuals perceive with others. In social interactions, fostering a sense of connection, establishing relationships, building trust, and expressing concern are essential. These emotional support patterns—particularly when the environment provides sufficient acceptance, care, and warmth—enables individuals to face challenges and achieve psychological growth [8]. According to Deci and Ryan [8], self-determination is a form of

intrinsic motivation that encourages individuals to actively engage in actions that fulfill the three aforementioned basic psychological needs without requiring external incentives. Frustration with these needs may lead to mental and physical health problems, emotional exhaustion, or other negative outcomes [15]. According to the literature, the manner in which the three aforementioned basic psychological needs are satisfied can affect an individual's well-being. SDT views these needs as distinct elements, each contributing positively to overall well-being.

2.1. Independent effects perspective

According to SDT, autonomy, competence, and relatedness are three independent basic psychological needs, each exerting a positive effect on well-being. In the context of seafarer work, these needs exhibit an additive effect on well-being, meaning that satisfying any one of these needs enhances seafarers' well-being. Given the unique characteristics of seafarer work, significant variance is observed in the satisfaction of these three needs. Competence needs are easily fulfilled because of the nature of seafarer work, which involves global navigation and offers high income [16,17]. By contrast, satisfying autonomy and relatedness needs can be more challenging because of onboard work discipline and social isolation [18,19].

Although the work settings of seafarers differ from those of more conventional workplaces, many studies have confirmed that satisfying the three aforementioned basic psychological needs still contributes to well-being among seafarers [8,10,11]. Such findings underscore the universal value of pursuing basic psychological needs satisfaction, irrespective of the nature of one's job. Although degrees of psychological needs satisfaction may vary across occupations, fulfilling each need independently contributes to well-being. In other words, each basic psychological need independently contributes to well-being upon its satisfaction regardless of whether other psychological needs are satisfied.

The present study hypothesized that satisfying the three aforementioned basic psychological needs independently and positively influences the well-being of seafarers. Consequently, the following hypotheses were proposed:

Hypothesis 1: Satisfying each basic psychological need independently and positively influences the well-being of seafarers.

Hypothesis 1-1: Satisfying competence needs positively influences the well-being of seafarers.

Hypothesis 1-2: Satisfying autonomy needs positively influences the well-being of seafarers.

Hypothesis 1-3: Satisfying relatedness needs positively influences the well-being of seafarers.

2.2. Interaction effects perspective

In addition to the assertion that the three aforementioned basic psychological needs have independent effects on well-being, some researchers have also suggested potential interactions among these needs [13]. For example, seafarers often work in a unique maritime environment that fails to satisfy their autonomy and relatedness needs. However, their high degree of competence needs satisfaction somewhat compensates for this deficiency. Therefore, in certain contexts related to competence needs satisfaction, the positive effects of autonomy and relatedness needs satisfaction on well-being may be disrupted. Similarly, the varying levels of autonomy and relatedness needs satisfaction may interfere with the positive effects of competence needs satisfaction on well-being. In this interactive relationship, although each basic psychological need can directly influence well-being, these needs may interfere with each other, leading to varying effects on well-being. This relationship suggests that the three aforementioned basic psychological needs do not independently affect well-being. Despite the constraints and weak social connections experienced by seafarers in their work environment, their high degree of competence needs satisfaction compensates for their unmet autonomy and relatedness needs, which in turn increases their overall well-being. Taken together, these findings indicate that the work characteristics of seafarers do not necessarily affect their overall well-being. Hence, the following hypotheses were proposed:

Hypothesis 2: The interaction effects associated with basic psychological needs satisfaction positively influence the well-being of seafarers.

Hypothesis 2-1: The interaction effects between competence needs satisfaction and autonomy needs satisfaction positively influence the well-being of seafarers.

Hypothesis 2-2: The interaction effects between competence needs satisfaction and relatedness needs satisfaction positively influence the well-being of seafarers.

Hypothesis 2-3: The interaction effects between relatedness needs satisfaction and autonomy

needs satisfaction positively influence the well-being of seafarers.

2.3. *Balanced perspective*

According to the balanced perspective, the satisfaction levels of the three aforementioned basic psychological needs should not be too disparate, and they should not unconditionally complement one another [20]. In the context of seafarer work, even if competence needs are satisfied (through remuneration and worldwide travel opportunities), severe frustration with autonomy (order conformity and hierarchical control) and relatedness (social isolation) needs may still have a negative effect on well-being. As a result of loneliness and multinational crew composition, seafarers often experience frustration with psychological needs satisfaction despite having high salaries, leading to mental health problems and fatigue [21]. Therefore, if the three aforementioned basic psychological needs are not balanced, their satisfaction may not significantly affect well-being. Hence, the following hypothesis was proposed:

Hypothesis 3: Balanced satisfaction of the three basic psychological needs positively influences the well-being of seafarers.

2.4. *Threshold perspective*

In addition to the three aforementioned perspectives, this study introduces a fourth perspective by examining the unique characteristics of seafarer work. According to SDT, satisfying the basic psychological needs of autonomy, competence, and relatedness positively influences well-being; however, the nature of this influence may not be linear. For instance, regarding relatedness needs, seafarers often work long hours in isolation from society, and onboard teams are often composed of multinational crew members, leading to a sense of detachment or even conflict among peers [22]. Given these work characteristics, seafarers typically have low expectations toward satisfaction of their relatedness needs, and they tend to seek only basic communication support, well-organized onshore and offshore task assignments, improved working and living conditions, and a respectful and diverse work culture. These measures can partially fulfill their relatedness psychological needs. For seafarers, fulfilling higher-level relatedness psychological needs, as observed among general workplace employees, may not be possible. According to Herzberg's two-

factor theory [23], relatedness needs in the context of seafarer work are similar to hygiene factors in that a lack of satisfaction may lead to dissatisfaction; however, once a certain level of satisfaction is achieved, further increases in satisfaction may not significantly enhance well-being. In the male-dominated onboard work environment, many seafarers are accustomed to authoritative and obedient norms. These norms presumably lower their expectations toward autonomy compared with those of their general workplace counterparts. Therefore, meeting the minimum expectations of seafarers in the onboard work environment may prevent frustration associated with unmet psychological needs. Because of the unique nature of the seafarer work environment, even if the level of autonomy needs satisfaction is higher than expected, its positive effect on well-being may be diminished. Hence, the following hypotheses were proposed:

Hypothesis 4: The positive effect of basic psychological needs satisfaction on well-being decreases after a certain level of satisfaction is reached.

Hypothesis 4-1: The positive effect of competence needs satisfaction on well-being decreases after a certain level of satisfaction is reached.

Hypothesis 4-2: The positive effect of autonomy needs satisfaction on well-being decreases after a certain level of satisfaction is reached.

Hypothesis 4-3: The positive effect of relatedness needs satisfaction on well-being decreases after a certain level of satisfaction is reached.

3. Research method

3.1. *Measurement*

In this study, well-being and basic psychological needs satisfaction were employed as dependent and independent variables along with control variables. From the perspective of subjective well-being [24], seafarer well-being refers to an individual's evaluation of their overall life satisfaction and emotional experiences. From this perspective, well-being consists of three elements: life satisfaction, positive affect, and the absence of negative affect. In the present study, well-being was evaluated using the Satisfaction with Life Scale, developed by Pavot and Diener [24], where subjective well-being is evaluated using six items, such as "In most ways, my life is close to ideal" and "I am satisfied with my life." Satisfaction of the basic psychological needs of autonomy, competence, and relatedness were evaluated using a modified version of the Basic Psychological Needs Scale,

developed by Deci et al. [25], where autonomy needs satisfaction is evaluated using three items, including “I can decide how to complete my work” and “I can decide with whom to discuss work”; similarly, competence needs satisfaction is evaluated using three items, including “I believe that working on board can bring me a sense of achievement” and “I believe I have the ability to acquire new work knowledge.” Finally, relatedness needs satisfaction is evaluated using four items, including “I feel that my superiors care about me” and “I get along well with my onboard colleagues.” All variables are measured using a 5-point Likert scale.

In this study, in addition to basic psychological needs satisfaction, demographic variables were included as control variables, including age, gender, educational level, seniority level, marital status, and position (management level: captain, chief engineer, chief officer, or chief steward; operational level: second officer or wheelman; assistant level: boatswain, able seaman, helmsman, coppersmith, mechanic, chef, or steward).

3.2. Research design and data collection

A questionnaire survey was issued to active seafarers. Given the characteristics of seafarer work, electronic questionnaires were used for data collection. These questionnaires were distributed through collaboration with major shipping companies in Taiwan, specializing in container and bulk carriers. After their consent was obtained, the shipping companies’ maritime departments distributed the electronic questionnaires among their crew members, who completed them voluntarily. This survey was conducted from November to December 2021 and yielded 400 responses.

Among the respondents who provided valid questionnaire responses, most were men (375, 93.75%), with only 25 (6.25%) being women. Regarding marital status, 165 of the respondents were married (41.25%), and 235 were unmarried (58.75%). Regarding educational level, 97 of the respondents were high school or vocational school graduates (24.25%), 287 were university graduates (71.75%), and 16 were postgraduate degree holders (4.0%). Regarding position, 108 of the respondents had management-level positions (27.0%), 149 had operational-level positions (37.25%), and 143 had assistant-level positions (35.75%). Regarding seniority, the respondents were categorized into six levels according their work experience: less than 1 year (3.75%), 1–2 years (18.25%), 3–5 years (14.75%), 6–10 years (37.5%), 11–15 years (12.25%), and 16 years or more (10.5%). Overall, the present sample

was representative of the demographic distribution of seafarers in the Taiwanese shipping industry.

4. Data analysis results

4.1. Reliability and validity analysis

Confirmatory factor analysis of autonomy, competence, relatedness, and well-being was conducted using structural equation modeling. After two items with factor loading below 0.5 were removed (one item for competence and one item for relatedness), the model fit parameters were as follows: chi-square/degrees of freedom = 2.618, goodness-of-fit index = 0.945, adjusted goodness-of-fit index = 0.910, comparative fit index = 0.963, root mean square error of approximation = 0.065, and standardized root mean square residual = 0.047. These findings indicated good fit for the four-variable measurement model. In addition, in accordance with Doll, Xia, and Torkzadeh [26], these indicators suggested good fit adequacy. The composite reliability (CR) scores of the four variables were as follows: autonomy = 0.870, competence = 0.665, relatedness = 0.620, and well-being = 0.877 (Table 1). Each item's factor loading exceeded 0.5, thereby meeting the criteria for reliability and validity. Although the average variance extracted (AVE) values for only three measurements exceeded 0.5, with relatedness being the variable below this threshold (0.45), all four values exceeded the acceptable level of 0.36 [27]. In addition, the correlation coefficients between the variables were lower than the square roots of their AVE values, indicating the convergent validity of the measurements. Table 1 summarizes the average, standard deviation, CR value, AVE value, and correlation analysis of each variable. All three basic psychological needs were positively correlated with well-being, preliminarily supporting SDT.

4.2. Verification of independent effects

Table 2 presents the regression analysis results of the effects of basic psychological needs satisfaction on well-being among seafarers. An analysis of the variance inflation factor (VIF) and Durbin–Watson values revealed that the multicollinearity problems in the regression model were not severe [28,29]. Regression models were established, with well-being as the dependent variable. After the control variables were included (model 1), autonomy, competence, and relatedness were sequentially added (models 2, 3, and 4, respectively), and the significance of the regression coefficients was

Table 1. Intercorrelation analysis of variables.

	M	S	CR	AVE	1	2	3	4
1 Autonomy	3.320	0.912	0.870	0.692	1			
2 Competence	3.520	0.693	0.665	0.514	0.467***	1		
3 Relatedness	2.772	0.553	0.620	0.450	0.415***	0.453***	1	
4 Well-being	2.667	0.782	0.877	0.595	0.353***	0.407***	0.497***	1

N = 400; ***p < 0.001.

Table 2. Regression analysis of the effects of basic psychological needs satisfaction on well-being.

	Model 1	Model 2	Model 3	Model 4	Model 5
Gender	0.181**	0.133**	0.134**	0.109*	0.108*
Age	0.202**	0.200**	0.224***	0.207***	0.200***
Education	0.132	0.093	0.087	0.104	0.106
Tenue	-0.039	-0.006	-0.048	-0.035	-0.025
Position	0.166*	0.167*	0.167*	0.121	0.128*
Marriage	0.044	-0.038	-0.053	-0.056	-0.057
Autonomy		0.399***	0.287***	0.180***	0.156**
Competence			0.242***	0.148**	0.246***
Relatedness				0.333***	0.263***
Balance					-0.106
R ²	0.063	0.214	0.258	0.337	0.343
F	4.076**	14.086***	15.677***	20.369***	18.784***

*p < 0.05; **p < 0.01; ***p < 0.001.

Male = 1, female = 2.

The VIF for each variable ranged from 1.05 to 2.24, with a Durbin–Watson value of 1.967 for the full model.

observed at multiple stages. For all four regression models (Table 2), the F-values reached significance, and R² gradually increased from 0.063 to 0.343 with the addition of variables, indicating the high explanatory power of each model. In models 2 to 4, the regression coefficients for autonomy, competence, and relatedness were 0.399 (p < 0.001, model 2), 0.242 (p < 0.001, model 3), and 0.333 (p < 0.001, model 4), respectively. These results indicated that the satisfaction of the three basic psychological needs independently influenced well-being, thereby supporting Hypothesis 1.

4.3. Verification of the balanced perspective

To verify the balanced perspective, a balance index for psychological needs satisfaction was developed as a variable to test the research hypotheses. According to the concept of balance, if significant disparity exists in the satisfaction levels of the three basic psychological needs, these psychological needs may not be evenly satisfied. In other words, although certain psychological needs may be adequately satisfied, others may remain unmet, and these imbalanced conditions may negatively affect the well-being of seafarers. In the present study, the approach of Dysvik et al. [13] was adopted; this approach utilizes the sum of the differences between the three basic psychological

needs as a measure. Control variables (model 1), satisfaction of three basic psychological needs (models 2 to 4), and balance of basic psychological needs (model 5) were sequentially added to the regression model (model 5, Table 2). The regression coefficient for the balance of basic psychological needs was -0.106 (p = 0.069), which did not reach the 5% confidence level; thus, Hypothesis 2 was not supported.

4.4. Verification of interaction effects

Table 3 presents the regression analysis results of interaction effects on well-being. Analysis of the VIF and Durbin–Watson values revealed that the multicollinearity problems in the regression model were not severe [28,29]. In the regression analysis procedure, after control variables were incorporated into the regression model (model 1), the interaction terms of the two variables of basic psychological needs satisfaction were added (models 2 to 4).

To address potential multicollinearity problems arising from the strong correlations between independent variables and interaction terms, the mean centering approach proposed by Kraemer and

Table 3. Regression analysis results of interaction effects on well-being.

	Model 1	Model 2	Model 3	Model 4	Model 5
Gender	0.181**	0.134**	0.120**	0.105*	0.103*
Age	0.202**	0.226***	0.213***	0.192***	0.199***
Education	0.132	0.087	0.116*	0.111	0.102
Tenue	-0.039	-0.049	-0.059	-0.012	-0.048
Position	0.166*	0.167*	0.117	0.122	0.120
Marriage	0.044	-0.052	-0.034	-0.043	-0.04
Autonomy		0.160	0.059		0.138*
Competence		0.230		0.038	0.168**
Relatedness			0.274	0.166	0.315***
Auto*comp		0.121			0.080
Auto*relate			0.224		0.008
Comp*relate				0.343	0.004
Aut*com*rel					0.102
R ²	0.063	0.258	0.317	0.325	0.345
F	4.076**	13.929***	18.540***	19.262***	14.428***

*p < 0.05; **p < 0.01; ***p < 0.001.

Male = 1, female = 2.

The VIF for each variable ranged from 1.08 to 2.53, with a Durbin–Watson value of 1.976 for the full model.

Blasey [30] was adopted. This approach involves subtracting the mean from each independent variable before calculating the interaction term. After the centered independent variables and interaction terms were incorporated into the regression model, the VIF values for the variables in the regression model were found to range approximately from 1.08 to 2.53, indicating that the multicollinearity problems were not severe [28].

As shown in Table 3, the interaction effects of autonomy \times competence, autonomy \times relatedness, and competence \times relatedness, as well as three-way interaction, did not reach statistical significance; thus, Hypothesis 3 was not supported.

4.5. Verification of the threshold perspective

To verify the threshold perspective, median values were employed as cutoff points. Depending on the satisfaction levels of the three aforementioned basic psychological needs (with medians of 3.33, 3.67, and 2.75 for autonomy satisfaction, competence satisfaction, and relatedness satisfaction, respectively), the research sample was divided into two groups: a high-satisfaction group and a low-satisfaction group. Separate regression analyses were subsequently conducted these two groups to analyze the results (Table 4).

As shown in Table 4, analysis of the VIF and Durbin–Watson values revealed that the multicollinearity problems in the regression model were not severe [28,29]. When the levels of satisfaction exceeded the median for all three basic psychological needs, regression coefficients of 0.076 (nonsignificant), 0.305 ($p < 0.001$), and 0.280 ($p < 0.001$) were obtained for autonomy, competence, and relatedness, respectively. By contrast, when the levels of satisfaction dropped below the median for all three basic

psychological needs, regression coefficients of 0.307 ($p < 0.001$), 0.416 ($p < 0.001$), and 0.375 ($p < 0.001$) were obtained for autonomy, competence, and relatedness, respectively. The Chow test was used to identify significant differences in regression coefficients between the high- and low-satisfaction groups [31]. The results indicated significant differences, with F-values of 61.14 for autonomy, 52.03 for competence, and 54.61 for relatedness ($p < 0.001$).

Significant differences were observed between the regression coefficients of the high- and low-satisfaction groups. Specifically, the regression coefficients of the low-satisfaction group were significantly higher than those of the high-satisfaction group. In the case of autonomy satisfaction, the regression coefficient of the high-satisfaction group was not significant; this finding was consistent with the threshold perspective adopted in this study, suggesting that when the satisfaction level of basic psychological needs is low, increasing it significantly contributes to well-being. By contrast, when the satisfaction level of basic psychological needs exceeds a certain threshold, further increases in satisfaction contribute less or may not significantly contribute to well-being. These findings support Hypothesis 4.

In summary, the present study findings support Hypotheses 1 and 4, indicating that the impact of satisfaction with the three basic psychological needs on well-being is primarily characterized by independent effects. However, as the level of satisfaction with these needs exceeded a certain threshold, their effect on well-being would decrease. Hypotheses 2 and 3 were not supported, indicating there is no significant interaction between the satisfaction of the three basic psychological needs on well-being, and balance of three basic psychological needs has no significant effect on well-being.

Table 4. Regression analysis of the effects of basic psychological needs satisfaction on well-being.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	Below	Above	Below	Above	Below	Above
Gender	0.102	0.238**	0.050	0.181*	0.099	0.144
Age	0.175	0.280*	0.149	0.217*	0.131	0.279*
Education	0.120	0.096	0.068	0.112	0.142	0.146
Tenue	-0.061	-0.130	0.001	-0.024	-0.004	-0.052
Position	0.282**	0.048	0.226*	0.096	0.173	0.051
Marriage	-0.099	0.099	0.015	-0.037	0.076	-0.110
Autonomy	0.307***	0.076				
Competence			0.416***	0.305***		
Relatedness					0.375***	0.280***
R ²	0.170	0.115	0.228	0.166	0.199	0.157
F	5.600***	3.015**	7.096***	5.276***	6.802***	4.318***

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Male = 1, female = 2.

The VIF for each variable ranged from 1.03 to 2.21, with a Durbin–Watson value of 1.650–1.881 for each model.

5. General discussion and implications

Overall, this study not only validated the effect of satisfying the basic psychological needs of autonomy, competence, and relatedness—as posited by SDT—on the well-being of seafarers but also attempted to identify the interactive relationships between these needs and the potential effects of these relationships on the well-being of seafarers. In the data analysis procedure, multiple approaches were employed to represent the perspectives of independent, interaction, balance, and threshold. Besides independent effect verification, these approaches included the pairwise multiplication of independent variables, the sum of differences between independent variables, and the categorization of independent variables into high and low groups. Regression analysis was conducted to verify the various perspectives. The present study findings provide valuable insights into the relationship between basic psychological needs satisfaction and well-being within the domain of maritime work.

First of all, each of these needs independently influences well-being. These findings are consistent with SDT and emphasize the independent effect of each basic psychological need on well-being, even in unique and specific occupational settings. From the job demands-resources viewpoint, the fit between an individual and their work depends not only on their job characteristics but also on their work conditions [32]. Seafaring jobs involve long periods characterized by family separation, social isolation, male dominance, and obedience [18,19,33]. These job demands are more likely to generate a person–work fit with seafarers characterized by higher competence, lower autonomy, and relatedness needs. However, from independent perspective, low levels of relatedness satisfaction do not significantly influence the effects of the other two needs on well-being. Similarly, high levels of competence satisfaction fail to modify the effects of the other two basic psychological needs on well-being.

The balanced perspective and the interaction perspective represent two fundamentally distinct viewpoints. The balanced perspective posits that disparities in the fulfillment levels of the three basic psychological needs should not be excessively large, as such discrepancies could detrimentally impact well-being. Conversely, the interaction perspective contends that the satisfaction of these three basic psychological needs would interact with each other, wherein the fulfillment of one basic psychological need can serve as a positive contextual variable that reinforces the relationship between the fulfillment of other psychological needs and well-being. For

instance, in scenarios involving high levels of autonomy satisfaction, it can reinforce the weak positive association between relatedness needs and well-being. There is no consensus has yet been reached regarding whether the effects of satisfying the three aforementioned basic psychological needs on well-being are independently or interrelated significant [13]. This discrepancy may be attributable to differences in the occupational domains examined. Overall, the results of this study in the maritime domain do not support either balanced or interaction perspective; this outcome is consistent with the findings of van den Broeck et al. [12], who indicated that satisfying the three basic psychological needs independently influences well-being without significant interactions among these needs.

In this study, a threshold perspective was introduced, with the satisfaction of the basic psychological needs of autonomy, competence, and relatedness viewed as hygiene factors. Fig. 1 depicts the association between the satisfaction of these needs and well-being.

In the maritime domain, the relationship between basic psychological needs satisfaction and well-being is not linear. After basic psychological needs are partially satisfied, the phenomenon of diminishing returns occurs. Therefore, in practical management scenarios, although each of these needs independently affects well-being, relying on a single aspect of psychological satisfaction (e.g., salary increase) while neglecting the effects of other basic psychological needs (e.g., family or social connections) is inappropriate. Given the constraints and limited resources related to seafaring, achieving balanced satisfaction with all three basic psychological needs offers limited contribution for enhancing the well-being of seafarers. Seafaring managers should seek to eliminate the factors that decrease the satisfaction levels of basic psychological needs. For example, low levels of relatedness satisfaction may be attributable to prolonged family separation and difficulties in establishing positive relationships with supervisors and

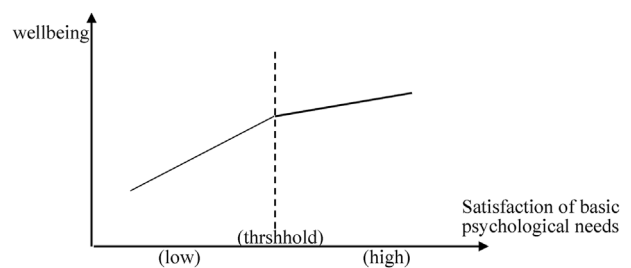


Fig. 1. Relationship between basic psychological needs satisfaction and well-being (threshold perspective).

colleagues, resulting in a sense of loneliness. Therefore, seafaring managers should focus on offering adequate resources and assistance to help seafarers who are unable to achieve the minimum satisfaction levels for their relatedness and autonomy needs.

According to the regression coefficients shown in [Table 2](#), certain demographic variables (age and gender) significantly influence the well-being of seafarers. Among these variables, age is significantly positively associated with well-being, indicating that as individuals aged, their need for family care may decrease as their children grow up, potentially leading to reduced work–family conflict and improved well-being. For seafarers, well-being strongly correlates with family life and career development. Therefore, seafaring managers should strive to account for the diverse family lifestyles of seafarers to achieve more appropriate arrangements.

In addition to age, gender also has a significant effect on well-being, with female seafarers exhibiting improved well-being. According to Tang [34], the differential treatment of female seafarers in terms of career development remains a major problem in the field of seafaring management. In light of these findings, this study posited that the factors influencing seafarer well-being are highly complex. The currently low proportion of female seafarers in active service suggests a low individual–job fit for most female seafarers. Nevertheless, further research is required to determine the reasons underlying the high individual–job fit observed among a minority of female seafarers.

6. Limitations and recommendations for future research

This study endeavors to apply the perspective of SDT to the well-being of seafarers and further explore different types of interaction relationships among the satisfaction of the three basic psychological needs. Based on the empirical findings of this research, the following limitations are summarized, along with corresponding recommendations for future studies.

6.1. Individual differences in job demands and resources

This study included specific factors such as seniority and position as control variables. These variables not only directly influence well-being but also may vary because of differences in an individual's position within their family life cycle. For instance, newlywed seafarers or seafarers with underage children are likely to have higher demands for family relationships compared with those in the

empty-nest period. In the same work context, the patterns of basic psychological needs satisfaction may also vary. Seafarers who have independent children and who work on ships for years may have lower demands for family relationships and instead prioritize friendships and job achievements. Utilizing a single pattern to explain the association between psychological needs satisfaction and well-being for all seafarers may not fully reflect the actual situations of all of them. Accordingly, further research should utilize a model that integrates job demands and personal resources, with fit as a predictor of well-being, to offer more comprehensive explanatory power. Categorizing seafarers on the basis of their familial background may offer deeper insights into the association between basic psychological needs satisfaction and well-being.

6.2. Influence of different work contexts on well-being

This study focused on merchant seafarers and did not account for crew members on cruise ship or other types of ferries. Given that merchant ships differ considerably from cruise ships, discrepancies in the satisfaction levels of basic psychological needs and well-being may arise among seafarers. Accordingly, further research should analyze seafarers from a wider variety of work contexts to better understand their occupational conditions.

6.3. Mitigation of possible sampling period errors

During the data collection period of this study, strict border control was still in place worldwide because of the COVID-19 pandemic. According to Wong [7], COVID-19 had a severe effect on the well-being of seafarers. Therefore, the sampling data collected during the present data collection period may have underestimated levels of basic psychological needs satisfaction and well-being. Accordingly, future research should continue exploring problems related to basic psychological needs satisfaction and well-being among seafarers after the pandemic to facilitate the long-term monitoring of changes in these trends.

6.4. Effect of company management policies

This study—grounded in SDT, with seafarers as its core focus—did not account for the effects of management measures or job characteristics in shipping companies as environmental factors. With employee well-being regarded as a key social responsibility of modern enterprises, companies typically seek to establish internal incentives and assist their employees in terms of striking an

appropriate work–family balance through various human resource management systems. In recent years, many shipping companies, faced with challenges such as seafarer shortages and COVID-19, have started to focus on mental and physical health problems commonly experienced by seafarers. In addition, several improvement measures for seafarer management systems have been proposed. Nevertheless, despite these advancements, further research is required to determine the effectiveness of such measures in assisting seafarers in enhancing their well-being.

Ethical statement

This study was performed in line with the principle of Declaration of Helsinki.

Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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