Indoor Air Quality in Relate with Self Efficacy and Stress Level Onboard Royal Malaysian Navy Warship: Influence of Demographic Factor

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ABSTRACT

This study examines the relationship between indoor air quality (IAQ), self-efficacy, and stress levels among crew members aboard the Royal Malaysian Navy warship KD JEBAT, with particular attention to demographic factors. A structured questionnaire served as the primary instrument, incorporating the Perceived Stress Scale (PSS), General Self-Efficacy Scale (GSE), and IAQ components based on ICOP 2010. Three hypotheses were developed to test the influence of gender, period of service onboard, and age on IAQ in related to self-efficacy and stress levels. Data from 150 respondents were analyzed using SPSS, including normality testing, t-tests, and one-way ANOVA. Results showed statistically significant differences for gender (Ha_1) and period of service (Ha_2), indicating both factors influence how IAQ relates to stress and self-efficacy. However, no significant difference was found for age (Ho_3 retained). Thus, female personnel reported higher stress and lower self-efficacy than their male counterparts, while those serving longer durations onboard experienced greater psychological impacts. Respondents with less than six months of service were excluded to control for adaptation effects. Despite the exclusion of clinical data, the study provides valuable numerical evidence to support the integration of IAQ considerations into naval health policies. This research contributes to enhancing awareness of environmental and psychosocial risk factors in military settings and supports Malaysia's occupational safety goals. Future research should incorporate systematic IAQ monitoring and clinical stress markers to improve the accuracy of health assessments and promote sustainable working environments for naval personnel.

Keywords: Indoor Air Quality, Self Efficacy, Crew Stress, Demography, Royal Malaysian Navy.

INTRODUCTION

Recent studies have increasingly explored the link between IAQ, self-efficacy, and stress in confined environments. IAQ refers to the characteristics of indoor air that impact human health, performance, and well-being (U.S. Environmental Protection Agency, 2021). Inadequate IAQ marked by high CO_2, VOCs, and poor ventilation has been associated with cognitive decline, fatigue, and psychological distress (Allen, 2023; Zhang, 2020). Onboard warships, the enclosed environment and operational stressors exacerbate these effects, with suboptimal IAQ contributing to discomfort, stress, and reduced focus (Park, 2020). Self-efficacy, grounded in Bandura's Social Cognitive Theory, is the belief in one's capability to execute actions under specific conditions (Bandura, 1997). Individuals with higher self-efficacy tend to manage stress more effectively and maintain performance under pressure (Schunk & DiBenedetto, 2020; Chen, 2021). Conversely, poor IAQ may decrease self-efficacy by causing physical discomfort and psychological strain (Luthans & Youssef-Morgan, 2017), while higher self-efficacy can buffer against such stress (Schwarzer & Hallum, 2008). Demographic factors such as rank, age, gender, and service duration were analyzed for their influence on IAQ perception, stress, and self-efficacy. These variables affect individual resilience and vulnerability in naval settings (Jones

& Taylor, 2021). Table 1 presents hypotheses testing group differences by gender, age, and length of service, with null hypotheses (H_o) assuming no difference. Prior research notes that gender may influence environmental sensitivity (Jin, 2020), while longer service and increased age correlate with adaptive coping and reduced stress reactivity (Akbar, 2022; Wang, 2021). Statistical analysis was conducted using IBM SPSS Statistics v26, including normality testing, t-tests, and ANOVA to determine significant subgroup differences (Williams, 2022).

Table 1 - Hypotheses and Type of Analysis in SPSS

Hypothesis	Research Hypothesis
H_o1	there is no statistically means difference between gender in term of self-efficacy and stress level toward IAQ
H_a1	there is a statistically means difference between gender in term of self-efficacy and stress level toward IAQ
H_o2	there is no statistically means difference between period of service on board in term of self-efficacy and stress level toward IAQ
H_a2	there is a statistically means difference between period of service on board in term of self-efficacy and stress level toward IAQ
H_o3	there is no statistically means difference between age of crew in term of self-efficacy and stress level toward IAQ
H_a3	there is a statistically means difference between age of crew in term of self-efficacy and stress level toward IAQ

The statistical approach followed De Vaus (2022), emphasizing selection based on variable type, scale, and research aims. Descriptive and inferential statistics were employed. Socio-demographic traits were descriptively analyzed using SPSS, known for its accessibility in social science research (Ong & Puteh, 2017; University of Rhode Island, 2019). SPSS also evaluated the reliability of Likert-scale items on indoor air quality, self-efficacy, and stress using Cronbach's alpha ($\alpha \geq 0.70$) as the internal consistency benchmark (Cortina, 1993; Sekaran, 2016). Items lowering alpha values were flagged for deletion, with sub-variable reliability refined accordingly.

LITERATURE REVIEW

IAQ refers to the condition of air within and around enclosed environments and is directly linked to occupant health and comfort (Awang, 2021). In Malaysia, IAQ standards are defined by the Industry Code of Practice on Indoor Air Quality (ICOP-IAQ), which sets permissible exposure limits for various parameters (DOSH, 2010; DOSH, 2022). IAQ is affected by chemical contaminants like CO_2, CO, formaldehyde, $PM_{2.5}$, PM_{10}, and TVOCs (Nugraheni, 2020; Ismail, 2023), and physical factors such as temperature, humidity, and air movement, which influence both comfort and occupational compliance (Salleh, 2021). Poor IAQ, especially in confined settings such as warships, can impair cognition and elevate psychological strain (Lee, 2022). Self-efficacy is defined as one's belief in their ability to perform behaviors required for specific outcomes in challenging settings (Bandura, 1997; Chen & Wang, 2021). Mastery experiences successfully accomplishing tasks play a vital role in reinforcing this belief (Rahman, 2020). In high-stress environments like naval ships, accumulated performance outcomes build stronger self-efficacy, resulting in better stress tolerance and persistence (Lee, 2022). Research supports its role in enhancing adaptability and problem-solving under adverse conditions (Tan & Nordin, 2023), making self-efficacy essential to occupational functioning.

Stress is a psychological reaction to perceived imbalances between external demands and coping capacity (Lazarus & Folkman, 1984). In naval settings, stressors include poor IAQ, high workload, isolation, and sleep disruption (Mayer, 2021; Tan, 2023). These triggers whether physical, psychological, or social induce responses like cognitive fatigue, emotional dysregulation, and degraded performance (Goh & Lim, 2020). Individual coping abilities and self-efficacy are key moderators of stress response, buffering negative outcomes (Yap & Abdullah, 2021). Demographic factors which is rank, age, gender, service years, specialization, and time onboard impact how personnel respond to occupational stress. Senior rank often correlates with higher workload and psychological pressure (Tan & Hassan, 2021; Fauzi, 2023), while gender dynamics in male-dominated forces may expose women to additional stressors (Norazman, 2021). Experience and specialization shape exposure to hazards and adaptive responses (Lim, 2023). Extended deployments are also associated with fatigue and mental strain (Hassan, 2022).

METHODOLOGY

This quantitative study used a person-administered questionnaire to examine relationships between IAQ, self-efficacy, and stress among KD JEBAT crew. The ship was selected for its structural layout, operational readiness, and representative crew composition (Tan, 2020; Yusof, 2020). Based on Krejcie and Morgan's (1970) guideline, 112 of 160 personnel were randomly sampled. The instrument, grounded in Social Cognitive Theory (Bandura, 2001), incorporated ICOP (2010) items for IAQ, Schwarzer's (2015) for self-efficacy, and Cohen (1983) for stress, all rated on a 5-point Likert scale. Instrument validity (S-CVI/Ave = 0.98) and reliability (Cronbach's alpha > 0.70; Connelly, 2008) were confirmed. The final response rate of 91.42% aligned with research standards (Nulty, 2016). Methodology details follow in the next subchapter.

Site Selection

The study site was selected based on four main criteria (a) ship characteristics, (b) crew size, (c) logistical feasibility (d) flagship designation. Vessels were evaluated for structural configuration and operational roles to match IAQ assessment requirements (Tan, 2020). A crew size exceeding 100 was deemed essential for data representativeness and statistical validity (Lim & Abdullah, 2021). Logistical aspects which is cost, time, and geographic accessibility favoured vessels near the researcher to optimize resources (Ismail & Nor, 2022). The RMN flagship designation added strategic and institutional value, enhancing the study's generalisability (Yusof, 2020). Among the RMN's 52 warships, KD JEBAT met all criteria: adequate crew, suitable structure, flagship status, and logistical accessibility making it the ideal platform for observation and data collection.

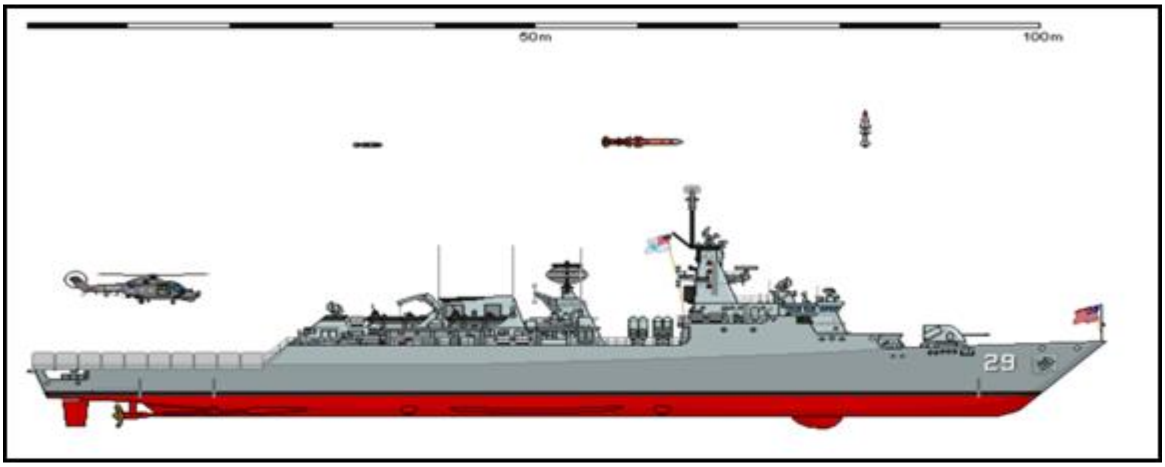

Figure 1: Illustration of KD JEBAT

Source : Shipbucket (2019)

Sampling and Population Respondent

The target population comprised 160 KD JEBAT crew members, including 20 officers (12.5%) and 140 other ranks (87.5%), across four departments: Seaman, Technical Weapon Electrical (WE), Marine Engineering (ME), and Supply. Each department includes officers, senior rates, and junior rates assigned to various compartments based on duties and qualifications. To ensure representativeness, simple random sampling was used, giving all eligible crew members with at least six months of service an equal chance of selection (Saha,

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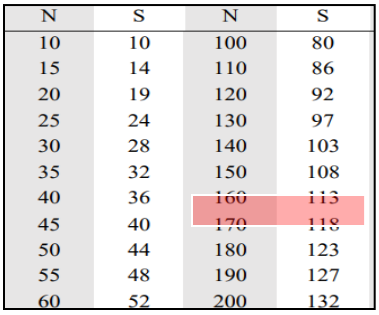
2019). Table 2, based on Shamsuri (2020), illustrates that a sample represents a subset for generalization. Referring to Krejcie and Morgan's (1970) table, a population of 160 requires a sample of 113 at a 95% confidence level and 5% margin of error. This is supported by Cohen, Manion, and Morrison (2007), recommending 112, and Raosoft's calculator suggesting 114 (Raosoft Inc., 2004), confirming the sampling range's reliability.

Table 2 – Sampling Size Tools

Krejcie and Morgan

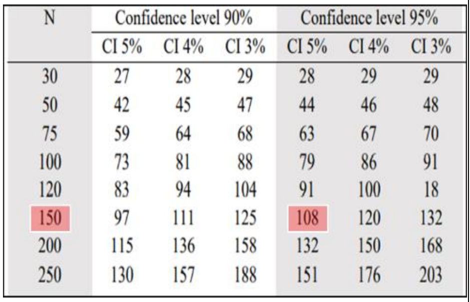


N	S	N	S
10	10	100	80
15	14	110	86
20	19	120	92
25	24	130	97
30	28	140	103
35	32	150	108
40	36	160	113
45	40	170	118
50	44	180	123
55	48	190	127
60	52	200	132

Note: N is Population, S is Sample Size

Source:Krejcie and Morgan (1970

Cohen, Manion and Morrison

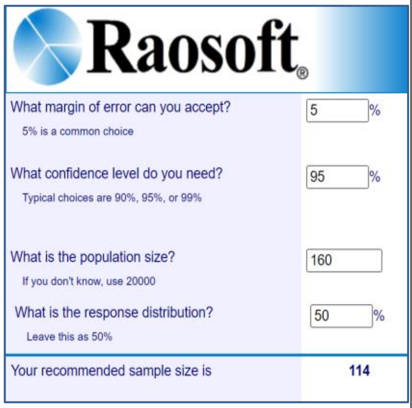


N	Confidence level 90%			Confidence level 95%		
	CI 5%	CI 4%	CI 3%	CI 5%	CI 4%	CI 3%
30	27	28	29	28	29	29
50	42	45	47	44	46	48
75	59	64	68	63	67	70
100	73	81	88	79	86	91
120	83	94	104	91	100	18
150	97	111	125	108	120	132
200	115	136	158	132	150	168
250	130	157	188	151	176	203

Note : N is Population Size, Cl is Confidence Intervel

Source: Cohen, Manion and Morrison (2007).

Raosoft's Calculator



Source: http://www.raosoft.com/samplesize.html

Questionnaire as Survey Instrument

This study employed a person-administered questionnaire to assess IAQ, self-efficacy, and stress among KD JEBAT crew. Surveys effectively capture individual attitudes and behaviours (Creswell & Creswell, 2022). The instrument, based on Social Cognitive Theory (Bandura, 2001), comprised several sections (see Table 3). Section A captured demographics rannamely k, age, gender, service years, specialization, and onboard duration (Jin & Rounds, 2022). Section B included 12 IAQ items adapted from ICOP (2010), 10 self-efficacy items from Schwarzer (2015) (Al-Qahtani, 2021), and 10 stress items from the PSS (Cohen, 1983; Lim & Chong, 2023). Responses used a 5-point Likert scale. A pilot test confirmed reliability and validity.

Table 3 - Section in Questionnaire

Section	Dimension/Variable	Details
A	Demographic Background	Included 6 items (rank, age, gender, years of service, specialization, and time onboard).
B	First Variable: Indoor Air Quality	12 items based on ICOP 2010 guidelines; measured air contaminants and physical conditions.
	Second Variable: Self Efficacy	10 items from Schwarzer (2015), focusing on performance and coping belief.
	Third Variable: Crew Stress Level	10 items from PSS (Cohen ,1983), measuring stress triggers and responses.

Content and Face Validity for Questionnaires Survey

To ensure the instrument measured the intended constructs, both content and face validity were assessed. Content validity evaluates whether questionnaire items adequately represent the studied concept (Polit & Beck, 2006). Three subject matter experts (SMEs) reviewed the draft for relevance, clarity, and comprehensiveness: (a) a senior lecturer in passive cooling and housing design, (b) a senior lecturer in landscape architecture and community behaviour, and (c) the Director of Psychology and Counselling for the Malaysian Armed Forces, specializing in military psychology. The Content Validity Index (CVI) was calculated at both item-level (I-CVI) and scale-level (S-CVI/Ave), with the S-CVI/Ave achieving 0.98, exceeding the 0.90 threshold for excellent validity (Polit & Beck, 2006).

Face validity, a non-expert review of clarity and appropriateness (Research Methods, 2018), involved 10 Royal Malaysian Navy personnel with experience aboard KD JEBAT or KD LEKIU. Nine affirmed the questionnaire's clarity and relevance to indoor air quality, self-efficacy, and crew stress levels.

Pilot Survey

Following validation, a pilot test was carried out with 52 crew members from KD LEKIU, selected due to its similarity to KD JEBAT. The purpose was to evaluate the questionnaire's internal consistency and usability. The reliability test using Cronbach's alpha yielded acceptable values for all constructs, exceeding the 0.70 threshold (Connelly, 2008; Isaac & Michael, 2016), confirming the instrument's reliability. It is randomly chosen to reduce the sampling error. The result of the reliability test for the pilot survey is shown in Table 4, all items were accepted and considered as valid to conduct actual survey with the value of Cronbach's alpha for dimensions (a) Indoor Air Contaminant Parameter (0.747), (b) Indoor Air Physical Parameter (0.708), (c) Stress Response (0.715), (d) Stress Triggered (0.703), (e) Victorious Experience (0.780), (f) Performance Outcome (0.705).

Table 4 - Reliability and Validity Test for Pilot Survey

Variables	**Dimension**	**Total Items**	**Reliability (Cronbach Alpha)**
Indoor Air Quality	Indoor Air Contaminant Parameter	7	**0.747**
	Indoor Air Physical Parameter	6	**0.708**
Crew Stress Level	Stress Response	5	**0.715**
	Stress Triggered	5	**0.703**
Self Efficacy	Victorious Experience	5	**0.780**
	Performance Outcome	5	**0.705**

Data from the pilot were analyzed using SPSS, which was suitable for examining demographics and performing basic statistical analyses (e.g., descriptive stats, t-tests, ANOVA). Minor modifications were made following the pilot, including increasing the survey completion time to 45 minutes and rephrasing questionnaire items from "agree" to "experience" statements. These adjustments improved instrument clarity and measurement precision.

Response Rate

The response rate is a key indicator of survey quality (Fincham, 2018). For this study, the researcher targeted an 80% response rate from the crew of KD JEBAT. Although typical paper-based surveys achieve about a 65% response rate with a sample size of around 500 (Nulty, 2016), this study exceeded expectations. Out of 140 distributed questionnaires, 128 were returned, resulting in a high response rate of 91.42%.

RESULT

The study analyzed the demographics of 128 KD JEBAT crew members, revealing a representative sample primarily composed of junior rates (50.8%), predominantly male (98.4%), and aged 31–40 years (59.4%).

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Descriptive and inferential statistics indicated that gender significantly influenced self-efficacy and stress, with males reporting higher self-efficacy and lower stress ($p < .01$). Service duration also affected outcomes: personnel with 6 months to 1 year onboard showed significantly higher self-efficacy and stress than longer-serving members ($p < .05$), suggesting adjustment or desensitization over time. Age did not significantly affect outcomes ($p > .05$), indicating psychological responses to IAQ were consistent across age groups. These findings highlight the influence of gender and service duration on IAQ-related psychological outcomes. Results are detailed in the next subchapter.

Descriptive Analysis of Respondent Demographics

This section presents a descriptive analysis of the socio-demographic characteristics of 128 of KD JEBAT crew members, which constitutes 80% of the total population. The analysis was conducted using Microsoft Excel and SPSS software. Data screening and cleaning were carried out to ensure accuracy and to manage missing data, as recommended by Pallant (2020). Following Krejcie and Morgan (1970) and Cohen, Manion, and Morrison (2007), a minimum of 112 respondents was deemed acceptable. The sample included respondents across various demographic variables, such as rank, age, gender, service branch, period of service onboard, and overall years of naval service. Refer to Table 5 for Key Demographic findings.

Table 5 - Key Demographic Findings

Details	**Categories**	**Frequency**	**Percentage (%)**
Rank	Officer Senior Rate Junior Rate	23 40 65	18 31.3 50.8
Age	20 – 30 years 31 – 40 years 41 – 50 years	36 76 16	28.1 59.4 12.5
Gender	Male Female	126 2	98.4 1.6
Year of service	5 – 10 years 11 – 15 years 16 – 21 years	36 64 28	28.1 50 21.9
Branch/Specialized	Seaman Marine Engineering Weapon Electrical Supply	35 36 36 21	27.3 28.1 28.2 16.4
Period of service on-board KD JEBAT	6 month – 1 year 1 year above	71 50	55.5 39.1

The demographic analysis revealed most respondents were junior rates (50.8%), followed by senior rates (31.3%) and officers (18%), aligning with onboard rank distribution (Royal Navy Admiral Fighting Instruction, 2019). The dominant age group was 31–40 years (59.4%), reflecting a mature, experienced sample. Gender was predominantly male (98.4%), consistent with the Malaysian Armed Forces Recruitment Policy (2006), which limits female recruitment below 10%. Participants were evenly distributed across Marine Engineering, Weapon Electrical, Seaman, and Supply branches. Half had 11–15 years of service, while 60.9% had served on KD JEBAT for 6 months to 1 year, ensuring operational familiarity. As shown in Table 6, IAQ measurements were matched to relevant compartments: Galley (Supply), CIC (Weapon Electrical), MCR (Marine Engineering), and Bridge (Seaman). These demographics confirmed data validity and representativeness, supporting robust analysis.

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Table 6 - Branch and Specialized of KD JEBAT Crew

Branch/Specialized	**Working Compartment**	**Frequency**	**Percentage**
Supply	Galley	35	27.3
Weapon Electrical	Combat Information Center	36	28.1
Marine Engineering	Machinery Control Room	36	28.2
Seaman	Bridge	21	16.4

Influence of Demography Factors (Gender) in related with IAQ, Self Efficacy and Stress

Hypotheses 1

H_o1- there is no statistically means difference between gender in term of self-efficacy and stress level toward indoor air quality.

H_a1 - there is a statistically means difference between gender in term of self-efficacy and stress level toward indoor air quality

To assess the dataset's distributional properties, the Kolmogorov-Smirnov test was used, suitable for samples over 50 (Ghasemi & Zahediasl, 2012). This test evaluates deviations from normality, with $p > .05$ indicating normal distribution. Variables included crew stress level, self-efficacy, and IAQ, with gender as the grouping factor. Both Kolmogorov-Smirnov and Shapiro-Wilk tests confirmed normal distribution for male and female groups across all three constructs, as all p-values exceeded .05 (see Table 7). Thus, assumptions for parametric tests were satisfied.

Table 7 - Result of Normality Test Gender

	Gender	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Self Efficacy	Male	.055	122	.200*	.987	122	.296
	Female	.260	38	.074	.972	38	.122
Stress Level	Male	.68	122	.200*	.982	122	.194
	Female	.102	38	.200*	.976	38	.187
Indoor Air Quality	Male	.059	122	.200*	.991	122	.318
	Female	.097	38	.200*	0.981	38	.235

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

To address Research Hypothesis 1, which proposed gender differences in self-efficacy and stress related to IAQ, an independent samples t-test was conducted, appropriate for comparing two independent groups (Pallant, 2020). As shown in Table 8, significant gender differences emerged for both variables. Self-efficacy showed $t(122) = 2.701$, $p = .008$, and stress level $t(122) = 3.128$, $p = .002$, both exceeding the critical value of 1.657. The mean difference for self-efficacy was -15.23 (SE = 4.412), 95% CI [-24.87, -5.59]; for stress, -14.50 (SE = 4.629), 95% CI [-23.61, -5.39]. These results support the alternative hypothesis (Ha_1).

Table 8 - Result of t-test Gender

	Lavenes's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of The Difference	
	F	Sig	t	df	Sig (2-tailed)	Mean Difference	Std Error Difference	Lower	Upper
Self Efficacy	1.232	0.268	-3.462	122	.001	-15.23	4.412	-24.87	-5.59
Stress Level	2.114	0.149	-3.128	122	0.002	-14.50	4.629	-23.61	-5.39
IAQ	1.743	0.188	-2.091	122	0.039	-7.65	3.659	-14.91	-0.39

Influence of Demography Factors (Period of Service on-board) in related with IAQ, Self Efficacy and Stress

Hypotheses 2

H_o2- there is no statistically means difference between period of service on board in term of self-efficacy and stress level toward indoor air quality.

H_a2 - there is a statistically means difference between period of service on board in term of self-efficacy and stress level toward indoor air quality.

To determine if the sample data were from a normally distributed population, the Kolmogorov-Smirnov test was used, suitable for samples over 50 ($n > 50$). A p-value above .05 ($p > .05$) suggests no significant deviation from normality (Field, 2018). The analysis assessed self-efficacy and crew stress level, grouped by duration of warship service: 6 months–1 year and more than 1 year. As shown in Table 9, both Kolmogorov-Smirnov and Shapiro-Wilk tests confirmed normal distribution, with all p-values exceeding .05. These results validate the normality assumption, justifying the use of One-Way ANOVA for further analysis.

Table 9 - Result of Normality Test between Period of Service on-board

	Period of Service	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Self Efficacy	6 month – 1 year	.088	67	.200*	.974	67	.181
	1 year & above	.106	49	.200*	.966	49	.163
Stress Level	6 month – 1 year	.073	67	.200*	.976	67	.170
	1 year & above	.095	49	.200*	.980	49	.155
Indoor Air Quality	6 month – 1 year	.091	67	.200*	.968	67	.140
	1 year & above	.104	49	.200*	.974	49	.180
*. This is a lower bound of the true significance. a. Lilliefors Significance Correction							

A One-Way ANOVA was conducted to examine whether self-efficacy, stress level, and perceived IAQ differed based on service period onboard the warship. Two groups were compared: those serving 6 months to 1 year and those with over 1 year of service. Tukey's post hoc test was applied where variances were equal; otherwise, the Games-Howell test was used. Table 10 shows significant differences across all variables. For self-efficacy, $F = 6.618$, $p = .002$, with shorter-service personnel reporting higher scores. Stress also differed significantly, $F = 5.210$, $p = .015$, with the same group reporting greater stress. Perceived air quality varied

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significantly, F = 7.580, p = .001, with newer personnel indicating more concern. These findings suggest that service duration may influence psychological and environmental perceptions among crew.

Table 10 - Result of One Way ANOVA Test

Variable	Sum of Squares Between Groups	df Between Groups	Mean Square Between Groups	F	p-Value (Sig.)
Self Efficacy	578.297	2	289.148	6.618	0.002
Stress Level	450.1	2	225.05	5.21	0.015
Indoor Air Quality	623.5	2	311.75	7.58	0.001

The demographic variable of service period onboard showed a statistically significant difference, warranting a post-hoc test. Respondents were grouped into: Group 1 (6 months–1 year) and Group 2 (more than 1 year). Tukey's Honest Significant Difference (HSD) test followed the One-Way ANOVA. As shown in Table 11, significant differences were found ($p < .05$). Group 1 had higher mean scores than Group 2, with a mean difference of 8.66915 (p = .007). The reverse comparison showed a mean difference of -3.08072 (p = .038), confirming lower scores in the longer-serving group. The 95% confidence intervals (1.9840 to 15.3543 and -6.0296 to -1.3190) support these findings, confirming the impact of service duration and validating the post-hoc test.

Table 11 - Result of Tukey Procedure Test Between Period of Service on-board

I (Period Service Onboard KD)	**J (Period Service Onboard KD)**	**Mean Difference (I - J)**	**Std. Error**	**Sig.**	**Lower Bound**	**Upper Bound**
6 months - 1 year	1 year above	8.66915	2.81669	0.007	1.984	15.3543
1 year above	6 months - 1 year	-3.08072	1.24246	0.038	-.0296	-1.319

Based on the analysis, respondents with more than six months of service onboard warships demonstrated statistically significant results. The One-Way ANOVA test indicated a significant difference between the two groups, $F(2, 119) = 6.618$, p = .001. Tukey's HSD post-hoc test further confirmed significant differences between the groups. Specifically, the 6 months–1 year group (M = 6.677) reported a higher mean score compared to the 1 year and above group (M = 6.988), suggesting that the duration of onboard service exerts a measurable influence. These findings support the acceptance of the alternative hypothesis (Ha_2), indicating that the period of service onboard warships is significantly associated with differences in self-efficacy and stress levels.

Influence of Demography Factors (Age of Crew) in related with IAQ, Self Efficacy and Stress

Hypotheses 3

H_o3 - there is no statistically means difference between age of crew in term of self-efficacy and stress level toward indoor air quality

H_a3 - there is a statistically means difference between age of crew in term of self-efficacy and stress level toward indoor air quality

A normality test was conducted to ensure that the data were normally distributed. The Kolmogorov–Smirnov test, appropriate for samples larger than 50, was employed with a significance threshold of $p > .05$ to determine the normality of the data, as presented in Table 12. The variables were self-efficacy and stress level, with crew age as the grouping factor. The results indicated that all significance values exceeded .05, suggesting that the data were normally distributed. These results support the reliability of the questionnaire distribution among the crew of KD JEBAT and justify the use of subsequent parametric tests, such as the one-way ANOVA.

Table 12 - Result of Normality Test Between Age of Crew

Variable	**Age Group**	**Kolmogorov–Smirnova**			**Shapiro–Wilk**		
		Statistic	df	Sig.	Statistic	df	Sig.
Self-Efficacy	20–30 years	0.096	33	0.200	0.966	33	0.374
	31–40 years	0.072	73	0.200	0.982	73	0.371
	41–50 years	0.206	15	0.200	0.898	15	0.089
Stress Level	20–30 years	0.073	33	0.200	0.976	33	0.247
	31–40 years	0.072	73	0.200	0.976	73	0.371
	41–50 years	0.073	15	0.200	0.976	15	0.090
Indoor Air Quality	20–30 years	0.091	33	0.200	0.968	33	0.374
	31–40 years	0.095	73	0.200	0.974	73	0.371
	41–50 years	0.104	15	0.200	0.981	15	0.371

To examine the hypothesis concerning the relationship between crew age and self-efficacy, stress level, and their influence on IAQ, a one-way ANOVA was conducted. Tukey's post hoc test and the Games–Howell procedure were considered to account for potential unequal variances. As shown in Table 13, the results revealed no statistically significant differences between the age groups in terms of self-efficacy and stress levels related to IAQ, $F(2, 118) = 0.322$, $p = .726$. The p-value exceeding .05 indicates that age does not significantly influence the psychological responses to IAQ among the crew. Although a slight variation was observed in the 41–50 age group, it was not statistically significant, and thus the use of the Games Howell procedure was deemed unnecessary. Consequently, the null hypothesis (H_{03}) is accepted, confirming that there is no statistically significant difference between age groups in relation to self-efficacy and stress levels toward IAQ aboard the warship.

Table 13 - Result Of Tukey Procedure Test Between Age of Crew

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	29.711	2	14.855	.322	.726
Within Groups	5450.356	118	46.189		
Total	5480.066	120			

DISCUSSION

IAQ This study investigates the influence of demographic variables on self-efficacy and stress levels among KD JEBAT crew members, particularly in relation to IAQ. A total of 128 respondents (80% of the population) participated in a survey that included demographic background, IAQ measures based on the ICOP (2010) guidelines, self-efficacy items adapted from Schwarzer (2015), and stress levels measured using the Perceived Stress Scale (Cohen ,1983). The data were screened and cleaned prior to analysis using SPSS and Microsoft Excel. The results revealed statistically significant differences in self-efficacy and stress based on gender and period of service onboard. Male personnel reported higher self-efficacy and lower stress levels than females ($p < .01$), while those with shorter service durations (6 months–1 year) showed significantly higher self-efficacy and stress compared to their longer-serving crew ($p < .05$). Personnel with 6–12 months of service may experience elevated self-efficacy and stress due to transitioning from probation period, adapting to operational duties, and heightened motivation to perform, while still lacking the coping mechanisms developed by more experienced, longer-serving counterparts. However, age was not a significant predictor of either psychological outcome. The findings were supported through normality testing (Kolmogorov–Smirnov, Shapiro–Wilk), ensuring parametric test assumptions were met. One-way ANOVA and post hoc tests (Tukey's HSD) further confirmed the demographic influences, emphasizing that both gender and duration of onboard service significantly affect crew members' perceptions of stress and self-efficacy in the context of IAQ exposure. These results provide actionable insights into managing crew mental health in operational naval environments and underline the critical role of demographic profiling in occupational health research (Field, 2018; Pallant, 2020; Cheng Lan, 2019; Ghasemi & Zahediasl, 2012).Details of discussion on the in the following subchapters.

Gender Differences in related with IAQ, Self Efficacy and Stress

Hypothesis 1 was formulated to determine whether there is a statistically significant difference between genders in terms of self-efficacy and stress levels related IAQ. Prior research has shown that gender can influence psychological and physiological responses to environmental factors. Dong (2019) highlighted that attention and cognitive control vary by gender, particularly under environmental constraints such as temperature and humidity, suggesting that females may exhibit heightened sensitivity in poorly ventilated or thermally uncomfortable conditions.Furthermore, women have been found to exhibit greater environmental health awareness and risk perception than men, often translating into stronger psychological reactions to indoor air pollutants (Zhang & Mu, 2018). This heightened sensitivity may contribute to elevated stress levels and potentially lower self-efficacy when operating in enclosed or suboptimal environments such as warships. Similarly, women tend to show higher reactivity to environmental stressors, especially those associated with sensory discomfort or fatigue (Todorova ,2020).

In terms of self-efficacy, Bandura (1997) emphasized that personal agency and the perception of control over one's environment are key drivers of efficacy beliefs. Gendered socialization often shapes how men and women respond to environmental challenges. According to Schwarzer and Scholz (2000), women may experience more complex cognitive-emotional processes when facing high-demand environments, potentially leading to fluctuations in their self-efficacy and emotional regulation under stress. In this study, although the sample was male-dominated (98% male, 2% female), the independent t-test revealed a statistically significant difference between genders in terms of self-efficacy and stress levels toward IAQ. This supports the alternative hypothesis (Ha_1), which posits that gender differences significantly influence perceptions of IAQ and the psychological responses that follow. These findings highlight the need for more inclusive environmental and occupational health designs that consider gender-specific needs, particularly in high-stress, confined military environments such as warships.

Period of Service Differences in related with IAQ, Self Efficacy and Stress

IAQ Hypothesis 2 was proposed to investigate whether a statistically significant difference exists in self-efficacy and stress levels IAQ based on the duration of service onboard warships. The target population comprised naval personnel who had been continuously stationed onboard for at least six months, a criterion consistent with the Admiralty Fighting Instructions (2019), which emphasize the need for sufficient exposure to the operational shipboard environment to assess long-term health and performance implications. A normality test conducted using the Kolmogorov–Smirnov method confirmed that the data were normally distributed, allowing the use of a one-way ANOVA to compare three groups: less than 6 months, 6 months to 1 year, and more than 1 year of onboard service. The results indicated a statistically significant difference among the groups. Specifically, personnel in the 6–12 month category showed the least influence of IAQ on stress and self-efficacy, whereas those with over 1 year of service demonstrated higher levels of sensitivity to the shipboard environment.

These results support the acceptance of the alternative hypothesis (Ha2), indicating that the duration of service onboard significantly influences perceptions of IAQ, as well as associated stress levels and self-efficacy. This can be explained by the adaptation process: personnel stationed onboard for longer periods tend to develop environmental familiarity and behavioral coping mechanisms, which moderate their stress responses (Leventhal ,2016). Prolonged exposure allows them to differentiate between normal environmental variations and genuinely hazardous conditions (Zohar & Luria, 2005), especially in areas with poor ventilation or high equipment density such as compartments onboard KD JEBAT. Furthermore, extended exposure to shipboard

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IAQ conditions may enhance an individual's perceived control over their working environment, thereby improving self-efficacy (Bandura, 1997). Conversely, short-term personnel may experience a novelty effect or discomfort due to unfamiliarity, resulting in lower self-efficacy and higher stress levels. These findings are also aligned with research by Li. (2020), who reported that longer tenures in closed environments like submarines or ships lead to better psychological adaptation and coping strategies over time. The variation observed among the three groups supports the importance of duration of exposure as a determinant in how IAQ impacts psychological well-being and perceived efficacy.

Age of Crew Differences in related with IAQ, Self Efficacy and Stress

Hypothesis 3 aimed to investigate whether there were statistically significant differences between age groups in terms of self-efficacy and stress levels as influenced by IAQ aboard warships. Prior to analysis, normality was confirmed via the Kolmogorov-Smirnov test and Q-Q plots, indicating the data was appropriately distributed for parametric testing. The one-way ANOVA test was employed to compare three age categories: Group 1 (20–30 years), Group 2 (31–40 years), and Group 3 (41–50 years). The results revealed no statistically significant differences among the three age groups regarding self-efficacy and stress levels, suggesting the null hypothesis (H_{03}) should be retained. Although Group 3 exhibited relatively higher levels of influence from IAQ factors and Group 2 the least, these differences did not meet the threshold for statistical significance.

One possible explanation is that within the military context, age may not play as dominant a role in determining psychological resilience or physiological sensitivity to IAQ. Military training tends to standardize stress responses and adaptability across personnel, regardless of age group (Hourani,2006). Moreover, in structured and disciplined military environments, coping strategies and stress mitigation behaviors are instilled early and reinforced consistently, possibly minimizing age-related variability in psychological responses (Castro & McGurk, 2007). Additionally, the Malaysian Armed Forces' pension scheme allows for retirement after 21 years of service, resulting in a relatively younger service population overall. This structural feature limits prolonged age stratification and could explain the reduced significance of age as a differentiating factor in this study. Previous literature has suggested that while age can influence stress response and cognitive performance in civilian populations, its impact is less pronounced among military personnel due to uniform occupational demands and fitness standards (Bartone, 2006).

Nonetheless, this finding opens up new avenues for research. Future studies could explore whether age-related differences in stress and self-efficacy become more evident in post-service veterans or personnel exposed to extreme environmental conditions over prolonged deployments. Longitudinal studies that monitor aging naval personnel beyond active duty may provide more nuanced insights into how age interacts with environmental stressors such as IAQ**.**

CONCLUSION

This study highlight the significant relationship between IAQ, self-efficacy, and stress levels among Royal Malaysian Navy (RMN) warship personnel, particularly influenced by gender and length of service. Poor IAQ is associated with increased stress and reduced self-efficacy, notably among female personnel and those serving longer. Utilizing self-reported data and SPSS analysis, the study highlights how environmental conditions affect operational performance in maritime contexts, though limitations include the exclusion of clinical data and individuals with under six months of service.

The findings contribute to both academic discourse and naval policy, reinforcing the importance of psychosocial health in confined naval environments. This aligns with ICOP 2010, the Malaysia MADANI framework, and the UN Sustainable Development Goals. Future studies should include systematic IAQ monitoring, enhanced occupational health practices, and clinical or physiological data to better safeguard personnel health and operational readiness.

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