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Occupational Stress and Aerobic Capacity Among Nursing Staff-An Observational Study

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Abstract:

Purpose: Occupational stress is a growing concern among healthcare professionals, particularly nursing staff, as it adversely affects both physical and mental health. Understanding its association with aerobic capacity is critical for developing preventive measures and improving overall well-being. This study aimed to assess occupational stress levels and aerobic capacity (VO_2 max) among nursing staff and to analyze the relationship between these variables.

Methods: This observational, cross-sectional study was conducted at Civil Hospital, Ahmedabad, and involved 100 nursing staff participants selected through convenience sampling. Occupational stress levels were measured using the Perceived Stress Scale-10 (PSS-10) and the Modified Nursing Stress Scale (MNSS). Aerobic capacity was evaluated using the 6-minute walk test (6MWT), from which VO_2 max was calculated. Data were analyzed statistically using Spearman's correlation to determine the relationship between stress levels and aerobic capacity.

Results: The results demonstrated that 63% of the nursing staff experienced moderate levels of occupational stress. ICU nurses reported higher stress scores compared to nurses from other departments. Statistical analysis revealed a significant negative correlation between occupational stress scores and VO_2 max values ($p<0.05$), indicating that higher levels of stress were associated with reduced aerobic capacity.

Conclusion: The study concludes that increased occupational stress is significantly linked to decreased aerobic capacity in nursing staff. These findings highlight the urgent need for effective stress management strategies and regular aerobic fitness assessments to promote better health outcomes among nursing professionals.

Keywords: Occupational Stress, Aerobic Capacity, VO_2 Max, Nursing Staff, 6-Minute Walk Test, Perceived Stress Scale.

Introduction:

Occupational stress refers to any force that strains an individual by overwhelming their psychological or physical capacity [(1)]. Among healthcare professionals, nurses are particularly vulnerable to occupational stress due to the demanding nature of their work [(2)]. Menzies was the first to systematically evaluate stress in nursing, identifying four key factors responsible for elevated stress levels: patient care responsibilities, decision-making, accountability, and organizational changes [(3)]. As the nursing profession continues to evolve and expand, the expectations placed on nurses have increased, leading to higher stress levels when demands surpass available coping resources [(4)].

Nurses often face complex situations that involve both emotional and physical challenges, including long working hours, insufficient staffing, complex patient care needs, and strained interpersonal relationships [(4, 5)]. According to Selye's General Adaptation Theory, stress triggers a biophysiological response that encompasses physical, emotional, psychological, and even spiritual dimensions (6). Over time, chronic exposure to these stressors can lead to emotional exhaustion, burnout, dissatisfaction, and deterioration in the quality of care provided to patients [(3, 4)].

Continuous occupational stress has been associated with a range of adverse health outcomes, including headaches, insomnia, fatigue, mood disturbances, musculoskeletal pain such as lower back pain, and chronic diseases like myocardial infarction, stroke, and diabetes mellitus [(7)]. In extreme cases, occupational stress has been recognized as a contributing factor to cardiovascular diseases (CVD) through mechanisms such as arterial stiffening and hypothalamic-pituitary-adrenal (HPA) axis dysregulation [(8, 9)]. In some regions, such as Korea, work-related cardiovascular events caused by long working hours and chronic overwork are classified as occupational diseases [(1)].

Apart from its psychological impact, occupational stress also influences the physical activity patterns of nurses. Evidence suggests that healthcare workers, especially nurses, engage in lower levels of physical activity compared to the general population, increasing their risk for obesity and related health complications [(10, 11)]. This decrease in physical activity and subsequent weight gain negatively affects their overall health status and job performance. Evaluation of cardiorespiratory fitness becomes crucial, as it serves both as a preventive measure and as an indicator of stress-induced cardiovascular risk [(12)].

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Maximal oxygen uptake (VO_2 max) is a widely accepted measure of cardiorespiratory fitness and reflects the body's ability to utilize oxygen during intense physical activity [13]. Assessing VO_2 max in nursing professionals can provide valuable insights into the physiological consequences of occupational stress and help guide preventive interventions aimed at improving both mental and physical well-being.

Materials And Methods:

Study Design and Setting:

This was an observational cross-sectional study conducted at Civil Hospital, Ahmedabad, Gujarat, India. The study was conducted over a period of 3 months following ethical clearance obtained from the Institutional Ethics Committee (Ref. No. GSIIESC/48/22).

Sampling Technique and Sample Size

The sample size for the study was 100 participants.

Justification: For qualitative data, sample size (n) was calculated using the formula: $n = 4pq / L^2$, Where, (n = calculated sample size, p = positive character, q = 100 – p, L = expected error (10% or 20% of p) and p = 0.51, q = 0.49, L = 10% of p [14]

Thus,

$n = 4pq / L^2$

$n = [\{4 \times (0.51) \times (0.49)\} / (0.1)^2]$

$n = [\{4 \times 0.51 \times 0.49\} / 0.01]$

$n = 0.9996 / 0.01$

$n = 99.96 \approx 100$

Participants

A total of 100 nursing staff members were included based on the following inclusion and exclusion criteria.

Inclusion Criteria

- Willingness to participate.
- Male and female nursing staff aged over 20 years and working more than 8 hours per day.
- 50% participants from Intensive Care Unit (ICU) and 50% from Surgical Ward.
- Minimum job experience of ≥1 year.

Exclusion Criteria

- Recent or previous cardiovascular and pulmonary complications.
- Any medical conditions such as diabetes mellitus or hypertension, or any surgical condition.
- Associated musculoskeletal and neurological conditions.

Materials Used

- Assessment form, consent form, pen, paper, pencil, eraser.
- Non-stretchable measuring tape, chalk stick, pulse oximeter, stopwatch.
- Two cones, chairs, sphygmomanometer, stethoscope, weighing machine.
- Stadiometer, calculator.
- Perceived Stress Scale-10 (PSS-10), Modified Nursing Stress Scale (MNSS).
- Rectangular walking area for 6-Minute Walk Test (6MWT).

Procedure

Participants were selected after obtaining written informed consent. Demographic data including name, age, gender, qualification, duty hours, years of experience, medical or surgical history were recorded.

Anthropometric measurements:

Height measured with stadiometer (cm), Weight measured with weighing scale (kg), BMI calculated using the formula: BMI = Actual Body Weight (kg) / Height² (m^2).

Assessment Tools:

1. **Perceived Stress Scale-10 (PSS-10):**

Participants completed the PSS-10 questionnaire, consisting of 10 items rated from 0 (never) to 4 (very often). The total score ranges from 0 to 40, with higher scores indicating greater perceived stress.

Score interpretation: [15]

- 0–13: Low stress
- 14–26: Moderate stress
- 27–40: High stress
- Reliability of PSS-10: 0.82. [16]

2. **Modified Nursing Stress Scale (MNSS): [17]**

Participants completed the MNSS, which includes 7 domains such as emotional conditions of patients, conflict with physicians and nurses, workload, and unpredictable changes. Each item was scored from 0 (never) to 3 (very frequently).

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- Total score ranges from 0 to 102.
- Reliability of MNSS: 0.93 [17]

3. **Aerobic Capacity (VO_2max) - 6-Minute Walk Test (6MWT):** [18]
   - Participants underwent the 6MWT following standardized protocol.
   - The test was conducted on a 30-meter rectangular walking area marked with chalk and cones at either end.
   - Participants were instructed to walk as far as possible for 6 minutes without running.
   - Standardized encouragement was given at fixed intervals.
   - Post-test vitals (HR) and 6MWD (six-minute walk distance) were recorded.

VO_2max Calculation

The VO_2 max was calculated using the following formulas: VO2max was calculated using numerical values obtained from the test.

The formula for men, [13]

VO2max = 110.546 + (0.063 × 6MWD) – (0.250 × age) - (0.486 × BMI) – (0.420 × height) – (0.109 × HR).

The formula for women, [13]

VO2max = 22.506 – (0.271 × weight) + (0.051 × 6MWD) – (0.065 × age.

Hypothesis

Grounded in **TAM** and **EI theory**, the study proposes the following hypotheses:

H1: AI adoption is positively associated with job performance.

Rationale: Faculty members who effectively adopt AI tools are likely to improve efficiency, teaching quality, and administrative outcomes.

H2: AI adoption is positively associated with emotional intelligence (or EI-related responses such as openness and adaptability).

Rationale: Engaging with AI technologies requires emotional readiness, adaptability, and openness to change, which may enhance EI among faculty members.

H3: Emotional intelligence is positively associated with job performance. *Rationale:* Faculty with higher EI are better at managing stress, communicating effectively, and handling academic challenges, leading to improved job outcomes.

H4: Emotional intelligence mediates the relationship between AI adoption and job performance.

Rationale: The impact of AI on performance may be more significant when faculty possess high EI, enabling them to leverage technology effectively and cope with associated challenges.

Results

The present study assessed occupational stress using the Perceived Stress Scale (PSS), Modified Nursing Stress Scale (MNSS), and aerobic capacity (VO_2 max) via the 6-Minute Walk Test (6MWT) among 100 nursing staff. Data analysis was conducted using SPSS version 16.0. Normality was assessed using the Kolmogorov–Smirnov test and the data was found to be not normally distributed; hence, non-parametric statistical tests were applied. Descriptive statistics are presented as median, mean, standard deviation, and frequency distributions. Spearman's rank correlation test was used to assess the association between variables. The level of significance was set at 5% with a confidence interval of 95%.

Demographic Characteristics

- Out of 100 participants, 94% (94/100) were females and 6% (6/100) were males. The mean age was 31.12 ± 8.03 years, ranging from 21 to 60 years.
- Regarding Body Mass Index (BMI), 11% (11/100) were underweight (<18.5 kg/m²), 55% (55/100) had normal weight (18.5-24.9 kg/m²), 27% (27/100) were overweight (25-29.9 kg/m²), and 7% (7/100) were obese class I (30-34.9 kg/m²), with a mean BMI of 23.00 ± 3.77 kg/m².
- The mean professional experience was 7.51 ± 3.77 years, with most nurses (52%, 52/100) having 1-5 years of experience.

Perceived Stress Scale (PSS) Findings

- Based on PSS scores, 19% (19/100) of nurses experienced low stress (median = 10), 63% (63/100) moderate stress (median = 20), and 12% (12/100) high stress (median = 27). The overall mean PSS score was 13.04 ± 6.18, with a median of 19.

Modified Nursing Stress Scale (MNSS) Findings

- According to MNSS scores, 48% (48/100) had low stress (median = 22), 51% (51/100) moderate stress (median = 45), and 1% (1/100) high stress (median = 69). The mean MNSS score was 34.77 ± 13.83, with a median of 37.

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Gender-wise Stress Level

- Among female nurses (n=94), the mean MNSS score was 34.75 ± 13.85 (median = 37), indicating moderate stress. Male nurses (n=6) had a mean MNSS score of 32.00 ± 1.66 (median = 28.5), indicating lower stress levels.

Department-wise Stress Level

- ICU nurses reported higher stress levels with a mean MNSS score of 44.40 ± 10.98 (median = 45), indicating moderate stress. Surgical ward nurses had a lower mean score of 24.92 ± 8.84 (median = 23), indicating low stress.

MNSS Stress Factors

- Among seven MNSS stress factors, "Unpredictable changes" (Factor 5) was most frequently reported overall by 49.2% (49.2/100), by 64% (64/100) of ICU nurses, and by 35.4% (35.4/100) of surgical ward nurses. Emotional and painful patient conditions (Factor 1) were more commonly reported among surgical ward nurses (35.4%).

Aerobic Capacity (VO_2 Max)

- The observed VO_2 max values were lower than predicted norms across all age groups. For female nurses, VO_2 max ranged from 28 ± 2.38 ml/kg/min (age 18–29) to 18.60 ± 1.51 ml/kg/min (age 50–59). Male nurses (n=6) also showed lower VO_2 max values compared to predicted norms, with a mean of 37 ± 17.5 ml/kg/min in the 18–29 age group.

Correlation Analysis

Spearman's correlation showed significant associations:

- **PSS Score:**

✓ Positive moderate correlation with MNSS score ($r = 0.690$, $p < 0.001$).
✓ Positive moderate correlation with VO_2 max ($r = 0.413$, $p < 0.001$).
✓ Negative weak correlation with experience years ($r = -0.0311$, $p = 0.002$).

- **MNSS Score:**

✓ Positive moderate correlation with PSS score ($r = 0.690$, $p < 0.001$).
✓ Positive moderate correlation with VO_2 max ($r = 0.430$, $p < 0.001$).
✓ Negative weak correlation with experience years ($r = -0.254$, $p = 0.01$).

- **VO_2 Max:**

✓ Positive moderate correlation with PSS ($r = 0.413$, $p < 0.001$) and MNSS ($r = 0.430$, $p < 0.001$).
✓ Negative moderate correlation with BMI ($r = -0.419$, $p < 0.001$), age ($r = -0.166$, $p < 0.001$), and experience years ($r = -0.254$, $p = 0.01$).
✓ Positive moderate correlation with 6MWD ($r = 0.624$, $p < 0.001$).
✓ Negative weak correlation with heart rate ($r = -0.237$, $p = 0.01$).

Summary:

Based on the above findings, the null hypothesis was rejected. There was a significant correlation between occupational stress and aerobic capacity among nursing staff.

DISCUSSION

The present study was conducted to assess the occupational stress and aerobic capacity among 100 nursing staff. Fifty percent of the staff were taken from the ICU and fifty percent from the Surgical Ward. Occupational stress is a recognized problem in health care workers [(2)]. Menzies conducted the first assessment of work stress in nursing and identified four factors that cause nurses to become anxious: patient care, decision-making, taking accountability, and change [(3)].

In the present study, the stress levels among nursing staff were assessed by the PSS-10 and MNSS Scale. The study by Eon-Hyun Lee (2012) showed that the PSS-10 can be used to measure perceived stress, both in practice and research [(15)]. The study conducted by Vasundhara Pathak, Tania Chakraborty, and Suman Mukhopadhyay (2013) stated that the MNSS was found to be a valid and efficient tool for assessing work-related stress among the Indian nursing population.

In this present study, out of 100 subjects, the overall nursing staff had a moderate level of stress. Ninety-four female subjects had a moderate level and six male subjects had a low level of occupational stress reported. Similar results were obtained by Lakshmi Narayanan et al. (1999) who found that situational constraints and workload were perceived to a greater degree by nurses while interpersonal conflict was reported to a greater degree by physicians. They stated that interpersonal conflict was a more frequently reported source of stress for women than men [(19)].

In this present study, out of 100 subjects, ICU nursing staff reported a moderate stress level, and Surgical Ward nursing staff reported a low level of stress. Sharma Parul et al. (2014) showed that the main nurses' occupational stressors were poor doctor's attitude, posting in busy departments (emergency/ICU), inadequate pay, too much work which stated a

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statistically significant association (P < 0.024) between department of posting and level of stress [3].

This present study showed that from seven factors of MNSS, factor no. 5 (Unpredictable changes) was more frequently reported than other factors by 49.2% of nurses overall. A similar result was obtained by Namrata Mohite et al. (2012) which stated that 49% of nurses reported frequent occurrence of stress due to uncertainty concerning treatment.

This present study showed that years of experience of nursing staff negatively correlated with perception of stress (r = -0.254, p = 0.01). A study conducted by Criadera Mohanty noted a significant relationship between stress and age (x^2 = 8.212), and years of experience (x^2 = 8.194). While Namrata Mohite et al. (2012) stated that stress level had no significant correlation with demographic data [4].

Occupational stress can also cause cardiovascular diseases by accelerating arterial stiffening [10]. Evaluation of cardiorespiratory fitness is required to prevent stress-induced cardiovascular disease [12]. The study by Marketa Savova et al. (2020) concluded that the usage of CPET (Bruce Protocol) during regular medical check-ups of staff significantly increases the detection of hidden diseases and thus improves care for nurses [11].

In this present study, aerobic capacity (VO_2max) of nursing staff was assessed by age and gender-wise predicted value from 6MWT. Research by Ari Manttari et al. (2018) evaluated that for men, the best predictors for VO_2max were calculated by walking distance, age, height, BMI, heart rate at the end of 6MWT; and for women, walking distance, age, and weight.

In this present study, overall nursing staff were reported to have low aerobic capacity. A similar result was obtained by R. Naidoo & Prof. Y Coopoo (2007) on the health and fitness profiles of nurses in KwaZulu-Natal which stated this is due to the lack of physical activity and exercise. A study was done by Piyanee Klainin-Yobas et al. (2015) which stated that students who exercised regularly tended to have better physical fitness, perceived physical health and psychological health. Those who did not have sleep problems had better psychological health [20].

In the present study, correlation between PSS score & MNSS score was strongly positive (r = 0.690, p < 0.05). Respondent age had negative correlation with MNSS score (r = -0.3, p < 0.05). Similar results were obtained by Stacey R. Purcell et al. (2011) who examined the relationships between nurses' stress and nurse staffing in a hospital setting. They stated younger nurses had more nursing stress than older nurses. Age, patient workload, and day of the week worked are important factors affecting nurses' stress levels [21].

In the present study, occupational stress had a significant positive correlation with aerobic capacity (VO_2max) [r = 4.30, p = 0.01]. This may be due to multiple appointments in one day (e.g., continuous long overnight duty, patient workload, shortage of staff), being physiologically activated multiple times to fulfill the tasks and change locations, which may result in increased physical activity. The study by Markus Reichert PhD et al. (2022) showed the complex bidirectional relationship of psychological stress (PS) with physical activity (PA). They found higher psychological stress predicted increased physical activity across days because of being physiologically activated multiple times to fulfill tasks and change locations [22].

The study by René Schilling et al. (2019) showed that cardiorespiratory fitness moderated the association between occupational stress, cardiovascular risk, and mental health. Similarly, the present study results also suggest that occupational stress may be more closely related to psychological health than physical health [19].

In the present study, VO_2max had a significant negative correlation with heart rate (HR) (r = -0.23, p = 0.01). Furthermore, VO_2max had a significant correlation with demographic data and 6MWD. Majid Jalili et al. (2018) suggested similar results in their study which provides a relatively accurate and convenient VO_2max prediction value from equation based on the 6MWT [23].

Therefore, the present study could contribute to increasing the identification of occupational stress level and aerobic capacity among nursing staff. Occupational stress is associated with cardiovascular disease. Hence, early prevention for stress-induced cardiovascular disease may be achieved by screening for occupational stress and aerobic capacity

Conflict of Interest Statement

The authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest (such as honoraria, educational grants, participation in speakers' bureaus, membership, employment, consultancies, stock ownership, or other equity interest, and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge, or beliefs) in the subject matter or materials discussed in this manuscript.

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Tables

Table 1. Demographic Characteristics of the Study Participants

Parameters	Categories	Frequency (%)	Mean ± SD	Median	Interpretation
PSS Score	Low	19 (19%)	9.8 ± 2.33	10	Low Stress
	Moderate	63 (63%)	20.19 ± 3.84	20	Moderate Stress
	High	12 (12%)	27.66 ± 0.98	27	High Stress
	Total	100 (100%)	13.04 ± 6.18	19	-
MNSS Score	Low	48 (48%)	22 ± 5.79	22	Low Stress
	Moderate	51 (51%)	45.82 ± 7.12	45	Moderate Stress
	High	1 (1%)	69.0	69	High Stress
	Total	100 (100%)	34.77 ± 13.83	37	-
Gender-wise MNSS	Female	-	34.75 ± 13.85	37	Moderate Stress
	Male	-	32 ± 1.66	28.50	Low Stress
	Total	-	34.64 ± 1.39	36	Moderate Stress
Posting-wise MNSS	ICU	-	44.40 ± 10.98	45	Moderate Stress
	Surgical Ward	-	24.92 ± 8.84	23	Low Stress

GENDER		
	Female	**Male**
	94 (94%)	6 (6%)
AGE		
	Frequency of nurses & Percentage	**Mean ± SD (In Years)**
21-30	63(63 %)	26.12±1.97
31-40	22(22%)	34.09 ±2.94
41-50	11(11%)	44.72±2.90
51-60	4 (4%)	50.60±8.29
Total	100	31.12 ± 8.03
BMI (BODY MASS INDEX)		
	Frequency (Percentage) of nurses	**Mean ± SD (kg / meter ^{2})**
<18.5	11 (11%)	17.0 ±1.09
18.5-24.9	55(55%)	21.58±1.61
25-29.9	27(27%)	24.04±1.30
30.0-34.9	7(7%)	30.42 ± 0.7
EXPERIENCE YEAR		
	Frequency (Percentage) of nurses	**Mean ± SD (kg / meter ^{2})**
1-5	52 (52%)	2.83±1.39
6-10	24(24%)	7.45±1.28
11-15	11(11%)	13.45±0.934
16-20	3(3%)	18.0±1.73
21-25	6(6%)	22.33±1.36
26-30	3(3%)	28.66±1.52

Table 2. Stress Levels Among Nursing Staff Assessed by PSS, MNSS, Gender, And Posting
(PSS SCORE: Perceived Stress Scale Score, MNSS SCORE: Modified Nursing Stress Scale Score, SD: Standard Deviation)

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Table 3. MNSS Factor among Nurses (in %)

FACTOR	among ICU nurses (%)	Among Surgical ward nurses %)	Among Overall nurses (%)
1.Emotional and Painful conditions of patients	48.4%	35.4%	41%
2.Conflict with physicians	37.6%	21.86%	29%
3.Lack of Support	24.33%	8.88%	16.7%
4.Conflict with other Nurses	45.46%	20.91%	33.2%
5.Unpredictable changes	64%	35%	49.2%
6.Workload	51.5%	22.83%	37.1%
7.Uncertainty concerning treatment	36.66 %	14.66%	25.66%

Table 4. Age-wise Comparison of Normal and Observed VO_2 Max Values

Age Group (Years)	Normal Predicted VO_2 Max (ml/kg/min) [13]	Observed VO_2 Max (Mean ± SD, ml/kg/min)
Female Group		
18–29	34.6	28 ± 2.38
30–39	33	23.24 ± 1.20
40–49	29.4	20.27 ± 0.46
50–59	27.5	18.60 ± 1.51
Male Group		
18–29	41.4	37 ± 17.5
30–39	37	-
40–49	34.6	-
50–59	32.2	-

Table 5. Spearman's correlation analysis between variables

Variables	Correlated With	*r* Value	*p* Value	Significant
PSS Score	Experience Year	-0.0311	0.002	Yes
	MNSS Score	0.690	0.00	Yes
	VO_2 Max	0.413	0.00	Yes
MNSS Score	Experience Year	-0.254	0.01	Yes
	PSS Score	0.690	0.00	Yes
	VO_2 Max	0.430	0.00	Yes
VO_2 Max	PSS Score	0.413	0.00	Yes
	MNSS Score	0.430	0.00	Yes
	Experience Year	-0.254	0.01	Yes
	BMI	-0.419	0.00	Yes
	Age	-0.166	0.00	Yes
	6-Minute Walk Distance (6MWD)	0.624	0.00	Yes
	Heart Rate	-0.237	0.01	Yes

(PSS: Perceived Stress Scale, MNSS: Modified Nursing Stress Scale, VO_2 Max: Maximal Oxygen Consumption, BMI: Body Mass Index, 6MWD: Six-Minute Walk Distance, HR: Heart Rate)

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Figures:

Figure 1. Gender Distribution

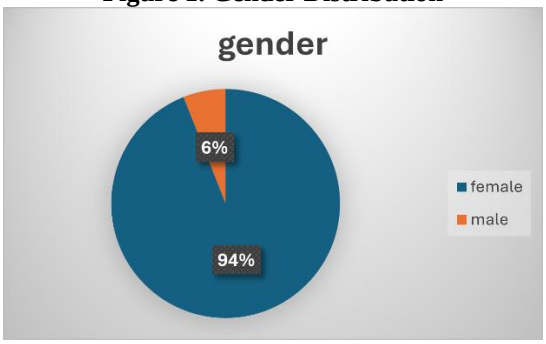

Figure 2. Age distribution

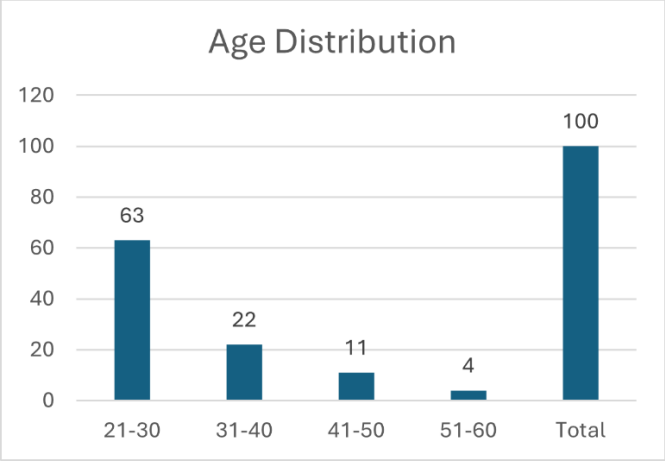

Figure 3. BMI Categorization

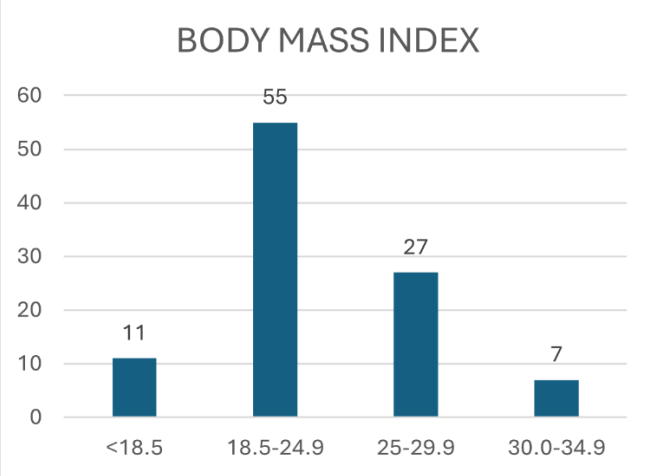

Figure 4. Level of stress among Nursing staff by PSS Score

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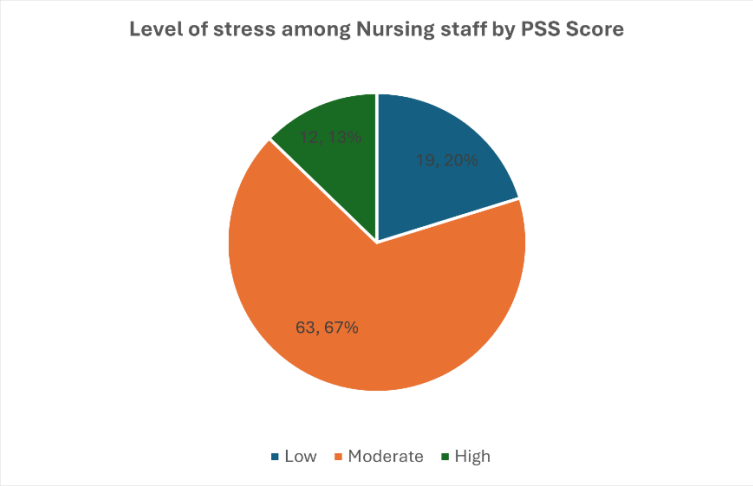

Figure 5. Level of stress among Nursing staff by MNSS Score

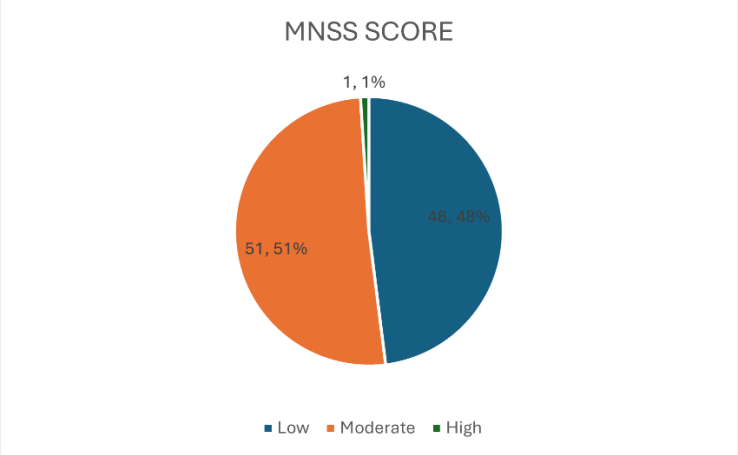

Figure 6. Stress Level among Female and male Nurses

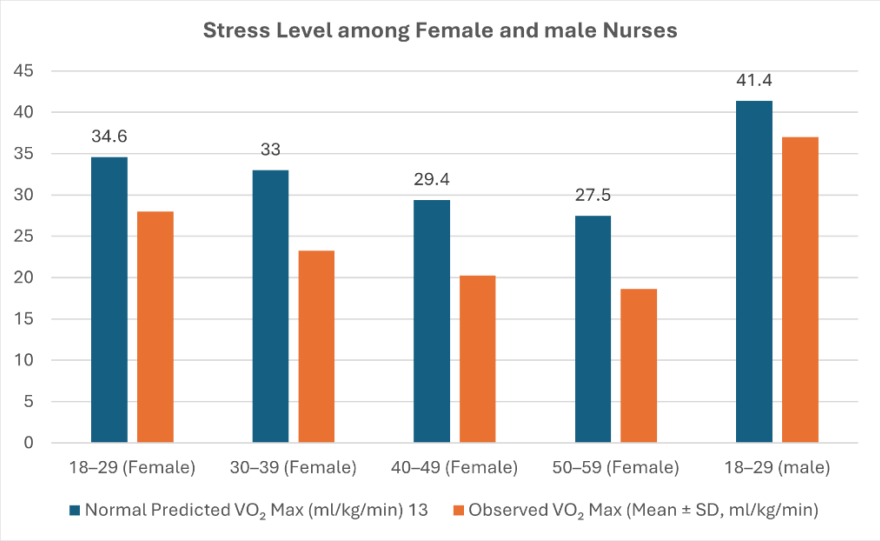

Figure 7. Stress Level among ICU and Surgical Ward Nurses

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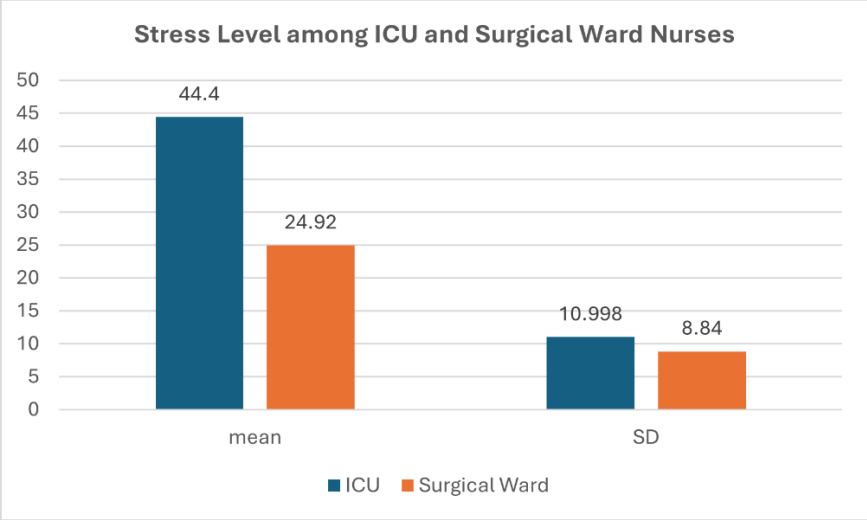

Figure 8. Scatter plot showing correlation between PSS score & MNSS score.

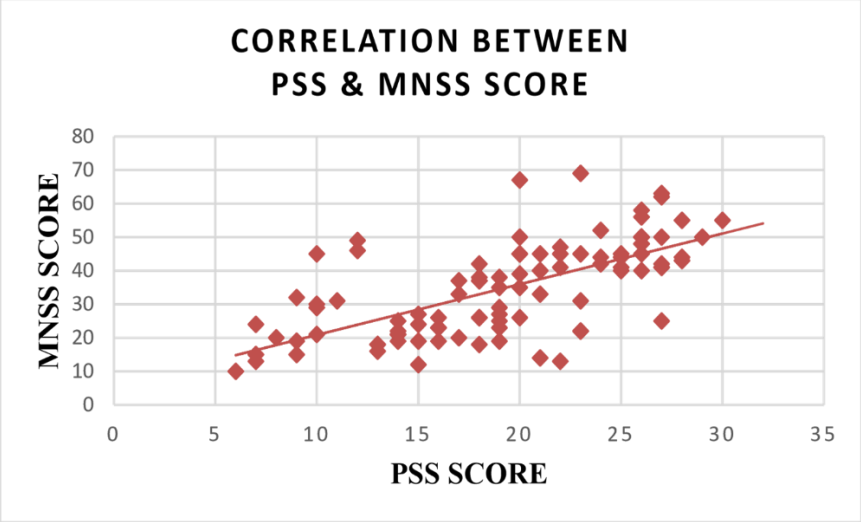

Figure 9. Scatter plot showing correlation between Stress level (PSS score) & (VO_2 max)

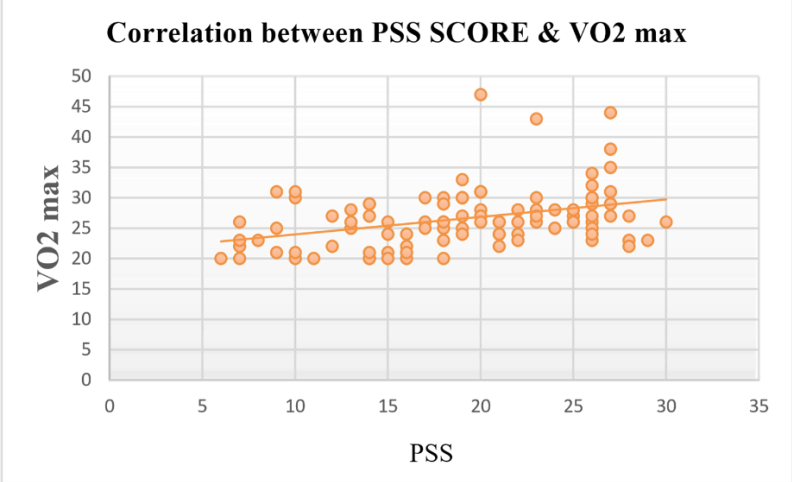

Figure 10. Scatter plot showing correlation between Stress level (MNSS score) & aerobic capacity (VO_2 max)

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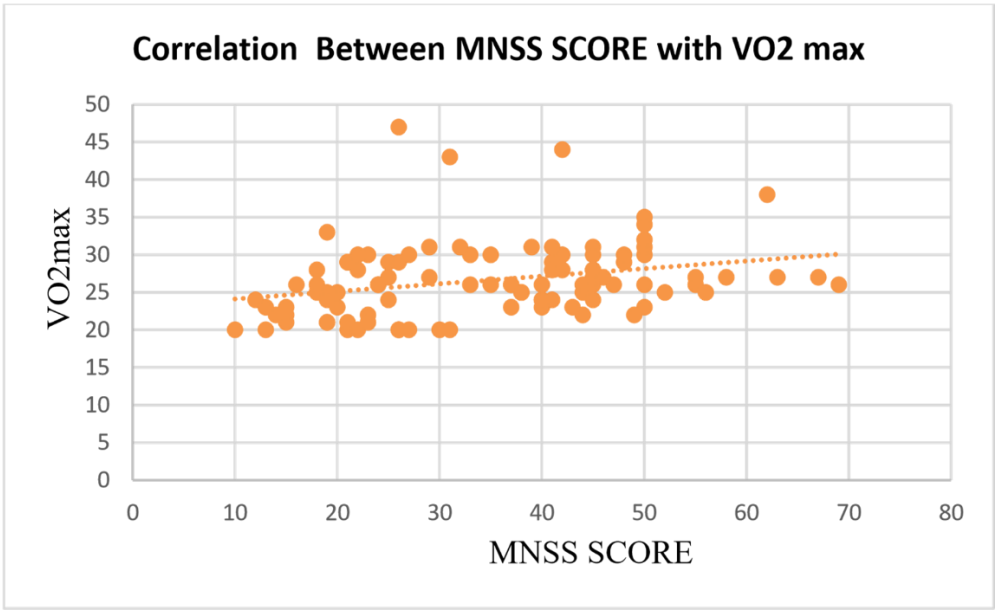

Figure 13. Measuring height and weight of subjects.

Figure 14. Females and Males subjects were filling the questionnaire

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Figure 15. Measuring Vitals.

Figure 16. Performing 6MWT