The Relationship Between High Altitude Work Environments and Anxiety Among Employees

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Abstract

The present study examines the relationship between high altitude and anxiety levels among employees at one of Indonesia's leading petrochemical company. Using a quantitative research design, the investigation focused on 42 employees working in distinct altitude zones within the facility. Data were collected over a six month period during normal operational hours, employing the Hamilton Anxiety Rating Scale (HARS) as the standardized psychological assessment tool. Altitude measurements for work zones were recorded precisely, with categorized levels defines as low, moderate, high and very high altitude zone. Descriptive statistics, including means, standard deviations, and range values, were computed and correlation tests conducted R programming to determine the strength and direction of the relationship between altitude and anxiety. Results revealed the mean HARS scores among 42 participants was 21.4 (SD = 5.7), with a range of 11 to 33 whilst a statistically significant positive correlation between increased altitude exposure and elevated anxiety scores ($r = 0.68$, $p < 0.001$), suggesting that higher work zone are associated with greater anxiety levels among employees. Implications for workplace design and employee well-being interventions are explored, with recommendations for future research addressing broader environmental and psychosocial variables.

Keywords: Anxiety, HARS, high altitude, work environments

Introduction

Occupational health and safety (OHS) have emerged as pivotal issues within industrial settings, particularly within the petrochemical sector where environmental and operational stressors often intersect (Zarini Harsini et al., 2020; Asgedom et al., 2019). The present study addresses one such critical intersection: the potential relationship between high altitude work environments and anxiety among employees. One of Indonesia's leading petrochemical company features distinct altitude levels across its operational zones. This variation provides a unique opportunity to examine whether altitude exposure contribute to psychological stress and anxiety. While anxiety is a well documented phenomenon that can adversely affect individual performance, decision making and overall mental health. Prior research has typically concentrated on environmental factors such as noise, temperature, and lighting. However, few studies have focused on altitude as a unique occupational factor. The Hamilton Anxiety Rating Scale (HARS), a widely recognized tool in clinical settings, offers a standardized approach for quantifying anxiety, thereby facilitating reliable comparisons across different altitude groups (Sepehri, 2019; Hamilton, 1959).

Anxiety is a prevalent mental health concern that affects individuals worldwide, with various biological, psychological, and environmental factors influencing its onset and severity (Alonso, 2019). One environmental factor that has gained increasing attention is high altitude, which exposes individuals to unique physiological and psychological stressors. The reduced oxygen levels at high elevations can lead to hypoxia, which has been linked to changes in brain function, mood, and anxiety levels. Understanding the relationship between high altitude and anxiety is crucial for individuals living in or traveling to high-altitude regions, as well as for healthcare providers managing anxiety-related disorders in these settings (Reuben, 2022; Brokamp, 2019).

High altitude environments impose physiological stress on the human body, particularly through hypobaric hypoxia, which reduces oxygen availability (Simpson, 2024). This condition can trigger the activation of the sympathetic nervous system, leading to symptoms such as increased heart rate, shortness of breath, and dizziness symptoms that closely mimic anxiety (Maiti et al., 2023). Additionally, alterations in neurotransmitter function, particularly involving serotonin and dopamine, may contribute to mood disturbances, including heightened anxiety. Studies suggest that individuals with pre-existing anxiety disorders may be more vulnerable to the effects of high altitude, potentially exacerbating their symptoms (Liu et al., 2024).

Beyond physiological factors, psychological and environmental stressors at high altitudes can further contribute to anxiety. The isolation, extreme weather conditions, and limited access to healthcare services in high-altitude regions may increase feelings of distress and uncertainty (Chen et al., 2023). Furthermore, individuals engaging in high-altitude activities, such as mountaineering or military operations, often experience increased stress and anxiety due to the demanding physical and cognitive challenges associated with these environments. These factors highlight the complex interplay between altitude, physiological responses, and psychological well-being (Zeng et al., 2024).

This study proposes that employees working at higher altitudes within the facility may experience greater anxiety, potentially due to physiological changes, for instance decreased oxygen partial pressure or psychological stress associated with heights. We hypothesize a significant positive relationship between altitude level and anxiety scores. Moreover, the research incorporates OHS perspectives by addressing the potential ling-term impacts of altitude induced anxiety on operational safety and employee well-being.

Given the increasing importance of stress management in industrial settings, this research aims to provide empirical data that could inform interventions and policy adjustments at one of Indonesia's leading petrochemical company. By documenting the altitude specific variations in anxiety levels using rigorous quantitative methods,

the study seeks not only to contribute to the scientific literature but also to offer practical insights for managing employee health risks in petrochemical operations.

Research Method

Study Design

A total of 42 employees working at one of Indonesia's leading petrochemical company voluntarily participated in the study. The sample included employees from various operational sectors within the facility, stratified according to the specific altitudes at which they perform their duties. Participants ages ranged between 20 and 45 years, with diverse job including technical, administrative and supervisory positions. In accordance with ethical guidelines, all participants provided informed consent prior to data collection and were assured confidentiality and the right to withdraw at any time without penalty.

The workplace at one of Indonesia's leading petrochemical company is segmented into clearly delineated zones, each with a specific altitude:

Table 1. Categorized level of altitude

No	Altitude (meters)	Zone Category
1	25 - 50 meters	Low Altitude Zone
2	51 - 100 meters	Moderate Altitude Zone
3	101 - 150 meters	High Altitude Zone
4	151 - 200 meters	Very High Altitude Zone

Each height measurement were documented for each work area using calibrated altimetry instruments, ensuring precise categorization and data consistency. Anxiety levels were measured using the Hamilton Anxiety Rating Scale (HARS), a clinical assessment tool comprising 14 items rated on a scale from 0 (not present) to 4 (severe). The total score, which ranges from 0 to 56, offers an index of overall anxiety severity. The HARS has been validated is numerous occupational health studies and has demonstrated robust psychometric properties in reliability and validity (Hamilton, 1959).

Data were collected over a period of four months coinciding with the normal operational hours of one of Indonesia's leading petrochemical company. A standardized data collection protocol was implemented, including (1) employees were recruited through an internal announcement detailing the objectives of the study, recruitment was voluntary and an informed consent form was provided to all potential participants; (2) a trained clinical psychologist administered the HARS instrument individually in a quiet, designated examination room to minimize distraction; (3) for each participant, the exact altitude of the work zone was recorded, and the altitudes were transformed into categorical variables according to pre-defined work zone categories; (4) all data were anonymized using unique identification codes which participant responses were digitally recorded and stored on an encrypted server accessible only by authorized research personnel.

Statistical analysis was conducted using R programming software (Ravelle, 2023). Descriptive statistics (mean, standard deviation, median, and range) were computed for HARS scores across each altitude category. A Pearson correlation test was performed to evaluate the relationship between altitude levels (treated as a continuous variable, based on recorded height measurements) and anxiety scores. An alpha level of 0.05 was set for all significance tests. While the R code snippet used for correlation analysis, the code enabled the computation of the Pearson correlation coefficient and provided confidence intervals and p-values for inferences regarding the significance of the relationship (Field, 2020).

Results

Descriptive statistics provided an overview of anxiety levels across different altitude zones. The overall mean HARS scores among 42 participants was 21.4 (SD = 5.7), with a range of 11 to 33. When the sample was stratified by altitude:

Table 2. Descriptive statistics for HARS score across altitudes zones

No	Altitude Zone	Altitude Range (meters)	Mean HARS Score	SD
1	Low	25-50	17.2	3.8
2	Moderate	51-100	20.5	4.9
3	High	101-150	23.1	5.3
4	Very High	151-200	27.4	4.6

The descriptive data indicated a trend of increased anxiety scores with rising altitude.

Table 3. Pearson correlation between altitude and HARS score

Variables	Altitude (meters)	HARS Score
Altitude (meters)	1.00	0.68**
HARS Score	0.68**	1.00

The Pearson correlation analysis revealed a statistically significant positive relationship between altitude (in meters) and HARS scores ($r = 0.68$, $p < 0.001$). This suggests that working at higher altitudes is associated with higher levels of anxiety among employees. Additional analyses included subgroup comparisons and explorations or potential confounding variables such as age and duration of employment. However, when controlling for these factors using partial correlation analyses, the relationship between altitude and anxiety remained robust.

Discussion

The findings of this study support the hypothesis that there is a significant relationship between higher altitude work environments and elevated anxiety levels among employees at PT Chandra Asri petrochemical. The statistically significant correlation ($r = 0.68$, $p < 0.001$) substantiates the notion that increases in work zone altitude are associated with heightened anxiety scores as measures by the HARS.

Several factors may underpin this relationship. Physiologically, exposure to higher altitudes can lead to reduced atmospheric pressure and lower oxygen levels, which have been associated with symptoms of anxiety and stress (Zeng et al., 2024). Psychologically, employees may experience discomfort or fear related to working at heights, especially in an industrial environment where safety risks are perceived to be higher. The cumulative effect of these physiological and psychological stressors may contribute to the significantly higher anxiety scores observed in higher altitude zones (Talks et al., 2022).

Exposure to higher altitudes can have significant physiological effects due to reduced atmospheric pressure and lower oxygen levels, leading to conditions such as hypoxia, which can trigger symptoms of anxiety and stress (Li et al., 2023). The body compensates by increasing heart rate and respiration, which may contribute to feelings of breathlessness, dizziness, and heightened physiological arousal, further exacerbating anxiety. These effects can impair cognitive function, reduce concentration, and increase fatigue, all of which pose risks in occupational settings, particularly for workers in high-altitude environments (Hüfner et al., 2022). Understanding these physiological responses is crucial for developing effective workplace interventions, such as acclimatization programs, oxygen supplementation, and stress management strategies, to ensure employee well-being and maintain productivity (Rajesh et al., 2021)..

Psychologically, working at heights can induce fear and discomfort, particularly in industrial environments where perceived safety risks are greater. This fear, combined with physiological stressors such as reduced oxygen levels and increased heart rate, can amplify anxiety and reduce cognitive efficiency, leading to impaired decision-making and heightened accident risk (Burtscher et al., 2022). Employees may experience a persistent sense of unease, affecting their confidence and overall performance. The cumulative effect of these

physiological and psychological stressors explains the significantly higher anxiety scores observed in higher altitude work zones. Addressing these concerns through proper safety measures, psychological support, and acclimatization strategies is essential to improving worker well-being and maintaining operational efficiency (Wang et al., 2023) .

Occupational health implications are significant. Elevated anxiety levels can compromise employee performance, increase the risk of accidents, and ultimately impair overall operational safety. The integration of these findings within an OHS framework suggest that interventions aimed at reducing the psychological burden on employees, such as enhanced safety training, stress management programs, and modifications to work environment, could mitigate these adverse effects (Jung et al., 2020). Working at heights poses significant occupational health risks, particularly due to elevated anxiety levels that can impair cognitive function, decision-making, and situational awareness, increasing the likelihood of accidents (Hasanzadeh et al., 2020). Integrating these findings into an Occupational Health and Safety (OHS) framework highlights the need for targeted interventions, such as enhanced safety training, stress management programs, and ergonomic modifications to work environments. Comprehensive training on fall protection, mental health support, and the implementation of advanced safety technologies can help alleviate psychological burdens, improving both worker confidence and overall safety (Benson et al., 2024). Additionally, fostering a strong safety culture through open communication, worker participation, and recognition of safe practices can further mitigate risks, ensuring a safer and more productive workplace (Akinbode et al., 2024).

Limitations and Future Research Directions

The methodological design of this study strengthens the internal validity of the results. The use of standardized instrument (HARS) and a rigorous data collection protocol ensured that measurement error was minimized. However, as with all cross sectional research designs, causality cannot be definitively established. Longitudinal studies would be required to determine whether sustained altitude exposure leads to chronic anxiety or if other confounding factors play a role over time. On the other hand, the use of R programming for statistical analysis proved valuable, offering transparency and reproducibility. Nevertheless, some limitations should be noted. The relatively small sample size (n = 42) constraints the generalizability of the findings, and potential confounding variables such as individual differences in baseline anxiety, personal life stressors, and job specific demands were not fully controlled. Future research could benefit from a larger, more diverse such as personal resilience, social support, and organizational safety culture. Future studies should consider employing multivariate analysis techniques to parse these intricate relationships.

Conclusion

In conclusion, the study offers compelling evidence for a significant positive relationship between high altitude work environments and increased anxiety levels among employees at PT Chandra Asri Petrochemical. The findings indicate that employees working zones with high altitudes (particularly above 100 meters) exhibit significantly elevated HARS scores compared to those in lower altitude zones. These outcomes highlight the need for occupational health interventions that address altitude related psychological stress and promote a safer, more supportive work environment.

While the current study provides important insight, its limitations suggest caution in the generalization or the results. Future research should expand the sample size, include longitudinal analyses, and environmental adjustments, implement robust stress management programs, and continually evaluate workplace safety protocols, particularly in high altitude areas.

This study underscores the importance of addressing mental health in the context of industrial safety and encourages a holistic approach to employee wellbeing where physical condition and psychological

responses are closely monitored and managed. This study also have direct implications for occupational health and safety policies in the petrochemical industry. Organization should consider regular mental health assessments, particularly for employees exposed to higher altitudes. Interventions may include the provision of psychological support services, stress management workshops, and modifications to job design to reduce the psychological burden associated with working at heights. Additionally, ensuring that employees are well informed about safety measures and environmental control in place can alleviate anxiety and foster a culture of health and safety within the organization.

Ethical Consideration

This study was conducted in strict adherence to ethical guidelines for research involving human participants. Informed consent was obtained from all participants, ensuring that they were fully aware of the study's aims, procedures, and their rights to confidentiality and withdrawal. Data were anonymized by assigning unique identification numbers, and all records were stored on an encrypted server accessible solely by authorized research personnel. The research protocol was reviewed and approved by the appropriate Institutional Review Board (IRB) at FIK Universitas Advent Indonesia with the number No. 271/KEPK-FIK.UNAI/EC/II/23.

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