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HEALTH AND SAFETY CHALLENGES IN ANDHRA PRADESH GRANITE MINES: AN EMPIRICAL ASSESSMENT OF WORKMEN CONDITIONS

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Abstract
This study explores the occupational health and safety issues encountered by workers in the granite mining industry of Andhra Pradesh, with a specific focus on the Chimakurthy area in Prakasam district. It highlights the critical risks faced by workers, such as job-related injuries and life-threatening illnesses like silicosis and tuberculosis, which are intensified by substandard working conditions and insufficient safety practices. The research is based on data gathered through structured questionnaires administered to 371 workers employed in various granite units across the region. The analysis delves into workers' perspectives on occupational hazards, the availability and use of protective gear, and preventive measures against accidents. The results indicate a wide range of views among workers regarding the seriousness of health threats and raise concerns about the adequacy and enforcement of existing safety regulations. The study offers evidence-driven insights to support practical recommendations for enhancing health and safety standards in the granite mining sector of Andhra Pradesh, thereby promoting a safer and more sustainable work environment.

Keywords: Granite Mining, Occupational Health, Safety, Worker Conditions

1. Introduction

The granite quarrying and processing sector plays a pivotal role in shaping the economy of Prakasam District, Andhra Pradesh, reflecting India's prominent position as one of the top global producers and exporters of natural stone, particularly granite. Despite contributing to local employment and economic growth, the industry raises serious concerns regarding the health and safety conditions of its workforce. These concerns are especially relevant given ongoing reports of labor and human rights violations in the South Indian granite industry, including hazardous working conditions (Global Research et al., 2017). In granite mining regions of Andhra Pradesh—particularly in the Chimakurthy area of Prakasam—workers are routinely exposed to a range of occupational health risks. Non-mechanized processing units are often associated with diseases such as silicosis and tuberculosis, which pose significant long-term health threats. Additionally, prolonged exposure to high noise levels contributes to hearing loss, while physically demanding tasks, such as lifting heavy materials manually, intensify the strain on workers' health. Disturbingly, basic safety tools like dust masks are often unavailable, leaving workers vulnerable to inhaling harmful dust particles. The lack of proper dust control systems and inadequate management of hazardous materials during blasting activities further endangers worker safety. This study focuses on analyzing the occupational health and safety challenges faced by laborers in select granite mining operations around Chimakurthy. Based on data collected through structured questionnaires completed by mine workers, the research assesses the real-world effectiveness of current safety measures. It examines worker perceptions about hazardous exposures, physical strain, availability and quality of protective gear, and the frequency of workplace accidents. The study also evaluates how well accident prevention strategies and healthcare provisions are implemented across these units. Understanding these challenges is vital for multiple reasons.

2.Literature Review

Bose (2012) examined how labor dynamics in India's automobile industry shifted following economic liberalization. He contended that the emphasis on productivity as part of the reform agenda often led to reduced focus on worker safety, an increase in precarious contract-based employment, and a decline in trade union influence. Although his study centered on manufacturing, these trends are equally applicable to the granite mining sector, where high-risk environments necessitate stringent safety policies and worker representation. In a comparative analysis of private versus cooperative granite quarries in Thrissur, Kerala, Markose (2013) found that private quarries generally demonstrated higher efficiency but differed in their enforcement of safety regulations. Conversely, cooperative quarries, while more attentive to worker welfare, often lacked adequate funding and operational capacity to maintain high safety standards. This study reveals the influence of governance models on workplace safety outcomes. Research from Luleå University of Technology (2014) focused on social sustainability in mining, highlighting the importance of diversity and inclusive work environments. It stressed that limited participation of women and marginalized groups may contribute to unsafe working conditions. This insight is particularly relevant to Andhra Pradesh's granite sector, where the promotion of inclusivity could serve as a crucial strategy for improving occupational safety. A comprehensive report by Glocal Research and the India Committee of the Netherlands (2015) shed light on labor practices across South Indian granite quarries, including those in Andhra Pradesh. The report documented grave violations such as child labor, unsafe work conditions, and forms of bonded labor, illustrating how systemic exploitation often correlates with poor health and safety frameworks. Dr.Naveen Prasadula (2025) investigated the living and occupational circumstances of mine workers in India, exposing frequent incidences of disease, fatal accidents, and limited access to protective infrastructure. These realities resonate with conditions in the Indian granite industry, where many workers face similar threats that remain inadequately addressed. The Kallahalli Iron Ore Mines provide a model for improving labor welfare. Initiatives such as routine medical checkups, employee housing, and educational support have led to increased worker satisfaction and retention. These strategies could be adopted in the Chimakurthy mining belt to improve employee well-being and industry stability (Study on Kallahalli Iron Ore Mines, 2017). According to research by the National Commission for Protection of Child Rights and its affiliates (2018), fully mechanized granite operations in Andhra Pradesh and Telangana largely do not involve child labor. However, school attendance among adolescents aged 13 and above remains irregular, indicating a need for education and skill-building interventions targeted at vulnerable youth. An article in *The New Indian Express* (2019) reported that semi-mechanized granite mining activities in Prakasam District employ more than 20,000 individuals. The pandemic led to significant disruptions in this workforce, prompting state support programs such as Nadu-Nedu. Despite these challenges, the region remains a critical export hub, supplying up to 80% of its granite output to China. Global trade dynamics continue to influence local mining strategies. A surge in granite exports from Brazil reflects increasing global demand, potentially encouraging Andhra Pradesh to refine its export strategies. In contrast, import restrictions in Sri Lanka have highlighted the unpredictability of international markets. After the COVID-19 crisis, Chimakurthy's granite sector struggled with labor availability and regulatory hurdles, causing major operational delays (Brazil's Granite Export Growth & Sri Lanka's Import Controls, 2020). On the sustainability front, Jain (2021) emphasized the potential of incorporating granite cutting waste into self-compacting concrete as a method to reduce dust-related hazards and promote environmental conservation. India's position as a major granite exporter makes such innovations particularly valuable. Sharma (2022) also encouraged eco-friendly practices by suggesting the reuse of granite slurry and construction waste as alternative materials. This method addresses the dual goals of minimizing industrial waste and supporting sustainable construction initiatives. A field survey by Rao (2023), involving 384 granite industry workers from Prakasam District, indicated generally favorable labor conditions. Most participants reported structured employment, fair wages, job

training, and access to healthcare—demonstrating adherence to prevailing labor standards and welfare practices. Lastly, the Government of Andhra Pradesh's 2024 socio-economic review provides broad insights into labor market trends, including employment levels and wage distributions. Though not confined to the granite industry, the report offers a useful context for shaping labor policies and safety regulations across the mining sector.

3.1. Statement of the Problem

The granite mining sector in Andhra Pradesh, India, while economically significant, exposes workers to substantial health and safety hazards. These include occupational injuries, respiratory illnesses (notably silicosis), musculoskeletal disorders, heat stress, and noise-induced hearing loss. Despite existing regulations, these challenges persist, indicating a need for systematic investigation. A lack of comprehensive data hinders the development of effective interventions and policies to protect this vulnerable workforce.

3.2. Objectives for Research: This research aims to:

1. Identify the primary health and safety hazards in Andhra Pradesh granite mines.
2. Assess the prevalence of occupational injuries and diseases among these workers.
3. Evaluate the effectiveness of existing health and safety measures and compliance.

3.3. Hypotheses: The following hypotheses will be tested:

- **H1:** Exposure to silica dust is significantly correlated with a higher prevalence of respiratory illnesses among granite mine workers in Andhra Pradesh.
- **H2:** Implementation of comprehensive safety training programs is associated with a lower incidence of occupational injuries in these mines.
- **H3:** Higher compliance with safety regulations is associated with a lower prevalence of occupational accidents.

4. Research Methodology

This study will employ a mixed-methods approach. A cross-sectional survey will collect quantitative data on working conditions, health outcomes, and safety practices from a representative sample of granite mine workers in Andhra Pradesh. Semi-structured interviews with workers, safety officers, and management will provide qualitative data, offering context and deeper insights. The population of the study was the employees of selected **Granite industries**. The total workforce employed in selected five units accounted for 5077 employees who were considered as the population of the study. From these workforces, 371 were judged as sample, by using the sample size determination formula, the number of participants was determined. During sampling procedures, the non-response rate was also considered. The number of respondents was selected by using a simplified formula of Yamane (1967). Quantitative data, gathered through a structured questionnaire with validated scales, will be analyzed using descriptive and inferential statistics (e.g., frequencies, means, chi-square test, ANOVA and t-test) with software like SPSS. Qualitative data will undergo thematic analysis to identify key themes and patterns.

5. Analysis and Discussion

Cronbach's alpha is a measure of internal consistency reliability, which indicates how closely related a set of items are as a group. In this case, the Cronbach's alpha coefficient is 0.806, and it's calculated based on 12 items. A common rule of thumb is that a Cronbach's alpha of 0.70 or higher is considered acceptable for most research purposes, though some fields might require higher levels of reliability.

5.1 Demographic Profile Analysis

The demographic profile of the granite industry in Prakasam district, Andhra Pradesh, often reflects a predominantly migrant workforce and a significant percentage hailing from nearby rural areas.

Additionally, there may be a mix of both skilled and unskilled laborers, with varying levels of education attainment among workers.

5.1.1 Sex

In the granite industry of Andhra Pradesh, there tends to be a notable gender imbalance, with a predominantly male workforce due to the physically demanding nature of the work. Efforts are underway to promote gender diversity and inclusion within the industry through targeted initiatives and policies.

Table 5.1.1 : Distribution of Respondents by Gender

Gender	Number of Respondents	Percentage (%)	Valid Percentage (%)	Cumulative Percentage (%)
Male	282	75.6	75.6	75.6
Female	91	24.4	24.4	100.0
Total	**373**	**100.0**	**100.0**	—

According to table 5.1.1, in the granite industry of Chimakurthy, Prakasem district, Andhra Pradesh, 75.6% of the workforce is male, while 24.4% is female. The above figure 5.1.1 also represents the male and female percentages.

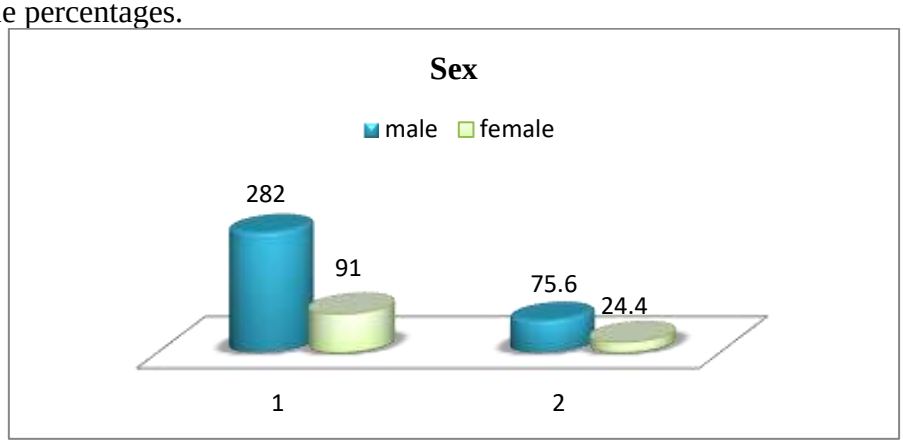

Figure 5.1.1: Sex

5.1.2 Employee Age

Table: Age-wise Distribution of Employees

Age Group	Number of Employees	Percentage (%)	Valid Percentage (%)	Cumulative Percentage (%)
18–30 years	156	41.8	41.8	41.8
31–43 years	130	34.9	34.9	76.7
Over 43 years	87	23.3	23.3	100.0
Total	**373**	**100.0**	**100.0**	—

The above table 5.1.2 revels that, 18-30 years age group work force are 41.8%, next 31-43 years are stood at 34.9% and above 43 years are 23.3% in the Chimakurthy granite industry. The cumulative age 18-43 years age group workforce stood at 76.7% in the granite industry and it also shown through the figure 5.1.2.

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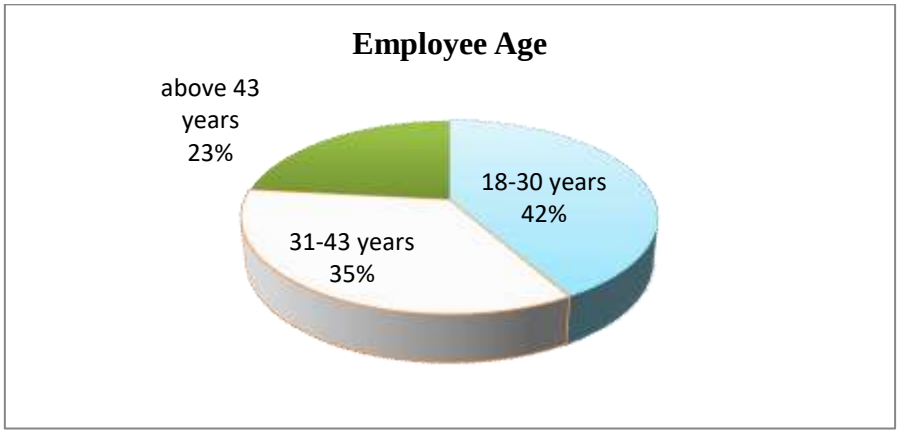

Figure 5.1.2: Employee Age

5.1.3 Size of family staying at work place including you

In the granite industry of Andhra Pradesh, the size of families residing at the workplace varies, with a significant proportion living with three family members, indicating a common trend towards nuclear family setups among workers.

Table 5.1.5 : Number of Family Members Residing at the Workplace (Including Respondent)

Family Size	Number of Respondents	Percentage (%)	Valid Percentage (%)	Cumulative Percentage (%)
One Member	42	11.3	11.3	11.3
Two Members	91	24.4	24.4	35.7
Three Members	220	59.0	59.0	94.7
Four Members	20	5.3	5.3	100.0
Total	**373**	**100.0**	**100.0**	—

The table 5.1.3 reveals that a majority of workers in the granite industry at the Chimakurthy work site live with three family members at their place of work, comprising 59.0% of the surveyed workforce. Additionally, a substantial proportion, 24.4%, reside with two family members, while only a smaller percentage live with either one or four family members, accounting for 11.3% and 5.3% respectively.

Additionally, smaller percentages are observed for families living with either one, two, or four members, suggesting a range of family structures within the industry.

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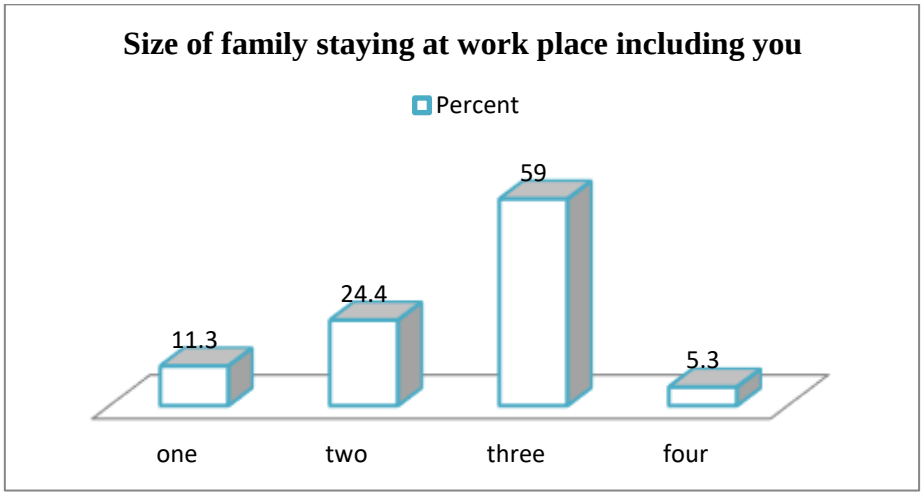

Figure 5.1.3: Size of family staying at work place including you

5.1.4 Type of tasks performed

Tasks performed by workers in the granite industry. The majority of workers, accounting for 57.6%, are engaged in quarrying activities, followed by 25.2% involved in cutting processes, and 17.2% engaged in polishing tasks. This indicates a predominant focus on quarrying, with cutting and polishing activities making up smaller but still significant portions of the workforce's responsibilities. Quarrying is the primary task performed by workers in the granite industry, with cutting and polishing tasks representing secondary and tertiary activities, respectively, indicating the sequential nature of the production process.

5.1.5 the researcher to evaluate the relationship between **Educational Qualification * Type of tasks performed**

Table 5.1.5a: Cross-Classification of Educational Background and Job Roles

Educational Level	Quarrying	Cutting	Polishing	Total
Up to Class VI	83	46	23	152
Class VII to X	59	21	12	92
Intermediate (10+2)	45	19	9	73
Graduate and Above	28	8	20	56
Total	**215**	**94**	**64**	**373**

H_o: There is no association between Educational Qualification and Type of tasks Performed

H_1: There is association between Educational Qualification and Type of tasks performed

The table 5.1.5b describes the sig. (p-value) 0.003 < 0.05, so null hypothesis (H_o) has been rejected at 5% level of significance. Hence alternate hypothesis (H_1) has been accepted.

Table 5.1.5b : Chi-Square Test Results

Test Type	Value	Degrees of Freedom (df)	Significance Level (2-sided)
Pearson Chi-Square	19.606	6	0.003
Likelihood Ratio	17.526	6	0.008
Linear-by-Linear Association	1.746	1	0.186
Number of Valid Observations	**373**		

Note: All cells had expected frequencies of 5 or more. The smallest expected frequency was 9.61.

Therefore Educational Qualification and Type of tasks performed associated positively, which shows in table 5.1.5a majority workers whose Educational Qualification; up to VI^{th} and VII^{th} to X^{th} are

quarrying & cutting tasks Performed, Graduates are involved in skilled work polishing. Hence there is positive association between Educational Qualification and Type of tasks performed.

5.2. Health and Safety – factor (12 variables): this factor makes it in to two sub parts

5.2.1 Health – factor-1 (seven variables)

5.2.2 Safety – factor-2 (five variables)

5.2.1 Health – factor-1 (seven variables)

 A considerable portion of respondents, accounting for 30.0% and 27.6%, selected "Disagree" and "Agree" respectively. This reflects a divided perspective among workers concerning the seriousness of the risks involved.

 A clear majority—66.2%—disagreed with the statement regarding tuberculosis, suggesting that most employees do not view it as a major health concern in these work environments.

 About 20.1% of participants remained neutral on the issue of hazardous material use in blasting operations, indicating either uncertainty or a lack of sufficient knowledge on the subject.

 Worker opinions on managing rainwater runoff in granite mining are diverse, highlighting the necessity for strong environmental management systems to reduce potential ecological damage.

 Differing viewpoints among employees on waste disposal methods point to the need for comprehensive and eco-friendly waste management practices that also prioritize worker health and safety.

 There is a clear call to strengthen both workplace safety protocols and healthcare benefits in the granite sector to address employee concerns and enhance their overall well-being.

 T-test findings reveal significant differences between married and unmarried workers in their opinions on two aspects: (1) the use of potentially harmful substances in compliance with blasting regulations, and (2) the methods or facilities used for managing granite waste and effluents, both of which relate to the broader health factor.

 Correlation analysis shows a weak but statistically significant negative relationship ($r = -0.219$, $p = 0.001$) between two variables: rainwater runoff management (e.g., use of mine pits or garland drains) and waste treatment/disposal practices aimed at protecting employee health. This implies that improvements in one area may not directly lead to improvements in the other.

 A combined 40.5% of respondents (17.7% strongly agreed and 22.8% agreed) believe that the government is taking steps to control noise pollution. Meanwhile, 25.2% neither agreed nor disagreed, possibly suggesting limited exposure to or awareness of such initiatives.

5.2.1.1 ANOVA for Health (factor-1) by mining exploitation method

Here the researcher identified the most important independent variable mining exploitation method (the open cast, semi mechanized & automatic) influence on **Health (factor-1).**

Null hypothesis H_0: There is no significant difference of mining exploitation method on Health (factor-1)

Alternate hypothesis H_1: There is significant difference of mining exploitation method on Health (factor-1)

Table 5.2.1.1: ANOVA for Health (factor-1) by mining exploitation method

Analysis of Variance (ANOVA) – Health and Safety Risk Perceptions

Statement	Source of Variation	Sum of Squares	df	Mean Square	F-Value	Significance (p-value)
Risk of contracting serious illnesses like silicosis and tuberculosis in non-mechanized units	Between Groups	7.378	2	3.689	2.051	0.130
	Within Groups	665.368	370	1.798		
	Total	672.745	372			

Statement	Source of Variation	Sum of Squares	df	Mean Square	F-Value	Significance (p-value)
Perceived occurrence of tuberculosis in non-mechanized settings	Between Groups	8.434	2	4.217	4.841	0.008**
	Within Groups	322.322	370	0.871		
	Total	330.756	372			
Noise exposure potentially leading to hearing impairment	Between Groups	5.433	2	2.716	1.722	0.180
	Within Groups	583.559	370	1.577		
	Total	588.992	372			
Use of hazardous materials in blasting activities affecting health and the environment	Between Groups	0.646	2	0.323	0.175	0.840
	Within Groups	683.901	370	1.848		
	Total	684.547	372			
Rainwater runoff handling during mining (e.g., mine pit collection, drain maintenance)	Between Groups	10.466	2	5.233	3.992	0.019*
	Within Groups	485.008	370	1.311		
	Total	495.475	372			
Granite waste treatment and disposal of solid/liquid waste to protect worker health	Between Groups	2.374	2	1.187	0.759	0.469
	Within Groups	578.457	370	1.563		
	Total	580.831	372			
Safety protocols for accident prevention and access to medical services at the workplace	Between Groups	2.078	2	1.039	1.207	0.300
	Within Groups	318.437	370	0.861		
	Total	320.515	372			

 *p < 0.05; **p < 0.01 indicate statistically significant results.*

 This table summarizes the variance in worker perceptions related to occupational health and safety risks across different groups.

As presented in Table 5.2.1.1, the p-values for the 1st, 3rd, 4th, 6th, and 7th variables (0.130, 0.180, 0.840, 0.469, and 0.300, respectively) exceed the 0.05 threshold. This indicates that the null hypothesis is accepted at the 5% level of significance, implying no statistically significant impact of mining methods on these specific health-related variables (factor-1). Therefore, workers employed

across different mining setups—open cast, semi-mechanized, and fully automated—share similar perceptions regarding the following issues: the likelihood of developing fatal illnesses like silicosis and tuberculosis in non-mechanized units, the potential for noise-induced hearing loss, the use of hazardous substances in compliance with blasting regulations, the adequacy of granite waste management and effluent disposal systems, and the implementation of safety measures and access to healthcare facilities. Conversely, for the 2nd and 5th variables, the p-values are 0.008 and 0.019, respectively—both below the 0.05 significance level. This leads to the rejection of the null hypothesis and acceptance of the alternative hypothesis, suggesting statistically significant differences in opinion. This means that workers from open cast, semi-mechanized, and automatic mining areas differ in their views on the prevalence of tuberculosis in non-mechanized units and the handling of rainwater runoff during mining activities, such as its collection in pits or the maintenance of garland drains.

5.2.2 Safety (factor-2)

The descriptive statistics—specifically the mean values and standard deviations (SD)—offer meaningful insights into worker perceptions regarding safety in the granite sector. A mean score of 3.27 for the item concerning the handling of extremely heavy loads points to a considerable level of concern among employees about physical strain, with a moderate SD of 1.279 reflecting differing levels of concern among individuals. Similarly, the mean rating of 3.21 for the availability of essential safety gear suggests a generally favorable view, although the SD of 1.295 indicates a degree of variability in these perceptions.

In contrast, a mean of 2.86 for the transparency of leave request procedures indicates that many workers perceive these processes as unclear, a finding supported by a moderate SD of 1.247. The awareness level regarding Occupational Health and Safety (OHS) programs appears to be relatively low, with a mean of 2.37 and a smaller SD of 1.025, indicating consistent concerns across respondents. Meanwhile, the mean score of 3.07 related to governmental efforts to address noise pollution reveals moderate confidence in such interventions, though the SD of 1.333 points to mixed views.

These findings reflect a diverse range of safety-related concerns and experiences among granite workers, highlighting the need for specific and targeted measures to improve workplace safety standards.

Overall Safety Perception Summary

The composite statistics further support these findings. An overall mean of 14.78 across five key safety items, along with a standard deviation of 3.106 and a variance of 9.645, suggests a moderate level of concern or satisfaction among workers regarding current safety practices. The variability in responses underscores the uneven implementation or awareness of these measures across the workforce.

Perception of Government Action on Noise Control

According to the data, 40.5% of workers (including 17.7% who strongly agree and 22.8% who agree) believe that government bodies are taking steps to address noise control. However, 25.2% of respondents remained neutral, possibly due to limited knowledge or direct exposure to such government-led initiatives.

ANOVA Findings on Safety Perceptions (Factor-2)

Analysis of variance (ANOVA) results indicate that workers across different operational setups—whether in open-cast, semi-mechanized, or automated environments—hold similar views on several safety-related aspects. These include perceptions about the physical burden of lifting heavy loads, the availability of protective gear like dust masks, government involvement in noise reduction initiatives, and the presence of OHS awareness programs conducted in collaboration with quarry operators, non-governmental organizations, and academic institutions.

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5.2.2.1 T-Test by Marital Status for Safety (factor-2)

This is independent sample t-test, test variables is **Safety (factor-2)** and independent variable should be in two groups, so in the demographic profile **Marital Status** is contain two groups married and unmarried. So the researcher interested to find the opinion of married and unmarried workmen on **Safety (factor-2)**.

H_0: There is no significant effect of **Marital Status on Safety (factor-2)** variables

H_1: There is significant effect of **Marital Status on Safety (factor-2)** variables

Table 5.2.2.1: Independent Samples Test for Safety (factor-2) by Marital Status

T-Test – Safety Factor-2 Based on Marital Status

Safety Variable	Marital Status	Sample Size (N)	Mean Score	Std. Deviation	t-Statistic	p-Value	Significant (S) / Not Significant (NS)
Handling of exceptionally heavy loads	Married	291	3.29	1.284	0.758	0.449	NS
	Unmarried	82	3.17	1.265	0.765		
Availability of essential safety gear (e.g., dust masks)	Married	291	3.10	1.288	-3.289	0.001	**S**
	Unmarried	82	3.62	1.244	-3.354		
Clarity of leave request and approval processes	Married	291	2.83	1.267	-0.945	0.345	NS
	Unmarried	82	2.98	1.176	-0.986		
Perception of government actions to control noise pollution in quarries	Married	291	3.14	1.359	1.876	0.061	NS
	Unmarried	82	2.83	1.215	1.997		
Participation in OHS awareness programs organized with quarry owners, NGOs, or institutions	Married	291	2.37	1.089	-0.081	0.936	NS
	Unmarried	82	2.38	0.764	-0.098		

Note:

S = Statistically Significant ($p < 0.05$)

NS = Not Statistically Significant ($p \geq 0.05$)

Below table 5.2.2.2 shows that, except 2nd variable all p-values (.449, .345, .061 & .936) > 0.05, hence null hypothesis has been accepted at 5% level of significance. That is there is no significant effect of Marital Status on four variables of Safety (factor-2) variables.

Hence, married and unmarried workmen have the same opinion on four variables 'Some workers may be tasked with handling exceptionally heavy loads', 'Processes for requesting and approving leave are clearly defined', 'Government bodies are actively implementing measures to mitigate noise levels in the quarry industry' and 'Awareness programs on Occupational Health and Safety are conducted in collaboration with quarry owners, NGOs, and educational institutions' variables of Safety (factor-2) variables2nd variable p-value (.001) < 0.05, hence null hypothesis has been rejected

and then accepted alternate hypothesis at 5% level of significance. That is there is significant effect of Marital Status on this variable of Safety (factor-2) variables.
Hence, married and unmarried workmen have the same opinion on 2nd variable 'Necessary safety equipment, such as dust masks, is provided' of Safety (factor-2) variables.

6. Conclusions, Suggestions and Recommendations

6.1. Conclusions

An evaluation of the health-related indicators (Factor-1) in Chimakurthy's granite sector reveals a Cronbach's alpha score of 0.806, indicating a strong level of internal consistency and reliability in the health and safety assessment tool used. The analysis points to diverse worker perceptions regarding health risks. For example, opinions vary considerably on the occurrence of tuberculosis and the handling of hazardous substances. While a smaller segment of respondents voiced concerns about environmental issues like waste disposal and rainwater drainage, many workers appeared indifferent or lacked awareness, suggesting significant communication or information gaps. Only 40.5% of the participants acknowledged government efforts in regulating noise pollution, with a considerable proportion expressing neutrality—highlighting either a lack of awareness or limited exposure to these interventions. The ANOVA results show that the type of mining method used has a statistically significant influence on how workers perceive certain health hazards, particularly in relation to tuberculosis ($p = 0.008$) and runoff water management ($p = 0.019$). This underscores the impact that varying levels of mechanization can have on the recognition of health risks in the mining environment. Regarding safety-related indicators (Factor-2), which cover five core variables, the data points to uneven levels of safety knowledge and practices across different groups of workers. Quarrying emerged as the most prevalent job activity (57.6%), followed by cutting and polishing. Educational background was significantly linked to job assignments ($p = 0.003$), with better-educated workers more likely to be involved in roles like polishing, which are generally seen as less physically demanding or hazardous. This job allocation pattern influences both the exposure to risks and how safety is perceived. Moreover, t-test results highlight variations in safety perceptions based on marital status, illustrating that demographic factors contribute to differing viewpoints on occupational health. These findings stress the importance of implementing focused health and safety education programs, improving environmental management practices such as waste and runoff control, and reinforcing regulatory measures to minimize workplace hazards and enhance worker welfare within the granite industry.

Suggestions - Health and Safety Suggestions:

In the granite sector, where employees often engage in labor-intensive and hazardous work, the implementation and consistent enforcement of safety procedures and ergonomic practices are essential. These measures are not only crucial for protecting worker health but also play a significant role in minimizing injury-related disruptions and improving operational efficiency. Although personal protective equipment (PPE) is reportedly provided in some cases, inconsistencies in its distribution and availability have been noted. Such irregularities create confusion and dissatisfaction among employees, highlighting a disconnect between established safety guidelines and their actual application in daily operations. It is essential for employers to perform routine safety evaluations, actively engage workers in identifying risks, and ensure that protective gear and ergonomic solutions are readily available and properly maintained. In addition, the results reveal concerns surrounding the clarity of workplace policies, particularly those related to health-related leave. Many workers reported feeling uncertain about the procedures for requesting time off, pointing to possible gaps in communication or insufficient policy training. This lack of clarity can lead to increased stress and a sense of being overlooked, which may impact overall morale and job performance. To remedy this, companies in the granite industry should strengthen their communication frameworks, provide comprehensive training on workplace safety and health policies, and develop a more transparent and

efficient leave management system. These actions would help close the gap between formal policies and their practical execution, ultimately nurturing a workplace environment built on care, accountability, and shared responsibility.

Recommendations

Based on the findings, several recommendations can be made. Granite mining companies should invest in providing adequate personal protective equipment (PPE), conduct regular safety training programs, and implement engineering controls to minimize dust and noise exposure. The government should strengthen regulatory oversight, conduct frequent inspections, and enforce penalties for non-compliance. Additionally, healthcare facilities should be readily accessible to workers, and comprehensive health surveillance programs should be established to detect and manage occupational diseases.

References

1. Bose, A. J. C. (2012). Labour relations in a liberalized industry: A study of Indian automobile workers [Unpublished doctoral dissertation]. B.R. Ambedkar Bihar University, Muzaffarpur, India.
2. Brazil's Granite Export Growth & Sri Lanka's Import Controls. (2020). Stone News Report.
3. Dr.Naveen Prasadula (2025) Review of Ananlysis on Health and Safety Challenges in Andhra Pradesh Granite Mines: An Empirical Assessment of Workmen Conditions
4. Breman, Jan (1985), Of Peasants, Migrants and Paupers: Rural Labour and Capitalist Production in Western India, Delhi: Oxford University Press.
5. https://scholar.google.com/citations?user=99wmG2IAAAAJ&hl=en
6. Global Research (Hyderabad), India Committee of the Netherlands (Utrecht), & Stop Child Labour (The Hague). (2017). The dark sites of granite modern slavery, child labour and unsafe work in Indian granite quarries - What should companies do? India Committee of the Netherlands Landelijke India Werkgroep. Retrieved from www.indianet.nl
7. Glocal Research & India Committee of the Netherlands. (2015). Rock bottom, modern slavery and child labour in South Indian granite quarries.
8. Government of Andhra Pradesh. (2024). Socio Economic Survey 2024–2025. https://apfinance.gov.in
9. https://orcid.org/0000-0002-9764-6048
10. Indian Labour Journal. (2013). Analysis of child labour in India.
11. International Labour Office. (2013). A rapid assessment of bonded labour in India's mining sector.
12. Jain, A. (2021). Utilization of granite waste in self-compacting concrete: A sustainable approach. International Journal of Construction and Building Materials, 273, 121715.
13. Luleå University of Technology. (2014). Gender diversity and working conditions in the mining industry.
14. Markose, V. (2013). Private and co-operative granite' quarries in Thrissur District: A comparative study.
15. National Commission for Protection of Child Rights, Partners in Change, & Glocal Research and Consultancy Services. (2018). Child rights violations in granite quarries of Andhra Pradesh and Telangana.
16. Rao, M. L. N. (2023). Labor standards in granite mining: A field survey of workers in Prakasam District. Journal of Labor and Development Studies, 12(1), 33–49.
17. Sharma, S. (2022). Reuse of granite waste for eco-friendly concrete. Environmental Engineering and Management Journal, 21(7), 1211–1222.
18. Study on Kallahalli Iron Ore Mines. (2017). Employee welfare best practices in mining. Indian Bureau of Mines.
19. The New Indian Express. (2019, July 3). Granite mining sustains thousands in Prakasam despite economic headwinds. https://www.newindianexpress.com