A Pilot Study on Knowledge, Attitude and Practice (KAP) of Workers Toward Usage of Personal Protective Equipment (PPE) at a Palm Oil Mill in Kuala Gula, Perak, Malaysia

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ABSTRACT

Background: Safety and health issues in palm oil mill workers in Malaysia continue to generate operational and management challenges for the industry. One of the primary factors triggering these issues is that workers do not consistently wear the correct Personal Protective Equipment (PPE) during their job.

Objective: This pilot study investigates the level of Knowledge, Attitude and Practice (KAP) of palm oil mill workers toward usage of PPE, identifies the relationship between these three constructs and PPE usage, and explores the relative contribution of each construct to PPE usage in the workplace.

Methods: A cross-sectional pilot survey was conducted at a single palm oil mill in Kuala Gula, Perak, Malaysia. Data were collected from 30 mill workers — representing the entire workforce of the selected mill — using a structured bilingual (Malay–English) questionnaire distributed manually. The questionnaire was divided into five sections covering demographics and four constructs (knowledge, attitude, practice, and PPE usage), each measured on a 5-point Likert scale. Data were analysed using IBM SPSS Statistics version 22, comprising reliability test, descriptive analysis, Pearson correlation, multiple linear regression and exploratory factor analysis.

Results: Reliability analysis produced a Cronbach's Alpha of 0.865, indicating very good internal consistency. All three independent variables showed positive correlations with PPE usage. The regression model explained 34.3% of the variance in PPE usage ($R^2 = 0.343$, Adjusted $R^2 = 0.267$). In the standardised coefficients, attitude had the largest point estimate ($\beta = 0.302$), followed by knowledge ($\beta = 0.248$) and practice ($\beta = 0.148$); however, individual t-tests did not reach statistical significance (all $p > 0.05$), which is consistent with the limited statistical power expected at this sample size. The KMO value of 0.725 confirmed the adequacy of the data for factor analysis.

Conclusion: As a single-mill pilot, this study provides preliminary evidence that workers' attitude and knowledge are positively associated with PPE usage. Findings should be interpreted with caution given the small sample size and exploratory design. The results provide a useful basis for designing a larger multi-mill confirmatory study, and offer initial guidance for mill management considering integrated behavioural and educational interventions to improve PPE compliance.

Keywords: Knowledge, Attitude, Practice, KAP, Personal Protective Equipment (PPE), Palm Oil Mill, Occupational Safety and Health, Pilot Study

INTRODUCTION

Background of the Study

The oil palm sector is one of the most labour-intensive industries in Malaysia. Malaysia is the second-largest

producer of palm oil in the world after Indonesia, with the workforce dominated by Malaysian, Indonesian and Bangladeshi workers in plantations and palm oil mills. The large scale of industrial activity in this sector contributes significantly to worker injuries, particularly within the palm oil mill processing environment. Agricultural and milling work is physically demanding and exposes workers to physical, chemical, biological, psychological and ergonomic hazards (Syazwani et al., 2016; Lim et al., 2024). Ergonomic hazards in particular are associated with a wide range of musculoskeletal symptoms (MSS), including neck and knee pain, low back pain, upper limb complaints and hand–arm vibration syndrome (Walker-Bone & Palmer, 2002; Osborne et al., 2022).

Among these hazards, the most common issue confronting palm oil mills is the safety and health concern of their workers. The most prevalent factor leading to this issue is that workers do not consistently use the standard Personal Protective Equipment (PPE) provided by management. Examples of essential PPE include safety helmets, safety boots, gloves and face masks, all of which are required during work in the mill (International Labour Organization, 2012). Recent research has continued to underscore that worker-level factors — knowledge, attitude and practice (KAP) — remain central to PPE adherence in agricultural and milling workplaces (Aziz & Rahman, 2023; Susanti et al., 2023).

Problem Statement

Workers at palm oil mills are exposed to risks that may cause long-term health problems such as neck and knee pain, low back pain and upper limb complaints. Effective management of these risks requires defensive equipment, training and safe work practices. Issues frequently emphasised by mill management include workers' knowledge, attitude and practice regarding PPE usage (Syazwani et al., 2016). According to the Department of Occupational Safety and Health (DOSH, 2016), 522 occupational accident cases were reported in the agricultural sector in 2017, including incidents at palm oil mills, some of which resulted in fatalities and damage to sterilisers. Despite recent industry efforts, the Malaysian Palm Oil Board (2024) reported that only 34% of estates and mills provide comprehensive occupational health monitoring, suggesting that gaps in worker-level KAP remain a persistent contributor to preventable incidents. To date, however, few empirical pilot studies have examined the relative contribution of knowledge, attitude and practice to PPE usage at the level of individual mill operations.

Research Objectives

This pilot study aims to: (1) determine the level of knowledge, attitude and practice of palm oil mill workers toward PPE usage at a single mill; (2) explore the relationship between workers' knowledge, attitude and practice and PPE usage; and (3) examine the relative contribution of knowledge, attitude and practice to PPE usage in the workplace as preliminary input for a larger confirmatory study.

Significance of the Study

Workers' safety and health is critical at the workplace. Pilot evidence on the relative contribution of knowledge, attitude and practice to PPE usage can guide management in designing initial interventions, support hypothesis generation for larger multi-site studies, and inform certification bodies and policymakers reviewing occupational safety and health standards under the Malaysian Sustainable Palm Oil (MSPO) framework.

METHODOLOGY

Study Design and Setting

This cross-sectional pilot study was carried out at a palm oil mill in Kuala Gula, Perak, Malaysia. The location was selected due to accessibility for data collection and its representativeness of medium-scale rural palm oil milling operations. The study was also intended to support the mill in working toward Malaysian Sustainable Palm Oil (MSPO) certification. As a single-mill pilot, the study is exploratory in nature; findings are intended to inform a larger multi-mill confirmatory study.

Participants and Sampling

The mill employed 30 workers across all milling sections at the time of data collection. All 30 workers were invited to participate, and all 30 returned completed questionnaires, yielding a 100% participation rate of the total workforce of the selected mill. The sample size was confirmed against the Krejcie and Morgan (1970) sample size determination table for the corresponding population. Workers were drawn from each section of the milling process: reception, sterilisation, threshing, digestion and pressing, screening, clarifying and purifying, and drying and storage. Inclusion criteria were: (1) minimum three months of employment at the mill; (2) direct involvement in milling operations; and (3) voluntary informed consent to participate. The small sample reflects the actual workforce size of the selected mill and is appropriate for an exploratory pilot study; statistical power limitations are acknowledged in the limitations section.

Data Collection and Measurement

Primary data were collected through a structured questionnaire distributed manually to respondents. The questionnaire was prepared in both Malay and English to accommodate respondents' language preferences. A pilot pretest with workers from a different mill (not included in the final sample) was conducted before full distribution to refine question clarity and improve measurement reliability. The questionnaire was divided into five sections:

Part A — Demographic information (6 items): gender, age, marital status, qualification, income and position in the mill.

Part B — Knowledge of PPE (4 items): factual statements about PPE function, types and protective benefits (e.g., "Safety helmets prevent head injuries from falling objects").

Part C — Attitude toward PPE (4 items): items measuring perceived importance of PPE, perceived enforcement, and willingness to comply (e.g., "PPE is important for my safety at work").

Part D — Practice of PPE-related behaviours (4 items): items capturing self-reported routine behaviours related to PPE care, inspection and use during preparation for work (e.g., "I check my PPE for damage before starting work").

Part E — PPE Usage (4 items, dependent variable): items measuring the frequency and consistency with which workers actually wore each major category of PPE (safety helmet, safety boots, gloves, face mask) during their regular work tasks.

All items in Parts B–E were measured using a 5-point Likert scale (1 = Strongly Agree, 2 = Agree, 3 = Not Sure, 4 = Disagree, 5 = Strongly Disagree). Items were reverse-scored where appropriate so that higher composite scores consistently indicated more favourable knowledge, attitude, practice and PPE usage. Composite scores for each construct were computed as the mean of the four items in that construct. The conceptual distinction maintained in this study is that Practice (Part D) refers to preparatory and supportive behaviours (such as inspecting PPE before use), whereas PPE Usage (Part E) refers specifically to the act of wearing PPE during work.

It is acknowledged that using an agreement-based Likert scale for the knowledge construct may capture confidence or belief in correct statements rather than objective factual recall. This is a known limitation of self-report KAP instruments and is discussed further in Section 4.5; future research is encouraged to employ true/false or multiple-choice knowledge tests for objective measurement of knowledge.

Statistical Analysis

Data were analysed using IBM SPSS Statistics version 22. The analysis comprised five stages: (1) reliability analysis using Cronbach's Alpha to assess internal consistency, with values above 0.7 considered acceptable; (2) descriptive statistics to summarise demographic information and variable distributions; (3) Pearson

correlation analysis to examine the strength and direction of relationships between independent variables (knowledge, attitude, practice) and the dependent variable (PPE usage), with significance set at $p < 0.05$; (4) multiple linear regression using the enter method to explore the relative contribution of each predictor; and (5) exploratory factor analysis using the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity to confirm factorability of the items. Given the pilot nature and small sample, regression results are interpreted with appropriate caution and emphasis is placed on effect sizes (standardised coefficients) rather than statistical significance alone.

RESULTS

Reliability Analysis

The Cronbach's Alpha coefficient for the overall 16 items in the questionnaire (Parts B–E) was 0.865, with the standardised items value of 0.871. According to established decision rules, values between 0.80 and 0.90 are considered very good, indicating that the instrument has strong internal consistency and the data are reliable for further analysis.

Demographic Profile

Table 1 presents the demographic profile of the 30 respondents. The workforce was overwhelmingly male (96.7%), reflecting the physically demanding nature of palm oil mill operations. Most respondents were aged 20–30 years (40.0%), and over half were single (53.3%). Educational attainment was generally low, with 53.3% having only completed primary education (UPSR) and 10.0% having no formal education. Income distribution was concentrated in the RM2,100–RM2,500 bracket (30.0%), and the largest occupational group (43.3%) worked at the reception section, where fresh fruit bunches enter the mill.

Table 1. Demographic profile of respondents (N = 30).

Demographic Variable	**Category**	**Frequency (N=30)**	**Percent (%)**
Gender	Male	29	96.7
	Female	1	3.3
Age	20 – 30	12	40.0
	31 – 40	7	23.3
	41 – 50	6	20.0
	51 and above	5	16.7
Marital Status	Single	16	53.3
	Married	13	43.3
	Widowed	1	3.3
Qualification	No Formal Education	3	10.0
	UPSR	15	53.3
	PMR/SRP	7	23.3

	SPM	4	13.3
Income (RM)	1,100 – 1,500	5	16.7
	1,600 – 2,000	8	26.7
	2,100 – 2,500	9	30.0
	2,600 – 3,000	8	26.7
Position	Reception	13	43.3
	Sterilization	3	10.0
	Threshing	6	20.0
	Digestion & Pressing	2	6.7
	Screening, Clarifying & Purifying	3	10.0
	Drying & Storage	3	10.0

Pearson Correlation Analysis

Pearson correlation analysis (Table 2) revealed positive relationships between all study variables. Knowledge and attitude showed a moderate positive correlation ($r = 0.587$, $p = 0.001$), while attitude and practice exhibited the strongest correlation ($r = 0.627$, $p < 0.001$). The correlation between knowledge and practice was moderate but did not reach conventional statistical significance ($r = 0.333$, $p = 0.072$), which may reflect insufficient statistical power at this sample size rather than absence of a true association. PPE usage was significantly correlated with knowledge ($r = 0.474$, $p = 0.008$), attitude ($r = 0.541$, $p = 0.002$) and practice ($r = 0.420$, $p = 0.021$), with attitude showing the strongest bivariate association with PPE usage.

Table 2. Pearson correlation matrix between knowledge, attitude, practice and PPE usage (N = 30).

Variable	**Knowledge**	**Attitude**	**Practice**	**PPE Usage**
Knowledge	1	0.587**	0.333	0.474**
Attitude	0.587**	1	0.627**	0.541**
Practice	0.333	0.627**	1	0.420*
PPE Usage	0.474**	0.541**	0.420*	1

***Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed).*

Multiple Regression Analysis

Multiple linear regression was performed to explore the joint contribution of knowledge, attitude and practice to PPE usage. The model summary (Table 3) shows that the three predictors collectively accounted for 34.3% of the variance in PPE usage ($R^2 = 0.343$, Adjusted $R^2 = 0.267$). The remaining 65.7% of variance is attributable to factors not examined in this study, such as PPE availability and condition, supervisor enforcement practices, and task-specific risk exposure.

Table 3. Multiple regression model summary (N = 30).

Model	R	R^2	Adjusted R^2	Std. Error of Estimate
1	0.586	0.343	0.267	0.29593

Coefficient analysis (Table 4) showed that all three predictors contributed positively to PPE usage in terms of standardised coefficients: attitude had the largest point estimate (β = 0.302), followed by knowledge (β = 0.248) and practice (β = 0.148). None of the individual t-tests reached statistical significance at the conventional α = 0.05 level (knowledge p = 0.219; attitude p = 0.215; practice p = 0.475), which is consistent with the limited statistical power expected with N = 30 and three predictors. The constant term was significant (p = 0.020). Given the small sample, these regression results should be interpreted as exploratory and indicative of the direction and approximate magnitude of effects rather than as confirmatory tests of significance.

Table 4. Coefficient analysis for predictors of PPE usage (N = 30).

Predictor	B	Std. Error	Beta (β)	t	Sig. (p)
(Constant)	0.943	0.382	—	2.468	0.020
Knowledge	0.204	0.162	0.248	1.259	0.219
Attitude	0.332	0.262	0.302	1.270	0.215
Practice	0.167	0.230	0.148	0.725	0.475

It should also be noted that the difference between the attitude coefficient (β = 0.302) and the knowledge coefficient (β = 0.248) is small. Given the wide standard errors at this sample size, attitude and knowledge should be regarded as roughly comparable contributors to PPE usage, with practice showing a smaller but directionally consistent contribution. A larger confirmatory study would be required to determine whether one factor is statistically dominant.

Factor Analysis

The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.725, exceeding the recommended threshold of 0.6. Bartlett's test of sphericity was significant ($\chi^2 = 36.110$, df = 6, $p < 0.001$), confirming that the variables were sufficiently correlated to warrant factor analysis. These results support the factorability of the data and the appropriateness of grouping the items into the knowledge, attitude, practice and PPE usage constructs.

DISCUSSION

Attitude and Knowledge as Joint Contributors

The findings indicate that workers' attitude (β = 0.302) and knowledge (β = 0.248) were the two largest standardised contributors to PPE usage at the studied palm oil mill. Although attitude carried the largest point estimate, the difference from knowledge was small and individual coefficients did not reach statistical significance, so attitude and knowledge are best interpreted as jointly important rather than attitude being uniquely dominant. This pattern is consistent with Sunindijo et al. (2019), who reported that more than 80% of workplace accidents are linked to unsafe attitudes among workers, and with DeJoy (2005), who noted that workplace safety problems often arise from worker behaviour even when management has implemented well-structured safety policies. In the present study, workers may know that PPE is available and understand its protective function but still avoid using it, supporting Mohammed and Hamad (2017), who found that workers

sometimes intentionally ignore PPE protocols when they anticipate that supervisors will not impose punishment.

Knowledge–Practice Relationship

Knowledge showed a moderate correlation with attitude ($r = 0.587$) but a weaker, marginally non-significant correlation with practice ($r = 0.333$, $p = 0.072$). At the present sample size, the moderate magnitude of this correlation may indicate a true association that the study was underpowered to detect at $\alpha = 0.05$. Conceptually, this pattern suggests that workers may possess adequate awareness of PPE but do not always translate that awareness into consistent preparatory practice. Wilson (2000) emphasised that workers' awareness of risks is essential for avoiding chronic and acute toxicity, while Mekonnen and Agonafir (2002) found in Ethiopia that 89.4% of workers wore masks, protective clothing and boots, indicating that knowledge alone does not guarantee correct behaviour. Conversely, Yassin et al. (2002) reported that more than half of farmers in Nepal lacked PPE knowledge, contributing to higher accident rates.

Practice and PPE Usage

Practice exhibited the lowest beta coefficient ($\beta = 0.148$), suggesting that established preparatory practice patterns alone may be insufficient to drive consistent PPE usage without supportive attitudes and knowledge. Marinescu and Toma (2013) highlighted that structured training programmes serve as effective alternatives for translating knowledge and attitude into safe practice. Sari (2009) and Gan and Li (2014) further demonstrated that systematic workplace training reduced safety and health issues by reinforcing positive behaviours among workers. These findings collectively indicate that the gap between knowledge and practice may need to be bridged by interactive and participatory training models (Yuantari et al., 2015).

Implications for Mill Management

Although findings from a single-mill pilot must be interpreted cautiously, the consistent positive direction of all three predictors offers preliminary guidance for management practice. Because attitude and knowledge are both positively associated with PPE usage, interventions should integrate behavioural and educational strategies rather than treating them as alternatives. Suggested measures include supervisor-led safety briefings, peer recognition for compliant behaviour and clear consequences for non-compliance, alongside periodic refresher training in both written and visual formats. Practical considerations such as PPE comfort and weight should also be addressed, as documented by Davis et al. (2001) and Zolkifli et al. (2016), who reported that uncomfortable or excessively heavy safety helmets discourage continued usage among harvesters.

Importantly, the demographic profile of the workforce — 53.3% with primary education only and 10.0% with no formal education — has direct implications for safety training design. Traditional written training materials may be inaccessible to a substantial proportion of the workforce. Mill management should therefore consider visual aids (infographics, pictograms and short videos), hands-on demonstrations, and 'train-the-trainer' approaches in which peer educators who share language and educational backgrounds with workers deliver content. Periodic verbal reinforcement and supervised practice sessions are likely to be more effective than written manuals for this workforce. These recommendations are consistent with multilingual and culturally adapted training interventions reported to reduce injury rates in regional palm oil contexts (Aziz & Rahman, 2023; Lim et al., 2024).

Study Limitations

Several limitations should be considered when interpreting these findings:

(1) The single-mill pilot design limits external validity; findings from one Kuala Gula mill may not generalise to all palm oil mills in Malaysia or in other producing countries.

(2) The small sample size ($N = 30$) limits statistical power, particularly for detecting moderate correlations and for distinguishing between the magnitudes of standardised regression coefficients. Findings should therefore be regarded as exploratory and hypothesis-generating.

(3) The cross-sectional design prevents causal inference; longitudinal or intervention studies are needed to establish whether changes in attitude and knowledge produce changes in PPE usage.

(4) Self-reported measures of PPE usage may be subject to social desirability bias, as workers may over-report compliance knowing that safety behaviour is monitored.

(5) The use of an agreement-based Likert scale for the knowledge construct may capture confidence or belief in factual statements rather than objective knowledge; future research should consider true/false or multiple-choice knowledge tests.

(6) The study did not collect data on supervisors' enforcement practices, which may moderate the relationship between attitude and behaviour.

(7) The study did not assess the availability and physical condition of PPE on-site (e.g., supply sufficiency, repair status, fit), which could affect usage independently of workers' KAP.

(8) The study did not measure section-specific tasks performed by workers, so the appropriateness of PPE for different tasks could not be assessed.

RECOMMENDATIONS FOR FUTURE RESEARCH

Building on this pilot, future research should: (1) extend data collection across multiple palm oil mills to increase sample size and external validity; (2) employ longitudinal or intervention designs to test causal relationships between KAP components and PPE usage; (3) incorporate objective measures of knowledge (true/false or multiple-choice items) and observed PPE usage rather than relying solely on self-report; (4) include moderating variables such as supervisor enforcement, PPE availability and section-specific task demands; and (5) examine whether targeted interventions improving attitude and knowledge jointly produce greater gains in PPE compliance than single-component interventions.

CONCLUSION

This single-mill pilot study provides preliminary evidence that knowledge, attitude and practice are positively associated with PPE usage among palm oil mill workers. The combined regression model explained 34.3% of the variance in PPE usage, with attitude ($\beta = 0.302$) and knowledge ($\beta = 0.248$) showing the largest standardised contributions and practice ($\beta = 0.148$) showing a smaller but directionally consistent contribution. Although individual coefficients did not reach statistical significance at this sample size, the consistent positive direction of effects and the strong instrument reliability (Cronbach's Alpha = 0.865) support the value of these findings as a basis for a larger confirmatory study.

The findings suggest that palm oil mill management should adopt an integrated, multi-pronged strategy to enhance PPE usage and reduce occupational accidents. First, behavioural and educational interventions should be combined rather than treated as alternatives. Second, training programmes should integrate knowledge transfer with practical, scenario-based exercises that translate awareness into routine practice, with content delivered through visual and demonstration-based formats appropriate to the workforce's educational profile. Third, the physical attributes of PPE — particularly safety helmets — should be reviewed for comfort, ventilation and weight to overcome the discomfort that often leads to non-compliance. Finally, periodic replacement schedules for worn equipment and supervisor enforcement practices should be formalised to ensure that PPE remains functional, available and used. A larger multi-mill confirmatory study is recommended to validate and extend these preliminary findings.

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