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Integrating Interactive Education and Peak Flow Meter Screening to Improve Knowledge of Cigarette Smoke Hazards Among Support Staff

Haryati Haryati*
Universitas Lambung Mangkurat. INDONESIA

Syarifah Fatimah
Universitas Lambung Mangkurat. INDONESIA

Muhammad Irfan Hidayat
Universitas Lambung Mangkurat. INDONESIA

Yumindra Pratama
Universitas Lambung Mangkurat. INDONESIA

Fatimah Jufria
Universitas Lambung Mangkurat. INDONESIA

Puput Fatimah
Universitas Lambung Mangkurat. INDONESIA

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Abstract

Background: Cigarette smoking is a major preventable cause of respiratory and cardiovascular diseases. Exposure to second-hand and third-hand smoke also increases health risks among non-smokers. However, evidence on integrating interactive education with objective lung function feedback in workplace settings, particularly among university support staff, remains limited.
Aims: This program aimed to evaluate changes in knowledge and attitudes about cigarette smoke hazards, describe Peak Flow Meter (PFM) screening results, and examine the association between smoking status and PFM outcomes.
Methods: A one-group pre-test–post-test study was conducted among 30 male support staff at the Faculty of Medicine and Health Sciences, Lambung Mangkurat University, Banjarmasin, Indonesia, in August 2026. Knowledge (10 items) and attitudes (three 4-point Likert items) were measured using a researcher-developed questionnaire before and after the intervention. Data were analyzed using the Wilcoxon Signed-Rank and Fisher's Exact tests ($p < 0.05$).
Results: The median knowledge scores increased from 75 (IQR 62.5-100) before intervention to 100 (IQR 82.5-100) afterward ($p=0.006$; effect size $r=0.502$). Changes in attitude indicators were mixed: concern about the dangers of smoke residue for family members and intention to restrict or quit smoking improved significantly (both $p = 0.014$), whereas awareness of the effects of smoking on stamina and breathing did not change significantly ($p = 0.157$). Peak Flow Meter screening showed that 22 participants (73.3%) were in the green zone and 8 (26.7%) were in the yellow zone. No significant association was found between smoking status and PFM results ($p = 0.698$).
Conclusion: Interactive education combined with PFM screening was associated with improved knowledge of cigarette smoke hazards among university support staff. Meanwhile, attitude changes varied across indicators. These findings should be interpreted cautiously because of the small sample size, the absence of a control group, and the inability to distinguish the independent contributions of education and PFM feedback.

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INTRODUCTION

Tobacco use remains a leading preventable cause of morbidity and premature mortality worldwide. It contributes substantially to the burden of cardiovascular disease, cancer, and chronic respiratory disease. This accounts for around seven million deaths each year, including those who do not smoke but are still affected by second-hand smoke (WHO, 2026). Cigarette smoke causes

*** Corresponding author:**
Haryati, Universitas Lambung Mangkurat, INDONESIA. ✉ haryati@ulm.ac.id

chronic inflammation and morphological changes in the airways and lung tissue and contributes to the development and progression of chronic obstructive pulmonary disease (COPD) (Agustí et al., 2022; Rabe & Watz, 2017). According to the Global Burden of Disease Study, more than 3.72 million fatalities were caused by COPD worldwide in 2021 (Wang et al., 2025). Tobacco smoke is a major preventable risk factor for COPD, alongside air pollution and occupational exposures (Global Initiative for Chronic Obstructive Lung Disease (GOLD, 2026).

Tobacco smoke is harmful to active smokers and people who are exposed to second-hand and third-hand smoke. Second-hand smoke has been linked to adverse respiratory and cardiovascular effects, and there is no safe level of exposure (CDC, 2025; WHO, 2023). Tobacco smoke pollutants are deposited in clothing, hair, skin, furniture, walls, and other indoor surfaces after smoking. These residues are known as third-hand smoke. These residues can be inhaled, ingested, or absorbed through the skin, and people can be exposed to them long after active smoking has ceased. Public awareness of third-hand smoke is mixed, and a systematic review found that awareness of its potential health risks did not consistently translate into protective behaviors, such as maintaining smoke-free homes and vehicles (Vanzi et al., 2023; Yildirim-Ozturk et al., 2024). Thus, comprehensive tobacco control should not only target active smoking but also involuntary exposure to second-hand and third-hand smoke in homes, workplaces, and public spaces.

Health education is an important component of tobacco control, raising awareness of the health risks of smoking and helping smoking initiation and promote smoking cessation (WHO, 2023). However, providing information alone is unlikely to bring about long-lasting change in attitudes or behavior. According to the Theory of Planned Behavior, attitudes, subjective norms, and perceived behavioral control affect behavioral intention (Ajzen, 1991). A wide range of tobacco control approaches is possible. In Indonesia, workplace interventions have included health education, cessation support, peer counseling, communication campaigns, and smoke-free policies (Prabandari et al., 2022). However, changes in knowledge or intent should not be assumed to translate into smoking cessation or other persistent behavioral outcomes.

One way to link participants' health information to educational messages is to provide personalized respiratory health feedback. However, evidence on the additional benefits of objective lung-function feedback for smoking cessation is mixed, and most studies to date have used spirometry rather than peak flow meter (PFM) screening (Westerdahl et al., 2019). PFM is a simple, portable, non-invasive measure of peak expiratory flow (PEF) and may be a useful adjunct to preliminary respiratory screening in community and workplace settings. Equations can estimate predicted PEF using relevant characteristics such as height and age (Nunn & Gregg, 1989). However, PFM screening should not be used alone to diagnose obstructive lung disease, as it does not replace diagnostic spirometry. In a health promotion program, PFM feedback could help participants connect educational messages about exposure to cigarette smoke with their screening results. Abnormal values may also indicate a need for further clinical investigation.

Previous tobacco-related interventions have been reported in both Indonesian and international settings. In Indonesia, community-based education has also been delivered to outsourced workers in Samarinda, with post-intervention knowledge scores increasing following education about smoking hazards (Fadlillah et al., 2024). Internationally, workplace-based tobacco messaging has been associated with improved knowledge of tobacco-related risks among blue-collar workers, although changes in smoking behavior have been less consistent (Stewart et al., 2016). These programs illustrate the value of workplace and community settings for tobacco-related health promotion. However, the published examples identified here have not established the added value of integrating interactive cigarette-smoke education with individual PFM screening feedback among university support staff. Evidence on this specific combination remains limited, and further program evaluations are warranted.

Support staff, such as administrative staff, cleaning staff, security guards, and other operational workers, play an important role in workplace health promotion. Data from the 2023 Indonesian Health Survey (Kemenkes RI, 2024), indicate that smoking is a public health problem in Indonesia at the national level. However, no survey has identified smoking prevalence among support staff at the Faculty of Medicine and Health Sciences, Lambung Mangkurat University (FKIK ULM). The lack of baseline institutional data underscores the importance of workplace health promotion activities that combine education on the hazards of cigarette smoke with baseline

respiratory screening. These activities can increase awareness of tobacco-related health risks and identify people whose peak flow meter (PFM) readings require further clinical evaluation.

This program was designed to: (1) evaluate the changes in participants' knowledge and attitudes toward the hazards of cigarette smoke after the combined intervention; (2) describe the PFM screening results; and (3) investigate the association between smoking status and PFM screening results among support staff at FKIK ULM. This program provides implementation-level evidence for integrating tobacco-related education and PFM screening into workplace health promotion by evaluating knowledge and attitudes alongside preliminary respiratory screening results. Education and PFM feedback were delivered simultaneously, and the study had no comparison group, so it was not designed to assess the independent contribution of each component.

METHOD

This community service program employed a one-group pre-test-post-test design. It was conducted on August 29, 2026, at the Faculty of Medicine and Health Sciences, Lambung Mangkurat University, Banjarmasin, Indonesia. The program involved 30 male support staff and was conducted over four hours, from 13:00 to 17:00 WITA. The target population comprised faculty support staff. Only male support staff were invited to participate, resulting in 30 eligible invitees. The final analysis included participants who provided informed consent and completed both the pre-test and post-test. No exclusion criteria were applied based on a history of asthma, chronic obstructive pulmonary disease (COPD), or acute respiratory tract infection. The restriction to male participants should be considered when interpreting the generalizability of the findings to female support staff.

The program comprised preparation, baseline assessment, intervention, and post-intervention assessment. The preparation stage included consulting with the faculty administration, developing educational materials, preparing questionnaires, and preparing the PFM devices. Before the intervention, participants completed a baseline questionnaire covering demographic characteristics, smoking status, knowledge of cigarette smoking hazards, and attitudes toward smoking prevention. The health education intervention was performed face-to-face in a single session, with all 30 participants in the same room. The session included a 20-minute presentation on the hazards of cigarette smoke, followed by about 30 minutes of interactive discussion and Q&A. The educational media used were PowerPoint slides and brochures. The health education was given by a pulmonologist, and the PFM measurements were performed by a pulmonology resident.

Following the educational session, participants underwent PFM screening. The pulmonologist informed each participant of their individual peak expiratory flow rate (PEFR) result and corresponding screening-zone classification. Participants with yellow-zone results were verbally advised to seek further clinical evaluation. No formal referral or confirmatory diagnostic assessment was conducted as part of the program. After health education, PFM screening, and individual feedback, participants completed the same questionnaire as a post-test immediately after the program. Consequently, the pre–post comparison assessed short-term changes following the combined program, and the independent effects of health education and PFM feedback could not be distinguished.

The researcher-developed questionnaire was used to assess knowledge of cigarette smoke hazards and attitudes toward smoking prevention. The knowledge section consisted of 10 multiple-choice items. Each correct response was assigned a score of 1, and each incorrect response was assigned a score of 0, yielding a total score of 0–10, which was converted to a percentage. The attitude section included three statements rated on a four-point Likert scale, from 1 (strongly disagree) to 4 (strongly agree). Higher scores indicated more favorable attitudes toward smoking prevention. The questionnaire was developed for this program but had not undergone formal psychometric validation or reliability testing. The limited number of attitude items may not fully capture the multidimensional nature of attitudes toward cigarette smoke hazards; therefore, the attitude findings should be interpreted cautiously.

Peak expiratory flow rate (PEFR) was measured using a mechanical Peak Flow Meter (PF120; Rossmax, Switzerland) with a disposable mouthpiece for each participant. Before use, the device was checked to ensure that the indicator moved freely and returned to its starting position. This routine functional check did not constitute formal calibration. A pulmonology resident measured participants while they stood and demonstrated the correct maneuver before testing. Each participant performed three maximal expiratory maneuvers, with a brief rest between successive attempts, and the highest PEFR value was recorded for analysis. We estimated predicted PEFR values using reference equations from the Pneumobile Project Indonesia (1992), based on age, sex, and height. The highest measured PEFR was expressed as a percentage of the predicted PEFR using the following formula: Percentage of predicted PEFR = (measured PEFR / predicted PEFR) × 100. For screening purposes, results were classified into three zones: green (≥80% of predicted PEFR), yellow (50% to <80%), and red (<50%) (Mulyawan & Setiawan, 2024). This classification was intended for screening and health education, not for diagnosing respiratory disease.

Data were analyzed using IBM SPSS Statistics version 27.0. Descriptive statistics were used to summarize participant characteristics, smoking status, PFM screening results, and knowledge and attitude scores. Non-normally distributed continuous data were summarized using medians and interquartile ranges (IQRs), while categorical variables were presented as frequencies and percentages. Normality of knowledge and attitude scores was assessed using the Shapiro–Wilk test. Pre-test and post-test knowledge scores were compared using the Wilcoxon signed-rank test. Changes in the proportion of correct responses for each knowledge item were assessed using the exact McNemar test for paired binary data. Attitude scores before and after the intervention were compared using the Wilcoxon signed-rank test. The association between current smoking status and peak expiratory flow (PEF) meter zone classification was assessed using Fisher's exact test. The Wilcoxon signed-rank test effect size was reported as (r). All statistical tests were two-sided, and p-values < 0.05 were considered statistically significant. The Health Research Ethics Committee of the Faculty of Medicine and Health Sciences, Lambung Mangkurat University, approved this study on August 24, 2026 (approval number 161/KEPK-FKIK ULM/EC/VIII/2026). All participants provided written informed consent before data collection.

RESULTS AND DISCUSSION

Results

Participants were predominantly aged 30–40 years, and 43.3% were current smokers. Peak Flow Meter screening showed that most participants were classified in the Green Zone (73.3%), while 26.7% were in the Yellow Zone. No participants were classified in the Red Zone (Table 1).

Table 1. Participant Characteristics (n = 30)

Characteristics	N (%) or mean ± SD
Age (years) (mean ± SD)	36.97 ± 10.87
Age Range (years)	20-58
Age group (years)	
- <30	9 (30.0%)
- 30–40	11 (36.6%)
- 41–50	5 (16.7%)
- >50	5 (16.7%)
Height, cm	165.47 ± 5.49
Weight, kg	65.10 ± 11.24
Nutritional Status/Body Mass Index (BMI)	
- Underweight (<18.5)	3 (10.0%)
- Normal (18.5-24.9)	15 (50.0%)
- Overweight (25-29.9)	10 (33.3%)
- Obesity (≥30)	2 (6.7%)
Smoking Status	
- Current smokers	13 (43.3%)
- Former smokers	2 (6.7%)
- Never smokers	15 (50.0%)

Characteristics	N (%) or mean ± SD
Second-hand smoke exposure	1 (3.3%)
Work unit	
- Administrative staff	13 (43.3%)
- Cleaning services	7 (23.3%)
- Security guards	6 (20.0%)
- Others	4 (13.3%)
Peak Flow Meter Results	
- Green Zone	22 (73.3%)
- Yellow Zone	8 (26.7%)
- Red zone	0 (0%)

Knowledge scores increased significantly following the educational intervention, with the median score rising from 75 (IQR: 62.5–100) at pre-test to 100 (IQR: 82.5–100) at post-test (Wilcoxon signed-rank test, Z = −2.753, p = 0.006; r = 0.502) (Table 2).

Table 2. Comparison of Knowledge Scores Before and After the Intervention

Knowledge Score	Pre-test	Post-test
Median (IQR)	75 (62.5-100)	100 (82.5-100)
Mean ± SD	78.67 ± 17.37	90.00 ± 16.82
Minimum–Maximum	20–100	60–100
Wilcoxon signed-rank test		
Z statistic		-2.753
Effect size, r		0.502
p-value		0.006

*Evaluated using the Wilcoxon Signed-Rank test (significance threshold $p < 0.05$).

As shown in Table 3, the proportion of correct responses increased across the knowledge indicators following the educational intervention, with varying degrees of improvement. These findings suggest an overall improvement in participants' knowledge, although the magnitude of change differed between items.

Table 3. Proportion of Correct Responses per Knowledge Item Before and After the Intervention

No	Knowledge item	Pre-test, n (%)	Post-test, n (%)	Δ (percentage points)	p-value
1.	Content of harmful substances in cigarettes	21 (70.0)	28 (93.3)	+23.3	**0.039**
2.	Dangers of cigarette smoke to health	22 (73.3)	25 (83.3)	+10.0	0.453
3.	Third-hand smoke exposure and its health effects	21 (70.0)	28 (93.3)	+23.3	0.065
4.	Health risks of second-hand smoke exposure	20 (66.7)	27 (90.0)	+23.3	**0.039**
5.	Environmental impact of cigarette butt waste	16 (53.3)	25 (83.3)	+30.0	**0.012**
6.	Effects of smoking on respiratory function and physical endurance	22 (73.3)	27 (90.0)	+16.7	0.063
7.	Smoking-related lung disease	26 (86.7)	30 (100.0)	+13.3	0.125
8.	Function of Peak Flow Meter	26 (86.7)	30 (100.0)	+13.3	0.125
9.	Interpretation of the Peak Flow Meter examination results	28 (93.3)	28 (93.3)	0.0	1.000
10.	Benefits of smoking cessation for individuals, families, and the environment	26 (86.7)	30 (100.0)	+13.3	0.125

Note: Δ represents the absolute difference between post-test and pre-test percentages, expressed in percentage points. P-values were calculated using the two-sided exact McNemar test for paired binary responses.

As shown in Table 4, 30.8% of current smokers were classified in the Yellow Zone, compared with 23.5% of non-current smokers. The odds ratio was 1.44 (95% CI: 0.28–7.34); however, the association between smoking status and Peak Flow Meter screening results was not statistically significant (p = 0.698).

Table 4. Association between Smoking Status and PFM Screening Results

Smoking Status	Green Zone/(n, %)	Yellow Zone/(n, %)	OR (95% CI)	p-value
Current smokers	9 (69.2%)	4 (30.8%)	1.44 (0.28-7.34)	0.698*
Non-current smokers	13 (76.5%)	4 (23.5%)	Reference	-
Total	22	8	-	-

*Evaluated using Fisher's Exact Test (significance threshold p < 0.05). The non-active smoker group comprised never smokers and former smokers.

As shown in Table 5, changes in participants' attitudes varied across the three indicators. Concern about the effects of cigarette smoke residue on family members and intention to restrict/quit smoking/not smoke improved significantly (p=0.014). In contrast, awareness of smoking-related effects on stamina and breathing did not change significantly (p=0.157).

Table 5. Changes in Attitude Toward Smoking Prevention Before and After the Intervention

No	Attitude Indicator (Affective)	Pre-test, Median (IQR)	Post-test, Median (IQR)	p-value*
1.	Awareness that smoking affects stamina and breathing	4.0 (3.0-4.0)	4.0 (3.25-4.0)	0.157
2.	Concern about the dangers of cigarette smoke residue to family members	4.0 (3.0-4.0)	4.0 (4.0-4.0)	0.014
3.	Intention to restrict/quit/not smoke	4.0 (3.0-4.0)	4.0 (4.0-4.0)	0.014

*Remarks: Tested using the Wilcoxon Signed-Rank Test with a statistical significance limit of p < 0.05. Responses were rated on a four-point Likert Scale of 1 (Strongly Disagree) to 4 (Strongly Agree).

Discussion

The integrated educational program was associated with a significant improvement in participants' knowledge of cigarette smoke hazards, with the median score increasing from 75 to 100 and a within-group effect size of 0.502. This result is similar to previous workplace tobacco education studies with adults. Tobacco-related knowledge increased significantly following educational training among staff at substance use treatment centers (Le et al., 2021). Similarly, an anti-tobacco messaging campaign increased blue-collar workers' knowledge of tobacco-related hazards (Stewart et al., 2016b). Structured educational interventions have also enhanced smoking-related knowledge among industrial workers (Oo et al., 2025). Moreover, workplace tobacco education has been linked to increased awareness of smoking harms among employees (Lin et al., 2021). However, direct comparisons of effect magnitude are limited by differences in study design, intervention intensity, participant characteristics, and assessment instruments. The present program additionally incorporated education on second-hand and third-hand smoke, cigarette butt waste, and PFM screening, integrating tobacco-related health education with basic respiratory health awareness.

Knowledge of third-hand smoke exposure increased from 70.0% at pre-test to 93.3% at post-test, representing a 23.3-percentage-point improvement; however, this change did not reach statistical significance (p = 0.065). Although the health risks of active and second-hand smoking are widely recognized, third-hand smoke represents a distinct form of tobacco exposure involving persistent residues on indoor surfaces and in dust. Evidence suggests that public knowledge of the potential health consequences varies, underscoring the importance of incorporating third-hand smoke into tobacco-related health education (Almassi et al., 2025; Wu et al., 2022; Yildirim-Ozturk et al., 2024). There were significant improvements in knowledge of harmful substances in cigarettes, health risks associated with exposure to second-hand smoke, and the environmental impacts of cigarette butt disposal. Although some misconceptions may endure, targeted information dissemination has been associated with greater understanding of harmful and potentially dangerous elements in cigarette smoke (Venrick et al., 2023). The environmental dimension is also important, as recent research among adult smokers identified gaps in knowledge and practices concerning cigarette butt disposal (Hosseinnia et al., 2026). In addition, a recent

umbrella review synthesizing evidence from 111 systematic reviews and meta-analyses reinforced the substantial health risks associated with second-hand smoke exposure, including lung cancer and cardiovascular disease (S. Zhang et al., 2026). Together, these findings support the inclusion of cigarette composition, involuntary smoke exposure, and tobacco-related environmental pollution as complementary topics in workplace health education.

Interactive educational activities may encourage participant engagement by giving participants opportunities to ask questions, share experiences, and connect health information to everyday life. However, the present study did not include a lecture-only comparison group; therefore, the relative effectiveness of the interactive approach cannot be determined. Workplace smoking-cessation research has examined a variety of strategies, including individual counseling, group counseling, telephone coaching, and web-based interventions (Ayaz et al., 2024; Cahill & Lancaster, 2014). These findings highlight the potential value of tailored support in workplace health promotion, but they do not establish that interactive education is superior to conventional lectures for improving knowledge. In the present program, individual PFM measurements may have helped participants relate the educational messages to their respiratory health.

Individual PFM feedback may have helped participants relate the educational messages to their own respiratory health. Within the Health Belief Model, perceived susceptibility refers to an individual's belief about their likelihood of experiencing a health problem and may influence preventive health behavior (Rosenstock, 1974). However, perceived susceptibility was not directly measured in this study, and the independent contribution of PFM feedback cannot be separated from that of education because both components were delivered as an integrated program.

PFM screening identified eight participants (26.7%) in the Yellow Zone, indicating the need for further assessment rather than establishing a diagnosis of obstructive lung disease. Although the proportion of Yellow Zone results was descriptively higher among current smokers than non-current smokers (30.8% vs. 23.5%), the association was not statistically significant (OR = 1.44, 95% CI [0.28-7.34], p = 0.698). This finding should be interpreted cautiously because of the small sample size and wide confidence interval. A population-based study similarly found no significant association between smoking status and spirometry or PEF testing history. However, its outcome differed from the PFM screening results assessed in the present study (Carlsson et al., 2023). Thus, these findings support the potential value of workplace respiratory screening to identify individuals who may need further assessment, rather than demonstrating a statistically significant association between smoking status and PFM results.

The three indicators showed different post-intervention attitude changes. Participants showed high awareness of the effects of smoking on stamina and breathing, with no statistically significant difference between pre-test and post-test scores (median 4.0 on both assessments, p = 0.157). Conversely, statistically significant changes were observed in concern about the harmful effects of cigarette smoke residue on family members and intention to restrict, quit, or not smoke (p = 0.014 for each indicator). The high baseline scores may have limited further improvement, indicating a ceiling effect in which scores cluster near the top of a measurement scale, reducing sensitivity to detect further change (Chyung et al., 2020). Nevertheless, the findings should be interpreted cautiously because the sample comprised only 30 participants and attitudes were assessed using three indicators. Attitudes and behavioral intentions relate to health-related behavior, but intention does not necessarily translate into actual behavior change (Ajzen, 1991; Faries, 2016). A systematic review of smoking-cessation training also found that educational interventions could improve knowledge, attitudes, and self-efficacy, although evidence of changes in practice was more limited (G. Zhang et al., 2024). Workplace smoking-cessation interventions have likewise shown benefits, but outcomes vary with the type and intensity of support provided (Ayaz et al., 2024). Since actual smoking cessation and sustained behavioral change were not assessed in the present study, the observed findings should be interpreted as changes in selected attitude indicators rather than evidence of smoking behavior change.

Implications

The findings support the potential value of integrating tobacco-related health education with basic respiratory screening in workplace health promotion. Participants' knowledge scores improved significantly after the program, from a median of 75 to 100 (p = 0.006), including

knowledge of cigarette smoke hazards, second-hand smoke exposure, and the environmental impact of cigarette butt waste. However, attitudes varied across the three indicators, suggesting that knowledge gains do not necessarily translate into consistent changes in attitudes or behavioral intentions. PFM screening identified eight participants (26.7%) with Yellow Zone readings who may benefit from further respiratory assessment. Although Yellow Zone readings were descriptively more frequent among current smokers than non-current smokers, the association was not statistically significant (OR = 1.44, 95% CI [0.28-7.34], p = 0.698). These findings suggest that workplace programs may combine tobacco-related education with preliminary respiratory screening to identify individuals who may warrant further assessment. Nevertheless, PFM should not be used to diagnose obstructive lung disease, and the uncontrolled design and small sample size limit conclusions about the independent contribution of screening to educational outcomes.

Research contribution

This program demonstrates the feasibility of integrating tobacco-related health education with PFM screening in a workplace health promotion activity. By combining knowledge and attitude assessments with respiratory screening, the program provided immediate, personalized health feedback that reinforced educational messages about the hazards of cigarette smoke. The observed improvement in knowledge scores and identification of participants with Yellow Zone PFM readings illustrate the potential practical value of this integrated approach. However, because education and PFM screening were delivered together without a comparison group, we could not determine each component's independent contribution. These findings provide preliminary evidence of implementation for integrated tobacco-related education and respiratory screening among university support staff.

Limitations

Several limitations should be considered when interpreting these findings. First, the one-group pre-test–post-test design lacks a control group, making it difficult to infer causality because factors other than the program may have contributed to the observed changes. The post-test was also administered after the educational session and PFM feedback, so the individual contributions of the two study components cannot be identified. The immediate post-test of the same questionnaire may also have introduced testing or recall effects. Moreover, the questionnaire used was designed by the researcher and was not formally psychometrically validated. The study measured attitudes using only three items, which limited the comprehensiveness of the measurement. The small sample size of 30 participants from one institution also limits the statistical power and generalizability of the findings. Because all participants were male support staff, the results may not apply to female staff or other occupational groups.

Regarding respiratory screening, PFM readings provide preliminary information on PEF and should not be interpreted as a diagnosis of obstructive lung disease. The association between current smoking status and PFM zone classification was not statistically significant, and the wide confidence interval indicates considerable uncertainty in the estimate. Moreover, smoking exposure was classified according to current smoking status without fully accounting for its intensity, duration, or cumulative exposure. Other factors, including respiratory history, occupational exposures, and the effort-dependent nature of PFM maneuvers, may also have influenced the readings. Finally, the study assessed knowledge and attitudes immediately after the program and did not evaluate sustained changes in knowledge, actual smoking cessation, or long-term respiratory outcomes.

Suggestions

Future programs should include larger, more diverse workplace populations and follow-up assessments to determine whether improvements in knowledge and attitudes are sustained and linked to behavioral change. A quasi-experimental study with a control group could help assess outcomes beyond changes observed over time, while a factorial design could help distinguish the contributions of tobacco-related health education and PFM feedback. Future studies should also use validated measurement instruments, assess smoking exposure more comprehensively, and

consider spirometry for participants with abnormal PFM screening results to support further respiratory evaluation.

CONCLUSION

The integrated program combining interactive health education and PFM screening was associated with a short-term improvement in participants' knowledge of cigarette smoke hazards. Changes in attitude indicators varied across the three items. PFM screening identified participants who may benefit from further respiratory assessment, although no statistically significant association was observed between current smoking status and PFM screening results. These findings support the potential value of integrating tobacco-related health education with preliminary respiratory screening in workplace health promotion. However, the lack of a control group, small sample size, and long-term follow-up limit causal interpretation and conclusions about sustained changes in knowledge, attitudes, or smoking behavior. PFM screening should not be considered a substitute for diagnostic spirometry.

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AUTHOR CONTRIBUTION STATEMENT

H conceptualized the program, developed the community service framework, and drafted the main manuscript. SF coordinated field implementation and managed program finances. PF and FJ developed the educational materials and facilitated the educational sessions. MIH and YP conducted the clinical PFM screenings and tabulated the participant data. All authors critically reviewed and approved the final manuscript for publication.

AI DISCLOSURE STATEMENT

The authors used an AI-based writing tool solely for language editing and to improve readability. The authors were responsible for and verified all scientific content, data analysis, interpretation of results, and final manuscript preparation, who take full responsibility for the content of this manuscript.

CONFLICTS OF INTEREST

The authors declare that they have no financial, institutional, or personal conflicts of interest that could have influenced the conduct of this study, data analysis, or submission and publication of the manuscript.

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