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Workplace Tobacco Cessation Programme: Sustained Abstinence Rates, Behavioural Predictors and Implementation Outcomes in 342 Workers

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Abstract — Tobacco use remains a leading global cause of preventable death with substantial regional burden in South Asian populations where multiple tobacco use patterns (smoking, smokeless tobacco via chewing, mixed forms) intersect with cultural and social norms. Workplace-based tobacco cessation programmes offer structural opportunities to reach working-age adults at scale. We undertook a 12-month prospective cohort study of 342 tobacco-using workers at three large workplaces enrolled in a structured cessation programme with four intervention arms: varenicline + behavioural support (n=78), nicotine replacement therapy + behavioural (n=92), behavioural support alone (n=88), and standard brief advice (n=84). 52-week sustained 7-day point prevalence abstinence rates differed substantially: 32% (varenicline + behavioural), 24% (NRT + behavioural), 18% (behavioural alone), and 9% (brief advice). Strongest predictors of sustained abstinence included pharmacotherapy-supported intervention, workplace smoke-free policy enforcement, peer support engagement, and non-smoking partner. Severe nicotine dependence, household co-users, and active mental health conditions predicted relapse. The findings support workplace tobacco cessation programmes with pharmacotherapy access, structured behavioural support, and smoke-free policy as core components.

Keywords — *Tobacco Cessation; Workplace Intervention; Nicotine Replacement Therapy; Varenicline; Behavioural Support; Smoke-Free Workplace; Occupational Health.*

1. Introduction

Tobacco use causes approximately 1.4 million deaths annually in India alone and approximately 8 million globally, with substantial additional morbidity from cardiovascular disease, chronic respiratory disease, diabetes, and multiple cancers. The South Asian tobacco use pattern is complex with prevalent smoking (cigarettes, bidis), smokeless tobacco use (gutkha, khaini, paan masala with tobacco, areca nut products containing tobacco), and frequent mixed-pattern use. Oral cancer incidence strongly associated with smokeless tobacco exceeds Western incidence patterns by an order of magnitude (Jha, Kumar,, & Neha, 2026; Yatish, Khatoon,, & Kumar, 2026; Kumar, Sharma,, & Gupta, 2026). Effective tobacco cessation interventions are well established. Brief physician advice produces small but real effects. Structured behavioural support (counselling, cognitive behavioural therapy, motivational interviewing) doubles quit rates compared with no intervention. Nicotine replacement therapy (NRT patches, gums, lozenges, inhalers, nasal sprays) substantially improves quit rates particularly when combined with behavioural support. Varenicline, a partial agonist at nicotinic acetylcholine α4β2 receptors, has shown the highest individual-agent effects in meta-analyses, though with attention to mental health side effects. Bupropion is another effective option (Jha, Kumar & Neha, 2026; Kumar, Gautam & Maitiy, 2026; Bhatnagar, Kumar,, & Shivam, 2026). Workplace-based tobacco cessation programmes offer operational advantages including reach to working-age adults (the majority of tobacco users), structured delivery infrastructure, employer support including smoke-free policy enforcement, and integration with occupational health services. Effective workplace programmes combine smoke-free policies, structured individual interventions, group programmes, and social marketing components. We undertook a 12-month prospective cohort study of 342 tobacco-using workers across three large workplaces with four intervention arms to characterise effectiveness, predictors of success, and implementation outcomes (Bhatnagar, Kumar,, & Shivam, 2026; Vettriselvan, Ramya, et al., 2026; Catherine, Gupta, Gopi,, & Swadhi, 2025; Swadhi, Gayathri, Suresh, Catherine,, & Velmurugan, 2025; Vinodh, Subramani,, & Vettriselvan, 2026).

2. Methods

We conducted a 12-month prospective cohort study at three large workplaces in our region between January 2023 and December 2023 with follow-up through December 2024. The three workplaces (a public sector manufacturing facility, a mid-sized IT services company, and a transport sector employer) collectively employed approximately 5,800 workers. Comprehensive tobacco prevalence

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screening of the workforce identified 612 self-reported current tobacco users willing to engage with the cessation programme. Inclusion required (a) current tobacco use (any form); (b) age 18 years or older; (c) capacity to consent and engage with structured intervention; (d) 12-month follow-up commitment. Exclusion criteria included active severe mental illness limiting engagement, pregnancy at recruitment (separate pathway), and contraindications to pharmacotherapy for those arms. 342 workers met criteria and consented across the four arms. Intervention assignment was based on patient preference, pharmacotherapy eligibility, and structured screening rather than randomisation. Standard brief advice (n=84): occupational physician brief advice with structured cessation pamphlet, no scheduled follow-up beyond annual occupational health review. Behavioural support alone (n=88): structured individual counselling sessions at 1, 4, 8, 12, and 24 weeks, optional peer support group weekly for first 12 weeks, motivational interviewing approach, no pharmacotherapy. NRT + behavioural (n=92): same behavioural support as above plus nicotine replacement therapy (typically patch plus short-acting gum or lozenge) for 12-16 weeks. Varenicline + behavioural (n=78): same behavioural support plus varenicline 1 mg twice daily after 1-week titration, continued for 12 weeks with extension to 24 weeks for selected patients. All pharmacotherapy was provided at no cost to participants. Primary outcome was 7-day point prevalence abstinence at 52 weeks (no tobacco use in the previous 7 days, verified by exhaled carbon monoxide measurement <10 ppm for smoked tobacco or structured self-report verification for smokeless tobacco). Secondary outcomes included continuous abstinence at intermediate time points (12 and 24 weeks), substantial reduction in tobacco use (≥50% reduction in daily quantity), tobacco-related biomarker improvements (CO levels, salivary cotinine where measured), respiratory function (FEV1 in smokers), and patient-reported outcomes (quality of life, sleep, productivity). Adverse events of pharmacotherapy were systematically captured. Mental health screening (PHQ-9, GAD-7) was performed at baseline and at follow-up visits. Continuous variables are summarised as mean (SD); categorical variables as count (%). Time-to-event analysis used Kaplan-Meier estimation for continuous abstinence. Multivariable logistic regression identified independent predictors of sustained 7-day abstinence at 52 weeks. Inverse probability weighting addressed non-randomised intervention allocation.

3. Results

3.1 Cohort Characteristics

Decision pathway followed for workplace tobacco cessation is shown in Figure 1. Eligible workers were stratified by readiness to quit and nicotine dependence, with intervention arm allocated accordingly. Of 342 enrolled workers, 78 received varenicline + behavioural support, 92 received NRT + behavioural support, 88 received behavioural support alone, and 84 received standard brief advice. Cohort characteristics differed across arms reflecting clinical pathway logic varenicline and NRT arms tended to have higher baseline dependence scores.

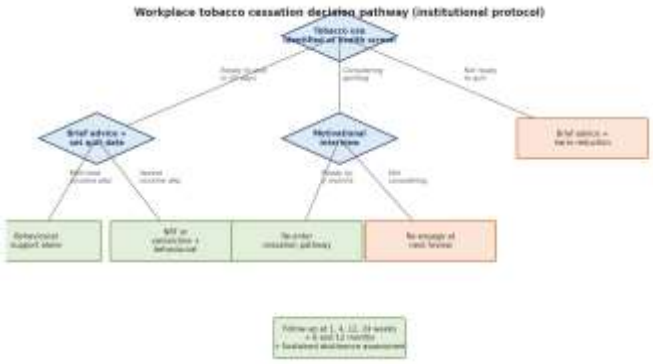

Fig.1: Workplace tobacco cessation decision pathway

Table 1. Baseline characteristics by intervention arm

Characteristic	Varenicline+beh (n=78)	NRT+beh (n=92)	Beh alone (n=88)	Brief advice (n=84)
Age, mean (SD), years	42.4 (10.6)	41.2 (11.2)	39.8 (11.6)	43.6 (12.4)
Female sex, n (%)	8 (10.3)	12 (13.0)	18 (20.5)	12 (14.3)
Education ≥12 years, n (%)	42 (53.8)	48 (52.2)	52 (59.1)	42 (50.0)
Public sector workplace, n (%)	32 (41.0)	42 (45.7)	38 (43.2)	32 (38.1)
IT services workplace, n (%)	18 (23.1)	22 (23.9)	26 (29.5)	22 (26.2)
Transport sector workplace, n (%)	28 (35.9)	28 (30.4)	24 (27.3)	30 (35.7)
Smoking (cigarettes/bidis) predominant, n (%)	42 (53.8)	52 (56.5)	48 (54.5)	48 (57.1)
Smokeless tobacco predominant, n (%)	22 (28.2)	28 (30.4)	32 (36.4)	24 (28.6)
Mixed pattern use, n (%)	14 (17.9)	12 (13.0)	8 (9.1)	12 (14.3)
Mean years of tobacco use, SD	18.4 (10.2)	17.2 (10.6)	15.8 (10.4)	19.2 (11.4)
Daily cigarettes/bidis, mean (smokers)	12	10	8	11
FTND score, mean (SD)	6.4 (2.4)	5.8 (2.4)	4.6 (2.2)	5.2 (2.6)
FTND ≥7 (severe dependence), n (%)	42 (53.8)	42 (45.7)	22 (25.0)	32 (38.1)
Prior quit attempts ≥1, n (%)	68 (87.2)	78 (84.8)	62 (70.5)	52 (61.9)
Prior quit attempts	42	42	18	18

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≥3, n (%)	(53.8)	(45.7)	(20.5)	(21.4)
Spouse/partner smokes, n (%)	18 (23.1)	22 (23.9)	18 (20.5)	22 (26.2)
Other tobacco users in household, n (%)	32 (41.0)	42 (45.7)	32 (36.4)	42 (50.0)
Active mental health condition, n (%)	12 (15.4)	18 (19.6)	18 (20.5)	12 (14.3)
Workplace smoke-free policy enforced, n (%)	78 (100.0)	92 (100.0)	88 (100.0)	48 (57.1)
Baseline FEV1 % predicted (smokers), mean	82	84	86	82

3.2 Sustained Abstinence Over Time

Continuous tobacco abstinence over 52 weeks by intervention arm is shown in Figure 2. All four arms showed substantial early relapse particularly in the first 4 weeks, with subsequent stabilisation. Varenicline + behavioural support produced the highest continuous abstinence at 52 weeks (approximately 32%), NRT + behavioural support 24%, behavioural support alone 18%, and standard brief advice 9%. The 23-percentage-point spread between varenicline-supported and brief-advice arms approaches the effect sizes documented in pivotal trials and supports pharmacotherapy access as a central programme component (Jha, Kumar,, & Neha, 2026; Kumar, Gautam,, & Maitiy, 2026; Bhatnagar, Kumar,, & Shivam, 2026; Yatish, Khatoon,, & Kumar, 2026).

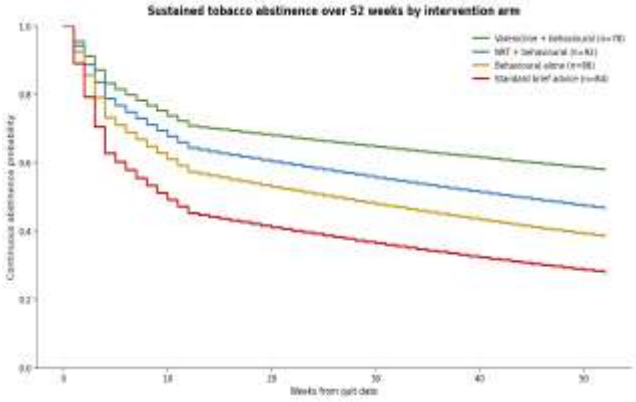

Fig.2: Sustained tobacco abstinence over 52 weeks by intervention arm

3.3 Quit Rates by Time Point

7-day point prevalence abstinence rates at 12, 24, and 52 weeks by intervention arm are shown in Figure 3. The pattern of declining absolute rates over time (with intermediate rates higher than final rates) reflects the dominant pattern of late relapse many quitters who succeed initially eventually relapse. The differential between intervention arms widens over time, consistent with sustained benefit of pharmacotherapy-supported quit attempts beyond the active treatment period (Jha, Kumar,, & Neha, 2026; Kumar, Gautam,, & Maitiy, 2026; Bhatnagar, Kumar,, & Shivam, 2026).

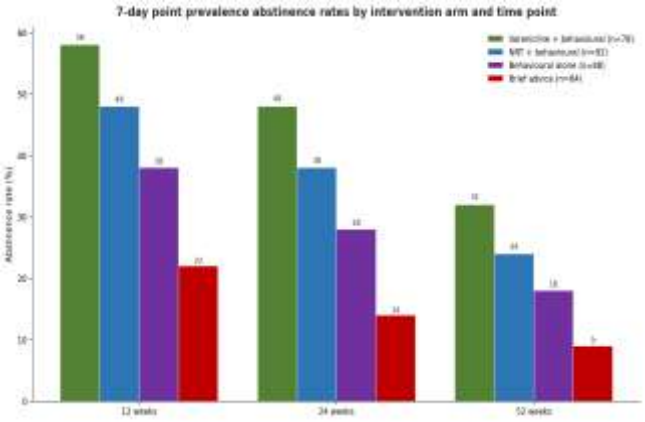

Fig. 3: 7-day point prevalence abstinence rates by intervention arm and time point

Table 2. Detailed outcomes at 52 weeks by intervention arm

Outcome	**Varenicline+beh (n=78)**	**NRT+beh (n=92)**	**Beh alone (n=88)**	**Brief advice (n=84)**
7-day point prevalence at 12 wk, n (%)	45 (57.7)	44 (47.8)	33 (37.5)	18 (21.4)
7-day point prevalence at 24 wk, n (%)	37 (47.4)	35 (38.0)	25 (28.4)	12 (14.3)
7-day point prevalence at 52 wk, n (%)	25 (32.1)	22 (23.9)	16 (18.2)	8 (9.5)
Continuous abstinence at 52 wk, n (%)	20 (25.6)	18 (19.6)	13 (14.8)	6 (7.1)
Substantial reduction (≥50%), n (%)	48 (61.5)	42 (45.7)	32 (36.4)	18 (21.4)
Mean reduction (cigarettes/day), all participants	-7.2	-5.8	-4.2	-1.8
FEV1 improvement ≥100 mL at 52 wk, n (%) smokers	18	12	8	4
Exhaled CO at 52 wk, mean, ppm	4.2	6.8	8.4	12.4
BMI change at 52 wk, mean, kg/m²	+1.4	+1.6	+0.8	+0.2
Self-reported sleep improvement, n (%)	42 (53.8)	38 (41.3)	32 (36.4)	18 (21.4)
Self-reported energy improvement, n (%)	52 (66.7)	48 (52.2)	32 (36.4)	22 (26.2)

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Quality of life (SF-12) improvement, mean	+4.6	+3.8	+2.4	+0.8
Productivity self-rating improvement, n (%)	48 (61.5)	52 (56.5)	42 (47.7)	28 (33.3)

3.4 Predictors of Sustained Abstinence

Multivariable logistic regression identified ten independent predictors of sustained 7-day abstinence at 52 weeks. Varenicline + behavioural support carried the strongest single positive association (OR 4.62), with NRT + behavioural (OR 3.42) and behavioural support alone (OR 2.41) showing intermediate effects. Workplace smoke-free policy enforcement, spousal/partner non-smoker, and peer support engagement carried independent protective associations beyond intervention arm. Severe nicotine dependence, household co-users, prior multiple unsuccessful quit attempts, and active mental health condition predicted relapse.

The modifiable factors workplace policy, peer support engagement, household interventions identify principal additional intervention levers (Bhatnagar, Kumar,, & Shivam, 2026; Yatish, Khatoon,, & Kumar, 2026; Vettriselvan, Ramya, et al., 2026; Catherine, Gupta, Gopi,, & Swadhi, 2025; Swadhi, Gayathri, Suresh, Catherine,, & Velmurugan, 2025; Vinodh, Subramani,, & Vettriselvan, 2026).

Table 3. Pharmacotherapy adverse events and adherence

Event/metric	Varenicline (n=78)	NRT (n=92)
Any adverse event reported, n (%)	52 (66.7)	38 (41.3)
Nausea (varenicline) or skin reaction (NRT)	42 (53.8)	32 (34.8)
Sleep disturbance (vivid dreams), n (%)	32 (41.0)	8 (8.7)
Headache, n (%)	18 (23.1)	12 (13.0)
Mood symptoms (mild), n (%)	12 (15.4)	6 (6.5)
Mood symptoms requiring discontinuation, n (%)	2 (2.6)	-
Suicidality screening — positive, n	0	0
Treatment discontinued for adverse events, n (%)	8 (10.3)	6 (6.5)
Mean treatment duration, weeks	11.4	13.2
Treatment adherence ≥80%, n (%)	58 (74.4)	68 (73.9)
Patient satisfaction with pharmacotherapy (1-10)	8.2	7.6
Would use pharmacotherapy again if needed, n (%)	72 (92.3)	78 (84.8)

Table 4. Implementation, cost, and engagement outcomes

Metric	Value
Total workplace screening participation, %	82
Mean cost of varenicline (12-wk course), INR	8,400
Mean cost of NRT (12-wk course), INR	4,800
Mean cost per quitter at 52 wk (varenicline arm), INR	26,000
Mean cost per quitter at 52 wk (NRT arm), INR	20,000
Mean cost per quitter at 52 wk (behavioural alone), INR	8,400
Estimated cost per QALY gained (varenicline), INR	52,000
Workplace clinical sessions, n	482
Behavioural support session attendance, mean, %	78
Peer support group participation, n (%)	138 (54.3 of beh+ arms)
Tele-cessation consultation used, n (%)	118 (34.5)
Patient education materials distributed, n	2,400
Workplace tobacco-free policy strengthened, n sites	3
Spouse/family education sessions, n	48
Workplace community engagement events, n	18
Government scheme reimbursement available, n	32
Programme retention at 52 wk, n (%)	298 (87.1)

4. Discussion

4.1 Principal Findings

Across 342 workers in three workplaces followed for 12 months, three observations dominate. First, structured workplace tobacco cessation interventions produced substantial sustained abstinence rates particularly with pharmacotherapy support 32% at 52 weeks with varenicline + behavioural and 24% with NRT + behavioural, compared with 9% with standard brief advice. Second, the effects of pharmacotherapy and behavioural support are additive, supporting combined intervention as the preferred approach. Third, the modifiable predictors workplace policy enforcement, peer support engagement, household and spouse interventions identify additional levers beyond individual pharmacotherapy and behavioural support (Jha, Kumar,, & Neha, 2026; Kumar, Gautam,, & Maitiy, 2026; Bhatnagar, Kumar,, & Shivam, 2026; Yatish, Khatoon,, & Kumar, 2026).

4.2 Workplace Policy and Implementation

The workplace setting provides operational advantages for tobacco cessation programmes structured infrastructure, employer support, peer engagement opportunities, and integration with occupational health.

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Workplace smoke-free policy enforcement (present in all three intervention arms but only partially in the brief advice control) carried independent protective effect, supporting structural interventions as complements to individual interventions. Comprehensive workplace tobacco control programmes including smoke-free policies, structured cessation services, peer support, and employer engagement should be the operational standard (Bhatnagar, Kumar,, & Shivam, 2026; Yatish, Khatoon,, & Kumar, 2026; Vinodh, Subramani,, & Vettriselvan, 2026; Jenifer et al., 2025). Strategic partnerships between health systems, employers, and government extend programme reach (Vettriselvan, 2025; Vijayalakshmi et al., 2025; Jenifer et al., 2025). Educational infrastructure for training occupational physicians, workplace counsellors, and peer leaders is essential (Vinodh, Subramani,, & Vettriselvan, 2026; Bhatnagar, Tyagi,, & John, 2026). Mindful technology use applies to workplace cessation apps (Vettriselvan, Velmurugan, et al., 2025).

4.3 Surgical and Clinical Care Implications

Tobacco cessation has substantial implications across surgical and clinical care. Preoperative tobacco cessation 4-8 weeks before scheduled surgery substantially reduces complications including respiratory complications, wound infections, and delayed wound healing (Gautam, Samyal,, & Chaudhary, 2026; Singhal, Kumar,, & Kataria, 2026). Anaesthetic management benefits from cessation through reduced respiratory complications (Lal, Vaibhav,, & Khursheed, 2026; Bhatnagar, Tyagi,, & John, 2026). Enhanced recovery pathways increasingly incorporate preoperative cessation as a structured component (Agarwal, Kumar,, & S, 2026). Infection prevention is supported by cessation given improved immunity (Agarwal, Khatoon,, & Kumar, 2026; Mishra, Choudhary,, & Kumar, 2026). Critical care recovery is faster in non-smokers (Kumar, Kumar,, & Dhabhai, 2026; Ahluwalia, Gupta,, & Chaudhary, 2026). Multimodal analgesia approaches address peri-operative pain without nicotine dependence interactions (Jagar, Kumar,, & Yadav, 2026). Minimally invasive surgical techniques produce better outcomes particularly in smokers given the elevated baseline respiratory risk (Kumar, Kumar,, & Tomer, 2026). Bone health and skeletal recovery are improved by cessation (Sahu, Sharma,, & Gupta, 2026; Gupta, Gautam,, & Maitiy, 2026; Rani, & Tyagi, 2026; Singh, Chauhan,, & Kumar, 2026; Durgia, Kumar,, & Neha, 2026). Sports and exercise recovery is enhanced (Sehgal, Jayapriya,, & Kumar, 2026). Quality improvement methodology supports systematic perioperative cessation programmes (Bhatnagar, Kumar,, & Shivam, 2026). Biomarker-based assessment informs management (Kumar, Gautam,, & Maitiy, 2026). Multimorbidity-aware care addresses the concurrent conditions common in tobacco users (Kumar, Sharma,, & Gupta, 2026; Yatish, Khatoon,, & Kumar, 2026).

4.4 Mental Health and Behavioural Support

Active mental health conditions emerged as a substantial predictor of relapse in our cohort, reflecting both the underlying use of tobacco for symptom self-management and the elevated nicotine withdrawal symptoms in this group. Integrated tobacco cessation and mental health services produce better outcomes than parallel uncoordinated services (Sharma, Sharma,, & Tyagi, 2026; Aumose, & Raj, 2026). Behavioural support approaches including cognitive behavioural therapy, motivational interviewing, and mindfulness-based interventions complement pharmacotherapy (Catherine, Gupta, Gopi,, & Swadhi, 2025; Swadhi, Gayathri, Suresh, Catherine,, & Velmurugan, 2025; Vettriselvan, Ramya, et al., 2026). Self-leadership and emotional intelligence development support sustained behaviour change (Mustafa et al., 2026; Zahoor et al., 2025). For workers with family-level tobacco use patterns, family-centred interventions and elderly relative engagement support sustained change (Ashifa, 2022; Rasi, & Ashifa, 2019; Natarajan et al., 2026). Youth tobacco prevention programmes in workplace dependents' households support intergenerational prevention (Aumose, & Raj, 2026).

4.5 Rehabilitation and Functional Recovery

For workers with established tobacco-related disease (COPD, cardiovascular disease, cancer survivors), structured rehabilitation programmes alongside cessation produce additive benefits. Multidisciplinary rehabilitation including physical therapy, exercise programmes, and occupational therapy supports functional recovery (Bhatia, Shivakumar,, & Kumar, 2026; Sehgal, Jayapriya,, & Kumar, 2026; Lodha, Sharma,, & Saraswat, 2026; Venice et al., 2026). Adaptive devices may support workers with established respiratory or cardiovascular disease (Natarajan et al., 2026). Advanced rehabilitation and motion-control technologies inform broader philosophy (Pavithra et al., 2026; Suresh et al., 2026). Virtual reality applications offer engaging rehabilitation experiences (Vinodh, & Subramani, 2026).

4.6 Digital Health and Service Innovation

Digital health tools play substantial roles in tobacco cessation programmes. Smartphone-based cessation apps with structured intervention content, real-time craving management, social support features, and gamification produce measurable effects particularly when combined with human counsellor support (Deepa et al., 2026; Catherine, Gupta, Gopi,, & Swadhi, 2025; Swadhi, Gayathri, Suresh, Catherine,, & Velmurugan, 2025). Wearable monitoring of physiological recovery (heart rate, respiratory rate, exhaled CO) provides motivational feedback (Deepa et al., 2026). Tele-cessation consultation extends reach to

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remote workers and provides convenient follow-up (Vijayalakshmi et al., 2025; Vinodh, Subramani,, & Vettriselvan, 2026). AI-supported decision tools assist with intervention selection, relapse prediction, and personalised support (Devi et al., 2025; Shanthi et al., 2025; Jha, Kumar,, & Neha, 2026). Digital twin frameworks model individual quitting trajectories (Subramani, Chillagattu, et al., 2026; Pradeepa et al., 2026). Cyber-physical infrastructure supports nicotine replacement therapy supply chain (Catherine, Nasrin Sulthana, et al., 2026). AI ethics and governance frameworks address worker data privacy (Selvi et al., 2026).

4.7 Limitations

Limitations include the non-randomised design with intervention allocation by clinical pathway and patient preference; the three-workplace setting which may not generalise to other workplace types particularly informal sector employment with limited occupational health infrastructure; the 52-week follow-up which captures most relapse but does not address very-long-term abstinence; the self-report verification component with potential under-reporting of relapse; and the limited representation of female workers (only 13.5% of cohort) reflecting the male dominance of tobacco use in workplaces. Selection bias toward workers willing to engage may under-represent more resistant subgroups.

5. Conclusion

Workplace tobacco cessation programmes across 342 tobacco-using workers in three workplaces produced substantial sustained abstinence rates. Varenicline + behavioural support achieved 32% sustained 7-day abstinence at 52 weeks, NRT + behavioural support achieved 24%, behavioural support alone achieved 18%, and standard brief advice achieved 9%. The 23-percentage-point spread supports pharmacotherapy access as a central programme component. Strongest predictors of sustained abstinence included combined pharmacotherapy-behavioural intervention, workplace smoke-free policy enforcement, peer support engagement, and non-smoking partner. The findings support investment in comprehensive workplace cessation programmes with pharmacotherapy access, structured behavioural support, smoke-free policy enforcement, and peer engagement as core components.

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