Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.47750/jptcp.2023.30.06.005

Association between Carbon monoxide level and Tobacco Abstinence Level among Construction workers in Chennai city- An Longitudinal Study

Sri sakthi.D[1*], Indumathy Pandiyan[2], N D Jayakumar[3], Meignana Arumugham Indiran[4], Leelavathi. L[5]

[1]Reader, Department of Public Health Dentistry, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, (SIMATS), Saveetha University,Chennai - 600077.

[2]Post-Graduate Student, Department of Public Health Dentistry, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, (SIMATS), Saveetha University,Chennai - 600077.

[3]Professor and Dean of faculty, Department of Periodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, (SIMATS), Saveetha University,Chennai - 600077.

[4]Professor and Head of the Department of Public Health Dentistry, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, (SIMATS), Saveetha University,Chennai - 600077.

[5]Reader, Department of Public Health Dentistry, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, (SIMATS), Saveetha University,Chennai - 600077.

***Corresponding author:** Sri sakthi. D, Reader Department of Public Health Dentistry Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, (SIMATS), Saveetha University,Chennai – 600077, Email: srisakthi@saveetha.com

Submitted: 17 February 2023; Accepted: 09 March 2023; Published: 02 April 2023

ABSTRACT

Background: Despite reductions in prevalence in recent years, tobacco smoking remains one of the main preventable causes of ill-health and premature death worldwide. Tobacco smoking increases the risk of contracting a wide range of diseases, many of which are fatal. The aim of the study is to assess the association between carbon monoxide level, tobacco abstinence level and compliance towards tobacco cessation among construction workers.

Materials and Method: A longitudinal study with 375 male construction workers aged 20 to 60 years was studied with information about demographic details, cigarette smoking, using smokeless tobacco. The primary outcome was to report their abstinence level at the end of 2 years.

Results: Of the 375 participants most of the participants were in the age group of 31 to 40 years (39.4%). At the age group of 31 to 40 years 20% of the participants used again smokeless tobacco which was the highest among all the age group. For smokers, among the age group of 31 to 40 years 10.93% had medium dependence, for smokeless users, among the age group of 21 to 30years 7.47% had low dependence. The abstinence level at the end of 2 years for smoking was 2.14±0.77, smokeless (2.20±0.72). The p value was statistically significant.

Conclusion: Exhaled CO measurements may provide a non-invasive, sensitive, and immediate way of assessing a patient's smoking status. Determination of exhaled CO level >6.5 ppm strongly suggests that the subject is a smoker

Keywords: *Chronic renal failure, Renin , Aspartate Amino Transferase Alanine Amino Transferase , Albumin, Globulin, Calcium , Sodium , Potassium*

INTRODUCTION

Smoking has long been known to be associated with a number of respiratory illnesses, both etiologically and prognostically (1). Demonstrating an immediate and potentially hazardous effect of smoking using a carbon monoxide (CO) monitor, according to research, boosted the number of persons who followed stop smoking suggestions (2).

The rise in ETRP use is multifaceted and complex, but it appears to be primarily driven by big tobacco firms' efforts to reinvent themselves and produce more enticing and presumably safe(r) tobacco products. However, it is becoming clear that these goods emit significant amounts of hazardous compounds, many of which have been linked to harmful health impacts, particularly in the cardiovascular system (3).

After inhalation with a CO monitor, CO from cigarette smoke replaces oxygen in the erythrocyte to produce COHb. Depending on factors including gender, physical activity, and ventilation rate, CO can remain in the bloodstream for up to 24 hours in this state and has a half-life of approximately 5–6 hours. Occult CO smoking is the most likely source of high exposure, even if CO exposure can occur in daily life due to pollution, passive smoking, and occupational exposure (4).

Since the Fagerström Test for Nicotine Dependence is a common tool for detecting the strength of physical addiction to nicotine, measuring exhaled CO level may provide a rapid, non-invasive means of monitoring smoking status [(5,6)]. In our study we have used CO monitor as an indicator for smoking and Fagerstom dependency scale to assess the smokers.

When it is an arduous job to detect smokers and motivate them to quit smoking, it is definitely an uphill job to maintain abstinence. Consistent definition of abstinence in smoking cessation clinical trials is critical to both comparing results across clinical trials and facilitating the merging of data for meta-analyses[(7)]. Three dimensions should be considered when determining abstinence:

1. A list of the products that the investigators included and omitted from their definition of abstinence;

2. Abstinence measures (perhaps include a grace period and tolerating any smoking beyond the quit day); and

3. Duration of abstinence, which includes determining the time of assessment's starting point (for example, the target quit day for aid-to-quitting trials, or the start of the intervention for trials to induce cessation) [(8)].

Abstinence is characterised as either point-prevalence abstinence (e.g., abstaining in the preceding 7 or 30 days), which is considered a "snapshot," or protracted abstinence (e.g., refraining for more than 30 days) (e.g., no smoking for months). Repeated point prevalence, prolonged, and continuous abstinence are all options for characterising extended abstinence. To more precisely approximate lifelong abstinence, six-month or 12-month continuous abstinence rates have been proposed (9,10). The majority of trials of behavioural or pharmacological therapies for smokers are limited to persons who say they are ready to stop. It's difficult to get people who say they're not ready to stop to participate in short, pre-cessation skills-building therapies (such practise quit attempts or nicotine replacement therapy [NRT] sampling).

A similar association has been reported with wealth, with lower stop rates and a reduced likelihood of being a former smoker among those below the poverty line. Furthermore, some studies have revealed inconsistent results for the likelihood of successfully quitting, with income but not education being a significant predictor, or education but not income being a significant predictor, respectively[(11)].

According to a recent study, some disadvantaged smokers have more stressful lives as a result of material hardship (or, in other words, less material capital): psychological differences and a higher rate of smoking among family and friends, as well as less motivation to quit (even when they have begun a quit attempt) (or less social capital related to smoking)[(12)]. Our study was conducted among construction workers and therefore it was very important to include the role of socio economic status to assess the smokers. The aim of the study is to assess the association between carbon monoxide level, tobacco abstinence level and compliance towards tobacco cessation among construction workers

MATERIALS AND METHODS

Participant cohort and study design

This study was designed as a 2-year intervention trial. Ethical approval was granted by the Institutional Review Board of Ethics (IHEC/SDC/PHD/21/130). Participants were recruited from the camps conducted by the department of Public Health Dentistry, Saveetha Dental College during the time period of September 2019- September 2021.The participants were all working in a construction site. We had a collaboration with the Builders association of India and conducted camps in multiple campsites. Consent forms were signed by parents if they agreed to participate. Sample size was approximated to be 250 (Sabrina Kastaun et al). Drop out was estimated to be 35% since it is a 2 year follow up of construction workers

Inclusion criteria

Workers from age 18-65 years were included
Workers who use smoking tobacco, smokeless tobacco were included
Workers who agreed to participate in the study were included.

Exclusion criteria

Workers who were systemically compromised were not included in the study
Workers exceeding the age limit were excluded and those who were not willing to participate were excluded

Intervention

Smokers who were identified in the camps were assessed for nicotine dependency level with Fagerstrom dependency scale and CO level with a CO monitor. They were all given anti tobacco counselling and were motivated to quit the habit. They were asked to report to the PG clinic in the department of Public Health Dentistry, Saveetha Dental College at the interval of 6 months, 1 year and 2 years.

Data collection and follow up

Smokers were assessed for CO level, fagerstrom nicotine dependency and Smoking Abstinence Self-efficacy Questionnaire at 6 months, 1 year and 2 years. For those who did not show up in person, phone calls were made and fagerstrom nicotine dependency and Smoking Abstinence Self-efficacy Questionnaire (SADEQ) was assessed [(13)].

Smokers were asked questions about number of quit attempts, their readiness to quit (Prochaska and Diclemente), their type of tobacco usage and if they consume alcohol. They were examined for premalignant and malignant lesions and socioeconomic status was determined by the Kuppusamy scale.

The SASEQ was developed using knowledge of the literature and a wealth of experience with smoking cessation therapies. It consists of six circumstances that smokers can rate on a 5-point Likert scale (0–4) based on their ability to abstain from smoking. The higher the score, the more confident you are in your ability to stop smoking. The SASEQ scale has a 0–24 range.

Statistical analysis

According to prior research, sensitivity was determined by the percentage of CO levels that were over the indicated abstinence criterion on days when at least one cigarette (>0) was smoked during the prior 24 hours (e.g., above 4 ppm,

above 8 ppm). Similarly, the percentage of CO levels below the abstinence requirement on days when no cigarettes were smoked in the previous 24 hours was used to determine specificity. SPSS v10.0 was used to conduct all statistical analyses. The data was presented as mean sd. ANOVA was used to compare all exhaled CO levels between groups. P value of 0.05 or less was regarded as significant.

RESULTS

There were 375 participants. Of which 16.8% were in the age group of 21 to 30 years, 39.4% were in the age group of 31 to 40 years, 19.6% were in the age group of 41 to 50 years and 10.6% were in the age group of 51 to 60years. All the participants were in the category of lower class (48.4%) and upper lower class (38.0%). All participants had detectable levels of exhaled CO. CO levels in the ambient air were between 0 and 2 ppm at the time of the observations. A total of 375 subjects had their breath CO levels measured. For the smokers, the mean daily cigarette intake was 19.79±9.04 cigarettes/d, and every single one of them admitted to smoking on the testing day.

TABLE 1: shows the distribution of type of habit to the age group of the population

	Type of habit						
Age group	Smoking (N)	Smokeless (N)	Smoking+ Alcohol (N)	smoking+smokeless+Alcohol (N)	Total (N)	Pearson chi-square value	P value
21 to 30years	12	31	18	12	73	15.956	0.05*
31 to 40years	26	75	50	20	171		
41 to 50years	5	35	39	6	85		
51 to 60years	8	21	11	6	46		
					375		

*p value was significant

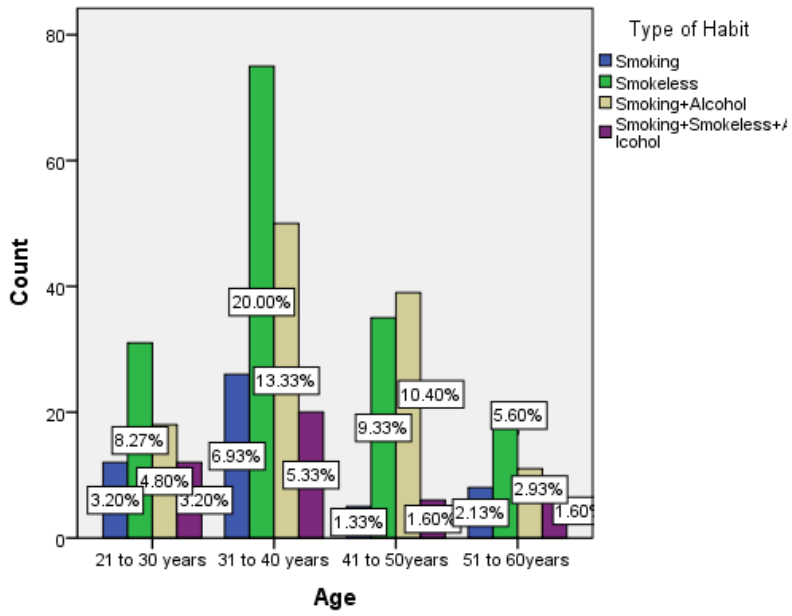

FIGURE 1: shows the percentage of type of habit with the age group of the population

J Popul Ther Clin Pharmacol Vol 30(6):e28–e36; 02 April 2023.

Figure 1 shows that at the age of 21 to 30 years most of the participants (8.27%) had the habit of using smokeless tobacco. At the age group of 31 to 40 years 20% of the participants used again smokeless tobacco which was the highest among all the age group. In the age group of 41 to 50 years most of the participants (10.40%) were under the category of using both smoking and alcohol. In the age group of 51 to 60 years again 5.60% had the habit of using only smokeless tobacco.

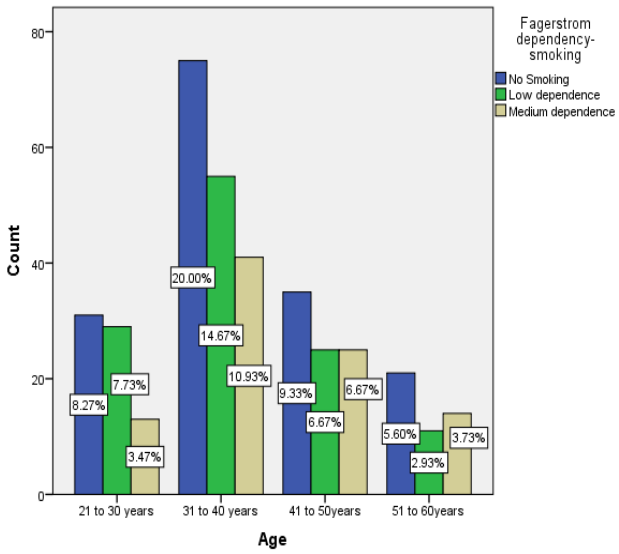

FIGURE 2: shows the percentage of Fagerstrom dependency level for smokers with the age group of the population

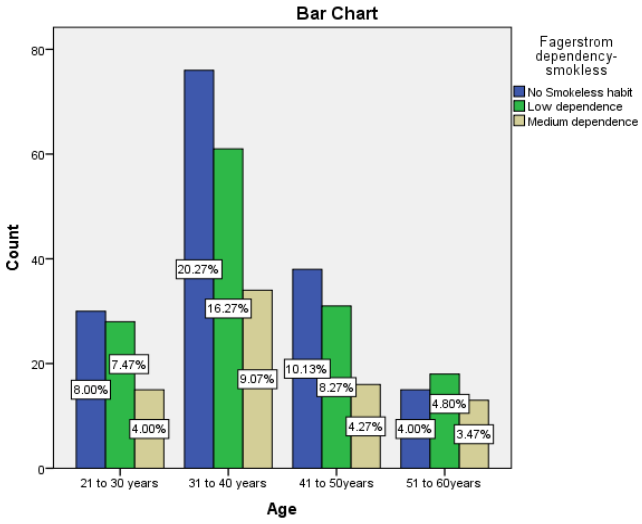

FIGURE 3: shows the percentage of Fagerstrom dependency level for smokeless with the age group of the population

Figure 2 and figure 3 shows the Fagerstrom dependency level among smokers and smokeless users respectively. For smokers, among the age group of 21 to 30years 7.73% had low dependence,3.47% had medium dependence. Among the age group of 31 to 40 years 10.93% had medium dependence, at the age group of 41 to 50 years both in low dependence and in

medium dependence 6.67% was present. For smokeless users, among the age group of 21 to 30years 7.47% had low dependence,4.00% had medium dependence. Among the age group of 31 to 40 years 16.27% had low dependence, at the age group of 41 to 50 years and in 51 to 60 years, 4.27 % and 3.47% had medium dependence respectively.

TABLE 2: Pearson chi-square value for smoking and smokeless population

	Smoking	Smokeless
Pearson chi-square	5.456	2.984
P value	0.04*	0.05*

*p value was significant

The mean exhaled CO level was 14.96±6.12 ppm at 6 months and 13.61±6.5ppm at 1 year, and 13.07±5.2ppm at 2 years. The mean exhaled CO level was significantly higher at 6 months when compared with the end of 2nd year. (P=0.03).

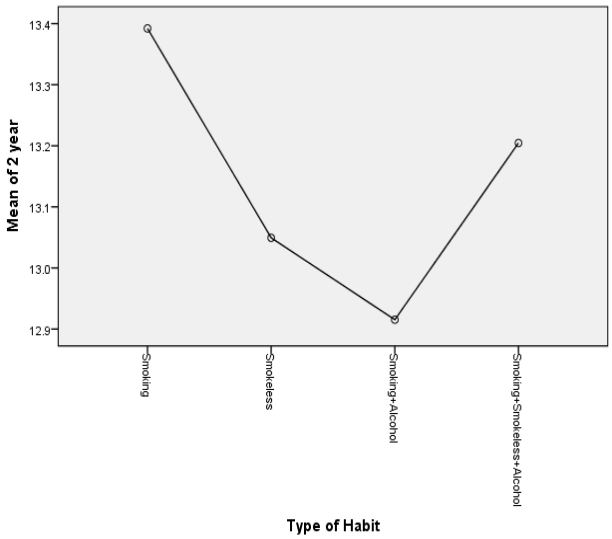

FIGURE 4: shows the mean plot for the type of the and the CO monitor level at the end of 2 year

TABLE 3: shows the mean and SD of abstinence level at 6months, 1- year and 2-year period

		N	**Mean**	**SD**	**P value**
Abstinence level- 6 months	Smoking	51	2.35	0.84	0.1
	Smokeless	162	2.45	0.80	
	Smoking+Alcohol	118	2.57	0.79	
	Smoking+ smokeless+alcohol	44	2.25	0.89	
	total	375	2.45	0.81	
Abstinence level- 1 year	Smoking	51	2.18	0.91	0.4
	Smokeless	162	2.18	0.79	
	Smoking+Alcohol	118	2.08	0.78	
	Smoking+ smokeless+alcohol	44	2.00	0.74	

	total	375	2.13	0.80	
Abstinence level- 2 year	Smoking	51	2.14	0.77	0.05*
	Smokeless	162	2.20	0.72	
	Smoking+Alcohol	118	2.13	0.64	
	Smoking+ smokeless+alcohol	44	1.86	0.66	
	total	375	2.13	0.70	

*P value significant for abstinence level at 2-year period.

The abstinence level at 6 months for smoking was 2.35±0.84, smokeless (2.45±0.80), smoking+Alcohol (2.57±0.79), Smoking+ smokeless+alcohol (2.25±0.89). The abstinence level at the end of 1st year for smoking was 2.18±0.91, smokeless (2.18±0.79), smoking+Alcohol (2.08±0.78), Smoking+ smokeless+alcohol (2.00±0.74). However, the result was not significant for both at 6 months and at 1st year. The abstinence level at the end of 2 years for smoking was 2.14±0.77, smokeless (2.20±0.72), smoking+Alcohol (2.13±0.64), Smoking+ smokeless+alcohol (1.86±0.66). The p value was significant (p=0.05)

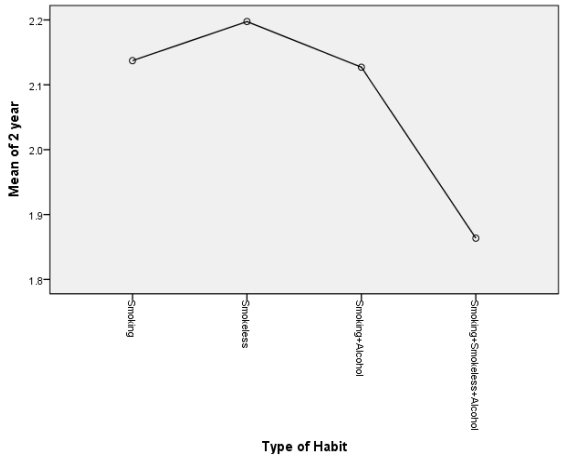

FIGURE 5: shows the mean plot for the type of habit and the abstinence level at the end of 2 year

DISCUSSION

The measurement of CO levels in the breath may be a quick and painless way to determine whether or not someone is smoking. Blood tests, are invasive, and neither the blood nor the urine tests provide quick results (14). This research backs up the idea that detecting CO levels in the breath is a quick, non-invasive, simple, and effective technique to establish a patient's smoking status. Additionally, in our study, the inhaled CO level measured by the Smokerlyzer at 6 months compared to the end of 2 years was significantly higher. The amount of carboxyhemoglobin (COHb) in a person's blood directly correlates with whether or not they smoke [(15,16)].

Exhaled CO measurements are frequently employed to calculate COHb and, consequently, to track patients' smoking patterns (17,18). Given that clinical settings frequently use a COHb value of less than 2% to differentiate between smokers and non-smokers(19). Our results showed that exhaled CO levels could be used to distinguish smokers from non-smokers in the same way as smokers and non-smokers could be distinguished. Jarvis et al (19).

Our results showed that there was a significantly positive correlation between age of the population using smoking and smokeless tobacco, and between type of habit and CO levels.

Any exposure to CO can occur in everyday life due to pollution, passive smoking, and occupational exposure; however, smoking is the most common cause of high amounts of exposure (20). Occult CO poisoning, such as from a malfunctioning automotive exhaust system or home heating system, is another source of high CO levels in the breath, albeit this is only likely to account for a small percentage of cases of elevated CO levels in the breath. CO in expired air has been reported to be an indirect measurement for the quantity of passive smoking (21) and exhaled CO can be used as an indicator of indoor smoking (22). Laranjeira et al (23)., reported that exposure to environmental tobacco smoke is the most likely cause for the increase in CO levels among non-smoking waiters. In this study it is reported that pre-exposure exhaled CO level was 2.0 ppm and post-exposure exhaled CO level was 5.0 ppm. In our study, as expected at 6 months the CO concentration was higher than at 2 years, this elevation was significant.

CONCLUSION

Exhaled CO readings can be used to determine a patient's smoking status in a non-invasive, sensitive, and quick manner. CO measurement will eventually take the place of the traditional query about the amount of cigarettes smoked. Furthermore, the exhaled CO level is recommended for determining passive smoking exposure. Exhaled CO levels more than 6.5 ppm significantly suggest that the subject is a smoker.

REFERENCES

1. Deveci SE, Erhan Deveci S, Deveci F, Açik Y, Tevfik Ozan A. The measurement of exhaled carbon monoxide in healthy smokers and non-smokers [Internet]. Vol. 98, Respiratory Medicine. 2004. p. 551–6. Available from: http://dx.doi.org/10.1016/j.rmed.2003.11.018
2. Zetterquist W, Marteus H, Johannesson M, Nordval SL, Ihre E, Lundberg JON, et al. Exhaled carbon monoxide is not elevated in patients with asthma or cystic fibrosis. Eur Respir J [Internet]. 2002 Jul;20(1):92–9. Available from: http://dx.doi.org/10.1183/09031936.02.00245302
3. Alarabi AB, Lozano PA, Khasawneh FT, Alshbool FZ. The effect of emerging tobacco related products and their toxic constituents on thrombosis. Life Sci [Internet]. 2022 Feb 1;290:120255. Available from: http://dx.doi.org/10.1016/j.lfs.2021.120255
4. Low ECT, Ong MCC, Tan M. Breath carbon monoxide as an indication of smoking habit in the military setting. Singapore Med J [Internet]. 2004 Dec;45(12):578–82. Available from: https://www.ncbi.nlm.nih.gov/pubmed/15568119
5. Cheng S, Lyass A, Massaro JM, O'Connor GT, Keaney JF Jr, Vasan RS. Exhaled carbon monoxide and risk of metabolic syndrome and cardiovascular disease in the community. Circulation [Internet]. 2010 Oct 12;122(15):1470–7. Available from: http://dx.doi.org/10.1161/CIRCULATIONAHA.110.941013
6. Salhi L, Seidel L, Albert A, Lambert F. Fagerström test for nicotine dependence as an indicator in tobacco-related studies in periodontology. J Periodontol [Internet]. 2021 Feb;92(2):298–305. Available from: https://onlinelibrary.wiley.com/doi/10.1002/JPER.20-0019
7. Sung HY, Wang Y, Yao T, Lightwood J, Max W. Polytobacco Use and Nicotine Dependence Symptoms Among US Adults, 2012–2014. Nicotine Tob Res [Internet]. 2018 Aug 14 [cited 2022 Apr 15];20(suppl_1):S88–98. Available from: https://academic.oup.com/ntr/article-abstract/20/suppl_1/S88/5073150
8. Piper ME, Bullen C, Krishnan-Sarin S, Rigotti NA, Steinberg ML, Streck JM, et al. Defining and Measuring Abstinence in Clinical Trials of Smoking Cessation Interventions: An Updated Review [Internet]. Vol. 22, Nicotine & Tobacco Research. 2020. p. 1098–106. Available from: http://dx.doi.org/10.1093/ntr/ntz110
9. Hughes JR, Keely JP, Niaura RS, Ossip-Klein DJ, Richmond RL, Swan GE. Measures of abstinence in clinical trials: issues and recommendations. Nicotine Tob Res [Internet]. 2003 Feb;5(1):13–25. Available from: https://www.ncbi.nlm.nih.gov/pubmed/12745503
10. Pierce JP, Gilpin EA. A minimum 6-month prolonged abstinence should be required for evaluating smoking cessation trials. Nicotine Tob

Res [Internet]. 2003 Apr;5(2):151–3. Available from: http://dx.doi.org/10.1080/0955300031000083427

11. Thakur JS, Prinja S, Bhatnagar N, Rana SK, Sinha DN, Singh PK. Widespread inequalities in smoking & smokeless tobacco consumption across wealth quintiles in States of India: Need for targeted interventions. Indian J Med Res [Internet]. 2015 Jun;141(6):789–98. Available from: http://dx.doi.org/10.4103/0971-5916.160704
12. Hiscock R, Dobbie F, Bauld L. Smoking Cessation and Socioeconomic Status: An Update of Existing Evidence from a National Evaluation of English Stop Smoking Services [Internet]. Vol. 2015, BioMed Research International. 2015. p. 1–10. Available from: http://dx.doi.org/10.1155/2015/274056
13. Spek V, Lemmens F, Chatrou M, van Kempen S, Pouwer F, Pop V. Development of a smoking abstinence self-efficacy questionnaire. Int J Behav Med [Internet]. 2013 Sep;20(3):444–9. Available from: http://dx.doi.org/10.1007/s12529-012-9229-2
14. Middleton ET, Morice AH. Breath carbon monoxide as an indication of smoking habit. Chest [Internet]. 2000 Mar;117(3):758–63. Available from: http://dx.doi.org/10.1378/chest.117.3.758
15. Jones RH, Ellicott MF, Cadigan JB, Gaensler EA. The relationship between alveolar and blood carbon monoxide concentrations during breathholding; simple estimation of COHb saturation. J Lab Clin Med [Internet]. 1958 Apr;51(4):553–64. Available from: https://www.ncbi.nlm.nih.gov/pubmed/13525831
16. Ringold A, Goldsmith JR, Helwig HL, Finn R, Schuette F. Estimating Recent Carbon Monoxide Exposures. Archives of Environmental Health: An International Journal [Internet]. 1962 Oct 1;5(4):308–18. Available from: https://doi.org/10.1080/00039896.1962.10663288
17. Jarvis MJ, Belcher M, Vesey C, Hutchison DC. Low cost carbon monoxide monitors in smoking assessment. Thorax [Internet]. 1986 Nov;41(11):886–7. Available from: http://dx.doi.org/10.1136/thx.41.11.886
18. Rea JN, Tyrer PJ, Kasap HS, Beresford SA. Expired air carbon monoxide, smoking, and other variables. A community study. Br J Prev Soc Med [Internet]. 1973 May;27(2):114–20. Available from: http://dx.doi.org/10.1136/jech.27.2.114
19. Jarvis MJ, Tunstall-Pedoe H, Feyerabend C, Vesey C, Saloojee Y. Comparison of tests used to distinguish smokers from nonsmokers. Am J Public Health [Internet]. 1987 Nov;77(11):1435–8. Available from: http://dx.doi.org/10.2105/ajph.77.11.1435
20. Jarvis M, Tunstall-Pedoe H, Feyerabend C, Vesey C, Salloojee Y. Biochemical markers of smoke absorption and self reported exposure to passive smoking. J Epidemiol Community Health [Internet]. 1984 Dec;38(4):335–9. Available from: http://dx.doi.org/10.1136/jech.38.4.335
21. Ece A, Gürkan F, Haspolat K, Derman O, Kirbaş G. Passive smoking and expired carbon monoxide concentrations in healthy and asthmatic children. Allergol Immunopathol [Internet]. 2000 Sep;28(5):255–60. Available from: https://www.ncbi.nlm.nih.gov/pubmed/11270085
22. Gourgoulianis KI, Gogou E, Hamos V, Molyvdas PA. Indoor maternal smoking doubles adolescents' exhaled carbon monoxide. Acta Paediatr [Internet]. 2002;91(6):712–3. Available from: http://dx.doi.org/10.1080/080352502760069160
23. Laranjeira R, Pillon S, Dunn J. Environmental tobacco smoke exposure among non-smoking waiters: measurement of expired carbon monoxide levels. Sao Paulo Med J [Internet]. 2000 Jul 6;118(4):89–92. Available from: http://dx.doi.org/10.1590/s1516-31802000000400003