

# Assessment of Nicotine Dependence and Its Potential Predictors Among a Cohort of Current Egyptian Cigarette Smokers - A Preparatory Phase of a Workplace Anti-Smoking Initiative: Part I

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## ABSTRACT

**Aim:** Combating smoking in workplaces is a cornerstone to fight smoking in the whole community. However, nicotine dependence (ND) is a key barrier to successful smoking cessation. The study assessed the nicotine dependence status and its potential predictors among a cohort of current Egyptian cigarette smokers.

**Subjects and methods:** Cross-sectional survey was conducted on a random sample of cigarette-smoking workers. ND status was assessed using the standard 6-items of FTND, Heaviness of the smoking index, and smoking parameters. The potential predictors for nicotine dependence have been studied including personal and smoking characteristics, the urinary cotinine creatinine ratio, knowledge, and smoking perception.

**Results:** A total of 113 current male cigarette smokers were included randomly in the survey. High nicotine-dependent smokers represented 80.5% of the smokers, high nicotine dependence was significantly more prevalent in low-educated than the highly educated ( $p < 0.0001$ ). The linear regression analysis model revealed a significant negative linear correlation between the age of starting smoking of the participants and their FTND score and a significant positive correlation with Cigarette Consumption/day, smoking rate, and urinary cotinine creatinine ratio ( $p < 0.0001$ ).

**Conclusion:** Nicotine dependence was highly prevalent among smokers, so combined approaches should be considered in the treatment strategy. The age of starting regular smoking, number of cigarette consumption/day, smoking rate, and urinary cotinine creatinine concentration ratio were significantly good predictors for nicotine dependence and increase vulnerability for its development. Combating starting smoking before 21 years old is a key to prevent nicotine dependence. The treatment priority should focus on smokers willing to change and want to be treated. The laws which prohibit smoking in workplaces must be activated.

**Keywords:** Smoking, Nicotine-dependence, Workplaces, Combating smoking

## INTRODUCTION

Tobacco smoking is a global epidemic with 1.1 billion smokers (21% of the world's population) and more than 8 million annual deaths all over the world of which 80% are in low and middle-income countries. It is a major risk factor for cardiovascular, and

respiratory diseases, and more than 20 different types of cancers [1]. Approximately, half of all children breathe air polluted by tobacco smoke, and 65,000 children in the world die each year due to illnesses related to second-hand smoke. Exposure of pregnant women to tobacco

smoking either directly through active smoking or indirectly through passive smoking can lead to several lifelong health conditions for babies [2]. According to the most recent statistics in 2023, the total smoking rate in Egypt is 21.4% where 42.3% of Egyptian males are smokers versus 0.4% of females [3]. The prevalence of high nicotine dependence has been studied in five Egyptian rural villages and reported as 9% in all smokers [4]. Chronic smoking in the community is synonymous with nicotine dependence and is associated with the long-term daily use of tobacco products including cigarettes, pipe, cigar, hookah, and chewing tobacco. In fact, the initiation and maintaining the behaviour of smoking are caused by the development of nicotine dependence, the presence of psychosocial factors, and genetic factors [5]. Nicotine is a highly addictive chemical substance present in tobacco and causes nicotine dependence which makes quitting smoking, is very difficult being the major obstacle in smoking cessation programs. It is rapidly absorbed via the oral mucosa and the lung alveoli in such quantities producing its pharmacological effects [6]. On regular smoking, the nicotine binds in the brain to nicotinic cholinergic receptors and opens ion channels for sodium and calcium; elevated intracellular calcium concentration stimulates the release of neurotransmitters including dopamine which is responsible for the pleasant experience and promotion of the re-administration behaviour [7]. Nicotine dependence is characterized by tolerance, craving, feeling the need to use tobacco with failure to control the amount of use, and withdrawal symptoms during any trial of abstinence. There are very few Egyptian studies that focused on the issue of nicotine dependence in spite of its clinical importance in implementing effective anti-smoking campaigns, especially in workplaces. The aim of this study is to assess the nicotine-dependent status among a cohort of currently smoking workers as a preparatory phase of a workplace anti-

smoking initiative. Such assessment will enable us to design and implement suitable interventions to fight smoking in workplaces.

## **MATERIALS & METHODS**

### **Study design**

A cross-sectional study was conducted as part of a three-year internal home project at the national research Centre, in Egypt.

### **Study population**

The target subjects in this study were the current cigarette male smokers working in the national research centre.

### **Steps of the survey**

A cross-sectional survey was conducted after obtaining the ethical approval of the national research center ethical committee to start the work. Field visits to the study location were preceded by mapping, classification, the numbering of the national research centre departments, and communication with leaders in the study location. The number of smokers in each department was counted including the Scientific and administrative departments. The total number of the recruited smokers during the frequent round surveys at different departments of the national research centre was 153 smokers with a mean age of  $44.9 \pm 11.4$  years and an age range of (25-80ys). They were smokers for  $24.3 \pm 11.2$  years ranging from 2 years up to 55 years. Three smokers have been excluded from sampling as one smoker was female and the other two smokers were shisha smokers. A simple randomization method was used to select 113 current male cigarette smokers to participate in the study representing 75.3% of the current male cigarette smokers in the workplace.

### **Tools of the Study**

All the eligible smokers were subjected to face-to-face interviews to fill pre-tested well-structured questionnaire form including the socio-demographic data,

medical history, smoking profile, and the standard 6-items of the Fagerström Tolerance of nicotine dependence (FTND). The overall score of FTND ranged between (0-10) and the cut-off point 6 was considered for high nicotine dependence [8]. The heaviness of smoking index (HSI) is a subset of FTND and consisted of two items only; “time to first cigarette upon waking” and the “quantity of cigarettes smoked in a day”. The overall score range of HSI is between (0-6), calculated for each participant individually, and the cut-off point 4 was considered for high nicotine dependence [9, 10]. Moreover, the smoking rate was calculated individually for each smoker as the number of cigarettes smoked per day X years of smoking / 20. Their knowledge about the risk of smoking and their perception of smoking was evaluated using the questions mentioned in Table 1.

#### Laboratory Measurements:

The morning urine samples have collected from the participants in sterile falcon tubes and centrifuged at the speed of 2000-3000rpm for 20-min. the supernatant was removed. The samples were kept at -20°C. A cotinine immunoassay has assessed using the commercial kits from Glory Science Co.,Ltd., the results were expressed as pg./ml. Correction of Cotinine concentration for Creatinine Excretion was performed and the cotinine creatinine ratio has been calculated as described by Benowitz 1983[11], the results are expressed as pg./mg.cr.

#### STATISTICAL ANALYSIS

The collected data were analysed using SPSS 20.0 for Windows (SPSS Inc. Chicago, IL). The significance of differences between the two groups was assessed using a student t-test for quantitative variables and expressed as mean  $\pm$  SD. The differences between proportions were assessed using the Pearson chi-square test ( $\chi^2$ ) for nominal variables. Logistic regression analysis was used to test

the association between two variables and the result was presented as an unadjusted odds ratio with a confidence interval (95% CI). Pearson correlation coefficient (r) and linear regression analysis were used to assess the direction and measure the strength of the relationship between the two variables. The potential confounding factors have been considered during the analysis. Statistical significance was considered at a p-value of  $<0.05$ .

#### RESULT

##### Smokers' general characteristics

A total of 113 current male cigarette smokers out of 150 male cigarette smokers were included randomly in the study. They were categorized into two groups based on their nicotine dependence status: low (LNDS) and high nicotine dependent groups (HNDS). As shown in Figure 1, it was observed that 80.5% of the smokers were highly nicotine-dependent smokers. The overall mean age of the smokers was  $43.8 \pm 11.1$  years old with a total range of (25-80) years old. It was observed that no significant differences were observed in the nicotine-dependent state of the smokers having different marital statuses or different studied occupational categories. It was observed that 45.4% of the low nicotine-dependent smokers versus 33.0% of the high nicotine-dependent smokers have a second non-governmental job with no statistical difference between the two groups ( $p > 0.05$ ).

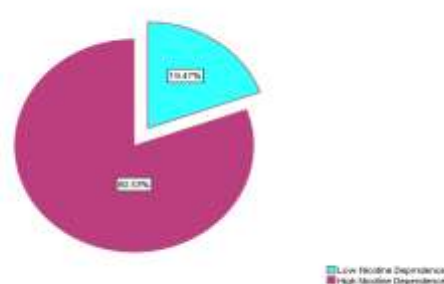


Fig.1 Nicotine Dependence Status of Studied Workers

### Nicotine Dependence Status

The high nicotine dependence group had statistically significant higher Fagerstrom nicotine dependence score (FTND), Heaviness of smoking index score (HSI), Smoking rate, Cigarette consumption per day, and in the duration of smoking when compared to the low nicotine dependence group (Table 1). Further, the urinary cotinine creatinine ratio concentration was significantly higher in the high nicotine-dependent smokers than in the other group ( $p=0.001$ ). The perception of smoking was assessed using three questions as presented in (Table 2), 81.8% of the low nicotine-dependent smokers versus 40.6% of the high-dependent smokers described smoking as bad behavior while 49.5% of them described it as harmful ( $p<0.05$ ). No significant differences were observed between the two groups in their initial cause of starting smoking. On the other hand, significant differences were observed between the two groups in their knowledge about health hazards of active and passive smoking with observed higher knowledge among the low-dependent smokers. The high nicotine-dependent smokers had started their smoking behavior at  $16.4\pm 4.1$  years old which is significantly earlier than that in the low nicotine-dependent smokers,  $19.6\pm 8.8$  years old ( $p=0.03$ ). The vast majority of highly nicotine-dependent smokers (91.2%) started smoking at an age younger than 21 years old. Moreover, the probability of being a high nicotine-dependent smoker is significantly higher when smoking started at age  $< 21$  years old ( $OR=3.8$ ,  $p=0.02$ ). The high nicotine dependent smokers practice smoking behavior during their work hours significantly at a higher rate (95.6 %) than

the low-dependent smokers do (81.8%) ( $p=0.02$ ). No statistically significant differences were observed between the two groups in their proportions of the comorbidities as well as in their desire to quit smoking ( $p>0.05$ ) (Table 1). The linear regression analysis model revealed a significant negative linear correlation between the age of starting smoking of the participants and their FTND score ( $r=-0.4$ ,  $p<0.0001$ ) (Table3, Figure.1). On the other side, the model revealed a significant positive direct linear correlation between the smoker's cigarette consumption/day (CPD), smoking rate and their FTND score ( $r=0.4$ ,  $p<0.0001$ ) (Table3, Fig.2). Moreover, a significant direct linear correlation was detected between the urinary cotinine creatinine ratio concentration of the smokers and their FTND score ( $r=0.6$ ,  $p<0.0001$ ). On the contrary, no significant correlation could be detected with the duration of smoking ( $r=0.01$ ,  $p>0.05$ ).

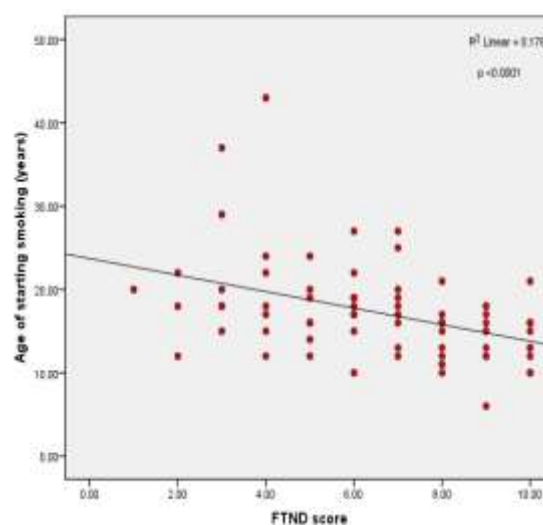


Fig.2. Linear correlation between Nicotine dependence score and Age of starting smoking

Table1. General characteristics of the studied smokers

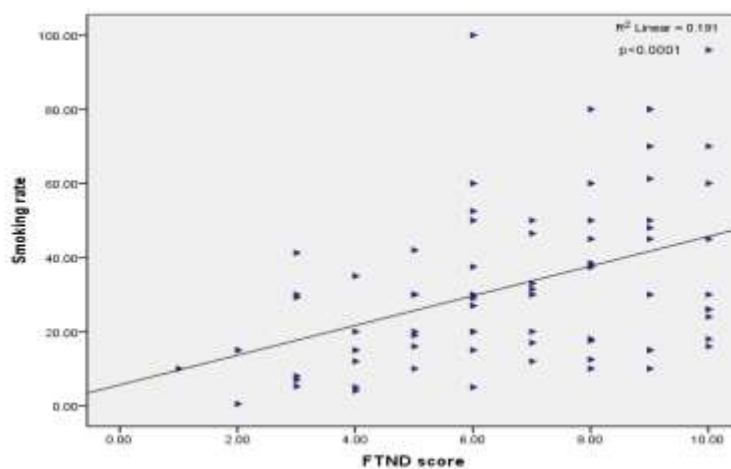
Variables	Low nicotine Dependence (n=22)	High nicotine dependence (n=91)	p value
Age (years)	44.7±15.9	43.5±9.5	0.6
Marital Status			0.3
Married	18(88.0)	81(89.0)	
Single	4(12.0)	10(11.0)	
Educational level			<0.0001*
Illiterate	1(4.5)	3(3.3)	
<High School	4(18.2)	71(78.1)	
≥High School	17(77.3)	17(18.6)	

Governmental Occupation			
Administrative	8(36.4)	36(39.5)	0.5
Service workers	12(54.5)	40(44.0)	
Scientists	2(9.1)	15(16.5)	
Monthly income	3935±1868.6	3897.5±1274.7	0.9
Non-governmental Occupation (yes/no)	10(45.4)	30(33.0)	0.2
FNTD Score	3.8±0.9	7.9±1.4	<0.0001*
Heaviness of smoking Index(HSI) score	3.2±1.1	4.0±1.6	0.04*
Smoking rate	15.7±11.6	36.6±22.1	<0.0001*
Initial cause of smoking			
Curiosity	2 (9.2)	23(25.3)	0.1
Peer's school pressure	14(63.6)	36(39.6)	
Escape from problems	3(13.6)	13(14.3)	
Contact with work or relative smokers	3(13.6)	19(20.8)	
Age of starting smoking <sup>#</sup>	19.6±8.8	16.4±4.1	0.03*
<21 years old	16(72.7)	83(91.2)	
>21 years old	6(27.3)	8(8.8)	0.018*
Smoking behavior			
Cigarette Consumption/day(CPD)	20.3±10.6	27.7±10.8	0.01*
Duration of Smoking (years)	13.4±6.2	29.5±9.6	<0.0001*
Previous trial to quit smoking (yes/no)	12(54.5)	51(56.0)	0.3
Smoke at workplace(yes/no)	18(81.8)	87(95.6)	0.02*
Desire to quite (yes/no)	16(72.7)	59(64.8)	0.4
Comorbidity (yes/no)	8(36.4)	26(28.6)	0.4
No Comorbidity	14(63.6)	65(71.4)	
Chronic Respiratory disease	2(9.1)	9 (9.9)	0.7
Primary male infertility	1(4.6)	5(5.5)	
Chronic non Respiratory disease	5(22.7)	12(13.2)	
Cotinine Creatinine ratio Concentration (pg/mg.cr)	16.7±3.4	30.2±7.7	0.001*

<sup>#</sup> Odds ratio (OR) =3.9, (95%CI) =1.2-12.7, p=0.02 \*p is significant

**Table2. Perception of smoking risk among the nicotine dependent smokers**

Variables	Low nicotine dependence (n=22)	High nicotine dependence (n=91)	p value
Perception of smoking			
Q1. Do you think smoking is a habit or an addiction?			
-Habit	16(72.7)	62(68.1)	0.8
-Addiction	4(18.2)	21(23.1)	
-Both of them	2(9.1)	8(8.8)	
Q2. Do you think smoking is a health problem must be fought? (yes/no)	20(90.1)	87(95.6)	0.3
Q3. Describe the smoking in a single word?			
-Bad behavior	18(81.8)	37(40.6)	0.0005*
-harmful	1(4.6)	45(49.5)	
-Just habit	3(13.6)	9(9.9)	
Knowledge about risk of smoking			
Q1. Mention one or more disease caused by active smoking?	20(90.1)	51(56.0)	0.002*
Q2. Mention one or more disease caused by passive smoking?	20(90.1)	33(36.3)	<0.0001*



**Fig.3. Linear correlation between Nicotine dependence score and smoking rate**



**Table 3. linear Regression Analysis for correlation between FTND and the smoking dependence variables**

Variable	Unstandardized Coefficients (95%CI)		Standardized Coefficients	t-value	p-value
	B	SE	Beta		
Age of starting and continuous smoking(years)	- 0.1	0.04	-0.3	- 3.2	<0.003*
Cigarette Consumption/day(CPD)	0.08	0.02	0.4	3.8	<0.0001*
Smoking rate	0.05	0.01	0.4	4.2	<0.0001*
Cotinine Creatinine ratio Concentration (pg/mg.cr)	0.15	0.03	0.6	5.0	<0.0001*

## DISCUSSION

The workplace is an ideal environment to reach potentially large numbers of smokers with important health messages. Workplace smoking cessation programs can provide valuable support to workers who want to quit smoking. They can only be effective when participants move beyond contemplation Phases related to smoking cessation so that smoking cessation becomes a personal priority [12]. It is clear that understanding the nature of nicotine dependence among smokers is a very important tool for the successful implementation of smoking cessation programs. Lack of well understanding of the level of nicotine dependence might be an obstacle to choosing appropriate cessation strategies [13]. Our study aimed to assess the nicotine-dependent status among a cohort of male Egyptian current cigarette smoking workers, as a preparatory phase for an antismoking initiative conducted as part of a three-year internal home research project. Fagerstrom test for nicotine dependence (FTND) and Heaviness of smoking index (HSI) are commonly used in both clinical and population surveys to assess nicotine dependence and may provide a simple way for clinicians prescribing dependency-based treatments to classify their patients [14].

In our study, based on the analysis of FTND and HSI methods, we found that 80.5% of the cigarette smokers in the studied workplace were highly dependent on nicotine, indicating the need for combined intensive approaches for smoking cessation (Fig.1). Many factors have been suggested to predispose to develop nicotine dependence in the smokers and have been examined as predictors for persistent cigarette smoking [15] including the

younger age, parental smoking, marital status, lower educational level, occupational category, the lower income of the smokers [16-20]. In our results, a significantly higher proportion of highly nicotine-dependent smokers (78.1%) was low educated while the main bulk of low-dependent smokers (77.3%) were highly educated ( $p < 0.0001$ ). Meanwhile, no significant association could be detected with the marital status, occupational category, and monthly income of the smokers ( $p > 0.05$ ). About one-half of the low nicotine-dependent smokers (45.4%) and approximately, one-third of the high-dependent smokers (33.0%) had another non-governmental job. It is suggested that the presence of two jobs in the worker's life may be a cause for initiation and persistence of nicotine dependence in the two groups due to exposure to more stress, and inadequate rest time, in addition to more contact with smokers in the second job.

Upon studying the initial cause of smoking in the two groups, we found that about two-thirds of the low-dependent smokers (63.6%) versus more than one-third of the high-nicotine-dependent smokers (39.6%) had started smoking initially in response to peer pressure in the school. In addition, about one-fourth (25.3%) of HNDS vs. 9.2% of LNDS, had started smoking due to curiosity as a trial to be stopped whenever they wanted. About one-fifth (20.8%) of HNDS vs. 13.6% of LNDS, had started it due to contact with smokers either in work or family relatives. Lower proportions of smokers (13.6% vs. 14.3% respectively) have started smoking initially to escape from solving their problems. These findings reflect the importance of school-based intervention programs to reduce the high prevalence of cigarette smoking among

students and consequently in the community.

Smoking perceptions are thoughts and feelings about cigarette smoking [21]. Understanding these perceptions as well as understanding the knowledge of smokers about smoking-related health problems is important to implement effective smoking cessation treatment programs [22]. In this study, most of the smokers in both groups believed that smoking is just a habit and not an addiction. Therefore, they believe delusionally that they have the ability to abstain from smoking whenever they want. In fact, more than half of the smokers in the two groups had failed attempts to quit smoking in the past years (Table 1). Further, 81.8% of low-dependent smokers versus 40.6% of high-dependent smokers described smoking as bad behaviour. About half of the highly nicotine-dependent smokers described it as harmful in general and 90.1% of LNDS vs.95.6% of HNDS believed that smoking is a health problem that must be fought. On the other hand, the low-dependent smokers significantly had more knowledge about the health-related risks of active and passive smoking, when compared to the knowledge of the highly nicotine-dependent smokers. Furthermore, a significantly high proportion of the high nicotine-dependent smokers (95.6%) usually smoke at work unconcerned with their non-smoking colleagues ( $p=0.03$ ). These findings may be an alarm from one side for the need to increase awareness regarding health hazards of active and passive smoking, and from the other side to strictly implement laws that completely prohibit smoking in the workplace (Table1).

The previous studies suggested that the risk of nicotine dependence is greater when the person starts smoking earlier in life [23, 24]. Our study revealed that the high nicotine-dependent group had started smoking on average at  $16.4\pm 4.1$  years old which was significantly earlier in life than in the low nicotine-dependent group ( $19.6\pm 8.8$  years old). Interestingly, we found that the risk to

develop high nicotine dependence is approximately fourfold when smoking started at an age younger than 21 years old ( $OR=3.8, P=0.02$ ) (Table 1).

Moreover, a significantly strong negative linear correlation could be detected between the age of starting smoking and FTND score (Table 3, Fig.2). The age of starting smoking was a good predictor for nicotine dependence, each year of a smoker's age in which he starts smoking early, was accompanied with an increase by 0.1 of the FTND score ( $p<0.0001$ ). Calculating the smoking rate for each smoker is clinically important because it reflects the risk to develop chronic obstructive lung disease (COPD). It is estimated that 10-20% of current smokers develop significant COPD in their life [25]. A smoking rate of 20-40 indicates an intense risk of COPD; in our results, the mean smoking rate in high nicotine-dependent smokers is significantly higher ( $36.6\pm 22.1$ ) than that in the low nicotine-dependent smokers ( $15.7\pm 11.6$ ), reflecting their higher risk for COPD and the importance of implementing a smoking cessation program. Actually, 9.9% of the studied HNDS vs.9.1% of LNDS had chronic respiratory diseases (Table 1).

The linear regression model revealed that the smokers' smoking rate, cigarette consumption per day, and urinary cotinine creatinine concentration ratio were good and significant predictors for nicotine dependence. It was found that each increase in smoking rate by one unit has increased nicotine dependence by 0.08. Similarly, each increase in cigarette consumption per day by one cigarette has increased the nicotine dependence score by 0.05. In addition, an increase in the urinary cotinine creatinine concentration ratio by 1  $\mu\text{g./mg.cr}$ , associated with an increase in the nicotine dependence score by 0.1 (Table 3, Figure.2, 3).

One of the most important strengths of this study is its uniqueness in addressing the issue of combating smoking in workplaces. However, the study was conducted in a

single workplace as a pilot study; a multicentre study is our intended future work. It is worth mentioning that a large number of participants in this study have been treated through the research project and the rates of smoking cessation were different among them [26], [under-publishing work].

## CONCLUSION

According to our findings, nicotine dependence is highly prevalent among smokers in the studied workplace. The age of starting regular smoking, number of cigarette consumption per day, smoking rate, and urinary cotinine creatinine concentration ratio were significantly good predictors for nicotine dependence and increase vulnerability for its development. Starting smoking before 21 years old is a risk factor for developing nicotine dependence. Thus, combating smoking in early ages <21 years old is key for the prevention of nicotine dependence. The effectiveness of implementing smoking cessation intervention in workplaces depends on many factors, such as the actual desire of the smoker to quit, his concept and attitude towards smoking, and his readiness to change i.e., quitting becomes his personal priority. If an individual "does not want to change" even if the interventions were acceptable and useful, it seems unlikely to be effective. Therefore, treatment priority should focus on those who are willing to change and want to be treated. It is recommended to activate the Egyptian law 52 of 1981 which prohibits smoking in workplaces to protect non-smokers from second-hand smoking, as well as to prevent relapse of smokers who have quit smoking.

## Declaration by Authors

**Ethical Approval:** Approved

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**Conflict of Interest:** The authors declare no conflict of interest.

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