ORIGINAL ARTICLE

The Correlation of Two Nicotine Dependence Measurement Methods: Fagerstrom Test for Nicotine Dependence (FTND) and Saliva Cotinine among a Group of Muslim Smoker in Malaysia

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ABSTRACT

Introduction: One of the known factors that hindered smoking cessation is nicotine dependence. Measurement of the nicotine dependence is important to better understand cigarette smoking addiction dependence and ways to overcome it. Among methods of nicotine dependence measurement are self-reported Fagerstrom Test for Nicotine Dependence (FTND) and biochemical assessment such as saliva cotinine. Biochemical assessment can be used to measure the accuracy of the self-reported measurement of nicotine dependence. **Objective:** To explore the correlation between the FTND and the saliva cotinine of the smokers in three different timeline. **Methods:** A total of 61 male smokers who currently smoke cigarette on daily basis were recruited. The study used the one-group pretest-posttest study design and the data were collected three times. The self-reported measurement were measured by using FTND and the biochemical assessment measured by using saliva cotinine from Saliva Bio oral swab (SOS) with the sensitivity of 0.15ng/ml. Data analysis was conducted by using Pearson correlation**. Results:** There was a significant association between the FTND score and saliva cotinine level of the smokers at baseline, second and third data collection ($p=0.014$, $p=0.003$, $p<0.001$). **Conclusion:** Both the self-reported measurement of nicotine dependence and biochemical assessment of the smokers are correlated and it could provide reliable information of the nicotine dependence.

Keywords: Nicotine dependence, Fagerstrom Test for Nicotine Dependence (FTND), Saliva cotinine, Correlation

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INTRODUCTION

The smoking prevalence remained high in some countries especially in most of the developing countries despite of all the establishment anti-smoking programs. Globally, cigarette smoking or tobacco used is a leading global disease risk factor (1). It is known to the public that smoking is bad for the health and one-half of the adult smokers die prematurely from smoking related diseases (2, 3). Smoking has become one of the greatest burdens economically, physically and socially to the country. Smoking give a great impact on the health setting as it causes many smoking related diseases that are preventable. Smoking related diseases cause around 6 million of mortalities globally each year (4). By 2030, smoking related mortalities are expected to increase to more than 8 million per year (4). Not only does smoking effect the health of the smokers, it also affect the second-hand smokers; whom are the public, family members, or friends which are non-smokers, but being near a smoker. Second-hand smoke contains more than 7000 chemical compounds in which more than 250 of these chemicals are known to be harmful and at least 69 of these are known to be cancer causing chemicals (5). It have been stated that globally, 2.5 million smoking related mortalities were among non-smokers who died from the exposure to second-hand smoke and 100,000 babies died due to parental smoking that include smoking during pregnancy (2).

Smoking cessation is a difficult process with nicotine dependence being the major barriers causing smokers unable to quit smoking (6). Nicotine dependence is an addiction to tobacco product caused by nicotine which

mainly affects dopamine and noradrenaline by altering the balance of these chemicals inside the brain (7, 8). Nicotine is absorbed rapidly into the body system through the lungs by inhalation in smoking practices (9). Repeated exposure to nicotine can lead to tolerance known as neuroadaptation (10). Alongside with the neuroadaptation, the number of nicotine cholinergic receptors (nAChR) binding sites in the brain also increase causing response to nicotine-mediated desensitization of receptors, thus cause elevation of craving and withdrawal (11).

Nicotine dependence is a hypothetical construct that is designed to explain and predict societally important outcomes such as problems caused by smoking (12). The importance of nicotine in smoking maintenance and cessation difficulty has been acknowledged in the last decade and thus led to efforts to measure nicotine dependence (13). In clinical research, tools for nicotine dependence assessment are important (14). With the increased in smoking cessation program, reliable indicators of the nicotine dependence are needed to accurately assess the efficacy of the programs (15). The measurement of the nicotine dependence is important, as it can be helpful when deciding the types of support needed by the smokers to quit smoking and provide valuable measures in studies that seek to gain a better understanding of cigarette dependence and best way to overcome or prevent it (16). There are two methods of measurement that is being used in order to assess the nicotine dependence, which is by self-reported from the smokers, and biochemical assessment. Depending on the use of information, both self-reported and biochemical assessment is useful when trying to measure the smoking exposure (17).

The most common tools that had been used to measure self-reported nicotine dependence are Fagerstrom Test for Nicotine Dependence (FTND) and for the biochemical assessment is through the measurement of saliva cotinine level. FTND is the most widely used tools to measure the cigarette dependence as the items in the FTND have been found to be a particular value and have been combined in a brief dependence measure (16). Cotinine is a major metabolite of nicotine and it is the most appropriate parameter to evaluate tobacco exposure and smoking status due to its higher stability and half-life compared to nicotine (17). Salivary cotinine level are highly correlated as cotinine diffuses easily from the blood into saliva and has a longer half-life than nicotine, thus it is more specific and sensitive marker for determining the exposure to nicotine (18-20).

Both FTND and saliva cotinine of the smokers are important information that can be used to identify the accurate nicotine dependence of the smokers. From this study, both measurements which were FTND as self-reported measurement and saliva cotinine as the biomarker measurement were taken and studied. The objective of this study is to explore the correlation between the FTND and the saliva cotinine of the smokers in three different timeline. By using both of the measurements methods, the finding of this study could provide information and understanding or whether the self-reported nicotine dependence measurement is the similar with the biochemical measurement.

MATERIALS AND METHODS

Study location, study design, sampling

This research was conducted at one of the municipal council in Petaling district in Selangor, Malaysia. Municipal council is the local government that is the lowest level in the hierarchy of governance in Malaysia. The local government in Malaysia are endowed with the power given by the Local Government Act 1976 to serve both obligatory and discretionary functions to local people. Local authorities were chosen as the study location for this study because it is an ideal representative of organization that represents many types of profession, field and work setting.

This study was conducted by using quasi experimental design in which there is one-group of respondents where the pretest-posttest was performed. The one-group pretest-posttest study design was chosen as the same respondents are needed to be observed in different timeline. In this study design, the pre-test observation, baseline (O_1) were recorded on a single group of person that later receive an intervention (X), and the post-test observation, second data collection (O_2) are made after they received the intervention (21) (Fig 1). In this study, additional data was collected one month after the second data collection, which is third data collection (O_3) to further understand the correlation of FTND and saliva cotinine. The intervention in this study was Ramadan which was marked as (X_1) for first day and (X_2) for the last day. The naturally changes in the environment of Ramadan which, it is socially unacceptable for Muslim smokers to smoke during the day of Ramadan act as the intervention of this study.

The respondents for this study were selected by using systematic sampling method. The respondents were picked from the list of current smokers provided by the human resource officer at the municipal council. The human resource officers identified the list of 188 male workers whom is a current smoker during the first data collection. The sampling fraction is equal to 3. By using the table of random number, the first respondent selected from the list is the respondent number 8. The second respondent for this study is respondent number 11 on the list name.

Data collection

Data were collected three times. The first data collection was at one week before Ramadan. The second data

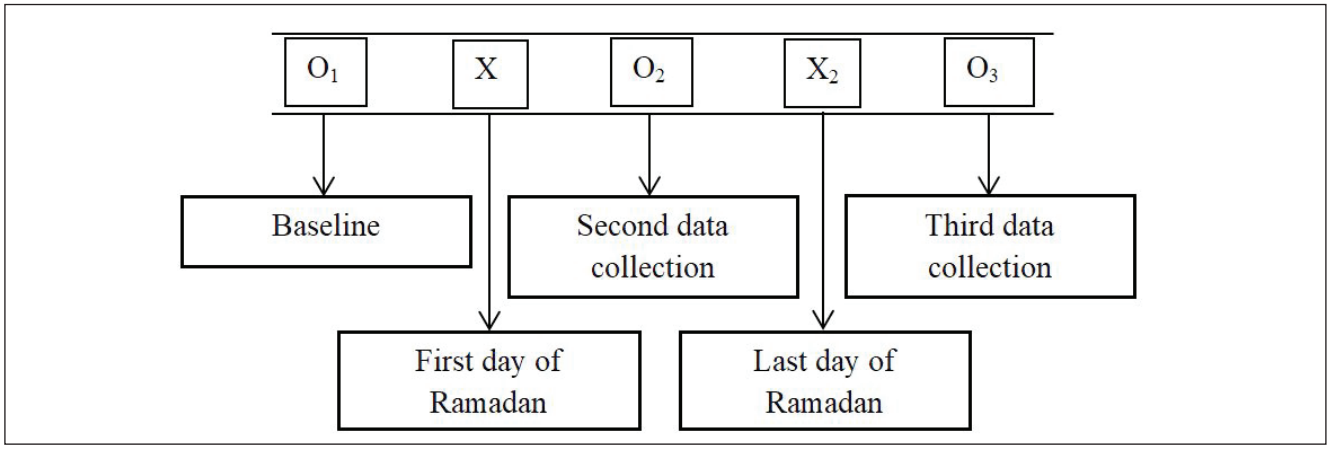

Fig. 1 : One-group pretest-posttest study design for association of FTND and saliva cotinine

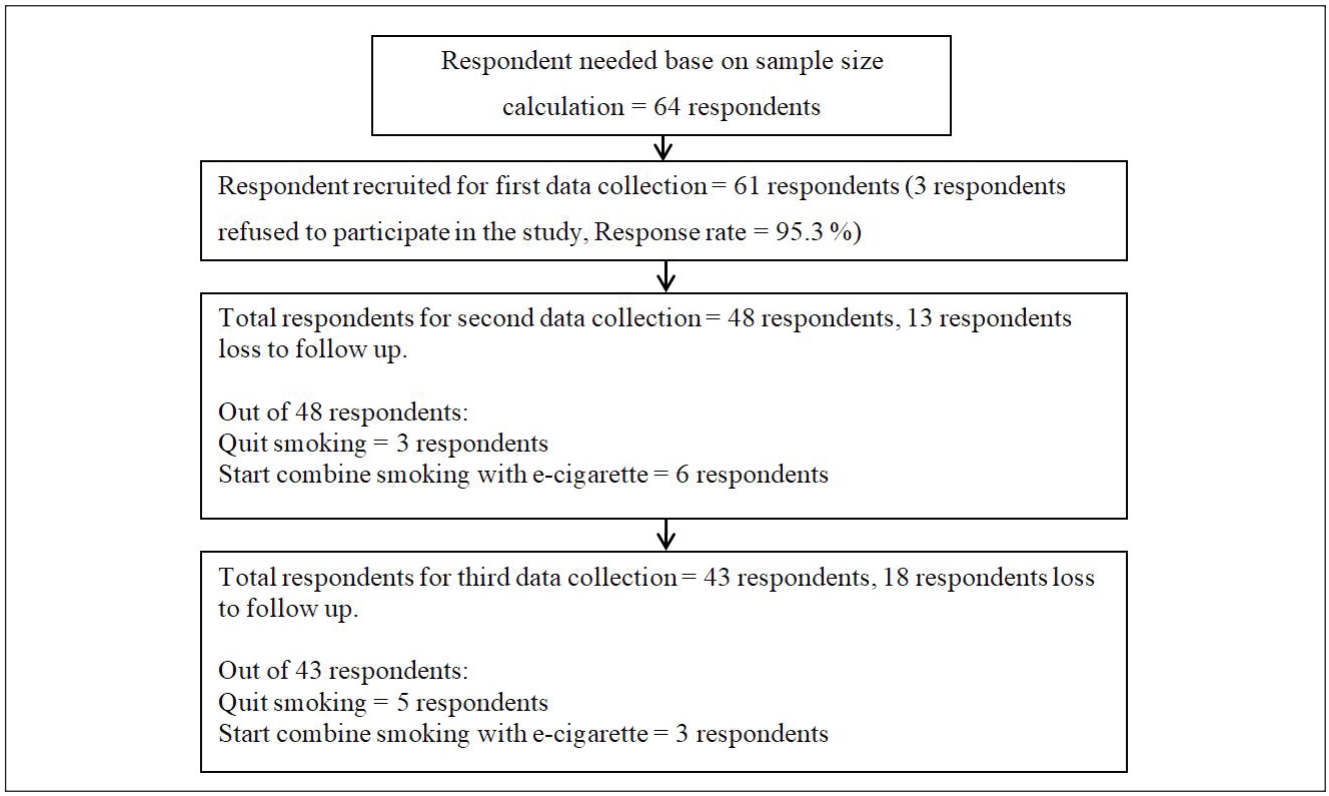

Fig. 1 : Respondents recruitment, loss to follow up and change in smoking behaviour

collection was taken at 21st Ramadan and the last data collection, was at 21 days after Ramadan. The instruments that were used in conducting this study were divided into two sections. The first section is the self-administered questionnaire, which is the self-reported measurement of nicotine dependence, Fagerstrom Test for Nicotine Dependence (FTND). The second section is the biochemical measurement, which is the cotinine biomarker that was taken from the saliva of the respondents. In this research, the cotinine level in the saliva was measured by using the SalivaBio oral swab (SOS) and cotinine biomarker research salivary assay kits and protocols from Salimetrics with the sensitivity of 0.15ng/ml. The kit in the SOS provide SalivaBio oral swab and swab storage tube.

The saliva samples were collected during the day of the data collection from nine in the morning until 12 noon. The respondents were asked to avoid any food and drink intakes at 30 minutes and gurgled with clear water and wait for at least 10 minutes before the sample was taken. The SalivaBio oral swab was to be placed under the tongue for two minutes and transferred into the swab storage tube without touching the swab throughout the process. The samples were then put inside the ice box with the temperature of less than 10˚C before transported

to the pathology lab within the same day the sample was collected. Then, the samples were stored inside the storage freezer inside the lab with the temperature of -10°C before being analysed. The saliva cotinine were analysed inside the pathology lab of Faculty of Medicine and Health Sciences, UPM. The saliva samples were first centrifuged by using the Compact Table Centrifuge KUBOTA 2100 and then analysed using the Personal Lab, Adaltis, Fully Automated ELISA Machine. In each of the data collection, the samples were analysed within 10 days after the samples were collected.

Data analysis

All the respondents that quit smoking during the study were also included in the data analysis, and for the respondents that were unable to be followed, they were analysed by using the intention-to-treat (ITT) concept. In this study, combine smoking with e-cigarette respondents were included in the data analysis as they are still able to answer the FTND items as they still used the conventional cigarette. The analysis was conducted by using Statistical Package for the Social Sciences (IBM SPSS) Version 22.0 software for Windows to analyses the data including descriptive and inferential statistical tests. Test for normality were done and it was found that the data for the Fagerstrom Test for Nicotine Dependence (FTND) score and saliva cotinine level for before, during and after Ramadan were normally distributed. The normality testing was visually confirmed by using histogram, box plot and p-p plot. Test for normality by using the Shapiro-Wilk test showed that *p* value is greater than 0.05, which indicated normally distributed data. The association of the FTND score and saliva cotinine level were analysed by using Pearson correlation test. The confidence interval was set at 95%, and the null hypothesis was rejected if the *p* value less than 0.05.

Ethical considerations

The ethical approval for this research was obtained from the Ethic Committee for Research Involving Human Subject (JKEUPM), Universiti Putra Malaysia. The permission to conduct the study was also obtained from the head of the municipal council. The information regarding the study was explained to the respondents and written consent was obtained. All the information given by the respondents were kept confidential. The respondents also have the right to choose to know the result of his own measurement in each data collection in this research if he wishes to. The respondents are also free to withdraw from the study at any given time and they can request to remove the data they had given from the study.

RESULTS

Socio-demographic characteristics of respondents

A total of 61 Malay, male, Muslim and current smoker respondents agreed to participate in this study (Table 1).

Respondent's recruitment, loss to follow up and change in smoking behaviour

During the first data collection, the number of respondents that were able to be recruited was 61 as 3 of the respondents refused to participate in this study due to personal reasons. As seen in Fig 2, during the first data collection, all respondents recruited does not used e-cigarette. During the second data collection, 13 respondents were unable follow up and 6 respondents claimed that they have started to combine smoking with e-cigarette. It is also found that, 3 respondents have quit smoking during the second data collection. The respondents are classified as quit smoking when they do not smoke at all for the past two week until the day of data collection. In the third data collection, another additional 5 respondents was unable to follow up. Thus the total of respondents that were unable follow up throughout the data collections are 18 respondents, due to changing of work place and unable to be found during the time of the data collection. It is also found that during the third data collection, the number of respondents that started to combine smoking with e-cigarette decreased to 3 respondents. Fortunately, the number of respondents that quit smoking increased to 5 respondents with additional 2 respondents that quit smoking in the third data collection.

The correlation of Fagerstrom Test of Nicotine Dependence (FTND) score and saliva cotinine level of the respondents

Pearson correlation and simple linear regression test was computed to assess the relationship between the Fagerstrom Test for Nicotine Dependence (FTND) score and saliva cotinine level of the respondents at baseline, second and third data collection (Table 2).

There was a positive correlation between the FTND score and saliva cotinine level at the baseline, r = 0.312, *p* value = 0.014. Overall, there was a significantly direct with weak relationship between the FTND score and saliva cotinine level of the respondents at baseline. However, only 9.8% of the variation of the outcome is explained by the variable.

There was a positive correlation between the FTND score and saliva cotinine level in the second data collection too, r = 0.377, *p* value = 0.003. Overall, there was a significantly direct with weak relationship between the FTND score and saliva cotinine level of the respondents during the second data collection. The variation of the outcome is explained by the variable improved to 14.2%.

For the third data collection measurement, there was a positive correlation between the FTND score and saliva cotinine level, r = 0.579, p value < 0.001. Overall, there was a significantly direct with fair relationship between the FTND score and saliva cotinine level of the

Table 1. Socio-demographic characteristics of respondents (N=61)

	Mean ± SD	Frequency (n)	Percentage (%)
Age (Years)	32.0 ± 6.6		
21 to 30 years old		29	47.5
31 to 40 years old		29	47.5
41 to 50 years old		1	1.6
51 years old and above		2	3.4
Marital Status			
Single		16	26.2
Married		45	73.8
Educational level			
Secondary school		41	67.2
Diploma		15	24.6
Bachelor Degree		5	8.2
Household income	RM 2713.8 ± 1473.5		
≤ RM 999		3	4.9
RM 1,000 – RM 1,999		18	29.5
RM 2,000 – RM 2,999		15	24.6
RM 3,000 – RM 3,999		13	21.4
RM 4,000 – RM 4,999		6	9.8
≥ RM 5, 000		6	9.8
Employment position			
Clerical		47	77.0
Managerial		14	23.0
Field works frequency			
< 3 days/week		27	44.3
> 3 days/week		34	55.7

Table 2. Correlation of FTND score with saliva cotinine level of the respondents (N=61)

Variable	Correlation (r)	R square (r^2)	F value (df)	Unstandardized Coefficients (β)		*p* value
				Constant	Variable	
Baseline	0.312	0.098	6.379 (1, 59)	2.228	0.028	0.014
Second data collection	0.377	0.142	9.755 (1,59)	1.816	0.026	0.003
Third data collection	0.579	0.336	29.825 (1,59)	0.949	0.037	<0.001

*significant at *p* value <0.05

respondents during the third data collection. 33.6% of variation of the outcome is explained by the variable.

DISCUSSION

There are two types of measurement of an individual nicotine dependence, which are through self-reported and biochemical assessment. Many studies had stated that a self-reported measurement is not accurate and reliable as the majority of the respondents will under-reporting the nicotine dependence by using the FTND (22). This is because self-reported measurement may be unreliable as respondents unwilling to admit to a health problem or social behaviour that many perceive to be undesirable or when there are laws banning certain behaviours (23, 24). However, self-reported nicotine dependence is also important to truly identify the smoker's nicotine dependence as FTND demonstrated better psychometric properties such as internal consistency and ability to predict cessation outcomes (25, 26). FTND also reflect both the instrument's concentration on cigarette smoking and smoker's general understanding that tobacco dependence is driven by factors in addition to nicotine (27).

On the other hand, cotinine have been widely used as the biological markers to determine tobacco smoking status and estimate the exposure to environmental tobacco smoke (28). Cotinine from the body fluids are considered the marker of choice for the absorption of tobacco smoke (29). The cotinine level from the saliva is one of the most specific and sensitive biomarker of tobacco exposure by giving the same information about cotinine disposition in the body (29, 30). Cotinine is often used as objective biochemical measures of nicotine exposure to investigate the validity of self-reported nicotine dependence measures as it is the primary metabolite of nicotine (11, 31, 32). Saliva cotinine biomarker also predicts self-reported smoking with 100% sensitivity and 96% specificity (33). Thus, biochemical confirmation is needed for accurate assessments of tobacco use to overcome inaccuracies of self-reported tobacco use (34, 35). One of the methods for biochemical assessment is salivary cotinine that provide a reliable validation of smoking status following changes in daily smoking pattern (36).

This study shows that there was a positive, significant direct weak relationship between the FTND score and saliva cotinine level of the respondents at baseline. Similarly, the correlation is weak with a significant direct relationship between the FTND score and saliva cotinine level of the respondents in the second data collection and in the third data collection. The significant value and the correlation between the FTND score and saliva cotinine level is improved from baseline to second and third data collection. This finding is different from the finding of other studies, as it is found that the self-reported measurement is different with the biochemical measurement of smoking exposure (37). The different environment of social approval in smoking might cause the difference in finding of the study. Therefore, even though self-reported measurement methods possess several limitations in term of the reliability and validity and direct measures such as biomarker measurement are believed to offer more precise information (38); the finding of the study support otherwise.

Studies had shown that, during the first data collection, recall bias might be happening as respondent need to recall their smoking practices for many years before the first data collection. By using self-reported measurement, respondent's responses regarding their recent smoking practices are mainly affected by recall bias resulting in inaccurate reporting of current tobacco use (23). During the second and third data collection, respondents only needed to recall up to one month prior to the data collection which make the recall bias become smaller. This suggests that, the self-reported measurement has become much more accurate in the second and third data collection compare to first data collection. Information that were collected in the second and third data collection are much more accurate in understanding the smoker's level of nicotine dependence.

CONCLUSION

Both the self-reported measurement of nicotine dependence and biochemical assessment of the smokers are important as it can provide reliable information of the nicotine dependence. Depending on the use of information, both types of measurement is useful to understand the nicotine dependence level of smoker.

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