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PAIN DETECTION THRESHOLD AND PAIN TOLERANCE THRESHOLD IN SHISHA SMOKERS IN LEBANON - A HEALTH HAZARD

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PAIN DETECTION THRESHOLD AND PAIN TOLERANCE THRESHOLD IN SHISHA SMOKERS IN LEBANON - A HEALTH HAZARD

Abstract

Shisha smoking is a common method of tobacco smoking in the Mediterranean Region with prevalence ranging between 20% and 70%. Actually, shisha smoking is becoming increasingly popular method of tobacco smoking worldwide. Pain is a subjective experience influenced by genetic, developmental, familial, psychological, social and cultural variables. An increase in pain tolerance threshold (Ptt), which is defined as the highest intensity of painful stimulation that a tested subject is able to tolerate, was noticed with cigarette smoking. However, the relation between shisha smoking and pain detection threshold (Pdt), defined as the lowest intensity of a painful stimulus at which the subject perceives pain and pain tolerance threshold (Ptt) has not been studied. The purpose of this study was to determine the association between Pdt and Ptt in shisha smokers in Lebanon. A total of 400 participants from different areas in Lebanon were recruited of which 216 were non-smokers and 184 were shisha-smokers. The sphygmomanometer cuff technique was used to detect Pdt and Ptt. As a result, the mean age of these participants was 27.46 years (standard deviation=11.79). Shisha-smoker male participants represented 53.7% while female shisha-smokers presented 40.8%. Pdt and Ptt were significantly greater in shisha smokers than in non-smokers with $P = 0.001$ and $P < 0.001$ respectively. The mean number of heads of shisha smoked was 2.64 heads (standard deviation = 4.70). Both Pdt and Ptt are significantly increased in shisha smokers who smokes more heads of shisha per day with a p value of 0.031 and 0.002 respectively. However, in shisha smokers, the mean number of shisha smoking years was 2.68years (standard deviation = 5.22). Only Ptt significantly increased ($P = 0.007$) with more smoking years. Moreover, Pdt and Ptt were both significantly higher ($P < 0.001$) in males than in females. One may conclude that shisha smokers have higher tolerance thresholds for pain than non-smokers.

Keywords

Shisha, pain detection threshold (Pdt), pain tolerance threshold (Ptt), Lebanon.

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1. INTRODUCTION

According to the World Health Organization (WHO) in 2016, tobacco smoking, including both cigarette and shisha smoking, is one of the greatest health threats the world has ever confronted, causing the death of more than 7 million individuals every year (WHO, 2016). About 1100 million smokers, presenting one-third of the general population, are above 15 years of age (Ip.M, Chan Yeung. M, Lam.W.K. et al, 2005). Despite its health hazards, tobacco smoking still manifests a high prevalence (Memon A, Moody PM, Sugathan TN, et al., 2000).

Cigarette smoking is a well-known danger to health and executes roughly 6 million individuals every year (WHO, 2017). Shisha has been known as a common technique for tobacco smoking in the Middle East, the Indian subcontinent and worldwide for quite a few years (Mirahmadizadeh A & Nakhaee N., 2008; Chaouachi K., 2009 & 2015). Researchers have claimed that the prevalence of shisha smoking in the Eastern Mediterranean Region is the highest in the world, ranging between 20% and 70% (Haddad L, Kelly DL, Weglicki LS, et al., 2016). Other studies in Lebanon reported a high prevalence of shisha smoking among school and university students of 25% and 28% respectively between 2006–2015 (Singh SK, Enzhong L, Reidpath DD, et al., 2017).

The tobacco utilized in shisha smoking is essentially of three sorts: Mussel, Agami and Jurak (Mirahmadizadeh A, Nakhaee N., 2008). In shisha, the tobacco is warmed utilizing charcoal. A worldwide general thought exists that the dangers of smoking are less by shisha smoking than cigarette smoking (Al Mutairi SS, Shihab- Eldeen AA, Mojiminiyi OA, et al., 2006). This evolves from the belief that heated tobacco smoke is filtered from toxins when bubbled in the water vase before being breathed in by the consumer (American Lung Association, 2007; Maziak W, Eissenberg T, Rastam S, et al. , 2004; Sajid KM, Chaouachi K, Mahmood R, 2008). Actually, tobacco leaf combustion produces toxic vaporous and particulate fragments such as carbon monoxide, nitrosamine, acetaldehyde, erratic hydrocarbons, formaldehyde and hydrogen cyanide (Sajid KM, Chaouachi K, Mahmood R., 2008). Curiously, researchers from the Middle East region concluded that in a pipe loaded with Jurak (a blend of 15% of tobacco leaves and 47% starches), shisha smoke contained just 142 aggravates. Cigarette smoke, on the other hand, contained around 4800 aggravates, 69 of which are cancer-causing agents (Chaouachi K., 2009; Husain H, Al-Fadhli F, Al-Olaimi F, et al., 2016). Moreover, there is evidence of a considerable increment of carcinoembryonic antigen among substantial shisha smokers (Sajid KM, Chaouachi K, Mahmood R., 2008).

As stated by the WHO in 2005, one-hour session of smoking shisha can be the same as smoking 100 or more cigarettes. Relative to cigarette smoking, shisha smoking has greater carboxyhemoglobin (COHb), same nicotine peak exposure, and more smoke exposure (Eissenberg T, Shihadeh A., 2010; Cobb CO, Shihadeh A, Weaver MF, et al., 2010). These smoke constituents are related to different complications (Daher N, Saleh R, Jaroudi E, et al., 2010), such as asthma, respiratory diseases, hypertension, high glucose levels, and sleep disturbances (Husain H, Al-Fadhli F, Al-Olaimi F, et al., 2016). Lane et al suggested the presence of antinociceptive effect of smoking (Lane JD, Lefebvre JC, Rose JE, et al., 1995).

Pain has been defined as ‘unpleasant sensory and emotional experience related with real or potential tissue damage’ (Cohen,M, Quintner, J., & van Rysewyk, S.,2018). It is a multifactorial process mediated by many variables such as relaxation, anxiety, and cognitive rehearsal (DePalma MT, Weisse CS., 1997; Bobey MJ, Davidson PO., 1970). Pain sensitivity varies substantially among humans. How torment is perceived by people, relies upon a wide variety of factors including, age, sex, desires, and psychosocial factors (DePalma MT, Weisse CS., 1997). A study showed that cigarette smoking might have anti-nociceptive effects, which may depend both on nicotine and on other factors associated with smoking. This study used thermal pain stimulation on otherwise healthy 18 cigarette smokers, who were tested for their Pdt and Ptt after an overnight abstinence. The group who were offered normal nicotine cigarettes showed an increase in their pain tolerance relative to the group who remained abstinent (Lane JD, Lefebvre JC, Rose JE, et al., 1995).

Another one stated that pain detection threshold (Pdt) and pain tolerance threshold (Ptt) increase with nicotine smoking in men (Jamner LD, Girdler SS, Shapiro D et al., 1998). Pdt is the lowest intensity of a painful stimulus at which the subject perceives pain (Farlex Partner Medical Dictionary, 2012), while Ptt is the highest intensity of painful stimulation that a tested subject is able to tolerate (Farlex Partner Medical Dictionary, 2012). Moreover, a research showed that both female and male smokers had higher pain threshold and tolerance to ischemic pain and cold pressor pain than non-smokers (Girdler SS, Maixner W, Naftel HA, et al, 2005). However some other studies claimed that Tobacco has been associated with several pain conditions that involve musculoskeletal pain, lower back pain, rheumatoid arthritis, and fibromyalgia (Riley III JL, Tomar SL, Gilbert GH., 2004; Shi Y, Weingarten TN, Mantilla CB, et al. , 2010; Ditre JW, Brandon TH, Zale EL,et al., 2011).

The aim of this study is to determine the association between pain detection threshold and pain tolerance thresholds in shisha smokers in Lebanon.

2. METHODOLOGY

2.1. Study Design and Ethical Considerations

This is a cross-sectional study where 400 volunteers, as calculated for a representative sample of the Lebanese population were recruited over a period of one year. Proposal was approved by the institutional board review IRB at Beirut Arab University (approval number 2017H-0061M-R-0229). The study was held anonymous for participants. Simple random sampling was done where investigators attempted visiting public places, universities, work places, parks in different governorates in Lebanon.

2.2. Inclusion/Exclusion Criteria

Those who were above 18 years old and who are currently shisha-only smokers or never smokers were include in the study. Yet, those who had history of cancer, diabetes, neuropathies, pain killer use in the last 24 hours, drug addicts, sensory impairment of upper limb, chronic pain, ischemic disease or surgery in the left arm were excluded.

2.3. Data Collection/ Technique

After signing the informed consent for each eligible participant, a 5 minute-questionnaire was distributed including inquiry about some demographic data including age, occupation, sex, residence, and current medications. Additional info about shisha smoking including smoking status, frequency of shisha smoking, and history of shisha smoking were also recorded by the investigators.

Pain detection threshold (Pdt) and pain tolerance threshold (Ptt) were measured on participants while sitting, using a medium sized blood pressure cuff and an aneroid sphygmomanometer. The length of the cuff's bladder was at least equal to 80% of the circumference of the arm. The manometer cuff was wrapped around the left upper arm of the participant with the cuff's lower edge one inch above the antecubital fossa. The cuff of the sphygmomanometer was inflated until the subject first perceived pain. The value noticed on the sphygmomanometer at this point was recorded as (Pdt). The cuff was further inflated until the subject experienced unbearable pain. The value noticed on the sphygmomanometer at this point was recorded as (Ptt). The cuff was then completely deflated (Durga P, Wudaru SR, Khambam SK, et al., 2016).

2.4. Data Analysis

Data were entered and analyzed using Statistical package of Social Science [IBM SPSS, version 21]. For analysis Categorical data were expressed as percentages while continuous data as mean \pm standard deviation (SD). Chi-square was used when appropriate to compare between groups. Mann-Whitney test was also used when needed. Results were considered significant when a p-value was 0.05 or less.

3. RESULTS

3.1. Sample Characteristics:

400 volunteers completed the test of which 216 were non-smokers (54%) and 184 were smokers (46%). The mean age of all participants was 26.90 years (standard deviation= 11.15). Of the 400 participants, 36.5% were males and 63% were females; 71.8% were single, 27.5% were married and 0.8% were divorced. As for the participants` occupation, 33% were workers while 67% were non-workers.As for the place of residency of the participants, 20% were from Beirut, 13% from Bekaa, 33% from Lebanon Mountain, 12% from the North, and 21.2% from the South and Nabatiya (Table 1)

Table 1: Residence and Smoking Status Count and Percentages in 400 participants.

Residence			Smoking Status		Total
			non-smoker	smoker	
Beirut	Count (N)		39	42	81
	% of Total		9.8%	10.5%	20.2%
Bekaa	Count (N)		28	24	52
	% of Total		7.0%	6.0%	13.0%
Lebanon Mountain	Count (N)		49	84	133
	% of Total		12.2%	21.0%	33.2%
North	Count (N)		35	14	49
	% of Total		8.8%	3.5%	12.2%
South and Nabatiya	Count (N)		65	20	85
	% of Total		16.2%	5.0%	21.2%

For the sake of statistical analysis, data for participants recording a pain detection threshold (Pdt) or pain tolerance threshold (Ptt) value above 300 mmHg (maximum recorded value on sphygmomanometer) were not included. Hence, a final population of 250 participants was included, of which 21.6% were males and 78.4% were females. The mean age of these participants was 27.46 years (standard deviation=11.79). Non-smoker male participants represented 46.3% while 53.7% were smokers. Female non smokers were 59.2% while smokers presented 40.8% (Table 2)

Table 2: Gender and Smoking Status count and Percentages in 250 participants.

Gender			Smoking Status		Total
			non-smoker	smoker	
male	Count (N)		25	29	54
	% of Total		10.0%	11.6%	21.6%
female	Count (N)		116	80	196
	% of Total		46.4%	32.0%	78.4%
Total	Count (N)		141	109	250

Regarding the occupation, 30% were workers and 70% were non-workers. In turn, 40% of workers were non-smokers and 60% were smokers whereas 63.4% of non-workers were non-smokers and 36.5% were smokers (Table 3).

Table 3: Occupation and Smoking Status count and Percentages in 250 participants.

Occupation	worker	Count (N)	Smoking Status		Total
			non-smoker	smoker	
		% of Total	12.0%	18.0%	30.0%
	non-worker	Count (N)	111	64	175
		% of Total	44.4%	25.6%	70.0%
Total		Count (N)	141	109	250

3.2. Correlation Between The Number Of Heads Smoked Per Day, Smoking Years and Pdt, Ptt:

Concerning shisha smokers the mean number of heads smoked per day was 2.64 heads (standard deviation = 4.70). Pain detection threshold and pain tolerance thresholds were both significantly increased in shisha smokers who smokes more heads of shisha per day with a p value of 0.031 and 0.002 respectively (Table 4)

Table 4: Pain detection threshold and pain tolerance threshold with respect to number of heads of shisha smoked per day and with respect to smoking years (Kruskal Wallis Test)

	Number of heads of shisha smoked per day		Smoking years	
	Pain Detection Threshold (Pdt)	Pain Tolerance Threshold (Ptt)	Pain Detection Threshold (Pdt)	Pain Tolerance Threshold (Ptt)
Chi-Square	19.867	27.605	24.470	34.647
Df	10	10	17	17
Asymp. Sig.	0.031*	0.002**	0.107	0.007**

However, in shisha smokers, the mean number of shisha smoking years was 2.68years (standard deviation = 5.22). Only pain tolerance threshold significantly increased ($P=0.007$) with more smoking years (Table 4).

3.3. Mean Of Pain Detection Threshold and Pain Tolerance Thresholds With Respect To Smoking Status:

The average value noticed in the 250 participants for Pain detection threshold (Pdt) and Pain tolerance threshold (Ptt) were 172.19 mmHg and 256.44 mmHg respectively. The mean value of Pdt in shisha smokers was 184.27mmHg which is significantly greater than that in non-smokers with a mean value of 162.89 mmHg ($P= 0.001$). Similarly in shisha smokers pain tolerance threshold showed a mean value of 267.89 mmHg which is significantly greater ($P<0.001$) than that in non-smokers with a mean value for of 247.60 mmHg (Table 5,6,7)

Table 5: Mean of pain detection threshold and pain tolerance thresholds with respect to smoking status

Smoking Status		Pain Detection Threshold (Pdt) $P= 0.001^{**}$	Pain Tolerance Threshold (Ptt) $P<0.001^{**}$
Non-smokers (N=141)	Mean	162.86 mmHg	247.60 mmHg
	Std. Deviation	50.077	41.289
Smokers (N=109)	Mean	184.27 mmHg	267.89 mmHg
	Std. Deviation	44.674	32.434
Total (N=250)	Mean	172.19 mmHg	256.44 mmHg
	Std. Deviation	48.875	38.942

Table 6: Mean of Pain detection threshold with respect to smoking status (Mann-Whitney Test)

Smoking status	Pain Detection Threshold	P Value
Smokers (N= 184)	Mean value = 184.27mmHg	0.001**
Non- smokers (N= 163)	Mean value = 162.89mmHg	

Table 7: Mean of Pain Tolerance threshold with respect to smoking status (Mann-Whitney Test)

Smoking status	Pain Tolerance Threshold	P Value
Smokers (N= 184)	Mean value = 267.89mmHg	< 0.001***
Non- smokers (N= 163)	Mean value = 247.60mmHg	

3.4. Mean Of Pain Detection Threshold and Pain Tolerance Threshold With Respect To Gender:

The mean values of Pain detection threshold and Pain tolerance threshold were both significantly higher ($P < 0.001$) in males than in females (Table 8).

Table 8: Mean of pain detection threshold and pain tolerance threshold with respect to Gender (Mann-Whitney test)

Gender		Pain Detection Threshold (Pdt)	Pain Tolerance Threshold (Ptt)
		$P < 0.001$	$P < 0.001$
Male (N=54)	Mean	206.67	281.39
	Std. Deviation	41.844	23.661
Female (N=196)	Mean	162.69	249.57
	Std. Deviation	46.417	39.553
Total (N=250)	Mean	172.19	256.44
	Std. Deviation	48.875	38.942

3.5. Pain Detection Threshold and Pain Tolerance Threshold With Respect To Occupation

Regarding occupational status, a significance in Pain tolerance threshold ($P = 0.017$) only was detected in those who are working (Table 9).

Table 9. Pain detection threshold and pain tolerance threshold with respect to occupation (Kruskal Wallis Test)

	Occupation	Percentage % (Number)	Mean Rank
Pain Detection Threshold (Pdt) $P = 0.099$	Worker	30 (75)	136.99
	Non-worker	70 (175)	120.58
	Total	100 (250)	
Pain Tolerance Threshold (Ptt) $P = 0.017^*$	Worker	30 (75)	142.09
	Non-worker	70 (175)	118.39
	Total	100 (250)	

4. DISCUSSION

Shisha smoking is a common method of tobacco smoking in the Eastern Mediterranean Region, recording the highest prevalence in the world (Haddad L, Kelly DL, Weglicki LS, et al., 2016). Some studies demonstrate a correlation between cigarettes smoking and pain tolerance (Lane, James D., Lefebvre et al, 1995). However, the relation between shisha smoking with respect to pain detection and tolerance thresholds has not been studied.

Regarding participants who have Pain detection threshold (Pdt) and Pain tolerance threshold (Ptt) equal or below 300 mmHg there was a significant increase in both Pdt and Ptt in shisha-smokers compared to non-smokers. Lane, James D., Lefebvre et al showed similar results by studying the effect of cigarette smoking on pain tolerance where it was significantly higher in cigarette smokers than non-smokers (Lane, James D., Lefebvre et al, 1995). Furthermore, the increase in number of heads per day and years of smoking shisha shows a significant increase in as shown in tables 4 & 5 respectively. A good explanation can be related to studies that showed nicotine involvement in pain modulation through animal experiments. Nicotine's analgesic effect is mainly due to the binding to nicotinic acetylcholine receptors (nAChRs) in central and peripheral nervous systems. In the central nervous system, activation of post-synaptic nAChRs directly acts on excitatory neurons through cation channels (sodium, potassium and calcium channels). On the other hand, the activation of presynaptic nAChRs lead to the release of other neurotransmitters, including dopamine, glutamate, γ -aminobutyric acid (GABA), 5-hydroxytryptamine (5-HT), histamine and noradrenaline. This reduces descending excitatory pain pathways and enhances descending inhibitory pain pathways, resulting in reducing transmission of nociceptive impulses (Shi Y, Weingarten TN, Mantilla CB, et al., 2010).

Nevertheless, some other studies claimed that tobacco has been associated with several pain conditions that involve musculoskeletal pain, rheumatoid arthritis, low back pain, and fibromyalgia (Riley III JL, Tomar SL, Gilbert GH., 2004; Ditre JW, Brandon TH, Zale EL, et al., 2011). Ditre, J. W., Brandon, T. H., Zale, E. L. et al claimed that low back pain may be caused by malnutrition of spinal disc cells which will lead to disc degeneration via by carboxy-hemoglobin-induced anoxia or vascular disease. In addition, they have suggested that smoking introduces a variety of toxic substances (e.g., carbon monoxide) that may damage the interior lining of blood vessels through decreasing their capacity to carry oxygen which leads to tissue starvation, degeneration, and death (Ditre, J. W., Brandon, T. H., Zale, E. L. et al., 2011).

Moreover Pain detection threshold and Pain tolerance threshold were significantly higher in males than females with a p value less than 0.001 (Table 2), which agreed with a study done by Jamner, Larry D et al (Jamner, Larry D et al, 1998). Actually, there is evidence that men are culturally reinforced to handle pain due to sociocultural beliefs about gender appropriate behavior Yet, women are more sensitive to nociceptive stimulation and more vulnerable to long-term pain conditions than men (Meints SM, Edwards RR, 2018). However, some showed that nicotine increased the pain threshold and tolerance in both men and women (Girdler SS, Maixner W, Naftel HA, et al., 2005). As regard occupation, significant increase in Pain tolerance threshold was observed in those who have a job more than in those who don't work (Table 3). This might be referred to the participant's type of occupation and his interest in it. If the participant is involved in an enjoyable, meaningful and satisfying occupation, pain tolerance often increases (Fisher GS, Emerson L, Firpo C, et al. 2007).

Despite of the above results, pain is an alarming sign for receiving medical care and treating a certain pathology. Decrease in pain sensation can mask an undergoing disease or can delay the initiation of treatment which may lead to the progression of the pathology or the disease.

5. CONCLUSION

- A- This study has shown that shisha smoking significantly increases pain detection threshold (Pdt) and pain tolerance threshold (Ptt).
- B- Shisha smokers can tolerate more pain than non-smokers, mostly in males.

6. LIMITATIONS

- Limiting the final sample of the study to 250 participants instead of the 400 calculated sample in order to have more accurate statistical analysis.
- The effect of different occupation on pain perception was not studied well.
- Age related nociceptive perception was not studied

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