Driving Under the Influence of the Hookah (Nargila)

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Abstract

This research examines the influence of smoking the hookah on driving behavior and the risk of involvement in road accidents. In the context of this study, an attempt is made to examine the changes in the concentration of oxygen and carbon monoxide (CO) in the blood following the smoking of the hookah, and the influence of these changes on driving and on the risk of becoming involved in road accidents. The study is based on an experiment that includes a hundred persons aged 18 to 60 years, both women and men. 70% of the participants are hookah smokers (the experimental group) while 30% are non smokers (the control group). The experiment focuses on the Arab population from two villages Binin and Der-Alasad. The methodology deals with the problem with an overall approach through the employment of a number of methods:

1. Testing the level of blood oxygenation using a special Pulse Oxymeter instrument.
2. A questionnaire.
3. A driver simulator that enables the measuring of various participant driving behaviors.

The results show that smoking a hookah has a significant impact on driving behavior and on the risk of being involved in road accidents and causing driving to become riskier and less careful and stable. To the best of our knowledge, this is the first time such relationships have been tested. After smoking a hookah the total number of traffic accidents and driving violations increase. The results show a significant increase in the pulse rate immediately after smoking a hookah with a decrease in the saturation rate (the level of blood oxygenation); these changes continue half an hour after hookah smoking.

Keywords: Smoking Hookah, Driving Behavior, Road Crashes, Carbon Monoxide

תקציר

המחקר הנוכחי עוסק בבחינת השפעת עישון הנרגילה על התנהגות הנהיגה ועל הסיכון למעורבות בתאונות הדרכים. במסגרת המחקר בדקנו את השינויים בריכוז החמצן וחד תחמוצת הפחמן בדם כתוצאה מעישון הנרגילה, והשפעת שינויים אלה על הנהיגה ועל הסיכון למעורבות בתאונות הדרכים. המחקר מתבסס על ניסוי שכלל 100 משתתפים: נשים וגברים בגילאים 18 עד 60. 70% מהמשתתפים עישנו נרגילה ואילו 30% מהם לא עישנו נרגילה והיוו קבוצת ביקורת. המחקר התמקד באוכלוסייה הערבית והמשתתפים נבחרו משני ישובים ערביים מהגליל: בענה ודיר אלאסד. בניסוי נעשה שימוש במספר כלים עיקריים שיפורטו להלן על מנת לבחון את מצבם ויכולותיהם של המשתתפים בניסוי:

1. בדיקת רמת החמצן בדם תוך שימוש במכשיר מיוחד פלסימטר
2. שאלון שמורכב משני חלקים: הראשון כלל שאלות על המאפיינים השונים של המשתתף בניסוי, כמו: גיל, מגדר, השכלה, מצב תעסוקה, שימוש בסיגריות ושימוש בנרגילה. החלק השני כלל שאלון עמדות.
3. סימולאטור נהיגה שאפשר מדידת התנהגויות הנהיגה השונות של המשתתפים עקב עישון הנרגילה.

תוצאות המחקר הראו כי לעישון הנרגילה יש השפעה משמעותית על התנהגות הנהיגה ועל הסיכון למעורבות בתאונות דרכים. נהגים שעישנו נרגילה לקחו יותר סיכונים בזמן הנהיגה, והנרגילה הפחיתה את הזהירות ואת יציבות הנהיגה. למיטב ידיעתנו, זוהי הפעם הראשונה שמנסים לבחון קשר זה. מיד אחרי עישון הנרגילה הייתה עלייה בסך כל תאונות הדרכים ובמספר עבירות התנועה. כמו כן, מיד אחרי עישון הנרגילה הייתה עלייה משמעותית בדופק וירידה בשיעור הרוויה (רמת חמצון בדם); שינויים אלה נמשכו מחצית השעה אחרי עישון נרגילה.

מילות מפתח: עישון נרגילה, התנהגות הנהיגה, חד תחמוצת החמצן, תאונות דרכים

1. Introduction

1.1 Foreword

In recent years the smoking of hookahs (Nargili, shisha and goza) based in the Middle East has significantly spread in Israel - mainly within Arab society. In addition to smoking at home, a great number of coffee shops whose main activity is hookah smoking have opened. This phenomenon has also been spreading in other places throughout the world such as Europe, the United States and Canada (Health services, 2003). A great deal of literature deals with the influence of the use of various substances such as smoking cigarettes and drinking alcohol and various types of drugs, and their effect on public health in general and on road safety in particular. A great number of studies, for example, deal with the relationship between the use of such substances and driving behavior and the risk of becoming involved in road accidents (Asbridge, 2005; Yan, 2005; Blows, 2005); by comparison, only a limited number of studies deal with the influence of smoking hookahs on health, whereas the results of these studies indicate that the effects of smoking hookahs may be far more severe than those of smoking cigarettes (Health services, 2003; Alan Shihadeh, 2004; Mirjana, 2000; Mshafagoj, 2002, Bacha et al., 2007). For example, a study conducted at the Mayo Clinic at Colombia U. in 2003 showed that the amounts of nicotine that the smoker inhales when smoking a hookah is very considerable due to the greater quantity of smoke that is inspired with every inhalation. In addition, various other dangerous substances are inhaled, such as carbon monoxide and heavy metals. Moreover the myth that hookah smoking is safer than smoking cigarettes is false inasmuch as the tobacco is no less toxic. Hookah smokers actually inhale more tobacco smoke than do cigarette smokers because of the massive volume of smoke they inhale so that one hour of hookah smoking is equivalent to the smoking of 200 cigarettes (Mayo Clinic at Colombia, 2003). Other research shows that a 45 minute session of hookah tobacco smoking (molasses tobacco mixture) delivers slightly more tar and carbon monoxide (around 5-10%) than a pack of cigarettes (Hookah Trend is Puffing Along, 2005). The foregoing study has, however, come under criticism for using unrealistically high temperatures for the tobacco (600-650 degrees C) as well as arbitrary figures for tar filtration rates. This could possibly produce skewed results, as the carcinogenic and toxin levels of smoke increases dramatically with temperature (Wynder, 1958). Common practice is to keep temperatures to degrees which do not

"char" the hookah; that is, within a temperature range of 100-150 C. The effects of these lower temperatures on tar are inconclusive, though the author indicates the tar would be less harmful. Recent studies (BBC, 2009; Y net, 2011; Bacha et al., 2007) showed that hookah smoking increases the individual one - carbon monoxide in blood at least 5 times ,compared to that from smoking a few cigarettes. They claimed that this toxic substance can cause brain damage and loss of consciousness.

The World Health Organization Study Group on Tobacco Product Regulation (TobReg) presented an advisory note in 2005 on waterpipe (hookah) tobacco smoking (Encyclopedia Britannica, 2008) and concluded that it is associated with many of the same health risks as cigarette smoking, and may, in fact, involve some unique health risks." It is recommended that "waterpipes and waterpipe tobacco" should be subjected to the same regulation as cigarettes and other tobacco products. Many articles (Tobacco smoking using a waterpipe, report, 2004) suggest that there is simply not enough research to provide answers to determine the effects of hookah smoking.

It is known that cigarette smoking leads to accelerated cardiac rate as probably on the background of hypoxia (decrease in the concentrations of oxygen in the blood) hookah smokers testify to a more powerful effect compared to that of cigarette smoke which leads to vertigo from the very first puff. It is possible that hookah smoking leads to stronger and deeper hypoxia which is conducive, among other things, to the sensation of euphoria and to the tendency to take greater risks.

This phenomenon may constitute a negative influence on the risk of becoming involved in road accidents among hookah smokers. However, according to the information available, there are no studies that have tried to explain the effect of smoking a hookah on driving and on the risk to becoming involved in road accidents. The goal of the proposed research is to carry out a test of the effects of smoking hookahs on the concentration of oxygen and carbon monoxide in the blood and the influence that this may have on driving behavior and the risk of becoming involved in road accidents.

1.2 Research objectives

This research is intended to examine the influence of smoking a hookah on driving behavior and the risk of involvement in road accidents. In the context of the research, an attempt will be made to examine the changes in the concentration of oxygen in the blood following the smoking of the hookah, and the impact of these changes on driving and on the risk to becoming involved in road accidents. In addition, this study aspires to understand the variables that affect willingness to smoke the hookah including attitudinal variables, while taking into consideration socio-demographic characteristics and the extent of exposure to other hookah smokers.

1.3 Research contribution

This study constitutes an initial sample and a basis for future research on the subject of the effect of the smoking hookah pipes. To the best of our knowledge, this is the first study that attempts to examine the influence of smoking hookah on driving behavior and consequently on the risk of becoming involved in road accidents. The study results will serve as the basis for intervention by relevant authorities for road safety which includes the National Authority for Road Safety, the Ministry of Transportation and the police who may then take steps in the areas of legislation and enforcement as well as in the area of public education, in order to prevent the use of hookah pipes (in particular) prior to driving.

2. Literature review

In recent years the smoking of hookahs (Waterpipe, Hookah, shisha and goza) deriving from the Middle East has significantly spread in Israel mainly in Arab society. In addition to smoking at home a great number of coffee shops, whose main activity is smoking of hookahs, have been opened. The phenomenon is spreading also on other places on the word such as Europe, United States and Canada (Health services, 2003). Hookah (narghile, shisha, “water-pipe”) smoking is now seen by public health officials as a global tobacco epidemic (Chaouachi, 2009)

A great literature deals with the influence of the use of various substances smoking cigarette and drinking alcohol and various types of drugs and their effect on public health in general, and on road safety in particular. Bayly, Young, and Regan

(2009) argue that it has been found that smokers are more likely to be involved in crashes than nonsmokers (regardless of whether they are smoking at the time of the crush). They stress that this is true even if variable such as age, gender, driving experience, and education are held constant. They suggest that this effect might be the result of various factors, including greater risk taking character and monoxide toxicity. A great number of studies deal with the relationship between the use of such substances, driving behavior, and the risk for becoming involved in road accidents (Asbridge, 2005; Yan, 2005; Blows, 2005). Yet, not one study explored the relationship between hookah smoking and driving behavior.

A limited number of studies deal with the influence of smoking hookah on health in general, and the results of these studies indicate that the effects of smoking hookah may be far more severe than those of smoking cigarette (Health services, 2003; Alan Shihadeh, 2004; Mirjana, 2000; Mshafagoj, 2002). For example a research conducted in Mayo Clinic at Colombia 2003 showed that the amounts of nicotine that the smoker inhales when smoking hookah is huge because the quantity of smoke aspires with every inhalation is much greater than while smoking cigarettes. In addition, other various dangerous substances are inhaled, such as carbon monoxide and heavy metals. Moreover the myth that hookah smoking is safer than smoking cigarettes is false because the tobacco is no less toxic when consume through hookah. Hookah smokers actually inhale more tobacco smoke than do cigarette smokers because of the massive volume of smoke they inhale, and one hour of smoking hookah is equivalent to the smoking of 200 cigarettes (Mayo Clinic at Colombia, 2003). Other research shows that a 45 minutes session of hookah tobacco smoking (tobacco molasses) delivers slightly more tar and carbon monoxide (around 5-10%) than a whole pack of cigarettes (Hookah trend is puffing along, 2005). The foregoing study has, however, come under criticism for using unrealistically high temperatures for the tobacco (600-650 degrees C) as well as arbitrary figures for tar filtration rates. This could possibly produce skewed results, as the carcinogenic and toxin levels of smoke increases dramatically with temperature (Wynder, 1958). Common practice is to keep temperatures to degrees which do not "char" the hookah; that is within a temperature range of 100-150 C. The effects of these lower temperatures on tar are inconclusive, though the author (who?) indicates the tar would be less harmful. In 2009, British researchers found that a single narghile smoking increases the one level - carbon dioxide in blood for at least 5 times , compared to those from smoking a few

cigarettes (BBC, 2009). One of the newer studies conducted in Rambam Hospital by Dr Itay (Y net, 2011) show that after only a half hour of smoking ,there was significant damage to the body: there was a significant increase in levels of the poisonous substance carboxyhemoglobin to 26% .This increase usually requires a hospital oxygen therapy and sometimes treatment in a hyperbaric chamber .

The World Health Organization Study Group on Tobacco Product Regulation (TobReg) presented an advisory note in 2005 on waterpipe (hookah) tobacco smoking (Encyclopedia Britannica, 2008) and concluded that "waterpipe smoking is associated with many of the same health risks as cigarette smoking, and may, in fact, involve some unique health risks". The recommendation was: "waterpipes and waterpipe tobacco should be subjected to the same regulation as cigarettes and other tobacco products". Many articles (Tobacco smoking using a waterpipe report, 2004) suggest that there is simply not enough research to provide answers to determine the effects of hookah smoking. Research by Fogarty International Center-funded Syrian Center for Tobacco Studies, Egyptian Smoking Prevention Research Institute, Research for International Tobacco Control-funded Tobacco Prevention and Control Research Group at the American University of Beirut, Lebanon is in process currently.

Smoking of cigarette is known to lead to acceleration of cardiac rate as probably on the background of hypoxia (decrease in the concentrations of the oxygen in the blood) (West, 1995; Bacha et al., 2007). Hookah smokers testify to its greater effect than that of cigarettes smoke which leads to vertigo from the very first puff. It is possible that hookah leads to stronger and deeper hypoxia which is conductive among other things to the sensation of euphoria and to the taking of greater risks.

In the next paragraphs we will try to establish the relationship between smoking and hypoxia. We will review the literature on cigarette smoking and hypoxia, assuming that hookah smoking might be even greater risk for hypoxia. We will describe the effect of hypoxia on human health and in particular on human behavior. Then we will suggest that people suffering from hypoxia caused by hookah smoking, might be more prone to risk behavior in general and to take more risks while driving in particular.

Smoking and hypoxia

It is widely accepted that cigarette smoking can lead to hypoxia. The process of this effect was described by Rempher (2006) who indicated that the carbon

monoxide, a poisonous by-product of cigarettes smokes influence the delicate balance between supply and demand of oxygen in smokers. He claimed that carbon monoxide interferes with oxygen transport by competing with oxygen for the same binding sites. Moreover, hemoglobin's affinity for carbon monoxide is 200 times greater than its affinity with oxygen. When carbon monoxide binds to hemoglobin, carbon monoxy-hemoglobin is formed and replaces the oxyhemoglobin compound. The result is hypoxia as carbon monoxy-hemoglobin is unable to transport oxygen to the cells.

Astrup (1973) conducted some exposure studies in Rabbits and concluded that lipid accumulation in the arterial walls of cholesterol-fed rabbits is highly influenced by the composition of the air the animals breathe. The accumulation was increased by hypoxia and by carbon monoxide, and decreased by hyperoxia. Thus he concluded that smoking and hypoxia lead to the same symptoms. Astrup (1973) claimed that high carbon monoxy-hemoglobin levels, up to 20%, were found in inhaling tobacco smokers. He described some of the effects of these carboxyhaemoglobin levels on the central nervous system that were shown by McFarland et al. (1970) who demonstrated impaired discrimination of small differences in light intensity at 2% and 4% carboxyhaemoglobin respectively. Furthermore, various tests performances, e.g., the estimation of time intervals without having a clock and the duration of auditory signals, were found by some investigators to be decreased at carboxyhaemoglobin levels about 5 % (Beard & Grandstaff, 1970).

Anderson (1971) conducted a study in order to ascertain if smoking can cause significant hypoxia and to see if the various effects of smoking may affect the level of oxygen delivery to the cells, and concluded that in some instances, significant decrease in 02 deliveries for cellular metabolism can result from smoking.

Hypoxia

The absence of an adequate supply of oxygen to the tissues is termed *hypoxia*. Severe or acute hypoxia nearly always results in a rapid deterioration of body functions. The cells of the brain are particularly sensitive to a lack of oxygen. Hypoxia is characterized by a reduction of the partial pressure of oxygen (*p*O2) below the normal level, i.e., a lack of molecular oxygen. The target organ of hypoxia is the brain and within the brain the target cells are the neurons which exhibit a different susceptibility to oxygen deficiency

There are four types of hypoxia and each one is different in its causes. The symptoms and effects, however, are pretty much the same. Therefore, studies of the

effects of any kind of hypoxia are related to other kinds of hypoxia as well. The first category is **Hypoxic hypoxia** which is the most common type of hypoxia in aviation. It is also called **altitude hypoxia** since it happens when flying at altitude in an unpressurized aircraft or if the aircraft depressurizes in flight. When suffering from this type of hypoxia, the lungs become unable to effectively transfer oxygen from the ambient air to the blood in order to be carried to the body tissues. When altitude increases, the molecules of oxygen in the ambient air get more and more apart and as a result, they exert less pressure per square inch.

The second category of hypoxia is probably the most relevant to the current study. It terms **hypemic hypoxia**, which is caused by the blood not being capable of carrying oxygen. Even though there may be more than enough oxygen in the surrounding area, if the blood is not able to carry it to the body tissues, it will cause this type of hypoxia. There are several reasons why this might happen. The major cause of this type of hypoxia is the **ingestion of carbon monoxide**. In addition, it could also be a result of hemoglobin abnormalities within the individual, sulfa drugs or nitrites. **Tobacco users** also fall into this category, because they have at least some small amount of carbon monoxide in their blood. This carbon monoxide competes with oxygen to bind hemoglobin.

The third type of hypoxia is known as **stagnant hypoxia**. This is more of a circulatory problem, rather than respiratory. It occurs when the blood flow is compromised for any reason and then adequate oxygen cannot get to body tissues. This condition can be a result of a heart malfunction when it is not pumping blood effectively. Stagnant hypoxia can also occur when the body is exposed to colder temperatures and blood flow to extremities is limited, or following a rapid decompression in flight.

The fourth and last category is called **histoxic hypoxia**. This occurs in the cells of the body when they are impaired. Although the cells need the oxygen and it is available, the cells cannot take in the oxygen or use it to sustain metabolism. This is generally because of alcohol or narcotic use. Heavy alcohol use lowers the threshold of sensitivity to hypoxia by poisoning the nerve cells in the brain. Since oxygen is essential for the nerve cells to function, any impairment for other reasons, such as a hangover, makes it more likely to experience symptoms like confusion during an episode of hypoxia.

The influence of hypoxia on physiological, behavioral, and psychological aspects of human beings has been known for decades. Plenty of research has been carried out in order to reveal the effect of hypoxia. Most of these studies reflect the literature on the effect of high altitudes surroundings. There is also a body of research conducted with artificial surroundings which tries to mimic high altitudes conditions in a hypobaric chamber. Another line of research on this topic studies the effect of CO inhalation. Table 1 summarizes the various physiological and psychological effects known from the literature on this topic. We will review a part of this massive amount of literature in order to reveal the typical physiological, cognitive, affective, and behavioral effects of hypoxia. Although the physiological effects will be discussed here, we will emphasize the cognitive and behavioral effects, since we believe that these are more relevant for driving.

Table 1 Physiological and psychological effects on humans exposed to hypoxic hypoxia

Visual	Affective and Cognitive	Neuro-muscular and Physiological
Decrease in colour perception Decrease in peripheral awareness Decrease in acuity Dimming	Feeling of euphoria Task fixation Personality changes Amnesia Lethargy Mental confusion Cyanosis Loss of self criticism, judgement	Clumsiness Fine tremor Slurring of speech Slow movements Sensitivity to cold or heat Fuzziness (not dizziness)

Effect of Hypoxia on motor function

Virués-Ortega, Garrido, Javierre, and Kloezeman (2006) reviewed the literature on the effect of high altitude on various human functions and argued that abnormal motor function was frequently reported in the altitude literature. One of the common motor phenomenons that were reported in the literature was the reduced speed and precision in finger tapping (e.g., Berry, McConnell, Phillips, Carswell, Lamb & Prine, 1989; Hornbein, Townes, Schoene, Sutton & Houston, 1989).

Sharma, Malhotra and Baskaran (1975) measured motor speed using an eye–hand coordination test in 25 Indian young adults (21–30-years-old) in a community relocated to 4000 m from sea level. They found a motor delay which did not decrease over time even when people returned to live at lower altitude.

Effect of hypoxia on affective and psychological aspects

The typical effects of hypoxia on changes in the psychological state are elation, euphoria, overconfidence and lack of discipline, risky behavior, aggressiveness through loss of control, irresponsibility, and senselessness.

Greene (1957) reported about a state of 'Mental laziness', i.e. disinclination rather than an inability to perform mental work. Greene also reported that climbers reported about hallucinations, such as the feeling that another individual is present, sometimes as a benevolent protector. There are also descriptions of visual and auditory hallucinatory episodes, with a high incidence of illusions, for example described by climbers as the presence of a 'companion'. However, this phenomenon occurred above 6000 m, and may result from other variables such as emotional distress, lack of stimulation and physical exhaustion (Brugger, Regard, Landis & Oelz, 1999; Garrido, Javierre, Ventura & Segura, 2000).

Effect of Hypoxia on cognitive abilities

The effects of hypoxia on cognitive functions are a typical performance decrement, difficulty in concentrating and faulty judgments. For example, studies that have investigated metacognitive function at high altitude found that individuals have been underreport their own problems with performance on motor tasks, long-term memory capacity and their duration of sleep (Clark, Heaton & Weins, 1983; Nelson, Dunlowsky, White, Steinberg, Townes & Anderson, 1990; Reite, Jackson, Cahoon & Weil, 1975).

Another well-known characteristic of hypoxia is that it prolongs the reaction time, particularly on more complex tests of cognitive function (Bolmont, Bouquet & Thullier, 2001; Fowler & Prlic, 1995; Kramer, Coyne & Strayer, 1993; Mackintosh, Thomas, Olive, Chesner & Knight, 1988). While error rates also increase, a number of investigators have suggested that slowing might be a strategy designed to minimize mistakes. Hornbein (2001) claimed that investigators have documented decrements in performance on a variety of neuropsychometric tests after sudden exposure to even relatively moderate hypoxia (at altitudes of 2000–4500 m). Moreover, Denison, Ledwith, & Poulton, (1966) have been reported about changes in a visual-positioning test performed during light work at an altitude as low as 1500 m. These changes with acute hypoxia are evidence that even modest levels of hypoxia can impair brain function. However, the performance in hypoxic state does not suddenly change from

normal functioning to uselessness, but there is progressive performance deterioration, reflecting the arterial blood oxygen saturation.

Temporary impairments in cognitive functioning caused by hypoxia include deterioration of the ability to learn, remember and express information verbally, impaired concentration and cognitive flexibility, decline in feeling of knowing, and mild impairment in either short-term memory or conceptual tasks. Also known are impairments in grammatical reasoning and in pattern comparison. The brain areas associated with learning and memory (e.g. structures of the medial temporal lobe) are particularly sensitive to hypoxia (e.g. see Raman, Tkac, Ennis, Georgieff, Gruetter & Rao, 2005. Pelamatti, Pascotto and Semenza (2003) conducted a research with 15 adults (29–37 years old), who were tested under high altitude (4500 and 5050 m) conditions. The results showed an impaired ability to recall word lists, specifically words that came early in the list (primacy effect). A number of other studies have shown that verbal and visual short-term memory capacity and recall is impaired at altitudes starting at 2500 m (Cavaletti, Moroni, Garavaglia & Tredici, 1987; Hopkins, Kessner & Goldstein, 1995; Hornbein et al., 1989; Phillips & Pace, 1966; Regard et al., 1989; Townes, Hornbein, Schoene, Sarnquist & Grant, 1984; West, 1984, 1986).

Hypoxia can also influence language skills. There have been published, for example, case reports of transient aphasia associated with high altitude (e.g. Botella, Garrido & Catalá, 1993). Significantly diminished performance on verbal fluency tests with altitude exposure beyond 6000 m has been reported during actual ascent and in retrospective studies (Cavaletti et al., 1987; Kennedy, Dunlap, Banderet, Smith & Houston, 1989; Regard et al., 1989). Articulation and language processing speed (time required to comprehend a sentence) was found to be altitude dependent in alpinists climbing Mount Everest (Lieberman, Protopapas, Reed, Youngs & Kanki, 1994).

The effect of hypoxia on various psychosensorimotor and reasoning processes was explored by Abraini , Bouquet, Joulia, Nicolas, and Kriem (1998). They studied the effects of high altitude on the functioning of eight climbers who participated in a simulated climb from sea level to 8,848 m over a 31-day period of confinement in a decompression chamber. Visual reaction time, psychomotor ability, and number ordination were tested. The data of the climbers were compared with data of control participants who performed the tests at sea level. The results showed that for the control subjects at sea level continued testing revealed learning effects, showing an

improvement of performance in psychomotor ability and number ordination. On the other hand, for the climbers participants, similar learning effects occurred up to an altitude of 5,500–6,500 m, but, further increases in altitude, leaded to a progressive deterioration in the climbers' psychomotor performance and mental efficiency. This progressive deterioration caused significant differences in psychomotor ability and mental efficiency between control subjects and climbers. Interestingly, Three days (72 hours) after the climbers had returned to sea level, their mental and psychomotor performances were still significantly lower than those of control subjects (by approximately 10%). In contrast, visual reaction time showed no significant changes in either climbers or control subjects. The authors suggested that chronic hypoxic stress could alter selectively mental learning processes.

On the other hand, Henderson (2001) showed that the effect of mild hypoxia on performance reduced by expertise. He tried to determine the effects of prolonged exposure to a partially oxygen-deficient environment (mild hypoxic hypoxia) on the performance of experienced pilots. Accuracy on Manikin task reduced with decreasing blood oxygen saturation but there was no change in RT. Most importantly, a task of flying at a simulator was not affected by the mild hypoxia at all. According to Henderson (2001) these results suggest that behavior, at the skill-based level, is not affected by exposure to mild hypoxic conditions.

A reduction in cognitive capabilities was found also by Dzvonik (2000), which conducted a research with pilots who were testing as candidates for the mixed international crew of the Russian Space Station "MIR". Participants were exposed for 20-minute to 7,600m in a hypobaric chamber. Then their cognitive capacity was tested (by simplified mathematical tasks) and correlated with other tests of mental capability. In addition, the behavioral and mood changes were continuously observed and recorded. A reduction of 37% in math performance was found. Moreover, the results showed that 5 out of 26 participants declared feeling of well being or euphoria after 10 minutes at the hypobaric chamber, and 15 out of 26 declared this feeling after 20 minutes at the chamber.

Visual and auditory impact of hypoxia

Various aspects of human perception including vision and hearing are also sensitive to hypoxia. Some researchers tested the effect of hypoxia on the visual system and on visual performance. Laties and Merigan (1979) reviewed the available literature on the effect of CO on visual performance and concluded that most of the

studies indicate that visual function is quite insensitive to CO, although this view is challenged by the great sensitivity of vision reported in few research endeavors. For example, Beard & Grandstaff (1970) found that consistent impairments in thresholds on the brightness difference thresholds, critical flicker fusion, and vernier (or offset) were found following 27 to 50 min of exposure to 50 ppm (3 to 5% COHb estimated from expired air). Higher CO levels produced even greater threshold changes. A similar finding was reported by Seppänen, Häkkinen, and Tenkku (1977) who demonstrated consistent decreases in critical flicker fusion of smokers and nonsmokers with COHb levels of only 5%. Also threshold elevations were reported by McFarland (1970). Ernest and Krill (1971) studied the effect of hypoxia on several aspects of dark adaptation in three highly trained observers. They found that hypoxia raised both cone and rod absolute visual thresholds. However, cone thresholds were elevated to a greater degree than rod thresholds at a 5° retinal eccentricity where both were studied. They also concluded that hypoxia had a greater effect on peripheral rod thresholds (measured at 45° eccentricity) than on central rod thresholds (measured at 5° eccentricity). These findings are particularly relevant to driving, since they seem to imply that hypoxia can change the sensitivity of the visual system.

Auditory discrimination is only slightly affected by simulated high altitude exposure. For example, a 2.6dB reduction in auditory sensitivity at a simulated altitude of 3700 m has been reported (McAnally, Watson, Martin & Singh, 2003), and longer latency of the auditory evoked potential was found in a study conducted in the Himalayas (4300 m), suggesting a delay in sensory conduction (Singh, Thakur, Anand, Yadav, Banerjee & Selvamurthy, 2004). Other sensory modalities can become hypersensitive. An increased luminance threshold for visual stimuli has been described (Kobrick & Appleton, 1971), while visual contrast sensitivity remains unaffected or even enhanced due to short-term hypobaric hypoxia (Benedek, Kéri, Grósz, Tótka, Tóth & Benedek, 2002; Davis, Kamimori, Kulesh, Mehm, Anderson, Elsayed, Burge & Balkin, 1995). Colour discrimination can also be altered, particularly on the yellow-blue and red-blue axis (Bouquet, Gardette, Gortan, Therme & Abraini, 2000; Leid & Campagne, 2001; Smith, Ernest & Pokorny, 1976; Vingrys & Garner, 1987), suggesting an impairment of retinal ganglion cells. A colour discrimination test used by Bouquet and colleagues (Everest-Comex ’97 project) consisted of 24 pairs of identical or different coloured squares. Discrimination errors

were altitudedependent although the increased error rate only reached statistical significance at 8000 m and 8848 m simulated altitudes.

Effects of hypoxia on driving performance

In their comprehensive literature survey on effects of CO on human performance Laties and Merigan (1979) indicated some studies concerning driving performance. Exposure to CO can lead to hypoxia, since it is known that CO's reversible binding with hemoglobin, its affinity for hemoglobin being more than 200 times that of oxygen.

McFarland and his group (McFarland 1970; McFarland, Forbes, Stoudt, Dougherty, Crowley, Moore, Nalwalk, 1973; McFarland, Forbes, Stoudt, Dougherty, Morandi, & Nalwalk, 1971) concerned the amount of visual information needed by a driver to maintain his position in his lane on the highway. The driver wore a helmet with a shield that prevented him from seeing the road. By depressing a foot switch he could briefly raise the shield. He was instructed to do this sufficiently often to keep his car within the lane while maintaining a constant speed of either 30 or 50 mph on different trials on the deserted expressway that was the scene of the experiment. Ten drivers were tested, each serving as his own control, and each exposed to air or to enough 700 ppm CO to produce a COHb level of 17%. The results suggested that under CO the subjects required more roadway viewing when driving at the higher speed.

In a simulated driving tasks study by Wright, Randell, & Shephard (1973), no effects were found of a measured amount of 20,000 ppm CO that produced an increase in COHb of 3.4% over the pre-CO level, (average of 7.0% for smokers, and 4.4% for nonsmokers). However, when the various performance measures were categorized as either "brisk automatic responses to emergencies" (e.g. braking) or "careful driving habits" (e.g. releasing the parking brake, making tum signals) the authors found a marginally significant deterioration in the latter. Another simulator study was conducted by Rummo and Sarlanis (1974). The participant's task was to move the steering wheel in order to keep the car within his lane and to stay at a specified distance from a lead car. The lead car's speed was occasionally varied with 40 changes occurring during an uninterrupted 2 hr test period. The mean reaction times to the changes were 7.8 sec under the control conditions and 9.6 sec under CO condition, a statistically significant effect.

Ray & Rockwell (1970) examined the effects of 0, 10, and 20% COHb on the actual driving behavior of three men, each of whom was exposed to the three experimental conditions. These levels were attained by having them breathe either 0, 950, or 1900 ppm CO from rubberized canvas bags. The subject rode in an automobile yoked by a taut wire to a lead car driven ahead of it and attempted to detect slight changes in the relative velocities of the two vehicles while the lead vehicle was about 60 m in front. Time required to respond to a velocity change of 2.5 miles per hr was approximately 1.3 sec for the control condition, 3.3 sec when the COHb level was about 10%, and 3.8 sec when it was about 20%, with the changes considered to be statistically reliable.

3. Methodology

The study is based on an experiment that includes a hundred individuals aged 18 to 60, including both males and females. 70% of the participants are hookah smokers (the experimental group) and 30% are non-smokers (the control group). The experiment focuses on the Arab population from two villages, Binin and Der-Alasad.
The methodology deals with the problem with an overall approach by employing a number of methods:

1. Testing the level of blood oxygenation using a special Pulse Oxymeter. The pulse and the level of blood oxygenation for the participants were measured three times: prior to smoking the Hookah, immediately after the 30 minutes of Hookah smoking and 30 minutes subsequent to smoking the hookah.
2. Participants completed a questionnaire comprising three parts: the first included questions regarding various demographic and socio economic characteristics of the participant in the experiment such as age, gender, marital status, education, employment, income, years of smoking experience and years of driving ; the second part of the questionnaire dealt with 23 attitudinal variables measuring attitudes and perceptions toward the health risk of smoking a hookah, the subjective norms, self-control and acceptance in society; the final part aimed at examining the extent of the exposure to Hookah smoking. Concerning the attitudinal questions, each respondent rated his/her level of agreement with the attitudinal statements from 7 = strongly agrees, to 1 = completely disagrees. The choice of the various attitudinal questions was based on the literature review and the author's experience (Appendix 1). The attitudinal questions were based on a valid, reliable questionnaire developed by Ajzen & Fishbein (1980). By means of these questions, it will be possible to identify the relationship between attitudes and other socio-demographic characteristics of driving behavior following hookah smoking, and the frequency of such.

3. A driving simulator enabled the measurement of different participants' driving behavior.

4. In order to analyze the relationship between the different variables, descriptive statistics were employed. For a comparison between two groups, Pearson's x2 analysis is used for the comparison of categorical variables, while continuous variable is compared using Student's t-test. For testing the correlation between the different variables, bivariate correlation analysis was applied. A logistic regression model was developed for estimating variables that affect the frequency of smoking the hookah.

5. Since this study attempts to assess the effect of smoking a hookah on driving behavior, it is of great importance to establish active control for confounding variables that cannot be isolated from the main factors of interest. The importance of the control group is to account for these confounding variables, representing various differences between the participants such as in socioeconomic and demographic characteristics, years of driving experience, and years of hookah smoking. In addition, since the experiment includes three driving scenario changes in driving behavior, perhaps as a consequence of the learning process generated by driving simulator, a control group having similar characteristics was chosen for controlling to the confounding factors.

   In order to estimate the effects of smoking a hookah on driving behavior, the standard epidemiological analysis of odds ratio was applied to obtain confidence intervals. The odds ratio is a way of comparing whether the probability of a certain event is the same for two groups. The odds ratio in this case is the odds of the incidents (accidents, violations) occurring in the experimental group, divided by the odds of the incidents occurring in the control group.

Equation 1 shows the typical calculation of the odds ratio

$$(3)\ Odds\ ratio = \frac{NA_{In}/NB_{In}}{NA_{Nin}/NB_{Nin}} = \frac{271/126}{99/57} = 1.11$$

where

NA_{In} is the number of incidents in the experimental group after smoking a hookah.

NB_{In} is the number of incidents in the experimental group before smoking a hookah.

NA_{Nin} is the number of incidents in the control group after smoking a hookah.

NB_{Nin} is the number of incidents in the control group before the treatment (smoking a hookah).

4. The experiment

At the first stage, it was important to determine rules and criteria for selecting the participants.

Criteria for selecting the study participants.

1. Women and men aged 18-65 years.
2. People who smoke a hookah (Experiment Group) and people who do not smoke a hookah (Control Group). Both groups are similar (age, gender, driving experience, education level).
3. People who sign the agreement form.

People who could not participate in this experiment

1. People suffering from Asthma, COPD and are allergic to smoking.
2. People with anemia.
3. People having cardiac disease.
4. Sufferers from cirrhosis of the liver.
5. People with chronic renal failure.
6. People with malignancies.
7. Pregnant and breast feeding women.

The second stage was to prepare the driving scenarios. Three main scenarios were prepared for driving and a short scenario for the purpose of training drivers on the driving simulator. Every scenario included approximately 10 events.

1. The first scenario for the purpose of training was 5 km in length and included sections on inter-city and intra-city roads.
2. The second scenario was for the purpose of driving before smoking a hookah. The length of the scenario was 10 km and included sections on inter-city and intra-city roads. The scenario additionally included a number of events

(around ten) which could show changes in concentration and reaction time of drivers such as traffic lights, cars coming from a side road, pedestrians crossing the road, dogs crossing the road, cars entering the road in reverse, amounts of dirt, etc.

3. The third scenario was for the purpose of driving immediately after smoking a hookah, its length being ten kilometers. This scenario also included approximately ten incidents, but their locations were changed.
4. The last scenario was intended for driving half an hour after having smoked a hookah. Its length was ten kilometers and included about ten incidents.

Each participant smoked one head of tobacco. It was arranged that everyone smoked the same hookah tobacco with the same apple flavor (called "Double Apple," popular in Israel and is imported from Egypt). In addition, it was important to use the same type of hookah, and of course, to smoke in the same type of environment.

Also, before each scenario we examined the level of oxygen in the blood for each participant as well as the pulse rates.

5 Data analysis based on the study survey

5.1 Socio-economic and demographic characteristics

Table 1 presents the socio-economic and demographic characteristics for all subjects.

Table 1 Demographic and socio economic characteristics

Variable	Unit	Total sample	Experimental Group	Control group
Average age	Year	31.51	29.47	36.33
S.D.		10.31	10.45	13.92
Marital status				
Married	%	45.7	44.3	50.0
Unmarried	%	52.1	52.8	50.0
Widowed	%	1.1	1.4	0
Divorced	%	1.1	1.4	0
Years of driving (Average)	Year	11.15	9.7	14.46
S.D.		10.31	9.11	12.24
Education level				
0-9	%	9.0	5.7	16.7
10-12	%	60.0	62.9	43.3
Professional Diploma	%	7.0	11.4	10.00
16+	%	24.0	20.0	30.0
Income*				
Under Average	%	52.0	48.6	60.00
About Average	%	16.0	21.4	3.4
Above Average	%	20.0	18.6	23.3
No answer	%	12.0	11.4	13.3
Work status				
Salaried employee	%	57.0	61.4	46.7
Self-employed	%	13.0	12.8	13.3
Unemployed	%	6.0	2.9	13.3
Pensioner	%	1.0	0	3.3
Housewife	%	6.0	4.3	10
Student	%	17.0	18.6	13.4
Average number of cars in the household	Cars	1.85	1.83	1.87
S.D.		1.24	1.23	1.19
Household size (average)	Persons	5.25	5.40	5.07
S.D.		2.00	3.53	1.89
Availability of car for your use				
Yes	%	68.1	68.6	70.0
No	%	28.7	31.4	20.0
Sometimes	%	3.2	0.0	10.0

Here is a sample which included both the experimental and control groups. It consisted of 100 participants, whose ages ranged from 19 to 60 years (mean= 31.51; S.D=10.31). 45.7 percent were married. Data analysis shows that the percentage of participants with a graduate degree (B.A., Master's, Ph.D., or equivalent) was 24%. Most striking is that the income of 52 percent of the participants was below average (while the average is 8,300 Shekels per month), and 57 percent were salaried employees. Most of the participants (72.1%) found work outside the town; the average number of cars in the household was 1.85 (s.d=1.24), and not surprisingly, 68.1 percent of the participants had a car for their use. All the participants possessed a driving license.

5.2 Attitudes

5.2.1 Hookah smoking norms

Figure 1 How often the participants smoke a hookah

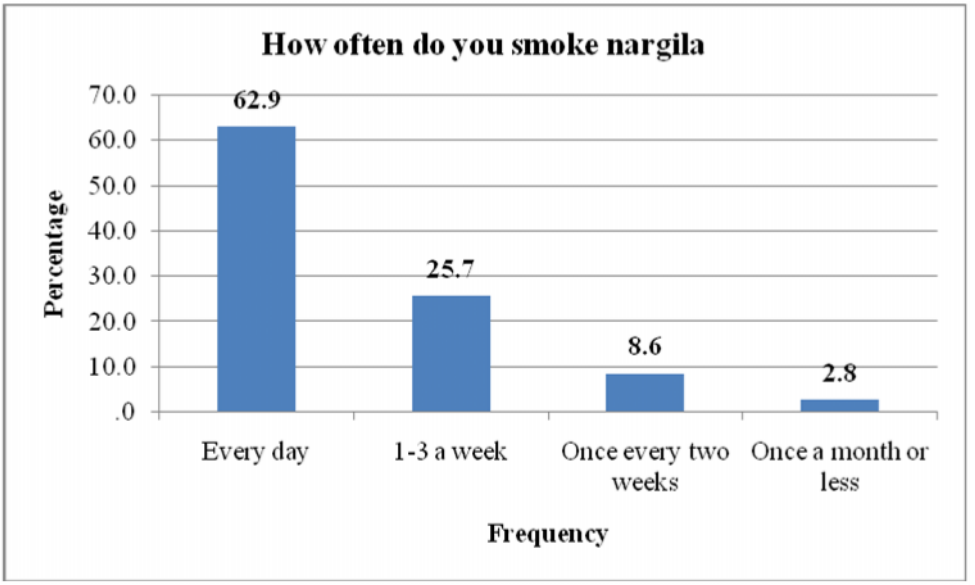


Figure 1 presents the frequency of smoking Hookah. Data analysis shows that a high percentage of the participants belonged to the experimental group (62.9 percent) smoke Hookah every day, and about quarter of them smoke once to three times a week. At the last week (figure 2), one can see that 57% of the participants smoked every day and 16% smoked from three to five times. This result is similar and consistent to the results in figure 1.

Figure 2 Participant frequency of hookah smoking the previous week

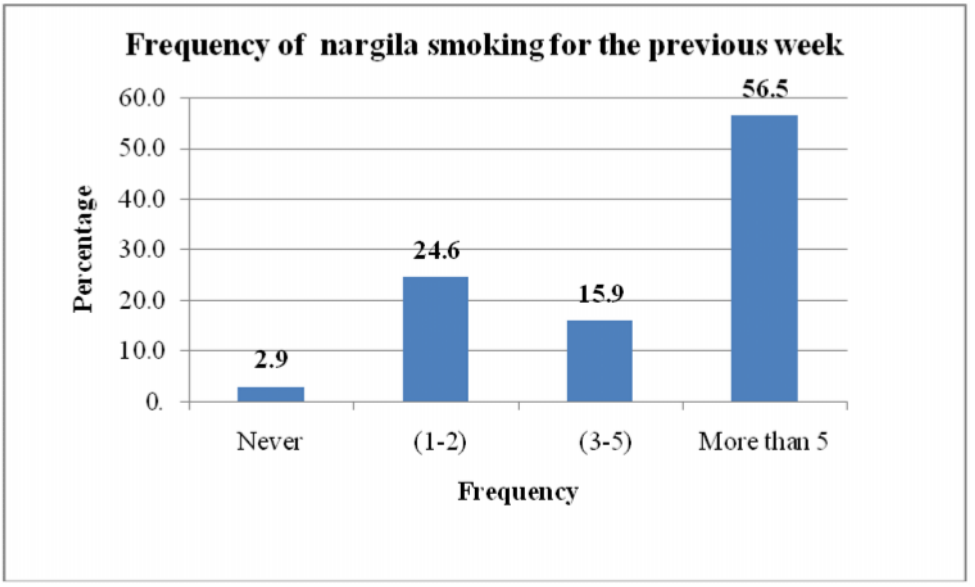


Figure 3 presents the participants' age of initial hookah smoking. The striking result is that 43 percent of the participants started smoking when they were under 18, and 39% between 19 to 25. This means that about 80 percent of the participants started smoking a hookah when they were under 26. One of the explanations for these results is that smoking a hookah has become popular among Israeli Arabs only during the last few years (the last decade).

Figure 3 Distribution of participant age for initially smoking a hookah

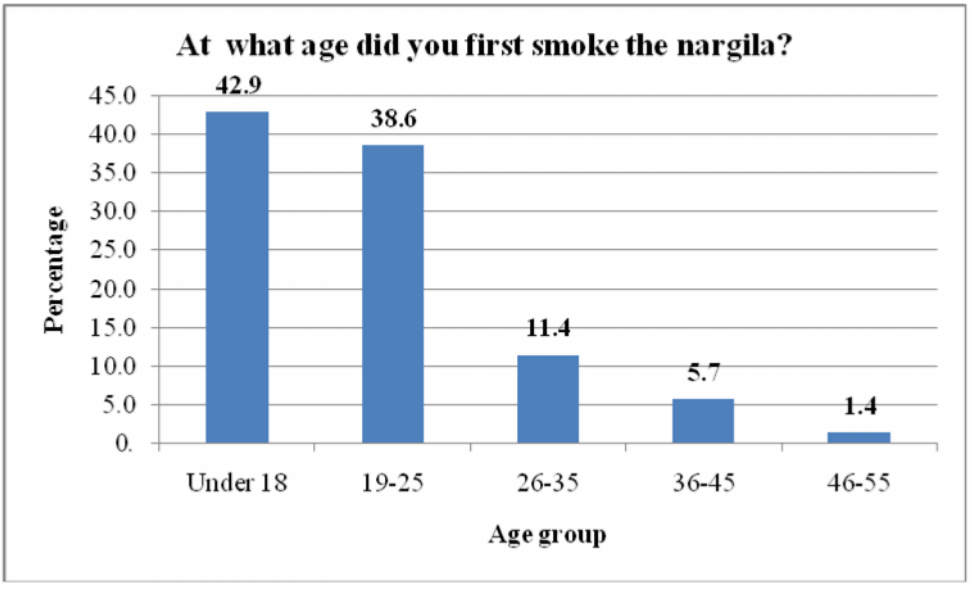


Figure 4 shows that most (78 percent) of the participants' parents have never smoked a hookah and only 13 percent of them smoke a hookah at least once a week.

Furthermore, about half (48.6 percent) of the participants' siblings smoke a hookah (figure 5).

Figure 4 Frequency of parental hookah smoking

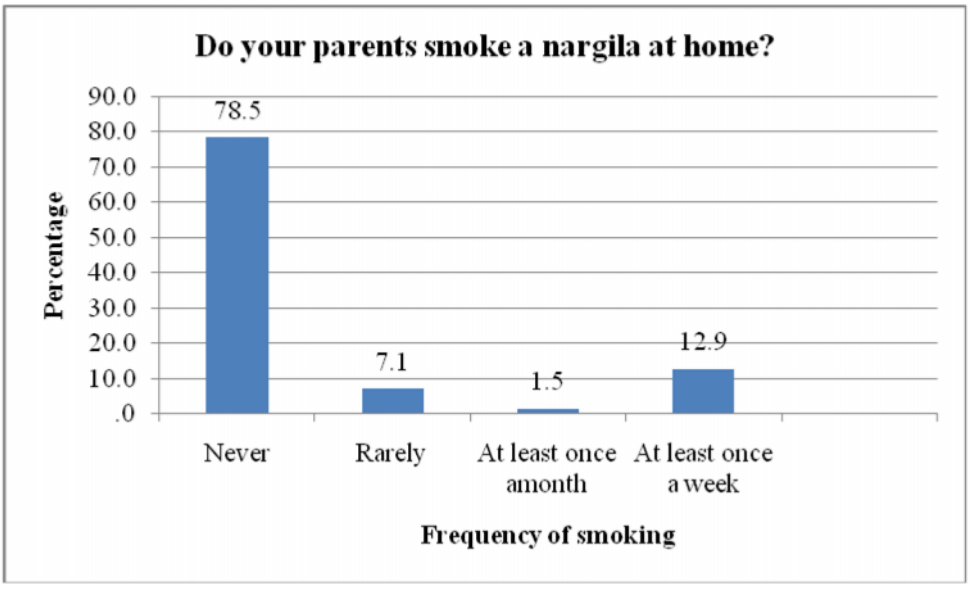
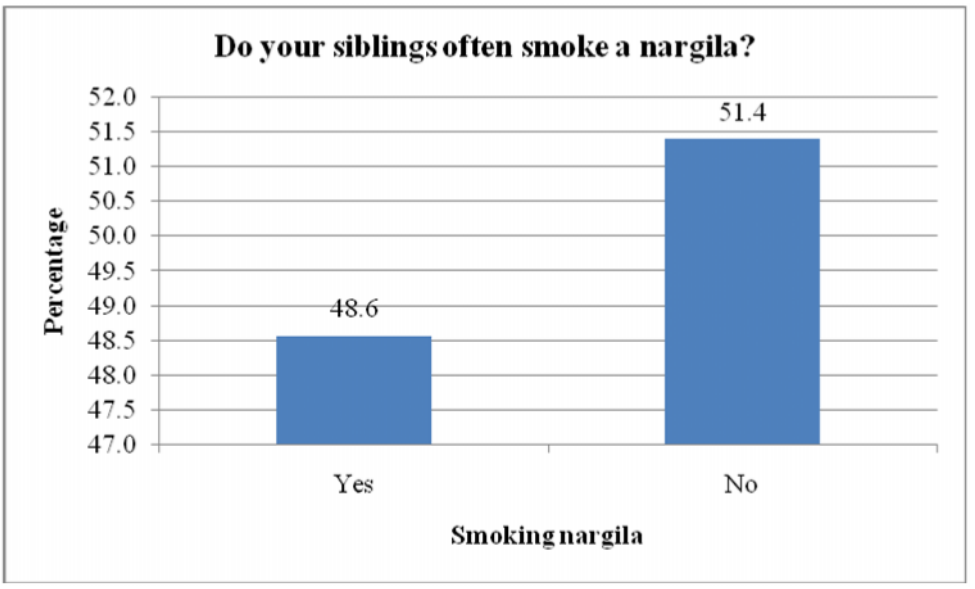


Figure 5 Sibling frequency of hookah smoking



From figure 6, one can see that 77 percent of the participants never smoke a hookah with their parents while 43 percent of them never smoke one with their siblings; these results are consistent with the previous ones.

Figure 6 Participant frequency of smoking a hookah with parents

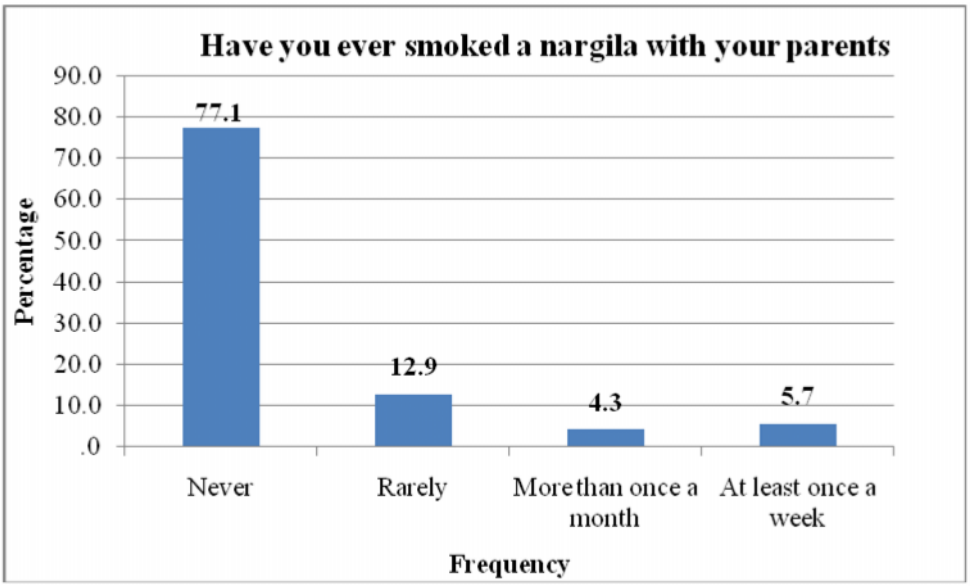


Figure 7 Participant frequency of smoking a hookah with siblings

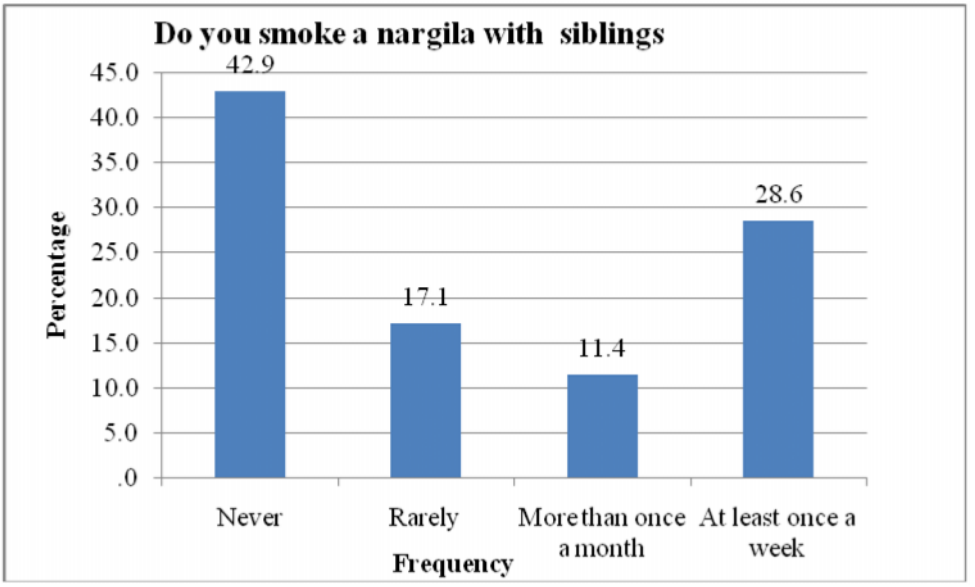


Figure 8 presents which day of the week the participants usually smoke a hookah. Most smokers (64 percent) indicated that they usually smoke on weekdays and weekends equally. This means that smoking a hookah has become an important part of their lifestyle. See figure 9, which presents the part of the day that the subject usually smokes a hookah: 29 percent smoke all day long, and 44 percent smoke in the evening, and 21 percent at night.

Figure 8 The day of the week on which the subject usually smokes a hookah

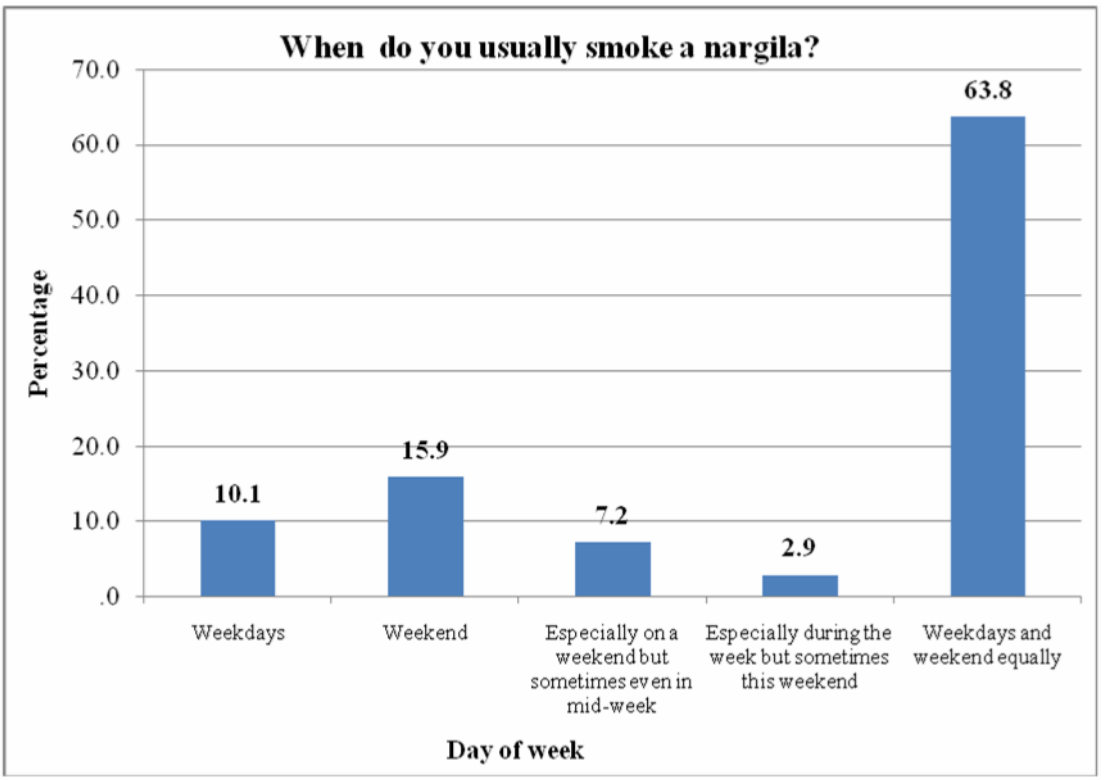
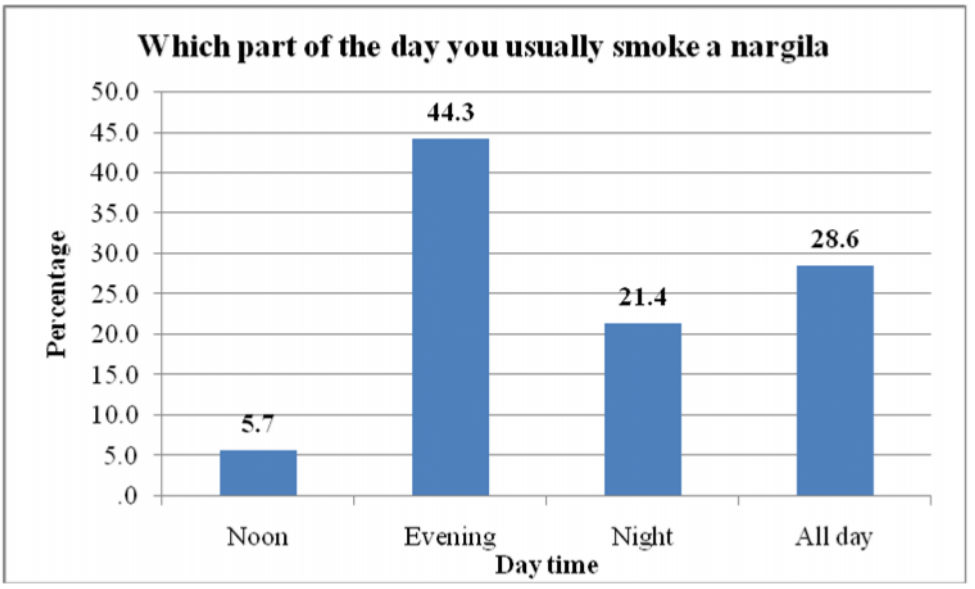


Figure 9 The time of day that the subject usually smokes a hookah



5.3 Effects of smoking a hookah

One of the study hypotheses is that smoking a hookah causes dizziness among the smokers as a result of the lack of oxygen in the blood. With this in mind, we asked the participants two questions: the first concerning "the frequency of dizziness after smoking a hookah", and the second concerning " how long you smoke a hookah until

you become dizzy". Figure 10 shows that about third of the smokers never felt dizzy after smoking a hookah, while a third of them felt dizzy twice or thrice. Only about 7 percent always experience dizziness after smoking a hookah. 26 percent of the smokers feel dizzy after half an hour of smoking a hookah, while 42 percent of them feel dizzy after one hour or more.

Figure 10 Frequency of dizziness after smoking a hookah

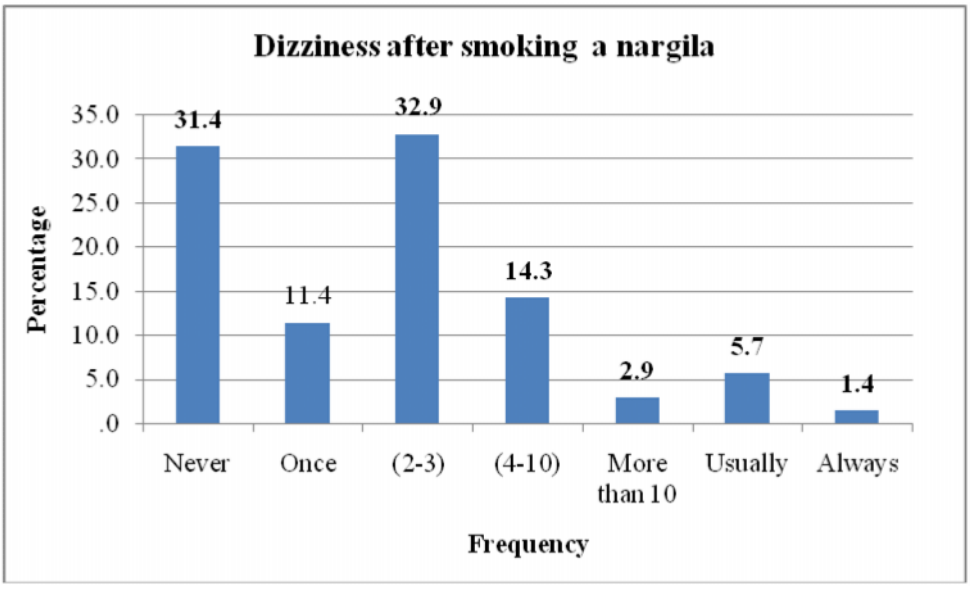


Figure 11 Length of smoking time leading to dizziness

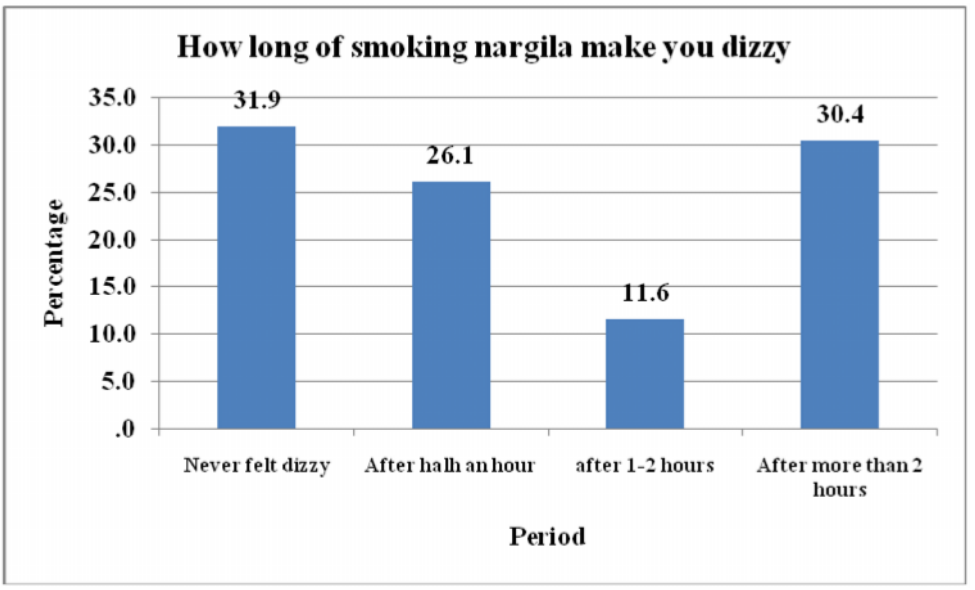
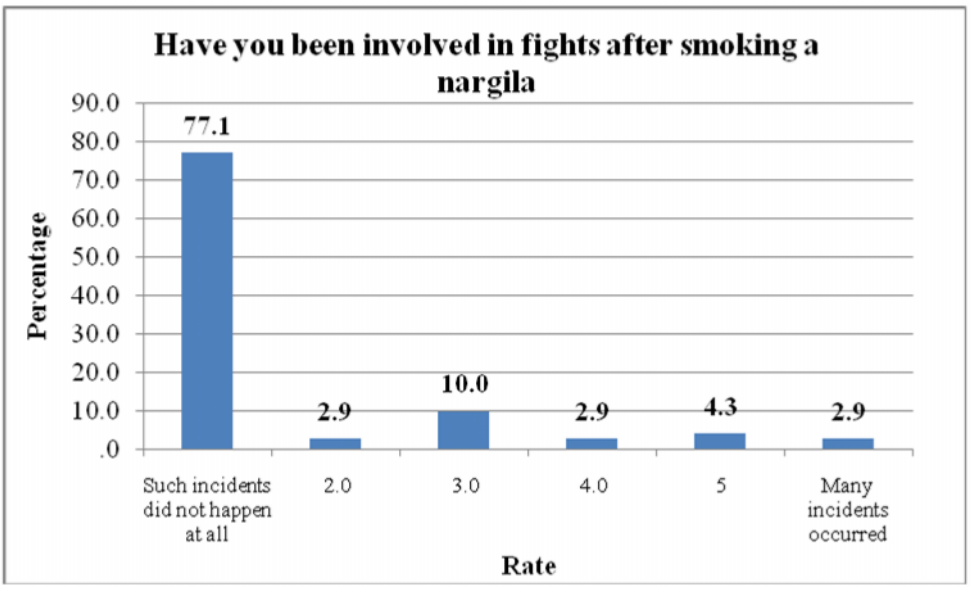


Figure 12 indicates the level of violence after smoking a hookah and whether such activity affects the smoker's tendency to perform violent acts.

Figure 12 Involvement in fights after smoking a hookah



One question is whether there is a relationship between smoking a hookah and cigarette smoking. Figure 13 shows that 81 percent of hookah smokers did not smoke cigarettes and 81 percent did not drink alcohol (figure 14). This means there is no correlation between smoking a hookah and smoking cigarettes, and smoking a hookah and drinking alcohol.

Figure 13 Smoking cigarettes

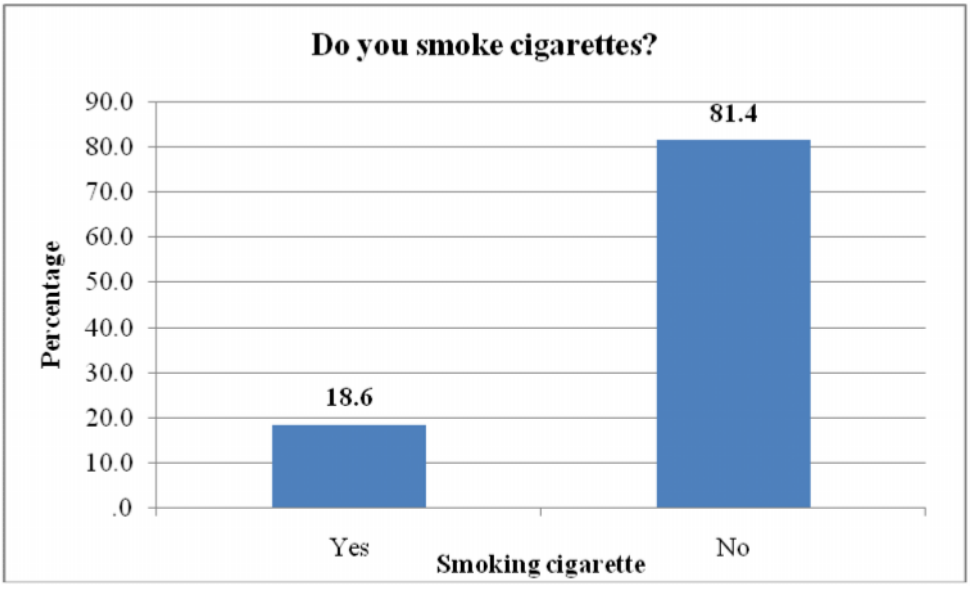
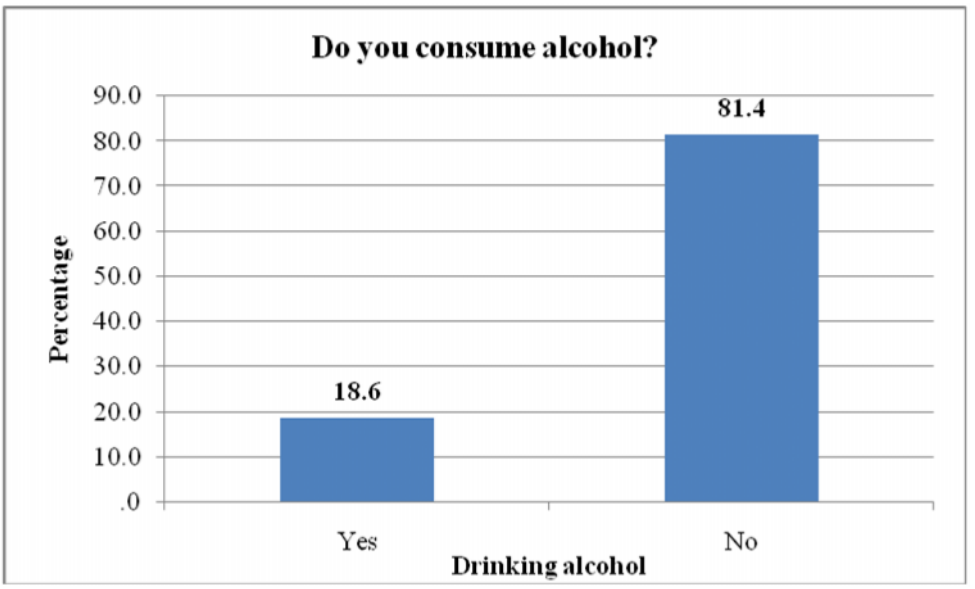


Figure 14 Alcoholic consumption



5.4 Bivariate correlation analysis

Table 2 presents the correlation between the frequency of smoking a hookah and the extent of exposure to smokers, and the correlation between the frequency of smoking and dizziness. Based on data analysis, there is no correlation between smoker frequency of smoking a hookah and their parents' frequency of smoking nor between brothers and sisters. In addition, there is no correlation between the frequency of smoking a hookah and dizziness.

Table 2 Correlation between the frequency of smoking a hookah and the extent of exposure to smokers

	Pearson Correlation	Sig. (2-tailed)	N
Frequency of parental hookah smoking	0.010	0.933	68
Whether siblings smoke a hookah	-0.011	0.929	68
Whether you smoke with your parents	-0.064	0.602	68
Whether you smoke with siblings	-0.112	0.362	68
How long until smoking a hookah make you dizzy	-0.078	0.529	67
Dizziness after smoking a hookah	0.064	0.612	65

5.5 Factor analysis

Table 3 presents the means of the degree of agreement to the 23 statements, when 7 – strongly agrees, and 1 – completely disagrees. The results indicate to what extent the participants believe that smoking a hookah has negative health impacts. For example, the degree of agreement with the statement " I believe that smoking a hookah may cause serious harm to my health" was 5.87, and for the statement " I believe that smoking hookah may injure the lungs" was 5.94. Furthermore, the participants believe that prolonged smoking of a hookah may lead to its addiction. (statement 4, mean=4.64).

Table 4 summarizes the results of the factor analysis, which included variable statements, and Cronbach's alpha. In all, 23 attitudinal statements were subjected to principal component analysis with Varimax rotation. five factors were identified: (1) being accepted, measuring one's feeling of freedom and confidence among his friends, brothers, parents and the opposite sex; (2) risk perception of health harmfulness , measuring the extent that harm to one's health affects the frequency of hookah smoking; (3) self-control, examining the participant's ability not to smoke a hookah even if his comrades are addicted to hookah smoking and not to become addicted to it; (4) subjective norms - friends, showing to what extent the participants comply with their friends' thinking; (5) subjective norm parents, showing to what extent the participants comply with their parents' thinking. A person's subjective norm is determined by his normative beliefs, that is, whether important referent individuals such as friends and parents approve or disapprove of this behavior (in this case, smoking a hookah), weighted by his motivation to comply with those referents. All five factors have sufficient internal reliability (Cronbach's alpha >0.65).

Table 3 Statement meanings

	Statements	Mean	Std. Deviation
1	I believe that smoking a hookah may cause serious harm to health	5.87	1.895
2	I believe that smoking a hookah may injure my ability to perform mental and physical activities	3.77	2.402
3	I believe that smoking a hookah may injure my lungs	5.94	1.940
4	I believe that prolonged smoking of a hookah may lead to addiction to that sort of smoking	4.64	2.265
5	I believe that smokinga hookah causes pleasure	5.44	1.733
6	The majority of my friends frequently smoke a hookah	5.34	1.768
7	I am sure that if my friends smoked a hookah, I would not smoke if I did not want to.	4.11	2.591
8	My fiends expect me to smoke a hookah as well.	3.97	2.322
9	My family expects me not to smoke a hookah.	5.80	1.862
10	Smoking a hookah with my fiends helps me to be more (acceptable/ amiable in society.	2.23	1.882
11	Smoking a hookah with my family makes me/ helps me to be/ more acceptable to my family.	1.69	1.623
12	If I smoke a hookah, I well have more friends.	2.61	2.286
13	Smoking a hookah helps me strengthen my self – confidence.	1.77	1.385
14	Smoking a hookah helps me feel freer and more confident among my friends.	2.21	1.693
15	I believe that smoking a hookah makes me feel freer and more confident amidst my family.	1.63	1.364
16	I believe that smoking a hookah makes me feel freer among those of the opposite sex.	1.99	1.646
17	I believe that even if my comrades (friends) are addicted to smoking a hookah, I can accompany them without smoking a hookah.	4.50	2.412
18	It is possible for me to cease hookah smoking.	5.49	1.939
19	If I want, I can stop smoking a hookah even if all around me smoke one.	4.79	2.461
20	I have free choice whether or not to smoke a hookah.	6.49	1.327
21	Most important people whose opinions I respect think that smoking hookah is acceptable.	4.43	2.246
22	My parents think that I must stop smoking a hookah.	5.87	1.910
23	My close friends think that I have to refrain from smoking a hookah.	3.09	2.225

Table 4 Summary of the factor analysis

Factor	Number of Items	Questions	Cronbach's Alpha (α)	Mean	S.D
Being accepted	5	11,13,14,15,16	.864	1.803	1.214
Self-control	4	7,17,18,19	.709	4.600	1.759
Subjective norms friends	3	8,10,12		2.923	1.648
Health risk perception	4	1,2,3,4	0.807 0.677	5.173	1.466
Subjective norm parents	2	9,22	.810	5.838	1.695

Table 5 presents the correlation between the five factors. As expected, a positive, significant correlation between being accepted and the subjective norms while the referent was the fiends was found, whereas a negative, significant correlation was found between being accepted and the subjective norms when the referents were parents. In addition, the results show a negative, significant correlation between self-control and the health risk perception, and a positive correlation between subjective norms when the referents were the parents and the health risk perception.

Table 5 Correlation between the attitudes

		Being accepted	Subjective norms-friends	Subjective norms-parents	Health risk perception	Self - control
Being accepted	Pearson Correlation	1	.525**	-.315*	-.108	-.011
	Sig. (2-tailed)		.000	.010	.391	.928
	N	65	65	65	65	65
Subjective norms-friends	Pearson Correlation	.525**	1	-.039	-.072	-.141
	Sig. (2-tailed)	.000		.760	.569	.264
	N	65	65	65	65	65
Subjective norms-parents	Pearson Correlation	-.315*	-.039	1	.301*	-.100
	Sig. (2-tailed)	.010	.760		.015	.428
	N	65	65	65	65	65
Health risk perception	Pearson Correlation	-.108	-.072	.301*	1	-.268*
	Sig. (2-tailed)	.391	.569	.015		.031
	N	65	65	65	65	65
Self - control	Pearson Correlation	-.011	-.141	-.100	-.268*	1
	Sig. (2-tailed)	.928	.264	.428	.031	
	N	65	65	65	65	65

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

In commencing the exploration of the relationships between the attitudes of hookah smokers and the demographic and socio-economic factors, bivariate correlations are calculated. These correlations, shown in Table 6, identify whether a statistically significant linear relationship exists between the given demographic trait and the attitudes at the 95 percent confidence level.

Table 6 presents the correlation between the five factors and the socio economic and demographic characteristics. There is a positive, significant correlation between self-control and the income level, and participants having a high income level possess greater self-control than those that suffer from a low income level. Furthermore, a positive correlation was found between the subjective norms when the referents were the friends and the income level. As expected, a negative correlation was found between the subjective norms when the referents were friends and the age and adults were less affected by friends' beliefs. Not surprisingly, a positive correlation was found between self-control and age. Married participants possessed more self-control, and a positive correlation was found between education level and self-control – the more education, the more self-control.

Table 6 Correlations between attitudes and demographic and socio-economic characteristics

		Age	Marital status	Education	Work status	Income
Being accepted	Pearson Correlation	-.128	-.100	-.137	-.182	.344**
	Sig. (2-tailed)	.308	0.430	.281	.151	.008
	N	65	65	64	64	58
Subjective norms-friends	Pearson Correlation	-.287*	-.228	.079	-.007	.313*
	Sig. (2-tailed)	.020	.068	.535	.954	.017
	N	65	65	64	64	58
Subjective norms-parents	Pearson Correlation	-.153	-.101	-.004	-.008	-.086
	Sig. (2-tailed)	.223	.426	.974	.950	.522
	N	65	65	64	64	58
Health risk perception	Pearson Correlation	.035	-.071	.033	-.027	-.027
	Sig. (2-tailed)	.781	.573	.794	.841	.841
	N	65	65	64	58	58
Self - control	Pearson Correlation	.379**	.294*	-.232	-.019	.186
	Sig. (2-tailed)	.002	.018	.065	.880	.163
	N	65	65	64	64	58

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

5.6 Estimated results of the smoking Hookah model

Table 7 shows the estimated results of the smoking hookah model. The model is logistic regression and consists of two alternatives: the first being smoking a hookah every day and the second not smoking, or rarely smoking a hookah. This model estimates the variables that affect the frequency of hookah smoking. The explanatory variables include the five factors and socio-economic and demographic characteristics. The results show a negative, statistically significant relationship between self-control and smoking a hookah. This means the more self-control, the less hookah smoking. A positive relationship was found between subjective norms when the referents were the participants' friends, and smoking a hookah. An unexpected result was that participants with a high degree of health perception risk were more likely to smoke a hookah. Unsurprisingly, believing that smoking a hookah causes pleasure encouraged hookah smoking.

Table 7 Estimated results of smoking a hookah model

Variable	β	t-statistics	Sig.
Constant	-15.153	2.53	.011
Self – control (Ordinal)	-.830	1.98	.048
Subjective norms-friends	1.791	2.37	.018
Health risk perception	1.029	2.15	.032
I believe that smoking hookah causes pleasure (Ordinal)	2.578	3.11	.002
Marital status (Dummy, Married =1)	3.824	2.35	.019
Income (Ordinal)	-1.043	1.55	.121
Work status (Dummy, work=1)	-3.142	2.13	.033
-2 Log likelihood	32.236	Statistical summary	
Chi-square	44.756*		
Sig.	.000		
Cox & Snell R Square	.538		
Nagelkerke R Square	.732		

Among the personal variables, marriage status is a positive predictor of hookah smoking: married people are more likely to smoke one. In contrast, employed participants are less likely to smoke a hookah. A negative relationship - but not statistically significant at the 0.05 level - was found between income and hookah

smoking, and low income level participants were more likely to engage in this activity.

This finding suggests that participants having a low level of self-control, tend to comply with their friends' thinking, and who unemployed and unmarried are more likely to partake in hookah smoking.

6. Experiment results

6.1 Health measures

Table 8 presents the mean of the pulse rate and the level of blood oxygenation (saturation rate) in the three scenarios: prior to smoking a hookah, immediately following smoking and half an hour subsequent to hookah smoking. In the experimental group, immediately following hookah smoking, a statistically significant increase (table 9) in the pulse rate was observed - from 80 to 95 ($t=11.84$, $p<0.05$), while in the control group a significant decrease in the pulse rate was observed - from 83 to 81. This result is similar to Al-Safi et al., (2008) and Shafagoj & Mohammed who showed that the heart rate changed from 76.40±10.46 to 76.81±10.19. One of the important results is that in the experimental group - even half an hour after hookah smoking, the pulse rate continues to be higher than that prior to hookah smoking, and the difference between the two scenarios is statistically significant ($t=5.54$, $p<0.05$). While in the control group, no significant change in the pulse rate was observed: it continued to be stable. By using the Oxymeter, the level of blood oxygenation was tested. In the experimental group immediately following hookah smoking, the saturation level decreased from 97.9 to 97.32, and the decrease is statistically significant ($t=3.01$, $p<0.05$); while in the control group, the no significant change in the saturation rate was observed. Furthermore, in the experimental group, half an hour after hookah smoking, the saturation rate continued to be higher than that prior to hookah smoking and the difference is statistically significant (t=, 3.02), while in the control group, no change in the saturation rate was observed half an hour subsequent to smoking a hookah. These results are compatible with the study hypothesis; namely, that hookah smoking leads to stronger, deeper hypoxia which means a condition of oxygen deficiency in body cells due to a lack of oxygen. As was mentioned in the literature review (chapter 2), there are four different sets of hypoxia. in our case we are refer, to the anemic hypoxia. Anemic hypoxia stems from the inability of blood cells to carry oxygen to body tissues. Anemia can be caused by

disease, general health problems, carbon monoxide inhalation or smoking too much. And in our study because smoking hookah.

Table 8 The mean of the participants' pulse rates in given hookah smoking scenarios

Sample	Scenario	Variable	Mean	Std. Deviation	Std. Error Mean
	Before smoking	pulse1	80.23	13.93	1.677
Experimental group	Immediately after smoking	Pulse2	94.90	15.38	1.851
	Half hour after smoking	Pulse3	87.18	14.39	2.036
	Before smoking	Saturation1	97.90	.60	.072
	Immediately after smoking	Saturation 2	97.32	1.55	.186
	Half an hour after smoking	Saturation 3	97.38	1.05	.148
	Before smoking	pulse1	82.50	11.25	2.055
Control group	Immediately after smoking	Pulse2	80.90	9.64	1.761
	Half an hour after smoking	Pulse3	80.08	10.77	3.11
	Before smoking	Saturation1	97.57	.94	.171
	Immediately after smoking	Saturation 2	97.63	.96	.176
	Half an hour after smoking	Saturation 3	97.75	.45	.131

Table 9 Mean differences between the three scenarios

Sample	Scenario pairs	t	Sig. (2-tailed)	Paired Differences			
				95% Confidence Interval of the Difference		Mean	Std. Deviation
				Upper	Lower		
Control group	pulse1 – pulse2	2.36	.025	2.99	.21	1.60	3.71
	Saturation1-Saturation2	-.57	.573	.17	-.31	-.07	.64
	pulse1 – pulse3	1.97	.074	5.64	-.31	2.67	4.68
	Saturation1-Saturation3	-.56	.586	.24	-.41	-.08	.51
Experimental group	pulse1 – pulse2	-11.84	.000	-12.20	-17.14	-14.67	10.29
	Saturation1-Saturation2	3.02	.004	.96	.20	.58	1.59
	pulse1 – pulse3	-5.54	.000	-4.73	-10.11	-7.42	9.46
	Saturation1-Saturation3	3.01	.004	.80	.16	.48	1.13

6.2 Driving behavior measures

The most important question in this study is whether smoking a hookah impacts driving behavior and the risk of becoming involved in road accidents. To this end, participants in both experimental and control groups, drove on four occasions and in accordance with four scenarios: a training scenario, prior to hookah smoking, immediately following hookah smoking and half an hour subsequent to smoking a hookah. The outcome of the driving scenarios is a set of driving measures for every participant and every scenario. These measures indicate the changes in travel behavior. Table 10, 11 present the average of the measures in the three main scenarios excluding the training scenario. The measures include total number of road crashes, road crashes (self crash), car accidents, pedestrian accidents, surpassing the speed limit (this measure tested the number of times the driver exceeded the speed limit), the total number of traffic light violations, centerline crossings, road shoulder crossings and speed limit violations (%time).This measure indicates the percentage of time relative to the total driving time the driver surpasses the speed limit. The final measure was for not driving within the lane (%time) which showed the percentage of time relative to the total driving time the driver drove over the center divider and the shoulder boundary.

Tables 12, 13 present the mean differences for the driving measures between the first scenario and the second scenarios (prior to hookah smoking and immediately following it) and between the first and third scenarios (prior to smoking a hookah and half an hour following it), respectively. From table 12, one can see that there is an insignificant decrease in the number of road accidents immediately following hookah smoking in both the experimental and control groups, although the decrease in the control group is higher. In the experimental group, a insignificant increase in the number of car accidents was observed, but in contrast, the control group experienced a decrease. For both groups, a significant decrease in the number of pedestrian accidents was observed, but the decrease within the control group was greater than within the experimental group. In the latter group, there occurred a significant decrease in the total number of traffic light violations, while in the control group, a statistically significant decrease was observed ($t=3.08$, $p<0.05$).

It should be noted that in this experiment, the importance of driving experience could be discerned as generated from the driving in the three scenarios, and an

improvement in many driving measures were found, but the question is whether the improvement was equal for both the experimental and control groups.

Table 10 Mean of the various driving measures for the experimental group

	Experimental group		
Variable	Scenario	Mean	Std. Deviation
Before smoking	Accident(road)1	1.77	1.95
Immediately after smoking	Accident(road)2	1.30	1.73
Half an hour after smoking	Accident(road)3	.71	.96
Before smoking	Accident(car)1	2.99	2.86
Immediately after smoking	Accident(car)2	3.06	2.32
Half an our after smoking	Accident(car)3	4.14	2.18
Before smoking	Accident(pedestrian)1	1.30	.91
Immediately after smoking	Accident(pedestrian)2	.57	.67
Half an hour after smoking	Accident(pedestrian)3	.71	.71
Before smoking	Surpassing speed limit1	10.48	7.22
Immediately after smoking	Surpassing speed limit2	9.54	6.61
Half an hour after smoking	Surpassing speed limit3	12.80	8.01
Before smoking	Total number of traffic light tickets 1	1.21	1.07
Immediately after smoking	Total number of traffic light tickets 2	1.12	.86
Half an hour after smoking	Total number of traffic light tickets 3	.69	.72
Before smoking	Centerline crossings1	7.03	6.53
Immediately after smoking	Centerline crossings2	8.97	7.69
Half an hour after smoking	Centerline crossings3	9.00	5.78
Before smoking	Shoulder crossing1	7.65	6.72
Immediately after smoking	Shoulder crossing2	5.80	4.92
Half an hour after smoking	Shoulder crossing3	4.88	4.40
Before smoking	Total time1	759.82	103.78
Immediately after smoking	Total time2	748.86	98.90
Half an hour after smoking	Total time3	715.13	121.20
Before smoking	Exceeding speed limit (%time)1	13.38	10.75
Immediately after smoking	Exceeding speed limit (%time)2	56.53	347.90
Half an hour after smoking	Exceeding speed limit (%time)3	17.64	11.22
Before smoking	Not keeping within lane (%time)1	7.22	6.67
Immediately after smoking	Not keeping within lane (%time)2	8.16	6.97
Half an hour after smoking	Not keeping within lane (%time)3	7.08	4.95

Table 11 Mean of the various driving measures for the control groups

	Control group		
Variable	Scenario	Mean	Std. Deviation
Before smoking	Accident(road)1	1.50	2.13
Immediately after smoking	Accident(road)2	.90	1.37
A half hour after smoking	Accident(road)3	.50	.67
Before smoking	Accident(car)1	2.47	2.61
Immediately after smoking	Accident(car)2	1.87	1.59
A half hour after smoking	Accident(car)3	3.17	1.75
Before smoking	Accident(pedestrian)1	1.30	.75
Immediately after smoking	Accident(pedestrian)2	.43	.50
A half hour after smoking	Accident(pedestrian)3	.67	.78
Before smoking	Exceeding speed limit1	8.60	6.75
Immediately after smoking	Exceeding speed limit2	8.63	7.58
A half hour after smoking	Exceeding speed limit3	11.17	6.09
Before smoking	Total number of traffic light tickets 1	1.27	.98
Immediately after smoking	Total number of traffic light tickets 2	.70	.79
A half hour after smoking	Total number of traffic light tickets 3	.50	.67
Before smoking	Centerline crossings1	5.87	4.73
Immediately after smoking	Centerline crossings2	7.93	7.04
A half hour after smoking	Centerline crossings3	6.42	4.32
Before smoking	Shoulder crossing1	6.30	5.09
Immediately after smoking	Shoulder crossing2	5.50	4.39
A half hour after smoking	Shoulder crossing3	4.25	3.91
Before smoking	Total time1	811.91	141.69
Immediately after smoking	Total time2	757.26	174.36
A half hour after smoking	Total time3	766.01	174.94
Before smoking	Exceeding speed limit (%time)1	10.09	9.27
Immediately after smoking	Exceeding speed limit (%time)2	13.21	12.35
Ahalf hour after smoking	Exceeding speed limit (%time)3	14.61	10.10
Before smoking	Not keeping within lane (%time)1	6.38	6.01
Immediately after smoking	Not keeping within lane (%time)2	7.60	6.84
A half hour after smoking	Not keeping within lane (%time)3	5.19	3.93

Table 12 differences in driving behavior prior to hookah smoking and immediately following it

Before smoking- Immediately after smoking scinario1-scinario2		Paired Differences				t	Sig. (2-tailed)
		Mean	Std. Deviation	95% Confidence Interval of the Difference			
				Lower	Upper		
Control group	Accident(road)	.60	2.16	-.21	1.41	1.52	.14
	Accident(car)	.60	2.74	-.42	1.62	1.20	.24
	Accident(pedestrian)	.87	.97	.50	1.23	4.88	.00
	Exceeding speed limit	-.03	4.84	-1.84	1.77	-.04	.97
	Total number of traffic light tickets	.57	1.01	.19	.94	3.08	.00
	Centerline crossings	-2.07	6.67	-4.56	.42	-1.70	.10
	Shoulder crossings	.80	4.22	-.78	2.38	1.04	.31
	Total time	54.66	204.83	-21.83	131.14	1.46	.15
	Total distance	145.63	1152.29	-284.64	575.91	.69	.49
	Exceeding the speed limit (%time)	-3.12	9.60	-6.71	.47	-1.78	.09
	Not within the lane (%time)	-1.22	5.03	-3.09	.66	-1.32	.20
Experimental group	Accident(road)	.46	2.11	-.04	.97	1.82	.07
	Accident(car)	-.07	3.08	-.81	.67	-.20	.85
	Accident(pedestrian)	.74	1.05	.49	.99	5.83	.00
	Over speed limit	.94	6.06	-.51	2.40	1.29	.20
	Total number of traffic light tickets	.09	1.29	-.22	.40	.57	.57
	Centerline crossings	-1.94	6.77	-3.57	-.31	-2.38	.02
	Shoulder crossings	1.86	5.74	.48	3.23	2.69	.01
	Total time	10.96	98.15	-12.62	34.54	.93	.36
	Total distance	-104.06	621.30	-253.31	45.20	-1.39	.17
	Exceeding the speed limit (%time)	-43.15	343.53	-125.68	39.37	-1.04	.30
	Not within the lane (%time)	-.94	6.62	-2.53	.65	-1.17	.24

Table 13 shows the mean differences for the driving measures prior to, and half an hour following, hookah smoking. There were no significant changes pertaining to all the measures within the control group. While in the experimental group, many significant changes in driving behavior were found, such as a decrease in the number of road accidents, a significant increase occurred in the number of car accidents, but a significant decrease in the number of pedestrian ones. In all these measures within the control group, the same direction of change was found, though this was not statistically significant. Within the experimental group, there was a significant

increase in the number of incidents in which the driver exceeded the speed limit and a significant increase in the number of times the driver crossed the solid divider.

Table 13 Table 12 Differences in driving behavior before smoking a hookah and half an hour following it

Before Hookah smoking -half an hour after smoking Pairs: Scinario1-Scinario3		Paired Differences				t	Sig. (2-tailed)
		Mean	Std. Deviation	95% Confidence Interval of the Difference			
				Lower	Upper		
Control group	Accident(road)	.25	1.06	-.42	.92	.82	.429
	Accident(car)	-1.08	2.15	-2.45	.28	-1.74	.109
	Accident(pedestrian)	.75	1.36	-.11	1.61	1.91	.082
	Exceeding the speed limit	-4.00	6.97	-8.43	.43	-1.99	.072
	Total number of traffic light tickets	.50	1.45	-.42	1.42	1.20	.256
	Centerline crossings	-1.33	4.12	-3.95	1.28	-1.12	.286
	Shoulder crossings	.75	3.86	-1.71	3.21	.67	.515
	Total time	87.00	155.39	-11.73	185.73	1.94	.079
	Total distance	-117.17	130.86	-200.31	-34.02	-3.10	.010
	Exceeding the speed limit (%time)	-7.81	10.81	-14.68	-.94	-2.50	.029
	Not within the lane (%time)	-.43	4.04	-3.00	2.13	-.37	.718
Experimental group	Accident(road)	.90	1.81	.38	1.42	3.48	.001
	Accident(car)	-1.65	2.27	-2.30	-1.00	-5.10	.000
	Accident(pedestrian)	.45	.89	.19	.70	3.53	.001
	Exceeding the speed limit	-2.57	6.04	-4.31	-.84	-2.98	.005
	Total number of traffic light tickets	.44	1.13	.11	.77	2.69	.010
	Centerline crossings	-2.71	4.25	-3.93	-1.49	-4.47	.000
	Shoulder crossings	2.29	6.26	.49	4.08	2.56	.014
	Total time	43.19	116.26	9.79	76.58	2.60	.012
	Total distance	12.39	959.89	-263.32	288.10	.09	.928
	Exceeding the speed limit (%time)	-5.41	8.85	-7.95	-2.86	-4.28	.000
	Not within the lane (%time)	-.57	5.12	-2.04	.90	-.78	.437

6.3 Odds ratio test

It is important to note that comparing means is not sufficient in examining the significance of the changes in driving behavior, since during the driving process, the participants - both those who smoke a hookah and those who do not, generate an experience. Therefore, to provide a control for the drivers' driving experience, the odds ratio test is used. Table 14 presents the odds ratio and the confidence interval. The odds ratio is a way of comparing whether the probabilities of the certain driving behavioral measures are the same for the two groups (the experimental and the control). An odds ratio of 1 implies that the event is equally likely in both groups. An odds ratio greater than one implies that the event is more likely in the first group, whereas an odds ratio less than one implies that the event is less likely in this group.
Upon comparing driving behavior before smoking a hookah and immediately after it, one can see from table 14 that there is a significant increase in the total number of traffic accidents and the estimated OR is 1.333 with CI of 1.008– 1.776 and it is statistically significant because the confidence interval did not include 1. The meaning of these results is that smoking hookah significantly increased the total number of traffic accidents by 33%. Furthermore, immediately following the smoking of a hookah, an increase in the number of the total number of traffic light tickets is found, but it is statistically significant at 0.1 and not at 0.05. The increase in measures, involvement in traffic accidents and the total number of traffic light violations indicate the risky driving of hookah smokers after having smoked a hookah.
This result can be explained by the stronger, deeper hypoxia caused as a result of hookah smoking; this deeper hypoxia is conductive, among other things, to the sensation of euphoria and to the taking of greater risks.

Comparing driving behavior before hookah smoking and half an hour following it, one can see from table 14 that there is an increase in the total number of accidents; this is not statistically significant at 0.05 as it is borderline, while a significant increase in centerline crossings and the estimated OR is 1.306 with CI of 1.016–1.679. In addition, the percentage of the total time not being within the lane relatively to the total driving time was increased and the estimated OR is 1.329 with CI of 1.025-1.722. The meaning of these results is that half an hour after smoking hookah the centerline crossings increased by 31% and the total time not being within

the lane increased by 33% . These two measures (the centerline crossing and not being within the lane) indicate driving stability, thus post smoking drivers are less stable and their driving more dangerous. In driving behavior, these can be explained by problems with coordination, dizziness, low energy, fatigue and sleepiness, which are the results of hypoxia. The question is why the effect of hookah smoking on driving behavior continue half an hour subsequent to it, and how it can this be explained? Based on the literature, tobacco smoking (through carbon monoxide inhalation) raises the blood levels of Carboxyhemoglobin (COHb) by a factor of several times than its normal concentrations. Similarly, though perhaps more seriously, smoking a hookah raises the blood levels of COHb. Hemoglobin binds to carbon monoxide preferentially as compared to oxygen (approx 240:1) (West, 1995) so effectively, COHb will not release the carbon monoxide; therefore, hemoglobin will not be available to transport oxygen from the lungs to the rest of the body. However, in smaller quantities, COHb leads to oxygen deprivation of the body causing tiredness, dizziness and unconsciousness. COHb has a half-life in the blood of 4 to 6 hours, but in cases of poisoning, this can be reduced to 70 to 35 minutes with administration of pure oxygen.

Table 14 Summary of the odds ratio test results

	Scinario1-Scinario2			**Scinario1-Scinario3**		
		95% confidence interval			95% confidence interval	
Variable	**Odds ratio**	**Lower**	**Upper**	**Odds ratio**	**Lower**	**Upper**
Accidents	1.333**	1.008	1.776	1.28*	0.961	1.705
Accident(road)	1.226	0.713	2.108	1.319	0.662	2.627
Accident(car)	1.351	0.911	2.002	1.287	0.881	1.880
Accident(pedestrian)	1.289	0.634	2.621	1.195	0.607	2.351
Exceeding the speed limit	0.907	.741	1.109	0.964	0.789	1.178
Total number of traffic light tickets	1.653	0.906	3.016	1.502	0.734	3.075
Centerline crossings	0.944	0.752	1.185	1.306**	1.016	1.679
Shoulder crossings	0.867	0.678	1.110	1.001	0.758	1.322
Exceeding the speed limit (%time)	0.850	0.715	1.011	0.996	0.832	1.192
Not being within the lane (%time)	0.949	0.757	1.190	1.329**	1.025	1.722

**. Significant at the 0.05 level (2-tailed).

*. Significant at the 0.1 level (2-tailed).

7. Summary

This research examines the effect of smoking a hookah on driving behavior and the risk of involvement in road accidents. In the context of this research, there is an attempt to examine the changes in the concentration of oxygen and carbon monoxide (CO) in the blood following the smoking of a hookah and the impact of these changes on driving and on the risk of becoming involved in a road accident. It may be assumed that this is the first time such relationships have been tested. The results show that hookah smoking has a significant influence on driving behavior and on the risk of being involved in road accidents.

Health measures

The results are consistent with the study hypothesis that smoking a hookah decreases the concentration of oxygen in the blood. The results show a significant increase in the pulse rate immediately after smoking hookah, with a decrease in the saturation rate. Unsurprisingly, the effect of hookah smoking continued for half an hour following this activity, and the results show both the pulse and saturation rates were significantly higher half an hour after smoking a hookah.

The continued impact of hookah smoking is derived from the results that have been confirmed by many studies (Bacha et al., 2007) - that hookah smoking increases the individual one - carbon dioxide in blood for at least 5 times ,compared to those from smoking a few cigarettes. The most important fact about one - carbon dioxide is that it has a half-life in the blood of 4 to 6 hours.

Driving measures

Parallel to the changes in pulse and saturation rates, changes in driving behavior were found. Immediately after smoking a hookah the total number of traffic accidents and traffic light tickets significantly increased. The increase in measures, involvement in road accidents and the total number of traffic light tickets indicate the risky driving of hookah smokers following the smoking of a hookah.

This result can be explained by the stronger, deeper hypoxia caused as a result of hookah smoking; this deeper hypoxia is conductive, among other things, to the sensation of euphoria and to the taking of greater risks.

The results additionally indicate that half an hour after smoking a hookah, a significant increase in centerline crossings and the percentage of the total time not

being within the lane relative to the total driving time were found. These two measures (the centerline crossings and not being within the lane) indicate driving stability, so post hookah smoking drivers are less stable, while their driving becomes more hazardous. Such driving behavior can be explained by problems with coordination, dizziness, low energy, fatigue and sleepiness which are caused as a result of the hypoxia (decrease in the one - carbon dioxide in blood).

Variables affect the frequency of hookah smoking

In order to suggest prevention programs for decreasing hookah smoking, it was essential to study variables that affect its frequency, including attitudes, demographic and socio-economic characteristics in addition to the extent of the exposure to hookah smoking. The estimated results of the logistic regression model that estimates the variables that affect the frequency of smoking hookah show a significant relationship between the frequency of hookah smoking and the participants' attitudes, and their socio-demographic characteristics. Participants possessing less self-control are more likely to smoke a hookah. Friends' subjective norms have a positive relationship on hookah smoking, meaning that participants who more often comply with their friends' thinking are more likely to smoke a hookah. As expected, believing that smoking a hookah cause's pleasure encourages this activity.

Among the personal variables, married people are more likely to engage in hookah smoking. In contrast, employed participants are less likely to indulge in this. Participants with a low income level or who are unemployed are more likely to smoke a hookah.

Limitation and future studies

As this is an initial study in exploring the relationship between hookah smoking, driving behavior and the risk of being involved in road accidents, there is need for much future work in this direction. Moreover, there is a need to broaden the sample to include more participants in order to examine the effects of additional demographic and socio-economic characteristics, such as gender, age and occupation, on hookah smoking and driving behavior.

סיכום

המחקר הנוכחי עוסק בבחינת השפעת עישון הנרגילה על התנהגות הנהיגה ועל הסיכון למעורבות בתאונות הדרכים. במסגרת המחקר בדקנו את השינויים בריכוז החמצן וחד תחמוצת הפחמן בדם כתוצאה מעישון הנרגילה, והשפעת שינויים אלה על הנהיגה ועל הסיכון למעורבות בתאונות הדרכים. למיטב ידיעתנו, זוהי הפעם הראשונה שמנסים לבחון קשר זה. תוצאות המחקר הראו כי לעישון הנרגילה יש השפעה משמעותית על התנהגות הנהיגה ועל הסיכון למעורבות בתאונות דרכים.

מדדי בריאות

התוצאות עולות בקנה אחד עם השערת המחקר כי עישון נרגילה מקטין את ריכוז החמצן בדם. התוצאות מראות עלייה משמעותית בדופק מיד לאחר עישון נרגילה עם ירידה בשיעור הרוויה כאשר לא היה שינוי בשני מדדים אלה בקבוצת הביקורת ולהפך בקבוצת הביקורת הייתה ירידה בדופק. באופן לא מפתיע ההשפעה של עישון נרגילה נמשכה חצי שעה לאחר סיום העישון, התוצאות מראות כי הדופק ושיעורי הרוויה היו גבוהים יותר באופן מובהק חצי שעה אחרי סיום עישון נרגילה. תוצאה זאת תואמת לממצאי מחקרים רבים (Bacha et al., 2007) שהראו כי עישון נרגילה מגדיל את חד תחמוצת הפחמן בדם לפחות 5 פעמים, בהשוואה לאלה שמעשנים סיגריות, וכי עישון נרגילה מעלה את הדופק (Al-Safi et al., 2008; Shafagoj & Mohammed, 2002). כמו כן הראו כי ההשפעה המתמשכת של עישון הנרגילה על ריכוז חד תחמוצת הפחמן לא מקרית מאחר ואורך החיים של חד תחמוצת הפחמן בדם היא בין 4-6 שעות (West, 1995).

מדדי נהיגה

במקביל לשינויים בדופק ושיעורי הרוויה (ריכוז החמצן בדם), נמצאו שינויים בהתנהגות הנהיגה.מיד לאחר עישון נרגילה הייתה עלייה ב- 33% בסך כל מספר תאונות הדרכים ובמספר עבירות אי ציות לרמזור אדום בהשוואה לקבוצת הביקורת שלא עישנו נרגילה. העלייה במספר התאונות ועבירות אי ציות לרמזור אדום מצביעות על עלייה בלקיחת הסיכון בזמן הנהיגה בעקבות עישון הנרגילה. תוצאה זו יכולה להיות מוסברת על ידי היפוקסיה חזקה ועמוקה שנגרמת כתוצאה של עישון נרגילה, היפוקסיה עמוקה גורמת, בין היתר, לתחושה של אופוריה וללקיחת סיכונים גדולים יותר. כמו כן, התוצאות הראו כי לאחר חצי שעה של סיום עישון הנרגילה הייתה עלייה ב- 31% יחסית לקבוצת הביקורת בחציית קוו האמצע (אי שמירה על קו

האמצע) ועלייה ב- 33% בסך כל הזמן שלא נמצא בנתיב הנסיעה וחוצה את הקו הצדדי והאמצעי של הנתיב. שני מדדים אלה חציית קו אמצע ואי שמירה על נתיב הנסיעה מצביעים על יציבות הנהיגה שמושפעת שלילית עקב עישון הנרגילה וכתוצאה הנהיגה הופכת לפחות יציבה ויותר מסוכנת.

משתנים שמשפיעים על תדירות עישון הנרגילה

על מנת להציע תוכניות מניעה להפחתת עישון נרגילה, היה חיוני לזהות את המשתנים המשפיעים על תדירות עישון הנרגילה, כולל עמדות, נורמות סובייקטיביות, מאפיינים דמוגראפיים וסוציו כלכליים בנוסף להיקף החשיפה לעישון הנרגילה. תוצאות אמידת מודל הרגרסיה הלוגיסטית שמטרתו הייתה בדיקת המשתנים המשפיעים על שכיחות עישון נרגילה מראים קשר משמעותי בין תדירות עישון נרגילה לבין העמדות של המשתתפים, הנורמות הסובייקטיביות והמאפיינים הסוציו דמוגראפיים שלהם.

משתתפים בעלי שליטה עצמית נמוכה נוטים יותר לעשן נרגילה. נורמות סובייקטיבית בנוגע לעישון הנרגילה שמבטא עד כמה עישון נרגילה הוא מקובל ורצוי בסביבתם, משפיע חיובית על עישון הנרגילה. כצפוי, ככל שהמשתתפים מרגישים כי עישון הנרגילה מהנה יותר הנטייה שלהם היא לעשן יותר.

בנוגע למשתנים האישיים, אנשים נשואים נוטים יותר לעשן נרגילה. לעומת זאת, המשתתפים שעובדים נוטים פחות לעשן נרגילה ולהפך משתתפים מובטלים נוטים יותר לעשן נרגילה. יש קשר שלילי בין רמת ההכנסה לבין עישון הנרגילה וככל שרמת ההכנסה יותר נמוכה תדירות עישון הנרגילה עולה.

מגבלות המחקר והצעות להמשך מחקר

מאחר ומדובר במחקר ראשוני שבוחן את הקשר בין עישון נרגילה לבין התנהגות הנהיגה והסיכון למעורבות בתאונות דרכים, יש צורך במחקרים נוספים בכיוון זה. יתר על כן, קיים צורך להרחיב את המדגם כדי להוסיף עוד משתתפים, על מנת לבחון את ההשפעות של מאפיינים דמוגראפיים וחברתיים כלכליים נוספים, כגון מין, גיל ותעסוקה, על עישון נרגילה והתנהגות נהיגה.

נספח 1

שאלון

משתתפים יקרים,

לפניכם שאלון, המהווה חלק מעבודת מחקר בטכניון ובבית חולים רבקה זיו.
השאלון הינו אנונימי (ללא פרטים מזהים) והמידע שיימסר ישמש לצרכי מחקר בלבד, ולא יועבר בשום תנאי לגורם נוסף.
השאלות מנוסחות בלשון זכר, מטעמי נוחות, אך פונות לשני המינים.

תודה על שיתוף הפעולה,

אליאס ופא

מרכז רן נאור

הטכניון

אנא ענה על השאלות הבאות על ידי הקפת המספר שמתאר בצורה הטובה ביותר את דעתך. מטעמי נוחות בלבד השאלות מנוסחות במין זכר, אך הן פונות לשני המינים.

דוגמאות:

לדעתי, חשוב לבצע פעילות גופנית לפחות שלוש פעמים בשבוע (אם התשובה היא מסכים מאוד)

מסכים מאוד 7 : 6 : 5 : 4 : 3 : 2 : 1 : לא מסכים בכלל

(אם התשובה היא לא כך כך מסכים)

מסכים מאוד 7 : 6 : 5 : 4 : 3 : 2 : 1 : לא מסכים בכלל

חלק א' אנא ענה על השאלות הבאות בכנות ובאופן מלא. אין תשובות נכונות ולא נכונות

1. אני מאמין, כי עישון נרגילה יכול לגרום לנזק בריאותי. מסכים מאוד 7 : 6 : 5 : 4 : 3 : 2 : 1 : לא מסכים בכלל
2. אני מאמין, כי עישון נרגילה יכול לפגוע ביכולת שלי לבצע פעילויות מוטוריות וקוגניטיביות (קושי בחשיבה הגיונית, קושי בביצוע פעולות יום יומיות כמו קליעת כדור לסל) מסכים מאוד 7 : 6 : 5 : 4 : 3 : 2 : 1 : לא מסכים בכלל
3. אני מאמין, כי עישון ממושך של נרגילה יכול לגרום לנזק בריאותי לריאות. מסכים מאוד 7 : 6 : 5 : 4 : 3 : 2 : 1 : לא מסכים בכלל
4. אני מאמין, כי עישון ממושך של נרגילה יכול להוביל להתמכרות לעישון הנרגילה. מסכים מאוד 7 : 6 : 5 : 4 : 3 : 2 : 1 : לא מסכים בכלל
5. לדעתי,עישון נרגילה הוא מהנה. מסכים מאוד 7 : 6 : 5 : 4 : 3 : 2 : 1 : לא מסכים בכלל
6. רוב החברים שלי מעשנים נרגילה לעתים תכופות. מסכים מאוד 7 : 6 : 5 : 4 : 3 : 2 : 1 : לא מסכים בכלל
7. רוב החברים שלי מעשנים נרגילה לעתים תכופות. מסכים מאוד 7 : 6 : 5 : 4 : 3 : 2 : 1 : לא מסכים בכלל
8. חבריי מצפים ממני, כי אעשן נרגילה. מסכים מאוד 7 : 6 : 5 : 4 : 3 : 2 : 1 : לא מסכים בכלל

9. משפחתי מצפה ממני, כי לא אעשן נרגילה.

מסכים מאוד 7 : 6 : 5 : 4 : 3 : 2 : 1 : לא מסכים בכלל

10. עישון נרגילה עם חבריי יעזור לי להיות יותר "מקובל" בחברה.

מסכים מאוד 7 : 6 : 5 : 4 : 3 : 2 : 1 : לא מסכים בכלל

11. עישון נרגילה עם משפחתי יעזור לי להיות יותר "מקובל" במשפחה.

מסכים מאוד 7 : 6 : 5 : 4 : 3 : 2 : 1 : לא מסכים בכלל

12. אם אעשן נרגילה, יהיו לי יותר חברים.

מסכים מאוד 7 : 6 : 5 : 4 : 3 : 2 : 1 : לא מסכים בכלל

13. עישון נרגילה יעזור לי להעלות את הביטחון העצמי שלי.

מסכים מאוד 7 : 6 : 5 : 4 : 3 : 2 : 1 : לא מסכים בכלל

14. אני מאמין, כי עישון נרגילה יגרום לי להרגיש יותר משוחרר ופתוח בקרב חבריי.

מסכים מאוד 7 : 6 : 5 : 4 : 3 : 2 : 1 : לא מסכים בכלל

15. אני מאמין, כי עישון נרגילה יגרום לי להרגיש יותר משוחרר ופתוח בקרב משפחתי.

מסכים מאוד 7 : 6 : 5 : 4 : 3 : 2 : 1 : לא מסכים בכלל

16. אני מאמין, כי עישון נרגילה יגרום לי להרגיש חופשי יותר עם בני המין השני.

מסכים מאוד 7 : 6 : 5 : 4 : 3 : 2 : 1 : לא מסכים בכלל

17. אני מאמין, כי גם אם חברי מכורים לעישון נרגילה, אני יכול לבלות איתם גם בלי לעשן .

מסכים מאוד 7 : 6 : 5 : 4 : 3 : 2 : 1 : לא מסכים בכלל

18 זה אפשרי עבורי להימנע מעישון נרגילה.

מסכים מאוד 7 : 6 : 5 : 4 : 3 : 2 : 1 : לא מסכים בכלל

19. אם אני רוצה, אני יכול שלא לעשן נרגילה למרות שכולם מסביבי מעשנים. מסכים מאוד 7 : 6 : 5 : 4 : 3 : 2 : 1 : לא מסכים בכלל
20. זה תלוי בי, אם אני מעשן נרגילה או לא. מסכים מאוד 7 : 6 : 5 : 4 : 3 : 2 : 1 : לא מסכים בכלל
21. מרבית האנשים, שחשובים לי ואני מעריך את דעתם, חושבים כי מקובל לעשן נרגילה. מסכים מאוד 7 : 6 : 5 : 4 : 3 : 2 : 1 : לא מסכים בכלל
22. הוריי חושבים, כי עלי להימנע מעישון נרגילה. מסכים מאוד 7 : 6 : 5 : 4 : 3 : 2 : 1 : לא מסכים בכלל
23. חבריי הקרובים חושבים, כי עלי להימנע מעישון נרגילה. מסכים מאוד 7 : 6 : 5 : 4 : 3 : 2 : 1 : לא מסכים בכלל

24. האם הוריך (או אחד מההורים) מעשנים נרגילה בבית?
    א.) אף פעם לא
    ב.) לעיתים רחוקות
    ג.) יותר מפעם בחודש
    ד.) לפחות פעם בשבוע
    ה.) לא יודע

25. האם אחיך ואחיותיך (לפחות אחד מהם) מעשנים נרגילה לעתים תכופות?

    א. כן

    ב. לא

26. באיזה גיל עישנת נרגילה לראשונה?
    א.) לפני גיל 18
    ב.) בגיל 19-25
    ג.) בגיל 26-35
    ד.) בגיל 36-45
    ה.) בגיל 46-55
    ו.) בגיל מעל 55
    ז.) מעולם לא

27. כמה פעמים עישנת נרגילה במהלך השבועיים האחרונים? (לפחות חצי שעה רצופה של עישון)
    1. אף פעם

2. 1-2 פעמים
3. 3-5 פעמים
4. יותר מחמש פעמים

28. האם אי פעם הרגשת שיש לך סחרחורת בזמן ואחרי עישון הנרגילה?

א.) לא, אף פעם
ב.) כן, פעם אחת
ג.) כן, 2-3 פעמים
ד.) כן, 4-10 פעמים
ה.) כן, יותר מ 10 פעמים
ו). כן, בדרך כלל
ז). כן, תמיד

29. כמה זמן של עישון נרגילה גורם לך סחרחורת?

א.) מעולם לא הרגשתי סחרחורת

ב.)- לאחר שעת עישון רצופה

ג.) בין שעה לשעתיים של עישון

ד.) מעל שעתיים עישון

30. באיזו תדירות אתה מעשן נרגילה כיום?

1. כל יום
2. 1-3 פעמים בשבוע
3. פעם בשבועיים
4. פעם בחודש או פחות
5. כלל לא

31. האם קרו מקרים בהם היית מעורב בקטטות לאחר עישון הנרגילה?

קרו מקרים רבים 7 : 6 : 5 : 4 : 3 : 2 : 1 : לא קרו מקרים כאלו כלל

32. האם קורים מקרים בהם אתה מעשן נרגילה יחד עם הוריך?

א.) אף פעם לא
ב.) לעיתים רחוקות
ג.) יותר מפעם בחודש
ד.) לפחות פעם בשבוע

33. האם קורים מקרים בהם אתה מעשן נרגילה יחד עם אחיד\ אחיותיך?

א.) אף פעם לא

ב.) לעיתים רחוקות

ג.) יותר מפעם בחודש

ד.) לפחות פעם בשבוע

34. מתי אתה בדרך כלל מעשן נרגילה?

א.) באמצע השבוע

ב.) בסוף השבוע

ג.) בעיקר בסוף השבוע, אך לפעמים גם באמצע השבוע

ד.) בעיקר באמצע השבוע, אך לפעמים גם בסוף השבוע

ה). באמצע השבוע ובסוף השבוע במידה שווה

35.) באיזה חלק של היממה אתה נוהג לעשן נרגילה ?

א.) בשעות הבוקר

ב.) בשעות הצהריים

ג.) בשעות הערב

ד.) בשעות הלילה

ה.) בכל שעות היום

36.) באיזו תדירות אתה מעשן נרגילה במקומות הבאים (סמן X במקום המתאים):

	כל יום	**1-3 פעמים בשבוע**	**1-3 פעמים בשבועיים**	**1-3 פעמים בחודש**	**פחות מפעם בחודש**	**אף פעם**
בבית						
בפאב או בית קפה						
אצל חבר\ה						
במסיבה						
במקומות מפגש כגון: גן ציבורי, ועוד						
אחר _____						

37. האם אתה מעשן סיגריות?

1. כן

2. לא

38. אם התשובה לשאלה הקודמת היא כן, כמה סיגריות בערך אתה מעשן ביום?

1. 5-10
2. 11-20
3. 21-30
4. 31-40
5. יותר

39. האם אתה שותה אלכוהול?

3. כן
4. לא

40. אם התשובה לשאלה הקודמת היא כן, באיזו תדירות אתה שותה?

6. פחות פעם בחודש
7. פעם בחודש
8. פעם בשבוע
9. 2-3 פעמים בשבוע
10. כל יום

חלק ב' פרטים דמוגראפיים

41. מצב משפחתי

1. **נשוי**
2. **רווק**
3. **אלמן**
4. **גרוש**

42. מצב תעסוקה

1. **שכיר**
2. **עצמאי**
3. **מובטל**
4. **פנסיונר**
5. **עקרת בית**

6. סטודנט
7. חי על קצבת ביטוח לאומי

~~43: סוג עבודה:----------~~

~~44: מקום עבודה:-------~~

45. הכנסת משק הבית ברוטו (הממוצע 13.339 ₪)

1. בהרבה מתחת לממוצע
2. תחת הממוצע
3. בממוצע
4. מעל הממוצע
5. הרבה מעל הממוצע
6. אין תשובה

46. מה היא השכלתך?

1. יסודי (עד 6 שנות לימוד)
2. 7-9 שנות לימוד
3. 10-12 שנות לימוד (12 ללא בגרות)
4. 12 עם בגרות
5. תעודה מקצועית
6. תואר ראשון
7. תואר שני
8. תואר שלישי

47. האם את\ה:
א.) זכר
ב.) נקבה

48. באיזו שנה נולדת? _____19

49. כמה אנשים גרים בבית (כולל אותך) ? _____

50. כמה מכוניות יש למשפחתך? _____

51. האם יש לך רכב לשימושך?

1. **כן**
2. **לא**
3. **לעתים**

52. האם יש לך רישיון נהיגה?

1. **לא**
2. **כן לרכב פרטי**
3. **כן אופנוע**
4. **כן רכב כבד (משאית)**
5. **כן אוטובוס**

53. כמה שנים יש לך רישיון נהיגה?

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