Determine the Effect Hookah Smoking on Health with Different Types of Tobacco by using Parallel Processing Technique

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Abstract. In this paper, we design efficient neural network as classification problem to examine the perception of health risks of different types of tobacco use in comparison to hookah use among 600 participants respond to a survey conducted in Baghdad city, who never smoke or smoke cigarette, hookah, both cigarette and hookah; and determine whether smoking status influenced the perceived health risks of hookah smoking when compared to other forms of tobacco use. The input data for suggested design is obtained from survey had 30 questions including questions about demographics, socioeconomic status, health care, etc. the network training based on numerical optimization procedure. This technique is much faster as compared to traditional approaches and it also provides highly accurate results. This study found that 48.1% of the participants believed that hookah was less harmful than each of the other tobacco products studied. Approximately 26% of cigarette smokers are likely to smoke hookah also. These findings emphasize the importance of spreading awareness about the health risks associated with hookah smoking and implementing strict laws for showing tobacco-related warnings in hookah advertisements and on the packets of hookah accessories given the increasing popularity of hookah, especially among the youth, in the Baghdad city.

Keywords: Neural network, Training algorithm, numerical optimization procedure

1. Introduction
Artificial neural networks (ANN) are excellent at approximating unknown mappings. Even a single hidden layer multilayer perceptron has universal approximation capabilities for classification problem [1-3]. These generalization abilities make the ANNs worthy of performing several complex tasks. Tobacco smoking is a major risk factor for many diseases such as chronic obstructive lung diseases, coronary heart disease, stroke, cancer, chronic bronchitis, and nicotine addiction [4,5]. Hookah also is known as a water pipe, narghile and shisha [6-8]. High school and college-aged students have shown a growing interest in hookah [9,10], as the most socially acceptable and attractive form of tobacco use when compared with cigars and cigarettes [11,12]. Studies have shown that hookah is considered less addictive [13-15], and less harmful than cigarettes [16, 17]. It is well documented the...
health risks of cigarette smoking but not for hookah smoking [18], Hookah smoke contains many of
the same harmful chemicals in traditional cigarette smoke, including Carbon monoxide, Arsenic,
Chromium, Cobalt, Cadmium, Nickel, Formaldehyde, Acetaldehyde, Acrolein, Lead, Polonium 210
[19], Nicotine, Tar, containing polycyclic aromatic hydrocarbons such as benzo (a) pyrene which is
react and bind to DNA, resulting several forms of cancer [20,21]. For example, a single hookah-
moking session causes the inhalation of carcinogenic substances insignificantly higher quantities than
smoking a single cigarette [22]. Another example, it has been shown that hookah smokers have a
higher risk for oesophageal cancer compared to non-tobacco users [23]. Because hookahs come into
direct contact with the mouth and are shared by multiple smokers, infectious diseases of the lungs,
mouth, lips, and gums can be spread to other people during a session [24]. Contagious disease ranging
from oral herpes to the flu, and more dangerous illnesses such as tuberculosis and hepatitis [24].
However, smoke emitted from a hookah contains many harmful chemicals, some in higher quantities
than in cigarette emissions, which can cause serious health risks to second-hand smokers including
workers at hookah lounges and individuals who cohabit with a hookah smoker [25]. The cigarette is a
common tobacco product against which other tobacco products are compared. There are many studies
comparing the perception of risks of hookah smoking to cigarette smoking [26, 27]. In this article, the
participants were asked to rate the harmfulness of smoking hookah versus chewing tobacco/snuff/dip,
cigars/ cigarillos/little cigars, cigarettes, filter cigarettes, and menthol cigarettes. Other paragraphs are
indented (Body text Indented style).

2. Study Population and Suggested Design for Neural Network

This study was conducted in a convenient sample in Baghdad city, and was approved by the
Institutional Review Board of Baghdad University. A survey was administered in paper forms among
adults from 1st January to 30th June 2019. The study populations which were considered for this study
were 600 individuals who answered most of the questionnaire on the hard copy of the survey as we
excluded the 30 webpage survey on their commendation of one of the reviewers. Also, 15 surveys
were excluded because of missing several questions in particular smoking status question. The study
participants were resident's in 50 zip codes of Baghdad. The survey had 30 questions including
questions about demographics (such as age); socioeconomic status (such as education); and health care.
Also, there were several other questions used in another study. Tobacco categories were determined
from the answers to the question, ‘If you currently smoke what you smoke?’. The answer was one of
the following: (a) cigarettes, (b) hookah, (c) both, and (d) never smoke. Base on that the study
populations were classified into four groups according to their smoking status. There were five
questions concerning health risk perception as follow

(a) How would you rate the health risks of chewing tobacco/snuff/dip, compared to hookah smoking?
(b) How would you rate the health risks of cigars/cigarillos/little cigars compared to hookah smoking?
(c) How would you rate the health risks of cigarette smoking compared to hookah smoking?
(d) How would you rate the health risks of cigarettes with filters compared to hookah smoking?
(e) How would you rate the health risks of Cigarettes with menthol, compared to hookah smoking?

The answer to these questions was as follows (1) I don’t know, (2) Less dangerous, (3) Equally as
dangerous, and (4) More dangerous. Thus the binomial variable for each question comparing the
health risks of each type of tobacco to hookah smoking was created with the categories “≥ harmful”
giving “1” to it) and “< harmful” (giving “0” to it).
So the suggested design consists of three layers: input, hidden, and output. The input layer consists of four neurons, the hidden layer consists of 40 neurons, and the output layer consists of one output neuron. All neurons between the layers are fully connected by a weight with log. sigmoid function in the hidden layer and purlin for the output layer.

Input data which is divided into three sets: training, testing, and validation set. The prevalence rate of tobacco smoke among the study population was 38.9%, while those who smoke hookah only were 8.8%, cigarette only 14.5% and those who smoke both 15.6%, other prevalence rates of sub-variables. Table 1 illustrates the accuracy of the suggested design. The training process is means that Simulink efficient training role for update the weight. Here we suggest the following update role:

$$\Delta W_k = \alpha_k \rho_k = \alpha_k (-g_k + \beta_k \rho_{k-1})$$ and $$\rho_0 = -g_0$$,

Where $$\alpha$$ is a learning rate, $$g$$ is the gradient, $$\rho$$ is the search direction, $$k$$ is the number of iterations and

$$g_k = \frac{\partial E}{\partial W_k}$$

$$E = \frac{1}{2} \| Y - b \|^2 = \frac{1}{2} \sum_{p=1}^{l} (y_p - b_p)^2$$, where E is error, $$b = W^T X$$

Then:

$$g_k = \frac{\partial E}{\partial W_p} = \sum_{p=1}^{l} (y_p - b_p)(-X_p)$$

In vector form, $$g_k = -(Y - b) X$$

Then:

$$\Delta W = \alpha_k ((Y - b)X + \beta_k \rho_{k-1})$$

Thus:

$$W_{k+1} = W_k + \Delta W_k$$

$$= W_k + \alpha_k ((Y - b)X + \beta_k \rho_{k-1})$$

$$= W_k + \alpha_k ((Y - W^T X)X + \beta_k \rho_{k-1})$$

$$= (I - \alpha_k XX^T)W_k + \alpha_k (YX + \beta_k \rho_{k-1})$$

It is possible to analyze this iteration in an asymptotic case as $$\alpha_k \longrightarrow 0$$, but it is not used in any way in practice.

The input data to our ANN are in $$\mathbb{R}^n$$, and we have a vector $$W \in \mathbb{R}^M$$, which describes the vector of weights. For the structure of linear ANN, the vector $$W$$ defines as the $$m \times n$$ weight matrix. For a multilayer ANN, $$W$$ computed as the Cartesian product of the weight matrices in each layer. In suggested design ANN computes a function $$g: \mathbb{R}^M \times \mathbb{R}^n \longrightarrow \mathbb{R}^m$$. Let $$V = g(w, x)$$, where $$V \in \mathbb{R}^m$$. For the input $$x_p$$, the corresponding output denoted by $$v_p$$, i.e., $$v_p = g(w, x_p)$$. We will assume that $$g$$ is differentiable with respect to $$W$$, and denoted by $$D = D(w, x)$$ the $$m \times M$$ matrix representation of the derivative with respect to the standard basis. For $$m = 1$$, the gradient may be representing as the row vector, where $$g$$ is differentiated with respect to the elements of $$W$$. Thus for a small change $$\delta W$$ and fixed $$x$$, we have:
\[ D(w, x) = \frac{g(w + \delta w, x) - g(w, x)}{\delta w} \]

Thus:

\[
g(w + \delta w, x) = g(w, x) + D(w, x)\delta w + O(||\delta w||) \tag{1} \]

Hence the accuracy of suggested design for a desired output \( y_p \) can be calculated by:

\[
E_p^2 = (y_p - v_p)^T(y_p - v_p) = q_p^T q_p \tag{2} 
\]

So, the total error is obtained by:

\[
E^2 = \sum_{p=1}^{t} E_p^2 
\]

The aim of training algorithm is to minimize \( E^2 \). Herein, we try to minimize \( E_p^2 \) not only \( E^2 \).

Now for a change \( \delta q_p \) in \( q_p \) from (2) we have

\[
\delta E_p^2 = (q_p + \delta q_p)^T(q_p + \delta q_p) - q_p^T q_p 
\]

\[
= 2\delta q_p^T q_p + \delta q_p^T \delta q_p 
\]

Since \( y_p \) is fixed, then

\[
\delta q_p = -\delta v_p = g(w + \delta w, x) - g(w, x) 
\]

\[
\delta q_p = -\delta v_p = -D(w, x_p)\delta w + O(||\delta w||) \tag{1} 
\]

Thus

\[
\delta E_p^2 = -2( D(w, x_p) \delta w)^T (y_p - g(w, x_p)) + O(||\delta w||) 
\]

\[
= -2 \delta w^T (D(w, x_p))^T (y_p - g(w, x_p)) + O(||\delta w||). 
\]

Hence, ignoring the part \( O(||\delta w||) \), and for a fixed size of \( \delta w \), the optimal minimization in \( E_p^2 \) can be obtained by setting:

\[
\delta w = a_k((D(w, x_p))^T (y_p - g(w, x_p)) + \beta_k \rho_{k-1}) 
\]

where \( \rho_0 = (D(w_0, x_p))^T (y_p - g(w_0, x_p)) \).

This is suggested search direction.

Training stops when any of the following conditions occurs: maximum number of epochs (repetitions) is reached; Performance has been minimized to the goal; and maximum amount of time has been exceeded. Input data which is divided into three sets: training, testing and validation set.
Table 1. Accuracy of suggested design for epoch and time.

| Types   | Performance | Epoch | Time       | Learning rate $\eta$ |
|---------|-------------|-------|------------|----------------------|
| Training| 1.74e-10    | 396   | 0:00:04    | 1.00e-07             |
| Testing | 3.34e-11    | 240   | 0:00:05    | 1.00e-08             |
| Validation| 1.24e-08  | 51    | 0:00:06    | 1.00e-08             |

Figure 1, represents the series weekly distributions for data and we see that data are stationary in the training and testing. Also, we plot autocorrelation functions (ACF) in Figure 2.
3. Discussion

The results of the study reveal the prevalence rate of tobacco smoking, irrespective of its types, among the study population, was 38.9%, those who smoke hookah only shows the lowest (8.8%) prevalence compare to those who smoke cigarette only (14.5%) or those who smoke both (15.6%), which is less than the prevalence of cigarette smoking among Baghdad population. However, the prevalence of hookah was higher among students (17%), youth age 18-24 years (15%), hold high school and more (10%), marital status single (12%), income more than $ 5,000 (11%) and those who do regular exercise (11%), and female (6%). This result is comparable to the result of another study that showed that hookah is considered more attractive and acceptable than some other tobacco products [15]. In addition, it was clear that the perception of health risk was less harmful in hookah smoking compared to the smoking behaviour of participants with different types of tobacco use. It is of interest to notice that 24 out of 25 possibilities of the responders of the survey thought that hookah was less harmful than all the other types of tobacco products studied. In general, 88.4% of total participants considered hookah to be less harmful than and any other types of tobacco product when we combined the five perceptions, it is of interest to find 68.1% of total participants who smoke filter cigarettes respond that health risk from smoking hookah was less than any other types of tobacco although the range of percentage between the study groups was varied. Those who were age 45 to 54 years were likely to rate the health risks of hookah as more harmful than those age 55 and above. Gender, marital status, education, and income did not have an effect on the perception of harm when adjusted for other factors.

4. Conclusions

This article found that hookah is considered to be less harmful than many other tobacco products including cigarettes irrespective of the smoking status of the participants. Approximately 26% of cigarette smokers are likely to smoke hookah also and those who smoke both hookah and cigarettes are more likely to have lower risk perceptions about hookah smoking than non-smokers. These findings emphasize the importance of spreading awareness about the health risks associated with hookah smoking and implementing strict laws for showing tobacco-related warning sin hookah advertisements and on the packets of hookah accessories given the increasing popularity of hookah, especially among the youth. Conforming the results of study with situated can be showed that the suggested design of ANN is very important tool to determine the results of similarity aim, manner and can be used for the large problem since ANNs is parallel processing technique has very important property such: too much memory, speed, implementation and accuracy.

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