THE ASSOCIATION BETWEEN SMOKING AND HYPERTENSION IN UKRAINE

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ABSTRACT

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Hypertension is defined as the level of blood pressure, which is greater than 140/90 mm Hg. The association between cigarette smoking and the development of hypertension is still not clear and is a matter of concern. Thus, this study was performed to see the association between smoking and hypertension with the data from the "Ukraine Household Survey", conducted in the 8 regions of Ukraine (Kyiv, Autonomous Republic of Crimea, Vinnytsia, Rivne, Lviv, Dnipropetrovsk, Luhansk and Odessa) in the year 2009 by the Ukraine Centre for Economic and Political Studies, named after Olexander Razumkov. This survey was funded by the World Bank and the Ukrainian Medical Alliance. In this study hypertension was used as the dependent variable, current smoking status as the independent variable and other covariates were age, gender, alcohol intake, overweight, high blood cholesterol and family history of hypertension.

The odds ratio obtained after performing the multinomial logistic regression, when considering the current smoking status and hypertension were OR, 0.48; 95% CI, 0.35-0.65 for daily smokers, OR, 0.64; 95% CI, 0.40-0.98 for the occasional smoker versus the non-smokers with the significance in the *p*-value. The adjusted odds ratio (OR) after performing the multiple logistic regression adjusting other covariates like age, gender, alcohol intake, overweight, high blood cholesterol, and family history of hypertension were adjusted OR, 0.74; 95% CI, 0.50-1.07 for daily smokers and adjusted OR, 0.82; 95% CI, 0.47-1.40 for the occasional smokers with no significance in *p*-value. Thus, this study was not supportive in considering smoking as one of the risk factors in the development of hypertension.

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ABBREVIATIONS

ABP	Arterial Blood Pressure
AHA	American Heart Association
ANS	Autonomic Nervous System
ASH	Action on Smoking and Health
BMI	Body Mass Index
BP	Blood Pressure
CAD	Coronary Artery Disease
CAP	Community Acquired Pneumonia
CDC	Centers for Disease Control and Prevention
CHD	Coronary heart disease
CHF	Congestive heart failure
CI	Confidence Interval
CNS	Central Nervous System
CO	Cardiac Output
COPD	Chronic Obstructive Pulmonary Disease
CPD	Cigarettes Per Day
CVA	Cerebrovascular Accidents
CVD	Cardiovascular Diseases
CVS	Cardiovascular System
DBP	Diastolic blood pressure
df	degree of freedom
GGT	Gamma-glutamyltranspeptidase
HL	Hosmer and Lemeshow
HR	Heart Rate
LVH	Left ventricular hypertrophy
MFMER	Mayo Foundation for Medical Education and Research
MTB	Mycobacterium tuberculosis
MI	Myocardial Infarction
MLR	Multinomial Logistic Regression model
mm Hg	Millimeter of Mercury
NIH	National Institutes of Health
OCP	Oral contraceptive pills

OR	Odds Ratio
PAD	Peripheral arterial diseases
PKD	Polycystic kidney disease
PROM	Premature rupture of membrane
PUD	Peptic ulcer disease
PVR	Peripheral vascular resistance
RF	Renal failure
SBP	Systolic blood pressure
SIDS	Sudden infant death syndrome
SOB	Shortness of breath
SPSS	Statistical Package for the Social Sciences
SV	Stroke volume
TB	Tuberculosis
WHO	World Health Organization

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1. INTRODUCTION

The World Health Organization (WHO 2013) defines hypertension as a blood pressure (BP) being equal to or above 140/90 mm Hg, where the numerator (140 mmHg) indicates the systolic blood pressure (SBP) and the denominator (90 mm Hg) indicates the diastolic blood pressure (DBP). It is one of the major public health problems globally. In most instances, cases of hypertension can be missed or get undiagnosed because most of the cases don't show any signs and symptoms in it's initial stage.

As mentioned above, the two numbers denote the blood pressure, i.e. the SBP denoted by the numerator and the DBP by the denominator. The SBP is the force exerted by the blood on the walls of the artery when the heart is in the state of contraction in its process of ejection of blood out of it and the DBP is the force when the heart is in the state of diastole or relaxation during the process of allowing the blood to flow back to the heart. Greater risk for the pathological process in the heart, brain, kidney, mortality, etc. is mainly exerted by the SBP than the DBP especially in the middle-aged and elderly groups. In the young adults, heart attack and stroke are mainly predicted by the DBP than the SBP (Harvey 2013).

There maybe the differences in the level of BP, hypertension prevalence, the changes in the BP with the increase in the age between different countries and even between populations living in the different regions of the same country (Longo et al., 2012). There is a steady rise in the level of blood pressure in the first two decades of life among the people living in the industrialized areas (Longo et al. 2012). The level of BP and growth/maturation is closely associated among the children and adolescent, which later on catches its normal pattern in the period between adolescence and young adulthood (Longo et al. 2012).

Hypertension affects multiple systems of the human body like the cardiovascular system (CVS), central nervous system (CNS), renal system, etc., resulting in the increased burden of cardiovascular diseases (CVD), cerebrovascular accidents (CVA), renal failure (RF) along with early onset of mortality and morbidity (WHO 2013). Among the various causes of the burden of diseases, one of the leading causes is hypertension worldwide (Longo et al. 2012). In 2001, about 13-15% of the total deaths were caused by hypertension, which was about 7.6 million deaths and disability-adjusted life years was about 92 million (Longo et al. 2012). It is estimated that globally about nine million deaths per annum occur due to hypertension (WHO 2013). About 45% of all deaths are from cardiovascular diseases and

51% of all deaths due to cerebrovascular accidents result from hypertension alone (WHO 2013). America has the lowest prevalence of hypertension whereas Africa has the highest. In 1980, the total number of hypertensive people was about 600 million, which has risen to one billion in the year 2008 (WHO 2013).

One of the biggest public health threats, which we are facing at present, is the epidemic of the tobacco use, which kills about six million people each year (WHO 2013). The raw material used to make the tobacco products may solely be the leaf tobacco or there may be addition of some other products as well. These products are used in many different ways like smocking, sucking, chewing, etc. The presence of nicotine is the main reason for its highly addictive characteristic. It is one of the leading risk factor for different types of chronic diseases, cancers, respiratory diseases, cardiovascular diseases, etc. (WHO 2013).

Status of hypertension and smoking in Ukraine

Ukraine is situated in the Eastern Europe between Poland, Moldova and Romania in the west and Russia in the east. The capital city of Ukraine is Kyiv. Ukraine has an area of 603,700 square kilometers and is the second largest country in Europe. In the year 2009, the population of Ukraine was estimated to be 46 million (Lekhan et al. 2010). Type of government in Ukraine is unitary parliamentary-presidential republic. Since 1991 Ukraine followed centralized Semashko system (Lekhan et al. 2010).

Ukraine Demographic and Health Survey conducted in the year 2007 reported that the percentage of men and women having hypertension were 32% and 25% respectively. Also, more than 50% of people who are equal to or older than 45 years have one or the other form of hypertension (Measure Demographic and Health Surveys 2008).

Smoking is one of the important public health issues in Ukraine as the number of people smoking has been increasing very rapidly. Ukraine has a very high prevalence of smoking especially among the men, which is 52.5% in comparison to the WHO European region average of 28.6%. In Ukraine, 15.5% of all deaths and 84.6% of deaths due to lung cancer is attributable to smoking (Squire et al. 2006). More than 50% of men and more than 15% of women are smoker, and men start to smoke at much younger age than the women in the Ukrainian population (Measure Demographic and Health Surveys 2008).

2. LITERATURE REVIEW

2.1 HYPERTENSION

2.1.1 CLASSIFICATION OF BLOOD PRESSURE

BP can be classified into normal, prehypertension, stage 1 hypertension, stage 2 hypertension and isolated systolic hypertension (Longo et al. 2012; NIH 2004; Madhur 2013).

- **Normal**

  Normal BP is denoted by the SBP of less than 120 mmHg and the DBP of less than 80 mmHg.

- **Prehypertension**

  Prehypertension is denoted by the systolic SBP of 120-139 mmHg or the DBP of 80-89 mmHg.

- **Stage 1 hypertension**

  Stage 1 hypertension is denoted by the SBP of 140-159 mmHg or the DBP of 90-99 mmHg.

- **Stage 2 hypertension**

  Stage 2 hypertension is denoted by the SBP of greater than or equal to 160 mmHg or the DBP of greater than or equal to 100 mmHg.

- **Isolated systolic hypertension**

  Isolated systolic hypertension is denoted by the SBP of greater than or equal to 140 mmHg and the DBP of less than 90 mmHg.

2.1.2 RISK FACTORS

There are various risk factors for the development of hypertension. These risk factors, either individually or in combination with the other risk factors result in the development of hypertension (MFMER 2012). The various risk factors of hypertension are:

- **Age and gender**

  The risk of being hypertensive is more with the advancement in the age and the risk is different in males and females. The risk of being hypertensive is greater among the males starting from the early middle age whereas in the females, they are at risk after the attainment of menopause (MFMER 2012; NIH 2012).

- **Race**

  Race is also one of the factors for the development of hypertension and blacks are more prone to be hypertensive than the whites in their lifetime. In addition to this, various complications of hypertension like stroke, myocardial infarctions, etc. are more commonly seen among the blacks than the whites (MFMER 2012; NIH 2012).

- **Family history of hypertension**

  An individual is at risk of suffering from hypertension if any member of his or her family (e.g. father, mother, siblings, etc.) has or had a history of hypertension before 60 years of age and family history is more strong if there are greater number of the family member with a history of hypertension before the age of 60 years (CDC 2005).

- **Overweight and obesity**

  The number of tissues becomes more and the cell size becomes bigger with increase in the weight. This growth in the tissue number and size ultimately causes the greater demand of oxygen and for the fulfillment of this demand of oxygen, more blood has to rush in towards the tissue, thus the pressure exerted by this higher flow of blood to the wall of the arteries will result in the blood pressure to rise (MFMER 2012; NIH 2012).

- **Sedentary lifestyles**

  Exercise is always very important for an individual to become healthy and live healthily. Physical inactivity acts as the risk of being hypertensive. The heart rate in an individual who is physically inactive is always high as compared to the individual who is physically active. If the heart rate is high in an individual then the heart must exert an extra effort with each contraction and ultimately exertion of higher pressure on the arterial wall (MFMER 2012; NIH 2012).

- **Smoking and chewing tobacco**

  The walls of the arteries is very prone to the damage that can be caused by cigarette smoking which may lead to the pathologic changes in the arterial walls like atherosclerosis. Atherosclerosis causes the narrowing of the lumen of the arteries. This narrowing of the lumen of the arteries increases the pressure of the flow of the blood inside the arteries thus leading to hypertension (MFMER 2012; NIH 2012).

- **High salt (sodium) intake**

  Salt (sodium) has the property of retaining the fluid inside the body. This retention of fluid inside the body results intravascular volume of fluid in the body to rise, thus leading to high BP. Thus greater dietary intake of salt (sodium) has the effect of elevating the level of BP (MFMER 2012; NIH 2012).

- **Alcohol consumption**

  Excessive alcohol consumption exerts the risk of hypertension due to its damaging effects to the heart (MFMER 2012; NIH 2012).

- **Stress**

  There is a temporary and very pronounced increase in the level of BP in the situations of stress and this normalizes with the subsidence of the stressful situations (MFMER 2012; NIH 2012).

2.1.3 ETIOLOGY OF HYPERTENSION

Etiologically, hypertension can be primary or essential hypertension and secondary hypertension.

- **Primary or essential hypertension**

  Primary or essential hypertension is the one where no identifiable cause can be found (Colledge et al. 2010; MFMER 2012; Klatt 2013). About 95% of the hypertensive cases fall under this category (Colledge et al. 2010). This type of hypertension develops over a period of time. Although it is not clearly understood about the pathogenesis of the primary hypertension, factors like the dysfunction of the kidney, dysfunction of the endothelium, resistance to insulin and other neurohumoral factors are considered as the potential contributors (Colledge et al. 2010).

- **Secondary hypertension**

  Secondary hypertension is the one, which develops due to the underlying conditions and tend to be sudden in onset with the level of BP higher than that of the primary hypertension. Following are the conditions that may lead to the development of secondary hypertension (Colledge et at. 2010; MFMER 2012; WebMD 2013; NIH 2004).

  - Kidney problems/diseases like the diseases of the vessels of the kidney, diseases of the parenchyma of the kidney especially glomerulonephritis (GN), cystic disease of the kidney like the polycystic kidney disease (PKD).
  - Diseases of the endocrine system like the tumor of the adrenal medulla (especially pheochromocytoma), acromegaly, thyrotoxicosis, Conn's syndrome, hyperparathyroidism, hypothyroidism (primary), etc.
  - Certain medications like estrogen containing oral contraceptive pills (OCP), painkillers that can be found over the counter, corticosteroids, anabolic steroids, etc. Also other illegal drugs like cocaine and amphetamines.
  - Alcohol
  - Obesity

- Pregnancy
- Smoking
- Excess salt intake
- Older age
- Genetics
- Family history of hypertension
- Sleep apnea

2.1.4 PATHOPHYSIOLOGY OF HYPERTENSION

There are two major factors responsible for the causation of hypertension and these two factors act independently or together. They are:

1. The pumping of the blood by the heart with excessive force than the normal (Harvey 2013).
2. The exertion of higher pressure along the blood vessels due to the narrowing down of the arterioles, which are the blood vessels, those are smaller in size (Harvey 2013).

Thus the cardiac output (CO) and the peripheral vascular resistance (PVR) are the factors responsible for determining the BP. The amount of blood pumped out by the heart per minute is known as the CO. The CO is the product of stroke volume (SV) and the heart rate (HR) (Longo et. al. 2012; Vincent 2008).

- Cardiac output (CO)=Stroke volume (SV) x Heart rate (HR)
  Where,
  - Stroke volume (SV) is the amount of blood ejected by the heart in each beat (in milliliters)
  - Heart rate (HR) is the number of heartbeats in a minute.

The anatomical and the functional changes mainly in the small sized vessels like the small arteries and the arterioles are responsible for different values of the peripheral vascular resistance (PVR).

Disturbances in any of the following may contribute to the development of hypertension (Longo et al. 2012):

- Intravascular volume
- Renin angiotensin aldosterone system
- Autonomic Nervous System (ANS)

2.1.5 CONSEQUENCES OF HYPERTENSION

People suffering from hypertension are predisposed to different kind of diseases, which may involve a single or multiple systems of the human body. The diseases caused as a consequence of hypertension may involve the cardiovascular system (CVS), central nervous system (CNS), renal system, etc.

- **Cardiovascular system**

  Hypertension has multiple adverse effects in the heart. It makes the heart more vulnerable for the pathological changes to take place in it, resulting in different types of heart diseases. The deaths occurring in the patients suffering from hypertension is most commonly due to the heart diseases. Some of the heart diseases and pathology as a consequence of hypertension are (NIH 2013; WebMD 2012; MFMER 2013; Blood Pressure Association 2008):

  - Left ventricular hypertrophy (LVH):
    Left ventricular hypertrophy (LVH), in which there is the thickening of the walls of the left ventricle of the heart, increases the risk for other diseases like stroke, congestive heart failure (CHF), coronary heart disease (CHD) and even sudden death.
  - Congestive heart failure (CHF):
    CHF may develop due to the abnormalities in the systole of the heart, diastole of the heart or both.
  - Atherosclerotic coronary artery disease
  - Cardiac arrhythmia
  - Microvascular diseases
  - Peripheral arterial diseases (PAD)

- **Central nervous system**

  - Stroke

    After heart diseases, stroke is the most common cause of death among the individuals suffering from hypertension resulting for about 5 million deaths per

annum. High SBP is particularly responsible for the development of stoke in the ageing group of population of more than 65 years (Longo et al. 2012).

- Deterioration of the cognitive function and dementia

  With the advancement of the age, hypertension also causes the deterioration of the cognitive function and dementia (Longo et al. 2012; MFMER 2013).

- Hypertensive encephalopathy

  Hypertensive encephalopathy results in a patient suffering from hypertension (malignant hypertension) when the auto regulation of the cerebral blood flow fails (Longo et al. 2012).

➢ **Renal system**

Hypertension results in the development of various type of kidney diseases and conversely different pathology of the kidney also results in the development of hypertension. Hypertension posses risk (Longo et al. 2012; MFMER 2103) for:

- Different types of renal injury
- Ischemic changes in the glomerular apparatus
- Ischemic changes in the post glomerular apparatus
- Glomerulosclerosis
- Focal necrosis of the glomerular tuft
- End stage renal disease

2.2 SMOKING

Smoke produced from the tobacco used in the cigarette has the acidic pH, thus it causes the reduction of nicotine absorption in the oral cavity and thus to gain the absorption of larger quantity of nicotine the smoke is inhaled. After inhalation the cigarette smoke gains the larger surface area of the lung for the absorption of the nicotine as required by the smoker to satisfy the addiction (Longo et al. 2012).

Nicotine which is the main constituent of cigarette smoke, causes the stimulation of the brain and in the regular smoker fall in the level of nicotine in the blood causes the development of various withdrawal symptoms like craving for the cigarette, headache, irritability, anxiety, restlessness, feeling of hunger, inability to concentrate, feeling of awfulness, etc. (Kenny 2012).

Another harmful constituent of cigarette smoke is tar. Tar contains many chemicals, which are very harmful for the human body. After it is inhaled, it gets deposited in the lung, which initiates various pathogenic processes and ultimately causes the development of various types of lung diseases. It also gains its access to the blood vessels and gets carried to almost every part of the body and is responsible for various types of cardiovascular diseases, renal diseases, etc. (Kenny 2012).

Carbon monoxide is another constituent of cigarette smoke. Carbon monoxide hampers the oxygen carrying capacity of the blood, hence causes the reduced oxygen supply to different tissues and organs in the body. This reduced oxygen carrying capacity by the blood is especially harmful during the period of pregnancy, as it causes decreased oxygen supply to the growing fetus and thus may lead to harmful conditions (Kenny 2012).

There is an acute effect of cigarette smoking in the level of BP. Thus, to know the exact effect of cigarette smoking in the level of BP, the BP should be measured no later than 30 minutes after the last act of smoking. BP, if measured within 30 minutes of last smoke, then the transient rise in the BP can be seen. In case of daily smoker, this transient rise can be evidenced after the first smoke in the morning, which can be up to 20mmHg rise in the systolic pressure. Apart from this, most of the studies with exclusion of some studies suggest that the daily or the habitual smokers have comparatively lower blood pressure than the nonsmokers, which can be explained by the fact of decreased body weight in the smokers and the action of nicotine as a vasodilator leading to decrease in the BP (Kaplan 2012).

2.2.1 SIGNS AND SYMPTOMS OF CIGARETTE SMOKING

There are many specific signs and symptoms by which we can identify a person whether he/she is a smoker or not. Some of the features, which help to identify the smokers, are (Stoppler 2013):

- A characteristic stain can be found in the fingers and teeth of the person who smokes. This stain in the fingers and teeth is known as the nicotine stain.
- A smell of smoke can be sensed in the clothing and the household items of the smoker.
- People who smoke have a characteristic type of cough, which differentiates them from the non-smokers. This type of cough present in the smokers is known as the smokers cough.
- Also, shapes of cigarette packets and lighter in the pocket or purse of a person may also be the feature that indicates the person is a smoker.

But there may be many different signs and symptoms, according to the diseases caused by cigarette smoking. Some of the features are:

- Diseases like the Chronic Obstructive Pulmonary Disease (COPD) and heart diseases may present with the feature of shortness of breath (SOB).
- Angina and heart attacks may present with the features of pain in the chest.
- Different cancers like the cancer of urinary bladder presents with the features of painless hematuria.
- Cancers of the oral cavity, larynx, pharynx, esophagus, etc., may present with the features of dysphagia, odynophagia and the hoarseness of voice.
- Patients with Burgers disease may present with the feature of pain in the legs on walking which subsides on rest.

2.2.2 DISEASES RELATED TO SMOKING

- **Diseases of cardiovascular system**

  The development of pathology of the large vessels like the atherosclerosis and small vessels pathology are more commonly seen among the smokers than the non-smokers. In addition to its role in the development of atherosclerosis, the risk of myocardial infarction (MI) and sudden cardiac death is also increased by the cigarette smoking due to the enhancement of the aggregation of platelet and occlusion of the vessels. In a population without diabetes, cigarette smoking is responsible for about 90% of the peripheral vascular diseases and about 50% of aortic aneurysm. Cigarette smoking also causes about 20-30% and about 10% of coronary artery disease (CAD) and cerebrovascular disease (occlusive) respectively (Longo et al. 2012; Armenian Medical Network 2011; Ambrose et al. 2004).

  The percentage of all coronary heart disease deaths in the United States each year attributed to cigarette smoking is about 30% with the risk being more with the frequency of smoking (Ockene et al. 1997).

- **Cancer**

  Cigarette smoking causes many different types of cancers and the number of cigarettes smoked per day along with the duration of smoking further enhances the causation of cancers. Cigarette smoking cause the cancers of respiratory system like the cancers of lung, oral cavity, nasopharynx, oropharynx, hypopharynx, larynx, paranasal sinuses, etc.; cancers of gastrointestinal system like the cancers of esophagus, stomach, etc.; cancers of hepatobiliary system like the cancers of liver, pancreas, etc.; cancers of the renal system like the cancers of kidney, ureter, etc.; cancers of genitourinary system like the cancers of urinary bladder, uterine cervix, etc.; and it also causes myeloid leukemia (Longo et al. 2012).

- **Diseases of respiratory system**

  Cigarette smoking has many harmful effects in the respiratory system of the human body. It is responsible for the causation of many different types of respiratory diseases. Following are the respiratory diseases attributed to cigarette smoking:

1. Chronic Obstructive Pulmonary Disease (COPD)

Smoking is the most important factor for the causation of COPD (Marsh et al. 2006). COPD is a disabling disease, which is progressive in nature that causes interference of the normal breathing due to the obstruction of the airflow. Bronchitis and emphysema are the types of COPD. People suffering from chronic bronchitis have the inflammation of the airway which becomes clogged with the mucus plugs thus they have the intermittent attacks of breathing difficulties. Whereas emphysema refers to the condition in which the alveoli in the lungs are destroyed (ASH 2011).

Smoking is the most common cause of COPD accounting for about 80% of the cases. There are about 210 million people living with COPD worldwide as per the estimate of the WHO (ASH 2011).

Globally, COPD is considered as the fourth most common cause of death and it is predicted that it will be the third most common cause of death by the year 2030 if the current trend continues (ASH 2011).

2. Pneumonia

Pneumonia is an acute respiratory infection in which there is the recent development of pulmonary shadow, which can be evidenced radiologically (Colledge et al., 2010). Cigarette smoking, both active and passive smoking are considered to be the risk factors of Pneumonia (Community acquired pneumonia).

Parental smoking is considered to be the risk factor for the development of pneumonia in children and childhood pneumonia is the leading cause of death in the world (ASH 2011). Smokers have the greater chance of suffering from the collapsed lung and suffering from pneumonia after anesthesia and surgical procedures than the non-smokers. The causation of invasive pneumococcal pneumonia is considered to be related with the dose i.e. the number of cigarette smoked per day and packs years of smoking.

3. Tuberculosis

Tuberculosis (TB) is the infectious disease and the causative organism of tuberculosis is *Mycobacterium tuberculosis* (MTb). Several studies have shown a strong association between cigarette smoking and tuberculosis and it is found to be

more common among the smokers than the non-smokers. Smoking is one of the causes of relapse of the disease (TB) even after it is being successfully treated (Chiang et al. 2007).

4. Asthma

Asthma is a chronic respiratory disease in which there are recurrent attacks of wheezing and breathlessness. The asthmatic attack is characterized by the swelling of the bronchial tube lining resulting the airway to be narrow, which reduces the airflow in and out of the lungs (WHO 2013). The exposure of the individuals to the secondhand smoke triggers the asthmatic attacks and worsens the symptoms. Asthma in the children is known to be caused by the parental smoking and its prevalence is dependent in the number of people who smoke in the home. The secondhand smoke is also responsible for the causation of adult onset asthma among the people who don't smoke.

5. Complications in pregnancy

Cigarette smoking during pregnancy can be associated with the complications like premature rupture of the membranes (PROM), placenta previa, abruption placentae, preterm delivery, spontaneous abortion, higher incidence of perinatal mortality rate, babies small for the gestational age, increased rate of infant respiratory distress syndrome, sudden infant death syndrome (SIDS), etc. (Longo et al. 2012).

6. Others

- It causes the delay in the healing process of peptic ulcer disease (PUD) (Longo et al. 2012).
- Risk of osteoporosis, cataract and degeneration of macula (Longo et al. 2012).
- It may cause the earlier onset of menopause in women, cause the skin to wrinkle early, gall bladder stone and inflammation of gall bladder in women (Longo et al. 2012) and
- It may be the cause of male impotence (Longo et al. 2012).

3. OBJECTIVE

The objective of this study is to examine the association of smoking status of the individual with hypertension in Ukraine.

4. STUDY DESIGN

Cross-sectional study.

5. HYPOTHESIS

There is difference in the prevalence of hypertension between daily, occasional and non-smokers.

6. MATERIALS AND METHODS

6.1 DATA DESCRIPTION

The survey was conducted in eight different regions of Ukraine. The method used for collection of data was in the form of household polls along with anthropometric and blood pressure measurements of members of the household. The "Ukraine Household Survey" was conducted by Ukraine Centre for Economic and Political Studies, named after Olexander Razumkov which was funded by the World Bank and the Ukrainian Medical Alliance. Ukraine Health Questionnaire, 2008 was used as the personnel questionnaire for the household members and household head within the age 18-65 years. The main objective of the survey was to study health service utilization, diabetes, hypertension, risk factors and opinions on healthcare by the people of Ukraine.

The household polling included 8 regions of Ukraine (city of Kyiv, Autonomous Republic of Crimea, Vinnytsia, Rivne, Lviv, Dnipropetrovsk, Luhansk, Odesa regions). These regions represented four main regions (the West, the Centre, The South and the East) of Ukraine. The household head was first interviewed with the household questionnaire, and then all the other household members within the age limit 18-65 were interviewed using the personnel questionnaires. If the household head also fall in the selected age group i.e. between 18-65 years, he/she was also interviewed using the same questionnaire used for other household members. The measurement included measurement of blood pressure, weight, height and weight circumference. Some household members only agreed for the interview but refused for the anthropometric measurements. In this condition, he/she was polled by using the interview form with refusal for measurement documented. The nurse did the anthropometric measurement. The household polling and the anthropometric measurements were started on 1st September 2009 and ended on 20th October 2009. Ninety-eight interviewers conducted the polls and 57 medics did the anthropometric measurements. The number of respondents that were polled from the questionnaires used for the household heads and with the questionnaires used for household members of 18-65 years were 1408 and 3430 respectively. The respondents who gave consent to anthropometric measurements were 3124 in number. The households, which were inaccessible due to closed doors, were counted to be 1966, especially of private houses and 2618 refused to participate.

Data entry, logical control and final form array cleaning was done using SPSS software.

6.2 STATISTICAL ANALYSIS

SPSS 21.0 software for Macintosh was used for the purpose of analysis of the data. This study also reports the extent of smoking distributed by age, gender, and geography of residence amongst the Ukrainians and following statistical analysis was carried out.

- Cross-tabulation was done between current smoking status of the subjects (independent variable) and hypertension (dependent variable) to know the frequency of the people with hypertension in daily, occasional and non-smokers. In the dataset the questionnaire has captured the current smoking status of the subjects (independent variable) and hypertension (dependent variable) as “how often do you smoke now?” and “has any health professional ever told you that you have high blood pressure?”.
- To examine the association between current smoking status and hypertension, chi-square test was done and the significance was assessed by the two-sided p-value of the test.
- Based on the assumption that the relationship between the dependent variable (hypertension) and the predictor variable/s are nonlinear, logistic regression analysis was done after controlling the confounding factors. Our dependent variable is categorized into three groups (’yes’, ’no’ and ’not sure’) and also not ordered, so we used multinomial logistic regression along with other covariates like age, gender, family history of hypertension, alcohol use, overweight, and serum cholesterol level. Thus, we estimate the risk of hypertension by calculating the OR with 95% confidence interval (CI).
- The multinomial logistic regression model (MLR) used in the study was subjected to ‘goodness-of-fit’ test using Hosmer and Lemeshow (HL) test for validation of the estimated results.

Table 1 LIST OF VARIABLES USED

Types of variable	Variable	Type
Dependent Variable	Hypertension	Categorical 1 = Yes 2 = No 3 = Not sure
Independent variables	Age	Categorical 1 = 18-29 years old 2 = 30-39 years old 3 = 40-49 years old 4 = 50-59 years old 5 = 60-65 years old
	Gender	Categorical 1 = Male 2 = Female
	Family history of hypertension	Categorical 1 = Yes 2 = No
	Alcohol use	Categorical 1 = Yes 2 = No 9 = I don't know/ Not sure
	Overweight	Categorical 1 = Yes 2 = No 9 = I don't know/ Not sure
	Serum cholesterol level	Categorical 1 = Yes 2 = No 3 = Not sure

7. RESULTS

7.1 BASELINE CHARACTERISTICS OF THE STUDY SUBJECTS

This study consists of total of 1342 respondents of 18-65 years from 1408 households for the smoking status. Among these respondents, 925 respondents (68.9%) were daily smokers, 167 respondents (12.4%) were occasional smokers and 250 respondents (18.6%) were non-smokers. Table 2 shows the comparison of these three groups i.e. smokers, occasional smokers and non-smokers according to the distribution by age groups in years, gender, geographical regions, alcohol intake, overweight, high blood cholesterol and the family history of hypertension.

Similarly, when considering the people suffering from hypertension, among 3422 respondents of 18-65 years old people, 943 respondents (27.6%) were suffering from hypertension, 2417 respondents (70.6%) have their blood pressure within the normal limit and 62 respondents (1.8%) were not sure about it. Table 2 also shows the comparison of these three groups i.e. hypertensive people, people with blood pressure within normal limit and the people who are not sure about the status of their blood pressure according to the distribution by age groups in years, gender, geographical regions, alcohol intake, overweight, high blood cholesterol and the family history of hypertension.

Table 2. Distribution of study subjects according to the current smoking and hypertension with selected factors.

	Current smoking status				Hypertension			
Variables	**Daily**	**Occasionally**	**Non-smoker**	**Total**	**Yes**	**No**	**Not Sure**	**Total**
Age group in years								
18-29	265 (74%)	54(15.1%)	39 (10.9%)	358 (100%)	70 (7.5%)	842 (90.1%)	22 (2.4%)	934
30-39	238 (71.9%)	39 (11.8%)	54 (16.3%)	331 (100%)	100 (14.6%)	578 (84.3%)	8 (1.2%)	686
40-49	198 (71%)	35 (12.5%)	46 (16.5%)	279(100%)	190 (29.6%)	441 (68.8%)	10 (1.6%)	641
50-59	165 (67.3%)	22 (9%)	58 (23.7%)	245 (100%)	352 (46.3%)	394 (51.8%)	14 (1.8%)	760
60-65	59 (45.7%)	17 (13.2%)	53 (41.1%)	129 (100%)	231 (57.6%)	162 (40.4%)	8 (2%)	401
Total	925 (68.9%)	167(12.4%)	250 (18.6%)	1342 (100%)	943 (27.6%)	2417 (70.6%)	62 (1.8%)	3422
Gender								
Male	737 (71.3%)	112 (10.8%)	185 (17.9%)	1034 (100%)	299 (19.5%)	1192 (77.9%)	40 (2.6%)	1531
Female	188 (60.8%)	56 (18.1%)	65 (21.0%)	309 (100%)	644 (34%)	1228 (64.8%)	22 (1.2%)	1894
Total	925 (68.9%)	168 (12.5%)	250 (18.6%)	1343 (100%)	943 (27.5%)	2420 (70.7%)	62 (1.8%)	3425
Regions								
Crimea	58 (48.3%)	27 (22.5%)	35 (29.2%)	120 (100%)	108 (28.2%)	273 (71.3%)	2 (0.5%)	383
Winnitca	109 (75.2%)	13 (9%)	23 (15.9%)	145 (100%)	92 (20.8%)	337 (76.1%)	14 (3.2%)	443
Dnipropetrovs'k	142 (70.6%)	27 (13.4%)	32 (15.9%)	201 (100%)	156(33.1%)	311 (65.9%)	5 (1.1%)	472
Kyiv	151 (71.6%)	21 (10%)	39 (18.5%)	211 (100%)	118 (29.9%)	269 (68.1%)	8 (2%)	395
Lugansk	129 (73.7%)	16 (9.1%)	30 (17.1%)	175 (100%)	128 (31.1%)	277 (67.4%)	6 (1.5%)	411
Lviv	109 (69.9%)	16 (10.3%)	31 (19.9%)	156 (100%)	109 (25.1%)	319 (73.3%)	7 (1.6%)	435
Odessa	144 (75.8%)	21 (11.1%)	25 (13.2%)	190 (100%)	110 (23.8%)	340 (73.6%)	12 (2.6%)	462
Rivne	83 (57.2%)	27 (18.6%)	35 (24.1%)	145 (100%)	122 (28.8%)	294 (69.3%)	8 (1.9%)	424
Total	925 (68.9%)	168 (12.5%)	250 (18.6%)	1343 (100%)	943 (27.5%)	2420 (70.7%)	62 (1.8%)	3425
Alcohol intake								
Yes	846 (68.6%)	150 (12.2%)	238 (19.3%)	1234 (100%)	692 (26.2%)	1902 (72%)	49 (1.9%)	2643

No	74 (74%)	16 (16%)	10 (10%)	100 (100%)	242 (32.2%)	497 (66.1%)	13 (1.7%)	752
Don't know/not sure	5 (55.6%)	2 (22.2%)	2 (22.2%)	9 (100%)	8 (30.8%)	18 (69.2%)	0 (0%)	26
Total	925 (68.9%)	168 (12.5%)	250 (18.6%)	1343 (100%)	942 (27.5%)	2417 (70.7%)	62 (1.8%)	3421
Overweight								
Yes	103 (60.6%)	23 (13.5%)	44 (25.9%)	170 (100%)	346 (64.1%)	192 (35.6%)	2 (0.4%)	541
No	786 (70.2%)	138 (12.3%)	196 (17.5%)	1120 (100%)	549 (20.1%)	2131 (78.2%)	46 (1.7%)	2726
Don't know/Not sure	19 (59.4%)	6 (18.8%)	7 (21.9%)	32 (100%)	33 (31.4%)	59 (56.2%)	13 (12.4%)	105
Total	908 (68.7%)	167 (12.6%)	247 (18.7%)	1322 (100%)	928 (27.5%)	2382 (70.7%)	61 (1.8%)	3371
High Blood cholesterol								
Yes	15 (44.1%)	5 (14.7%)	14 (41.2%)	34 (100%)	111 (84.1%)	21 (15.9%)	0 (0%)	132
No	838 (69.5%)	149 (12.4%)	219 (18.2%)	1206 (100%)	755 (24.7%)	2260 (74%)	38 (1.2%)	3053
Not sure	70 (70%)	14 (14%)	16 (16%)	100 (100%)	76 (31.9%)	138 (58%)	24 (10.1%)	238
Total	923 (68.9%)	168 (12.5%)	249 (18.6%)	1340 (100%)	942 (27.5%)	2419 (70.7%)	62 (1.8%)	3423
Family history of HTN								
Yes	430 (65.8%)	88 (13.5%)	135 (20.7%)	653 (100%)	625 (39.7%)	924 (58.7%)	26 (1.7%)	1575
No	483 (71.6%)	79 (11.7%)	113 (16.7%)	675 (100%)	310 (17.1%)	1470 (80.9%)	36 (2%)	1816
Total	913 (68.8%)	167 (12.6%)	248 (18.7%)	1328 (100%)	935 (27.6%)	2394(70.6%)	62(1.8%)	3391

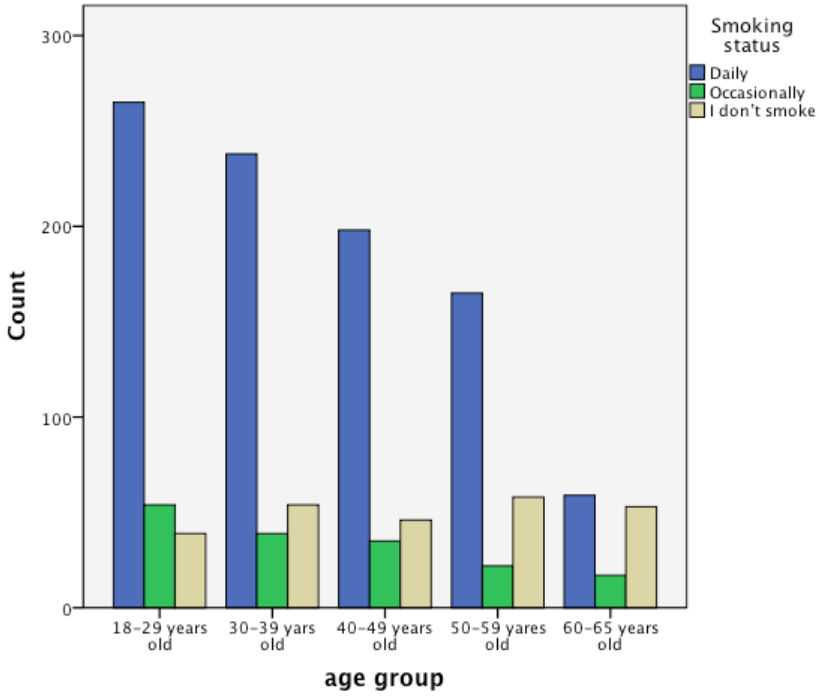

Figure 1. Frequency of smoking according to age.

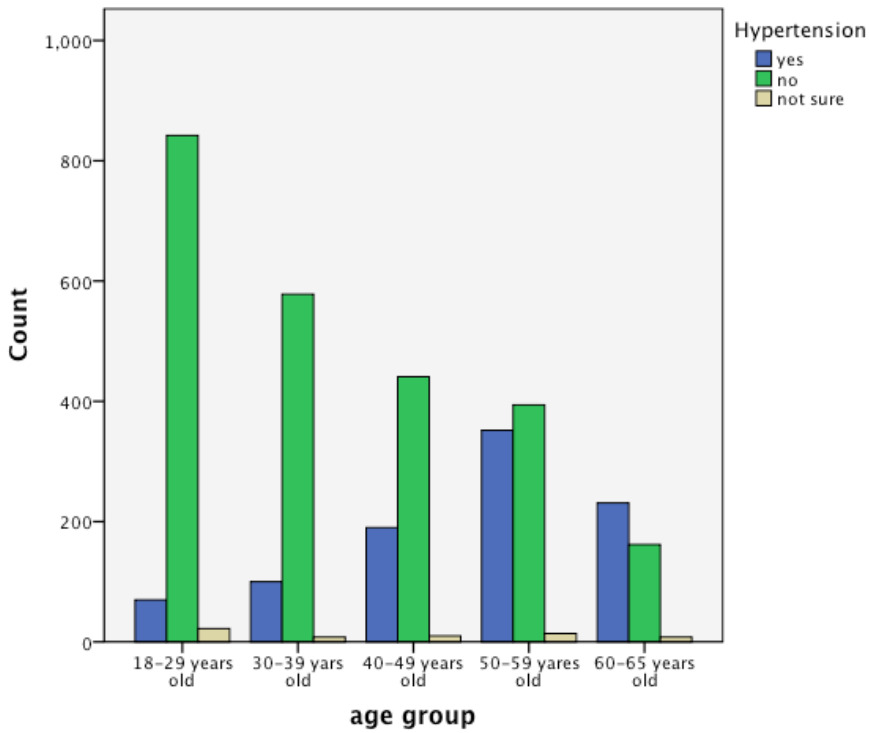

Figure 2. Number of cases of hypertension according to age.

Table 3 shows that among 925 daily smokers, 183 (19.8%) respondents were suffering from hypertension, 721 (78.0%) had their blood pressure within the normal limit and 20 (2.2%) of them were not sure about it. Whereas, among 168 occasional smokers 41 people (24.4%) were hypertensive, 123 people (73.2%) had the blood pressure within normal limit and 4 (2.4%) of them were not sure about it. Lastly, 84 people (33.7%), 160 people (64.3%) and 5 people (2.0%) were hypertensive, had blood pressure within the normal limit and were not sure about it respectively among 250 non-smokers.

Table 3. Distribution of the study subjects according to hypertension and current smoking status.

	Hypertension			
	Yes	**No**	**Not sure**	**Total**
Current smoking status				
Daily	183 (19.8%)	721 (78.0%)	20 (2.2%)	924 (100%)
Occasional	41 (24.4%)	123 (73.2%)	4 (2.4%)	168 (100%)
Non-smoker	84 (33.7%)	160 (64.3%)	5 (2.0%)	249 (100%)
Total	308 (23%)	1004 (74.9%)	29 (2.2%)	1341 (100%)

Note: *p*-value based on Chi-Square test (*p*-value < 0.05)

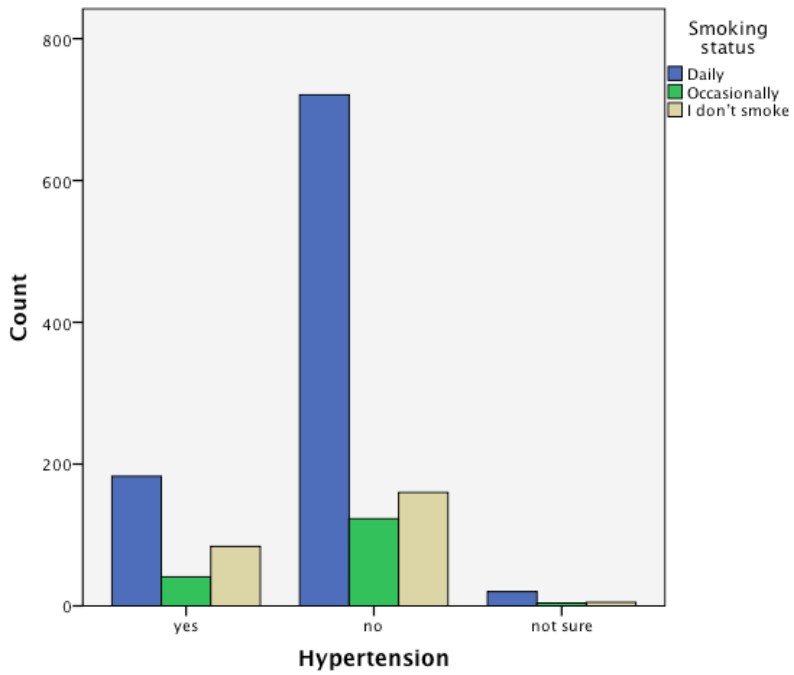

Figure 3. Frequency of hypertension according to smoking status.

Here, in table 4, the *p*-value of chi- square test at 4df is 0.000 which is lower than 0.05. Hence the null hypothesis is rejected. That is, there is difference in the prevalence of hypertension between daily, occasional and non-smokers.

Table 4. Chi-square test of hypertension and current smoking status

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	21.848[a]	4	0.000
Likelihood Ratio	20.614	4	0.000
Linear-by-Linear Association	18.350	1	0.000
N of Valid Cases	1341		

a.1 cells (11.1%) have expected count less than 5. The minimum expected count is 3.63.

7.2 UNADJUSTED ODDS RATIO OF HYPERTENSION BY SMOKING AND OTHER COVARIATES.

The multivariate analysis in of the data using the multinomial logistic regression (unadjusted) in table 5 revealed that the daily smoker and the occasional smoker are less likely to be hypertensive when compared to non-smoker, i.e. this analysis revealed the lower odds ratio for the daily smoker (OR, 0.48; 95% CI, 0.35-0.65) and the occasional smokers (OR, 0.64; 95% CI, 0.40-0.98) versus the non smoker.

This analysis using the age as an independent variable revealed the lower odds ratio for people aged 18-29 (OR, 0.059; 95% CI, 0.04-0.08), 30-39 (OR, 0.12; 95% CI, 0.09-0.16), 40-49 (OR, 0.30; 95% CI, 0.23-0.39) and 50-59 (OR, 0.63; 95% CI, 0.48-0.80) versus the people aged 60-65 to be hypertensive. Also males are less likely to suffer from hypertension with an odds ratio of 0.48 (95% CI, 0.40-0.56) when compared to the females.

When the alcohol intake was considered, the analysis revealed that the people who intake alcohol is less likely to be hypertensive with an odds ratio of 0.82 (95%CI, 0.35-1.89) than the ones who were not sure or who did not know their history of alcohol intake.

Overweight individuals were more likely to be hypertensive with the higher odds ratio (OR) of 3.22 (95% CI, 2.03-5.10) and the individuals who were of normal weight were less

like to be hypertensive with lower odds ratio (OR) of 0.46 (95% CI, 0.29-0.71) when compared to the individuals who were not sure or didn't know the status of their weight.

Considering high blood cholesterol, the analysis revealed that the individual with high blood cholesterol had the higher odds ratio (OR) of 9.60 (95% CI, 5.57-16.53) thus were more likely to be hypertensive than the individuals who were not sure about their blood cholesterol status and the individuals with the normal blood cholesterol has the lower odds ratio (OR) of 0.61 (95% CI, 0.45-0.81) thus were less like to be hypertensive when compared to the individuals who were not sure about their blood cholesterol status.

Lastly, the individuals with the family history of hypertension are more likely to be hypertensive with the higher odds ratio (OR) of 3.21 (95% CI, 2.73-3.76) compared to the individuals with no family history of hypertension.

Table 5. Unadjusted and adjusted odds ratio of hypertension by selected factors.

	Unadjusted Odds ratio (95% Confidence Interval for Odds ratio)	Adjusted Odds ratio (95% Confidence Interval for Odds ratio) [a]
Smoking status		
Daily	0.48 (0.35-0.65)**	0.74 (0.50-1.07)
Occasional	0.64 (0.40-0.98)*	0.82 (0.47-1.40)
Non-smoker	Ref.	
Age group in years		
18-29	0.06 (0.04-0.08)**	0.12 (0.06-0.21)**
30-39	0.12 (0.09-0.16)**	0.13 (0.07-0.22)**
40-49	0.30 (0.23-0.39)**	0.36 (0.21-0.60)**
50-59	0.63 (0.48-0.80)**	0.63 (0.37-1.04)
60-65	Ref.	
Gender		
Male	0.48 (0.40-0.56)**	0.55 (0.38-0.78)**
Female	Ref.	
Alcohol intake		
Yes	0.82 (0.35-1.89)	0.32 (0.06-1.68)
No	1.10 (0.47-2.55)	0.35 (0.06-2.00)
Not sure/I don't know	Ref.	
Overweight		
Yes	3.22 (2.03-5.20)**	2.32 (0.83-6.43)
No	0.46 (0.29-0.71)**	0.055 (0.20-1.43)
Not sure/I don't know	Ref.	
High blood cholesterol		
Yes	9.60 (5.57-16.53)**	4.30 (1.37-13.47)*
No	0.61 (0.45-0.81)**	0.78 (0.43-1.39)
Not sure	Ref.	
Family history of HTN		
Yes	3.21 (2.73-3.76)**	3.84 (2.77-5.30)**
No	Ref.	

Note: * $p<0.05$ and ** $p< 0.005$.
[a]: Note: R-Square=0.25 (Cox and Snell), 0.34 (Nagelkerke). Model Chi-Square = 368.914. * $p<0.05$ and ** $P<0.005$.

7.3 ADJUSTED ODDS RATIO OF HYPERTENSION BY OTHER COVARIATES

Table 6 shows the 'Goodness-of-fit' test using Hosmer and Lemeshow (HL) test for Multinomial logistic regression adjusted with age, gender, alcohol intake, high blood cholesterol, overweight and family history of hypertension (table 3), the *p*-value is 0.39. The null hypothesis in the Hosmer and Lemeshow test is that, we have a good level of fit. Here, the *p*-value is greater than 0.05, thus we retain the null hypothesis. Thus, this model is acceptable according to the goodness of fit test.

Table 6. 'Goodness-of-fit' test using Hosmer and Lemeshow test.

	Chi-Square	df	Sig.
Pearson	457.524	450	0.393
Deviance	336.695	450	1.000

In the table 5, the multivariate analysis using the multinomial logistic regression considering hypertension as the dependent variable and current smoking status as the independent variable adjusted with the other co-variates like age, gender, alcohol intake, overweight, high blood cholesterol and the family history of hypertension did not show that the current smoking status was associated with hypertension.

The association between the current smoking status of the individual and other selected factors are shown in the table 5. Here, we can see that age (i.e. 18-29 years, 30-39 years and 40-49 years) remained a significant factor after adjusting for other variables shown in the table, and these age groups were less likely to suffer from hypertension with the odds ratio of 0.12, 0.13 and 0.36 respectively when compared to the age group of 60-65 years. Males were less likely to suffer from hypertension than females with the adjusted odds ratio of 0.55 (CI 0.38-0.78) with the significance in the *p*-value. In addition, individuals with high blood cholesterol were more likely to suffer from hypertension when adjusted for other co-variates with the odds ratio of 4.30 (CI 1.37-13.48) with the significant *p*-value. Lastly, individuals with the positive family history of hypertension were more likely to suffer from hypertension with the adjusted odds ratio of 3.84 (CI 2.77-5.30). Association of smoking status, age group (50-59 years), alcohol intake, overweight and the subjects who didn't have high blood cholesterol was not statistically significant.

8. DISCUSSION

There are various risk factors for the cardiovascular diseases. One risk factor may have the higher impact in the development of the cardiovascular diseases than the other. Among those risk factors cigarette smoking is considered as one of the important risk factors in the development of the cardiovascular diseases and the associated complications thereof. It is a known fact that cigarette smoking acts as the risk for the causation of life threatening diseases like the myocardial infarction (MI), stroke and it may even cause sudden death. Thus a clear association can be shown between cigarette smoking and these diseases. But the association between cigarette smoking as a cause or the risk factor of hypertension has always been a matter of concern as no clear association has been shown between the two.

Many studies and researches has been done regarding the association between the cigarette smoking and its association with the development of hypertension but was unable to show the independent association between them, thus smoking is not regarded as one of the risk factors or the cause for the development of hypertension (Narkiewicz et al. 2005). Whereas, some authors have said that cigarette smoking has an acute effect in the change of the heart rate (HR) and the blood pressure and this acute effect is the increase in the heart rate (HR) and the blood pressure immediately following the act of smoking and the author has also stated that the long term effect of cigarette smoking in the development of high blood pressure still remains unclear (Shahab et al. 2010).

8.1 Studies showing the positive association between smoking and hypertension

Al-Safi (2004) study of 7400 males and 6910 females in Jordan has established the fact that the SBP, DBP and ABP (Arterial Blood Pressure) were significantly higher among the smoker males and female than the non-smokers in an otherwise healthy adult. Individuals with the positive family history of hypertension had higher blood pressure than the one with the negative family history of hypertension.

A descriptive study among 201 Vietnamese in a Gulf Coast Community stated that the percentage of the study subjects with hypertension was about 44% and smoking was significantly associated with hypertension (r=0.45) with a significant p-value (Duong et al. 2001). This result definitely showed the need of quality education and different kind of means to create awareness regarding smoking, alcohol use and the different types of cardiovascular diseases among the Vietnamese Americans.

Thuy et al. (2010) conducted a study with an objective to examine the association between smoking and hypertension among the Vietnamese men showed that the prevalence of hypertension was directly related to the number of years of smoking and pack-years of smoking when adjusted with age, BMI and intake of alcohol. The odds ratio of risk of hypertension in those who smoked for 30 years or more were 1.52 with 95% confidence interval between 0.95 and 2.44, and those who smoked 20 packs-years or more were 1.34 with 95% confidence interval between 0.94 and 1.91, when compared to never-smokers. Comparison between never-smokers and the subjects who were smoking during the study period showed that later were not at higher risk of hypertension. In addition, the risk for hypertension was higher in ex-smokers when compared to the subjects who never smoked.

Ex-smokers have the higher prevalence of hypertension than the people who never smoked. It was 13.5 % and 8.8% respectively with significance in *p*-value. A comparison between the ex-smokers and the never smokers showed that the ex-smokers carries the higher risk of hypertension with the odds ratio of 1.31 with 95% confidence interval between 1.13 and 1.52, and significance in *p*-value, regardless of the age and the amount of the alcohol intake. The subjects who have the risk of systolic hypertension were the ones with the age of 60 years or more and with a history of past and present smoking habit. The number of cigarettes smoked by the study subject and the duration that the subject had stopped smoking were associated with the risk factor of hypertension. When BMI was included in this study model, current smokers still carry the risk of systolic hypertension (Halimi et al. 2002).

8.2 Studies showing negative association between smoking and hypertension

In Inner Mongolia, a cross-sectional study was performed in 2589 study subjects between the year 2002 to 2003. The result obtained from this study was that the adjusted mean DBP among the smoker with a BMI of less than 25 kg per sq. meter were lower than that of the non-smoker study subjects with significance in the *p*-value (<0.05). Also, in a study subject with a BMI of more than or equal to 25 kg per sq. meter, there was a decrease in the SBP level with the increase in the number of cigarette smoked in a day with the *p*-value of less than 0.05. There was no statistical significance in the multivariate adjusted odds ratio (OR) of hypertension for 3 different groups of smoking. Thus it was concluded that smoking is not one of the risk factors of hypertension (Li et al. 2010).

A cross-sectional study with 2871 study subjects ranging from age 40 to 54, who are the

steelworkers in Japan, was performed in the year 1990. When non-smokers and the people who used to smoke in the past were considered no significant difference was observed after the analysis of the adjusted SBP and DBP. The analysis showed that, when light, moderate and heavy smokers were compared to non-and ex smokers, the adjusted SBP and DBP was lower among the former. No significant difference was seen among the smokers with the amount of cigarettes they smoked. Thus, the conclusion of this study showed that the level of the blood pressure (systolic and diastolic) was significantly lower among the smokers when compared to non- and ex-smokers, but the amount of cigarette smoked (dose) didn't matter among the smokers when considering the blood pressure (Okubo et al. 2002).

According to the study which was done in the year 1998, which consisted the evaluation of 8170 healthy males working in a company of steel manufacturing. The relative risk of hypertension (adjusted) among the study subjects who for the period of less than1, 1-3 and greater than equal to 3 years quitted smoking were 0.6 (95% CI 0.2 to 1.9), 1.5 (95% CI 0.8 to 2.8) and 3.5 (95% CI 1.7 to 7.4) respectively in comparison with the present smokers. Risk of hypertension was seen in the individuals if the year of their quitting of smoking is more and this was seen in the individuals who kept their weight maintained and as well as in the individuals who gained weight after cessation of smoking. In addition, the blood pressure (systolic and diastolic) were higher in the individuals who has quitted smoking for more than or equal to 1 year than the ones who is still smoking. Thus, the elevation in the blood pressures maybe the consequence of the smoking cessation (Lee et al. 2001).

A cross sectional study done from the data of national sample of German civilian in which the study group were the people of 18-79 years. The total number of study subjects was 6903. The result of this study showed that the adjusted OR for mild and moderate/severe hypertension was 3.6 (95% CI 2.3-5.7) and 6.5 (95% CI 3.6-11.8) respectively among the obese individual who left smoking for a period equal to 3 years or more. There was not any difference between the normal weight never/former smokers and normal weight current smokers (smoking greater than or equal to 15 cigarettes/day). The OR for normal weight never smokers and the normal weight former smokers were 1.1 (95% CI 0.8 to 1.5) and 0.8 (95% CI 0.5 to 1.3) respectively. Thus, the analysis of the data showed that there is no any relationship between never or former smokers and current smokers with hypertension when the normal weight individuals were considered (John et al. 2006).

8.3 Studies with mixed findings

The cross-sectional study of Primatesta et al. (2001) using a 3year panel (1994 – 1996) of 33,860 individuals has showed that (1) the male smokers who were older than or equal to 45 years old has the higher SBP than the male non-smoker of same age when adjusted for age, gender, BMI (Body Mass Index), alcohol intake and social class, (2) no difference in the SBP when compared to smoker and non-smoker younger men aged 16 to 44 years and (3) the DBP in both the age groups who smoke and who do not, were at the identical level. Further, female subjects who were light smokers (1-9 cigarettes/day) have the blood pressure lower than females who are the heavier smoker and also for, who never smoked.

In a study carried out among 7109 male workers of a metal factory with the age ranging from 18 to 60 years, the SBP after the adjustment among the smokers and non-smokers were 127.72 mmHg and 127.1 mmHg respectively with a *p*-value of less than 0.05. Conversely, the DBP among the smokers and non-smokers were 83.37 mmHg and 84.31 mmHg respectively with a *p*-value of less then 0.05. Thus the SBP after the adjustment was slightly higher among the smokers than the non-smokers and the DBP was lower among the smokers when compared to non-smokers. The difference in the number of cigarette smoked (i.e. light or heavy smoker) didn’t alter the mean blood pressure (Fogari et al. 1996).

Table 6. Summary of the studies in the literature review.

First author	Year	Result
Al-Safi	2004	The SBP and DBP were significantly higher in the smokers when compared with the nonsmokers.
Duong et al.	2001	Positive association between smoking and hypertension with a significant *p* value of <0.05.
Thuy et al.	2010	The risk of hypertension is higher among the current smokers than the one who is never smoker; also the risk of hypertension is higher among the ex smokers than never smokers.
Halimi et al	2002	This study showed that the risk of hypertension is higher among the smokers than the non-smokers and when BMI was considered the risk of hypertension was still high among the smokers but it was insignificant among ex smokers.
Li et al.	2010	This study concluded that smoking is not one of the risk factors of hypertension.
Okubo et al.	2002	The blood pressure was lower among the smokers when compared to non-smokers and ex smokers. The dose of smoking did not alter the result of this study.
Lee et al.	2001	This study showed that the increased blood pressure was the consequence of smoking cessation.
John et al.	2006	When considering the normal weight individuals, there was no association between never or ex smoker and hypertension; and current smokers and hypertension.
Primatesta et al.	2001	Male smokers of 45 years or more have higher SBP than the male non-smoker of the same age when adjusted for age, gender, BMI, alcohol intake and social class. No difference in the SBP between the smokers and the non-smokers aged 16 to 44 years. DBP was same among the smokers and non-smokers. Light smoker females have their blood pressure lower than the heavy smoker and non-smoker females.
Fogari et al.	1996	SBP was higher among the smokers and DBP was lower among the smokers when compared to non-smokers and the dose of smoking did not alter the result of the study.

Considering the above-mentioned results, when comparing this study with the previous studies, apart from showing some similarities in the result with some of the previous studies, this study also has different result than the studies that have been performed in the past. The result of this study shows that cigarette smoking has no association in the development of hypertension, showing some similarities as well as differences with the previously performed studies. The unadjusted OR between cigarette smoking and hypertension obtained after performing Multinomial logistic regression test showed that the risk of hypertension is lower among the individuals who are smokers. The adjusted OR between cigarette smoking and hypertension when adjusted with age, gender, alcohol intake, high blood cholesterol, overweight and family history of hypertension in the Multinomial logistic regression test was not significant. The result of this study is showing lower blood pressure among the smokers can be explained by the fact that smokers relatively have low body weight than the nonsmokers.

This study also showed important relationship between smoking and other covariates like age, overweight, high blood cholesterol level and family history of hypertension. In this study an important fact between age and hypertension can be seen clearly. We can see that the risk of the individual suffering from hypertension is higher with the advancement in the age i.e. the highest risk of developing hypertension is seen in the age group of 60 to 65 years whereas the least risk is seen in the age group of 18 to 29 years. Similarly, from this study we can see that the risk of developing hypertension is higher among the individuals who are overweight as compared to the normal weight individuals, but this association was found to be insignificant when adjusted with other covariates. Another significant association is between high blood cholesterol and hypertension with the risk of developing hypertension with hypercholesterolemia. Finally, another important and significant association was found between the positive family history of hypertension and hypertension with the higher risk of developing hypertension among the individuals with positive family history of hypertension than the ones who do not.

As we have seen the increased risk of developing hypertension in the individuals who are older, who are overweight, who have high blood cholesterol and who have positive family history of hypertension, thus these individuals should always be cautious about maintaining their blood pressure to the normal level. These individuals should have their blood pressure regularly measured, so that hypertension can be diagnosed at the earliest

possible stage so that proper interventions can be given and avoid the complications from occurring (Harvey 2013).

According to this study, even though cigarette smoking is not considered as one of the risk factors of hypertension, smoking should strongly discouraged as it has many other harmful effects in the human body like it is responsible for many cardiovascular diseases, it causes severe deterioration of the respiratory system hence causing many respiratory diseases, it also has many adverse effects in the renal system, etc. (Longo et al. 2012).

9. CONCLUSION

Various risk factors are associated with the development of hypertension. Some risk factors are very well studied and its role in the development of hypertension can be seen. Whereas, some risk factors are yet to be studied properly and researched upon to see its association in the development of hypertension. One such risk factor is the role of cigarette smoking in the development of hypertension because the association between the two is still unclear. Previous studies also shows different aspects of associations between the two. Some studies show the positive associations where some studies show the negative association and some other studies have one particular result without adjustment with the covariates and different results when adjusted with the covariates.

This study was done with the motive to show the clear picture of association between cigarette smoking and hypertension. In this study, the risk of developing hypertension was lesser among the smokers than the non-smokers with the significant *p* value. But the association, when adjusted with other covariates like age, gender, alcohol intake, overweight, high blood cholesterol and family history of hypertension was found to be insignificant. Thus from this study it was concluded that cigarette smoking is not associated with the development of hypertension from the analysis done with the data of Ukraine.

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