Natural and Applied Sciences International Journal (NASIJ)
eISSN: 2788-4619 (online)
https://doi.org/10.47264/idea.nasij/3.1.3
Vol. 3, No. 1, (January-June 2022), 34-44
https://www.ideapublishers.org/index.php/nasij

Research Article

Effect of cigarette smoking on blood biochemical parameters in males of district Swabi, Khyber Pakhtunkhwa, Pakistan

Bibi Rukhsana[1] | Mehreen Riaz*[1] | Saba Khalid[2]

1. Department of Zoology, Women University Swabi, Swabi, Khyber Pakhtunkhwa, Pakistan.
2. Department of Biotechnology, School of Life Sciences, University of Essex, Colchester Campus, United Kingdom.

***** Corresponding Author Email: drmehreen1986@gmail.com

Received: April 15, 2022 Accepted: June 20, 2022 Published: July 01, 2022

Abstract

Smoking is one of the most common preventable causes of mortality worldwide. It increases the risk of cardiovascular diseases by affecting lipid profiles and diabetes by elevating blood glucose levels. To investigate the injurious effect of cigarette smoking, the present study was done in the tehsil Topi of district Swabi. The study aimed to find an association between cigarette smoking and liver function, cardiovascular diseases, and diabetes. About 100 healthy males were selected, ranging from 20 to 35. They were divided into two groups, 50 were smokers, and 50 were non-smokers. Blood samples were taken to estimate serum liver function test and blood glucose levels. Serum Alkaline Phosphatase (ALP) in smokers was increased by 12% ($P < 0.05$) in comparison to non-smokers. At the same time, Aspartate Aminotransferase (AST) was increased by 17% ($P > 0.05$) for smokers as compared to non-smokers. Lactate Dehydrogenase showed a 4% ($P > 0.05$) increase in smokers. Blood glucose levels showed elevation by 7% ($P < 0.05$) in smokers. The study concluded that the injurious health effects of cigarette smoking increase with an increase in the number of cigarettes smoked in a day. It can affect blood glucose levels putting cigarette smokers at high risk of diabetes.

Keywords: Lactate Dehydrogenase, Aspartate Aminotransferase, Alkaline Phosphatase, smokers, non-smokers, liver enzymes, diabetes, blood glucose level.

How to Cite:
Rukhsana, B., Riaz, M., & Khalid, S. (2022). Effect of cigarette smoking on blood biochemical parameters in males of district Swabi, Khyber Pakhtunkhwa, Pakistan. *Natural and Applied Sciences International Journal (NASIJ), 3*(1), 34-44. https://doi.org/10.47264/idea.nasij/3.1.3

1. Introduction

It has been reported that cigarette smoking causes 63% of deaths worldwide (Hameed & Malik, 2021). In Pakistan, it is also one of the major underlying causes of health problems (Alam *et al.*, 2008). Statistical studies show that 36% of males and 9% of females are tobacco smokers in Pakistan (Jamshed *et al.*, 2017) and the rate of tobacco use is alarmingly increasing (Nawaz & Naqvi, 2008). The tobacco factories have a large economic contribution in Pakistan due to which taking a decision for limiting the use of tobacco is a major problem for government agencies in Pakistan (Mushtaq *et al.*, 2011). Chemicals present in cigarette smoke are more than 4000, out of which 400 are known to cause cancer. The cigarette burns at 316ºC to 482ºC, and the process of combustion produces many molecular compounds that are present in cigarette smoke.

The smoke produced from cigarettes can be differentiated into mainstream smoke and side stream smoke. Mainstream smoke is the smoke inhaled from the end of a cigarette that usually has a filter. This smoke is denser and hotter containing larger number of chemicals than side stream smoke. Side stream smoke is the smoke produced from the lite end of a cigarette. The most dangerous type of cigarette smoke is mainstream smoke however, side stream smoke can also be associated with certain illnesses. The particles in smoke inhaled from cigarette after reaching the upper respiratory tract moisturizes and increases in size rapidly. The mainstream smoke reaches the lungs and condenses and deposits 50 to 95 percent of chemicals in bronchi, bronchioles and alveoli (Stratton *et al.*, 2001). Nicotine is the most addictive ingredient in cigarette smoke which is absorbed in the mucous membrane of the mouth and reaches the brain cells in 7 seconds causing the feeling of relaxation due to the secretion of dopamine (Juranić *et al.*, 2018).

Quitting cigarette smoking is very difficult and requires repeated attempts involving various cessation methods. Long-term smoking cessation can be aided by five nicotine-based medications (patch, nasal spray, inhaler, lozenges and gums) and two non-nicotine-based medications (bupropion SR and varenicline). Moreover, naltrexone and cytisine have shown a potential role in quitting smoking (Walker *et al.*, 2014). Cigarette smoking produces many chemicals that can cause damage at the cellular level (Yao *et al.*, 2008). It has chemicals that can cause oxidative stress and oxidative injury in the body. Smokers are at greater risk for cardiovascular diseases respiratory disorders (bronchitis, emphysema, chronic obstructive lung disease and asthma), cancer (lung, pancreas, breast, liver, bladder, oral, larynx, oesophagus, stomach and kidney), peptic ulcers and Gastroesophageal Reflux Disease (GERD), male impotence and infertility, blindness, hearing loss, bone matrix loss and hepatotoxicity. Smoking can directly affect the organs of the body through which the smoke passes such as the respiratory tract as well as can have an indirect effect on the organs that are not in direct contact with it such as the liver. Moreover, smoking increases the risk of lung cancer by 60 percent in heavy smokers (Siddiqui *et al.*, 2010). The chances of diabetes type 2 increases with cigarettes smoked in a day (Afridi *et al.*, 2022).

There is limited literature available on the effects of cigarette smoking on biochemical parameters in young males of Pakistan. Therefore, the present study aimed to find the effects of cigarette smoking on the functioning of liver and blood glucose level in young males by the analysis of blood serum through tests.

2. Methodology

In the present study, 50 smoker males and 50 non-smokers males with age between 20 and 35 were randomly selected from villages of tehsil Topi district Swabi during January 2021-March 2021. They were divided into two groups i.e., test group (smokers) and control group (non-smokers) respectively. The participants of the test group were cigarette smokers for more than five years and were smoking less than ten cigarettes a day with no health problems. The information about age, cigarettes smoked per day and medical records were collected via interview. The mean age of the test group (smokers) was 25.96 ± 3.886, while for the control group mean age was 28.96 ± 3.987. Mean age for both groups were 27.45 ± 4.193.

2.1. Sample collection

Five millilitre of blood was collected by venepuncture in five millilitre disposable syringe. The syringe was inserted into a gel tube and allowed all the blood to be sucked up by it. Each gel tube was labelled with the name and age of the participant carefully. All the gel tubes were placed in upright position. One of the specific number tags present on the gel tube was removed and placed on a piece of paper another tag was left on the gel tube. All the biochemical tests to be performed were written on paper with tags. The blood serum was separated by centrifugation at 3000 rpm for ten minutes at room temperature. This step was repeated for all the samples. Serums were analyzed for blood biochemical parameters via semi-automated biochemical analyzer (Microlab 300 LX made in Netherlands).

2.2. Evaluation of liver function test

Serum from each sample was run through Microlab (semi-automated biochemical analyzer) which uses the principle of photometry. Photometry measures the light in the ultraviolet range which measures the quantity of analyte in solution. A specific light source and detector were used which produces an electrical signal proportional to light passed through a sample solution (Maire, 1990). Photometry utilizes Beer-Lamberts law for the calculation of coefficient obtained via transmittance measurement. A highly accurate measurement is achieved by establishing a correlation between analyte concentration and absorbance by a test specific calibration (Mäntele & Deniz, 2017). Commercially available kits of Spinreact (Spain) and Diatech (Switzerland) were utilized. The results for Aspartate Transaminase (AST), Alkaline Phosphatase (ALP) and Lactate Dehydrogenase (LDH) were noted and recorded for each participant carefully and tabulated.

2.3. Evaluation of blood glucose level

Blood glucose level was checked by glucometer. A test strip was placed in a glucometer. Index finger of each participant was pricked by spring loaded blood lancet. Blood drop was placed on the end of the test strip. Reading was noted after five minutes. Tests were repeated for each participant and results were recorded carefully.

2.4. Statistical analysis

All data were analyzed statistically by SPSS version 26 software. All parameters were expressed in mean and ± standard error. Means of each parameter under study were compared

for the test and control group to check the significance of variance by independent sample t-test. *P*-value less than 0.05 was considered statistically significant.

3. Results

Distribution of cigarettes smoked with reference to the number of cigarettes smoked in a day are given in table-1, indicating that 6 participants of the test group smoked 1-2 cigarettes a day, 2-3 cigarettes were smoked by 8 male participants of the test group, 3-4 cigarettes were smoked by 11 participants, 6 male participants smoked 4-5 cigarettes a day, 5-6 cigarettes a day were smoked by 7 participants of the test group, 2 participants of test group smoked 6-7 cigarette a day, 7-8 cigarette a day were smoked by 3 male smokers of the test group, 2 male smokers of test group smoked 8-9 cigarettes a day, 9-10 cigarettes were smoked by 1 male participant of the test group, 2 male smokers of test group smoked 10-11 cigarettes a day and 11-12 cigarettes were smoked by 2 male participants of the test group.

Table-1: Distribution of smokers regarding number of cigarettes smoked in a day

No. of cigarettes smoked	Frequency (n)	Percentage (%)
1-2	6	12
2-3	8	16
3-4	11	22
4-5	6	12
5-6	7	14
6-7	2	4
7-8	3	8
8-9	2	4
9-10	1	2
10-11	2	4
11-12	2	4

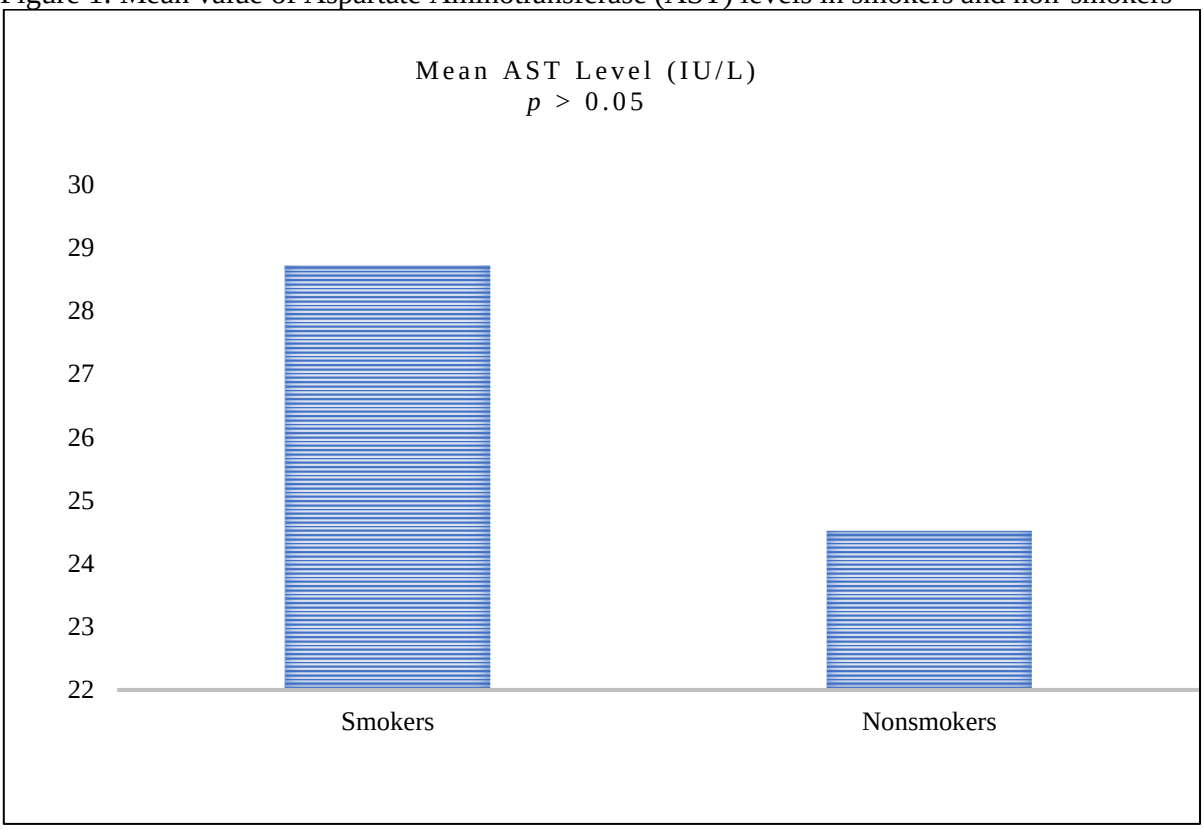
Significance of variance of means for the test and control group are shown in table-2. The results show that Aspartate Transaminase (AST) rises by 17% in smokers as compared to non-smokers and the statistical difference in mean values is not significant for test and control groups ($P > 0.05$), Alkaline Phosphatase (ALP) rises by 12% for smokers in comparison to non-smokers and has a significant difference ($P < 0.05$), Lactate Dehydrogenase (LDH) increases by 4% in smokers and is not significantly different ($P > 0.05$), whereas Blood Glucose Level increases by 7% in smokers (BGL) and the statistical difference is significant ($P < 0.05$) in both groups.

Table-2: Mean, standard deviation and P-value of blood biochemical parameters of test (smokers) and control (non-smokers) group

Parameters (units)	Smokers group (n=50)	Non-smoker group (n=50)	*P*-value (Significance)
AST (IU/L)	28.72 ± 1.855	24.52 ± 1.666	0.095
ALP (IU/L)	224.78 ± 7.198	200.32 ± 9.818	0.047*
LDH (IU/L)	250.46 ± 10.455	241.02 ± 8.729	0.490
BGL (mg/dl)	95.80 ± 2.464	89.14 ± 0.809	0.012*

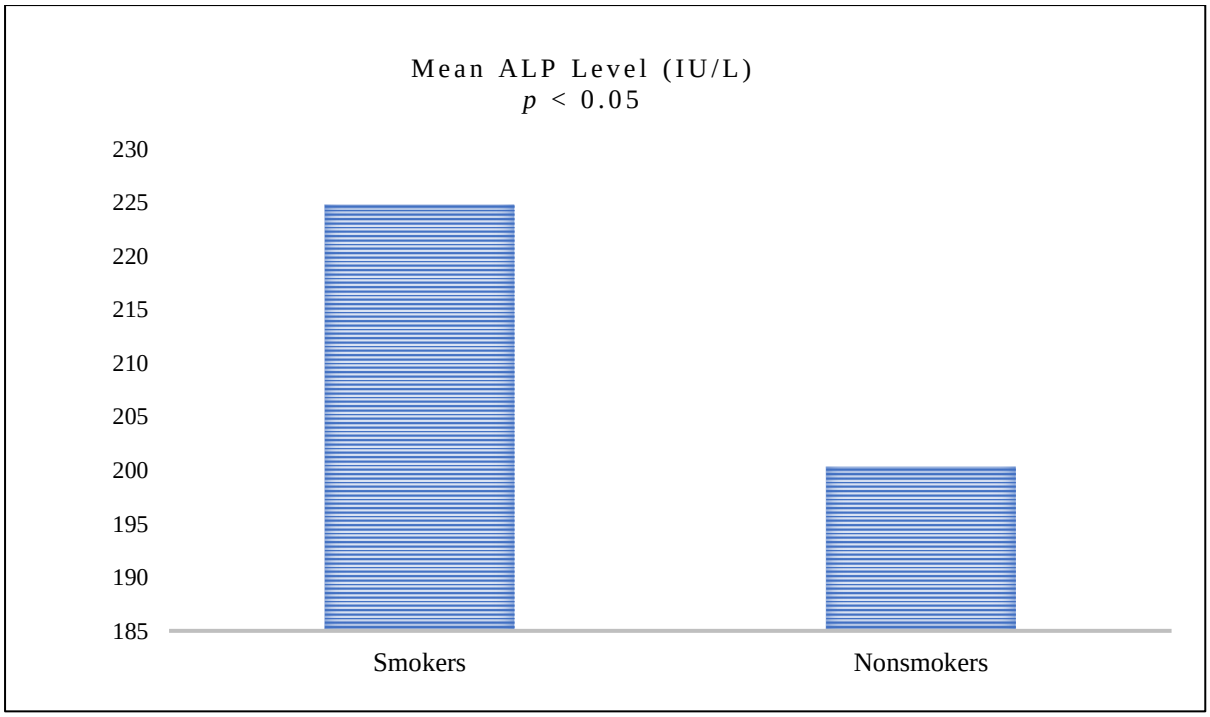
Note: Table-2 shows comparison of means ± standard deviation of blood serum biochemical parameters of smokers and non-smokers. Values are expressed as means of biochemical parameters of smokers and non-smokers calculated by independent sample t-test by SPSS version 26. * Significance $P < 0.05$.

Figure 1: Mean value of Aspartate Aminotransferase (AST) levels in smokers and non-smokers



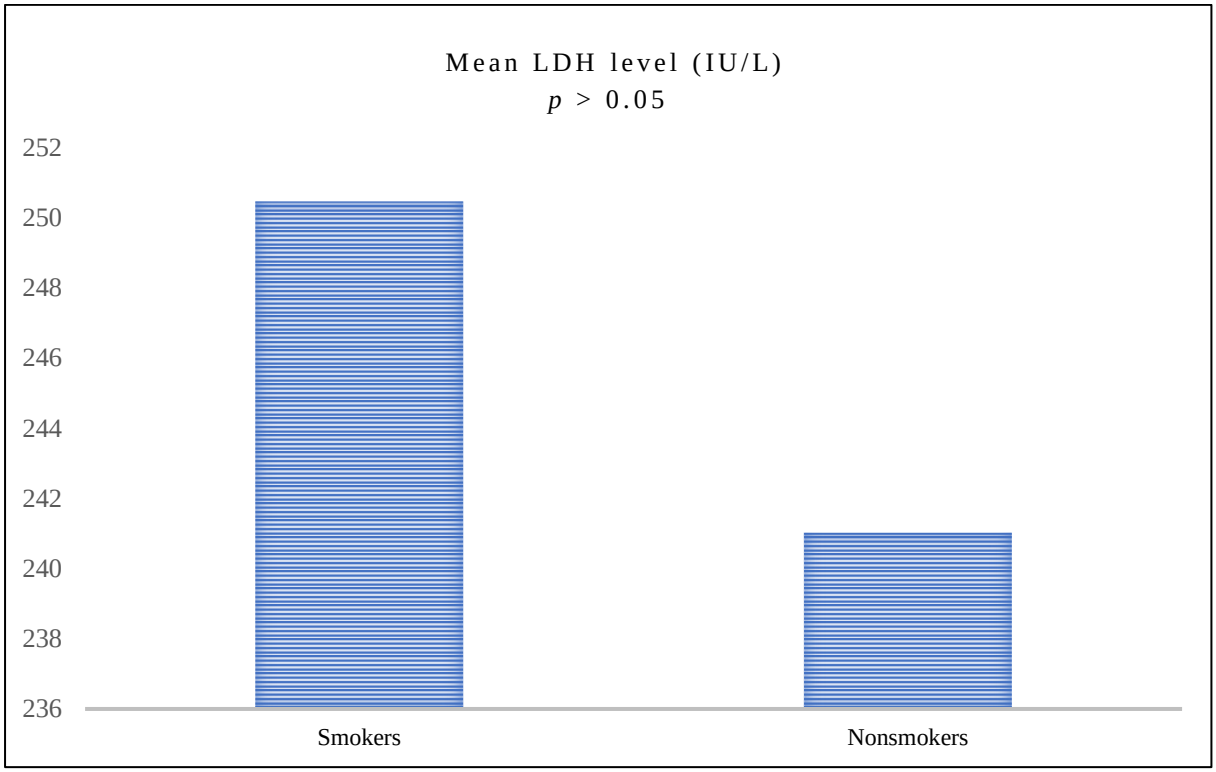
Note: One unit in the graph is equal to 1 international unit per litre (IU/L), which is the measuring unit for AST in the laboratory

Figure 2: Means value of Alkaline Phosphatase (ALP) levels in blood serum of smokers and non-smokers



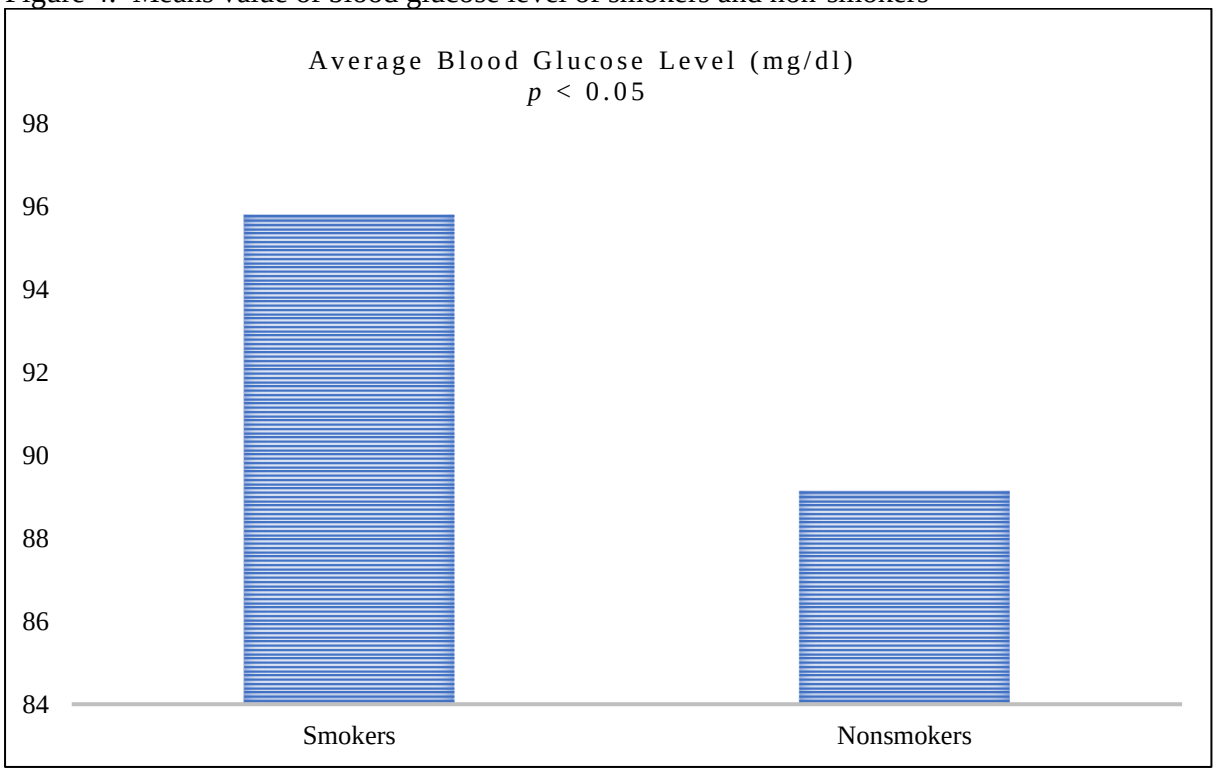
Note: One unit in graph is equal to five international units per litre (IU/L) which is a measuring unit for ALP tests in the laboratory

Figure 3: Shows the mean value of Lactate Dehydrogenase (LDH) level in smokers and non-smokers



Note: One unit in graph is equal to 2 international units per litre (IU/L) which is a measuring unit for LDH in the laboratory

Figure 4: Means value of blood glucose level of smokers and non-smokers



Note: One unit in the graph is equal to 2 milligram per decilitre, which is unit of blood glucose level measurement in laboratory

4. Discussion

Abnormal level of liver enzymes is one of the main causes of liver diseases. The detoxification function of the liver is burdened by smoking which can lead to inflammation and fatty liver that in long run can cause liver diseases. A few risk factors are known but there is disagreement among scientists about the effect of smoking on abnormalities of liver enzymes. The liver functions are known to change with certain conditions such as hypoxia, pathogens, drugs, menstruation and musculoskeletal growth. Cigarette smoking can cause resistance to insulin. In male smokers, cigarette smoking reduces the insulin-mediated uptake of glucose by 10% to 40% in comparison to non-smokers (Chang, 2012). Recent research has shown that current smokers have lower beta-cell function than non-smokers (Morimoto *et al.*, 2013). This study aimed to find the relationship between smoking, liver functions and blood glucose level. An important analyte of serum, Alkaline Phosphatase elevation can be used to prognose and diagnose liver diseases, bone disorders and other diseases. When liver is affected in certain conditions; liver cells release an abnormal amount of ALP into the blood. A higher level of ALP indicates either bone cell activity or damage to liver cells. The normal value of ALP may vary from laboratory to laboratory as well as with gender and age. The normal range of ALP is 98-279 IU/L in men and women (Jatoi *et al.*, 2007).

The result of the present study shows that serum ALP level rises significantly in the test group as compared to the control group. The study results are in parallel with the research conducted by Salihu (2019), Atta *et al.* (2019), Modawe *et al.*, (2019) and Hamza and Naji (2020) which indicated that smoking causes an elevation in ALP levels in smokers. As cigarette smoke has toxic chemical such as nicotine that can affect hepatic cells. This can cause nitrosative stress in which body cannot neutralize nitrogenous compounds and eliminate them from body, resulting in abnormal levels of liver enzymes (El-Zayadi, 2006). Aspartate Aminotransferase (AST) is an enzyme found in liver, heart cells, muscle tissue, red blood cells and other organs such as kidney and pancreas. Normal concentration in blood serum is 5 to 40 IU/L. However, when certain tissue or organs such as heart and liver are damaged, its level can increase up to 10-20 times the normal level. Therefore, the level of AST in the blood is an indicator of the extent of tissue damage (Hafkenscheid & Dijt, 1979). Smoking cigarette causes peroxidation of lipids resulting in damage to plasma membrane of hepatocytes. The damage can be indicated by levels of serum enzymes Aminotransferases which are sensitive indicators of liver cells damage (Rochling, 2001).

From the present study, it has been found that liver enzymes are not affected significantly in mild cigarette smokers. These results are in accordance with the study conducted by Ruchir *et al.* (2017) which indicated that there is a dose-response relationship between smoking and AST levels in blood serum levels as the number of cigarettes smoked in a day increases, level of AST will rise. Whereas the research of Hamad *et al.* (2020) and Turki (2021) has shown that level of AST increases with smoking, while the research of Atta *et al.* (2019) reveals that the level of AST lowers in smokers. Lactate Dehydrogenase (LDH) is an enzyme involved in anaerobic metabolic pathway. It is found in almost all cells of the body that are involved in carbohydrate metabolism. Its level is higher in liver, heart, skeletal muscles, erythrocytes, and kidney while its level is lower in brain, lungs and smooth muscles. LDH is elevated in a variety of disorders due to its widespread activity in body (Klein *et al.*, 2020). Normal range of LDH is 140-280 IU/L (Dmour *et al.*, 2020). Results of this study have shown that there is non-significant difference between smokers and non-smokers. The results are in accordance with

the studies conducted by Wannamethee and Shaper (2010), Turki (2021), Abdul-Razaq and Ahmed (2013) and Atta *et al.* (2009) which shows that smoking has a dose-effect response on liver cells. Whereas, Modawe *et al.* (2019), Jaafar (2020) and Hamza and Naji (2020) indicated that cigarette smoking affects liver enzymes. It is contrary to the present study.

It has been revealed from the present study that cigarette smoking significantly increases blood glucose level in smokers (test group) in comparison to non-smokers (control group). Cigarette smoking increases reactive oxygen species in smoker's body resulting in oxidative stress (Bhattacharjee *et al.*, 2015). Oxidative stress not only changes insulin resistance and blood glucose homeostasis but is also indirectly involved in rising blood glucose level. The exact mechanism of this phenomenon needs further investigation, but it is suggested that smoking increases the secretion of epinephrine and norepinephrine resulting in hyperglycemia by elevating the rate of gluconeogenesis and glycogenolysis (Vu *et al.*, 2014). The results are also in accordance with the study conducted by Lakshmi (2018), Sahab (2019), Bassey *et al.* (2020) and Hmood *et al.* (2020). It is concluded from the results, analysis and discussion, that blood glucose level increases in the smokers.

5. Conclusion

From the present study conducted, it is concluded that the effects of cigarette smoking are dose-exposure dependent and increases with an increase in the number of cigarettes smoked in a day. It can affect liver functioning non-significantly as ALP level increases in smokers while AST and LDH don't increase significantly. Therefore, mild smokers are not at risk of having injurious effects on the functioning of the liver. Blood glucose level increases significantly in smokers in comparison to non-smokers, therefore elevating the risk of diabetes in them. As the present study includes a limited number of liver enzymes, further study is required including other enzymes of the liver for better understanding the effect of smoking on liver functions. As the study is done on semi-automated Microlab, which is prone to human error. It is suggested that study should be done on fully automated machines in order to get more precise results without errors.

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