



# Epidemiological Profile of Diabetes Mellitus Patients in Diabetes Center in King Salman Specialist Hospital Hail Region Saudi Arabia

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## Abstract

**Objective:** To investigate the degree of association between the specific epidemiologic factors of diabetes in the Hail Region of Saudi Arabia.

**Methodology:** The research is considered a case study using information from the King Salman Specialist Hospital in Hail Saudi Arabia. 5000 Medical reports and records were used in the retrospective cross-sectional study. Data analysis was done using SPSS statistical software.

**Results:** The Chi-square results indicated an insignificant association between gender and follow-up status ( $P > 0.05$ ). Both males and females sought treatment equally, whether follow-up or new treatments ( $P > 0.05$ ). There was a significant association between gender and diabetes type. The t-test results had varied results for the differences in age, BMI, and diabetes treatment. Age differences had no significant impact on the prevalence of diabetes among males and females ( $t(4998) = -0.63, P > 0.05$ ). Men had lower glycohemoglobin levels (8.11) differed significantly from that of women (8.58)  $t(4786) = -10.62, p < 0.05$ . Also, the creatine levels were higher in females than males. There were significant differences in low-density lipoprotein, hemoglobin, and BMI between men and women.

**Conclusions:** The findings indicated differences in treatment such as unawareness of insulin injection, ignorance of health practices and unhealthy dietary habits, gender-related disparities, the inheritance of genes through which the disorder manifests, and exposure to environmental factors triggering and exacerbating the condition. Future studies should consider the genetic dimension Diabetes.

**Keywords:** Epidemiological; Diabetes Mellitus; Profile; King Salman Specialist Hospital, Hail, Saudi Arabia.

## Introduction

Diabetes mellitus is a metabolic disorder that increases blood sugar levels. chronic hyperglycemia and impairment in the metabolism of lipids, carbohydrates, and proteins were diabetes indicators [1]. In 1936, researchers identified the difference between Type 1 (T1DM) and Type 2 (T2DM) diabetes. The underlying cause is a defect in the secretion of insulin, its use, or both [2]. There are also genetic defects, certain drugs, the gestation hormonal environment, or other infections are other causal factors. Type 1 diabetes (Juvenile Diabetes) is characterized by insulin deficiency. An autoimmune response destroys beta cells, leading to insulin deficiency. Polyuria, constant hunger, polydipsia, fatigue, weight loss, and vision changes are T1DM characteristic symptoms. Type 2 diabetes (adult-onset diabetes) accounts for a majority (80%) of diabetes cases and is caused by the ineffective use of insulin. T2DM occurs due to physical inactivity and excessive body weight. The T2DM symptoms are similar to those of T1DM but less evident, which causes delayed diagnosis. Visceral obesity (associated with insulin resistance), hypertension, and dyslipidemia are common in patients with T2DM [3]. Gestational diabetes occurs in women during pregnancy, and unlike T1DM and T2DM, which occur under pathophysiologic conditions, it is classified as operational. The blood sugar levels are above average during pregnancy but remain below levels indicative of diabetes. Women with T1DM or T2DM that is diagnosed during (third trimester) or after their pregnancy are considered to have gestational diabetes[3]. Other specific types of diabetes have different etiologies and are grouped. These include individuals with insulin action defects, a genetic deficiency of the beta-cell functions, pancreatitis, pancreatic dysfunction caused by drugs or infections, or people with endocrinopathies dysfunction [4]. The "other specific types" category comprises less than 10 percent of diabetic cases. The incidence of diabetes has increased four times between 1980 and

2014. Currently, 1 in every 11 people has diabetes. T1DM cases in Europe and North America are intermediate to high, whereas the cases remain intermediate in Africa. In Asia, T1DM cases are low, except for Kuwait [2]. The prevalence in children is on a case by case basis for example, there is a 0.1 per 100,000 case in Venezuela compare to that in Finland at 40.9 per 100,000 children screened for diabetes [5]. T1DM could occur at any age but is prevalent in children between 0 and 14 years. There is a slight gender difference in incidences recorded with a higher incidence in males within populations with high occurrences where low incidence populations have higher cases among women. T1DM cases are higher among pubescents and are higher among young male adults. European natives are more susceptible to diabetes than non-Europeans, a statistic that varies as Europe shows higher diabetes occurrences than global increases. The IDF highlighted that diabetes consumes 10 percent of global expenditure [4]. Also, the occurrences of diabetes have evolved and presented new challenges, such as the occurrence of T2DM, which was common among adults, in children. This development indicates that care is needed in the management of diabetes. In Saudi Arabia, the challenge is considerable because it is among the top ten nations with high diabetes prevalence. Therefore, it is critical to profile the epidemiological occurrence of Diabetes

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mellitus in patients at the diabetes center in King Salman Specialist hospital in the Hail region of Saudi Arabia. This step will assist in proper health and intervention planning. The study conducted sought the identification of complications and risk factors of diabetes.

## Methods

### Study settings

The study was done between February and June 2020, at the Diabetic Center in King Salman Specialist Hospital in Hail city, Saudi Arabia.

### Selection and description of participants

The study was conducted using a cross-sectional analysis. The sample size included 5000 diabetes mellitus cases at the Diabetes Center in King Salman Specialist hospital. All diagnosed cases defined considered cases of DM within the past year. Eligible patients were confirmed by a diabetes doctor based on clinical presentations and laboratory exams and selected using gender and age matching criteria.

### Data collection methods, instruments used, and measurements

The cases and medical reports and records were investigated, and a questionnaire was used to collect demographics concerning the perception of voluntary diabetes treatment among patients. The study sample was randomly selected from verified diabetic patients at the Diabetes Center in King Salman Specialist hospital in Hail, Saudi Arabia. The patients were between 25 and 75 years who had been hospitalized and clinically diagnosed at the government facility. A review of reports and medical records was done to understand the epidemiological profile of diabetic patients. The variables in the study were measured using the nominal measurement scale.

### Data management and analysis

The collected information in the final electronic case report forms (eCRFs) was entered in the REDcap through the internet. The records were saved on the Diabetes Center in the King Salman Specialists hospital servers for security and integrity [6]. The system provided a data management approach that enabled easy data entry and analysis using statistical software. A one-way analysis was done on the information entered into SPSS (Statistical Package for Social Sciences) to identify notable variations between the identified risk factors, complications, and epidemiological features among diabetic patients. The Chi-Square test was used to identify variations between demographics and treatment traits. A p-value of  $>0.05$  was used to report significant values between males and females when exposed to demographic risk factors. The t-tests identified disparities in age, BMI, and diabetes treatment measures across gender. A p-value of  $>0.05$  and  $<0.05$  across different sample sizes was used to measure the accuracy of the disparities between the investigated risk factors. The t-tests were also used to investigate the differences in age, BMI, and Diabetes treatment measures across multiple diabetes types. The p-value of  $>0.05$  and  $<0.05$  were used to measure the sensitivity between the selected control factors and diabetic types. A multiple regression analysis was used to reveal the effect of age and BMI on the glycohemoglobin, creatine, and other attributes. The p-value of  $p<0.05$  and  $p>0.05$  was used to determine the statistical significance between age and BMI against glycohemoglobin, creatine, and different attributes, such as lipoproteins.

## Results

Chi-square results show no statistically significant association between gender and follow-up status (Table 1). The percentage of males who followed-up for diabetes treatment (45.1%) was not significantly

lower than the rate of females who followed-up on diabetes treatment (54.9%),  $p > 0.05$ . The percentage of new males who sought diabetes treatment (42.6%) was not significantly lower than the percentage of new females seeking diabetes treatment (57.4%). Both males and females were equally new or on follow-up for diabetes treatment. There was no significant association between gender and whether patients walked in or took an appointment for diabetes treatment,  $p > 0.05$ . This means that both males and females equally either walked in or made an appointment for diabetes treatment. There was no significant association between gender and schedule status of patients,  $p > 0.05$ . This implies that both males and females were equally either seen on schedule or not seen on schedule. There was a significant association between gender and diabetes type,  $p < 0.05$ . This indicates that the proportion of diabetic type 1 male patients (48.6%) was significantly lower than the proportion of diabetic type 1 male patient (51.4%). The proportion of diabetic type 2 male patients (42.7%) was considerably lower than the proportion of diabetic type 2 female patients (57.3%) (Table 2). There was a significant association between gender and treatment attendance following the last six months,  $p < 0.05$ . It means that the proportion of females (60.8%) who attended for treatment following the previous six months was higher than the proportion of males (39.2%) who attended for therapy following the last six months. Table 3 independent samples t-test results show that there existed no significant mean difference in age (years) between males and females,  $t(4998) = -0.63$ ,  $p > 0.05$ . Males mean age (53.50 years) was not significantly lower than the females' average age (53.77 years) [7]. There was a statistically significant mean difference in glycohemoglobin levels between males and females,  $t(4786) = -10.62$ ,  $p < 0.05$ . Males' mean glycohemoglobin level (8.11) was significantly lower than the females' mean glycohemoglobin level (8.58). There was a statistically significant mean difference in creatinine levels between males and females,  $t(4833) = 18.57$ ,  $p < 0.05$ . Males' mean creatinine level (91.57) was significantly higher than the females' mean creatinine level (64.04). There were also statistically significant mean differences in low-density lipoprotein, haemoglobin, and body mass index between males and females,  $p < 0.05$ . Males mean BMI (31.40) was significantly lower than the females' mean BMI (34.61). The mean low-density lipoprotein level for males (2.77) was deficient than the mean low-density lipoprotein level for females (2.92). The mean haemoglobin level for males (15.15) was significantly higher than the mean haemoglobin level for females (13.08). Independent samples t-test results reveal that there was existed a significant mean difference in age (years) between diabetic types,  $t(4281) = -51.72$ ,  $p < 0.05$ . Diabetic type 1 patients' mean age (22.11 years) was significantly lower than the diabetic type 2 patients' mean age (56.53 years), (Table 4). There was a statistically significant mean difference in glycohemoglobin levels between diabetic type 1 and diabetic type 2,  $t(4080) = 9.66$ ,  $p < 0.05$ . Diabetic type 1 patients' mean glycohemoglobin level (9.19) was significantly higher than the diabetic type 2 patients' mean glycohemoglobin level (8.33). There was a statistically significant mean difference in creatinine levels between diabetic type 1 and diabetic type 2 patients,  $t(4126) = -2.98$ ,  $p < 0.05$ . Diabetic type 1 patients' mean creatinine level (67.53) was significantly higher than the diabetic type 2 patients' mean creatinine level (76.88). There were also statistically significant mean differences in low-density lipoprotein, hemoglobin, and body mass index between diabetic type 1 and diabetic type 2 patients,  $p < 0.05$  (Table 5). Diabetic type 1 patients' mean BMI (27.06) was significantly lower than the diabetic type 2 patients' BMI (33.36). The mean low-density lipoprotein level for diabetic type 1 patients (2.99) was considerably higher than the low-density lipoprotein level for diabetic type 2 patients (2.85). The mean haemoglobin level for diabetic type 1 patients (14.81) was significantly higher than the mean haemoglobin level for diabetic type 1 patients (13.95). (Table 6) multiple regression results reveal that

Treatment traits	Description	Number of Males (%)	Number of Females (%)	P-value
New or Follow-up	Follow-up	584 (45.1)	712 (54.9)	0.124
	New	1578 (42.6)	2126 (57.4)	
Walk-in or appointment	Appointment	1248 (42.6)	1680 (57.4)	0.295
	Walk-in	914 (44.1)	1158 (55.9)	
Patient seen as scheduled	Yes	1999 (43.2)	2625 (56.8)	0.964
	No	163 (43.4)	213 (56.6)	
Diabetic type	Type 1	160 (48.6)	169 (51.4)	0.038
	Type 2	1690 (42.7)	2264 (57.3)	
Following the last 6 months	Yes	293 (39.2)	454 (60.8)	0.016
	No	1869 (43.9)	2384 (56.1)	

Table 1: Association between patient demographics and treatment traits.

Variable	Gender	N	Mean	Std. Deviation	Std. Error Mean
Age	Male	2162	53.50	15.74	0.34
	Female	2838	53.77	14.22	0.27
Last Creatinine result	Male	2086	91.57	67.17	1.47
	Female	2749	64.04	34.04	0.65
Last low-density lipoprotein result	Male	2039	2.77	0.92	0.02
	Female	2680	2.92	0.91	0.02
Hemoglobin test result	Male	397	15.15	1.43	0.07
	Female	482	13.08	1.61	0.07
Body mass index	Male	2117	31.40	57.21	1.24
	Female	2809	34.61	9.56	0.18
Last glycohemoglobin test results	Male	2061	8.11	1.36	0.03
	Female	2727	8.58	1.62	0.03

Table 2: Group Statistics by gender.

	t	df	Sig. (2-tailed)	Mean Difference
Age	-0.63	4998	0.527	-0.27
Last Creatinine result	18.57	4833	0.000	27.52
Last low-density lipoprotein result	-5.71	4717	0.000	-0.15
Hemoglobin test result	19.94	877	0.000	2.07
Body mass weight	-2.93	4924	0.003	-3.22
Last glycohemoglobin test results	-10.62	4786	0.000	-0.47

Table 3: Independent Samples T-Test Results: Disparities across Gender.

Variable	Diabetic Type	N	Mean	Std. Deviation	Std. Error Mean
Age	Type 1	329	22.11	8.47	0.47
	Type 2	3954	56.53	11.82	0.19
Last Creatinine result	Type 1	311	67.53	69.70	3.95
	Type 2	3817	76.88	51.58	0.83
Last low-density lipoprotein result	Type 1	294	2.99	1.00	0.06
	Type 2	3732	2.85	0.92	0.02
Hemoglobin test result	Type 1	35	14.81	1.87	0.32
	Type 2	470	13.95	1.87	0.09
Body mass weight	Type 1	321	27.06	43.63	2.44
	Type 2	3892	33.36	10.43	0.17
Last glycohemoglobin test results	Type 1	312	9.19	1.43	0.08
	Type 2	3770	8.33	1.52	0.02

Table 4: Group Statistics by Diabetic Type.

	t	df	Sig. (2-tailed)	Mean Difference
Age	-51.72	4281	0.000	-34.42
Last Creatinine result	-2.98	4126	0.003	-9.35
Last low-density lipoprotein result	2.47	4024	0.013	0.14
Hemoglobin test result	2.62	503	0.009	0.86
Body mass weight	-6.93	4211	0.000	-6.30
Last glycohemoglobin test results	9.66	4080	0.000	0.86

**Table 5:** Independent Samples T-Test Results: Disparities across Diabetic Types.

	(1)	(2)	(3)	(4)
Variables	Glycohemoglobin levels	Creatinine	Hemoglobin	Low-density lipoprotein
Age	-0.008*** (0.001)	0.615*** (0.051)	-0.014*** (0.004)	-0.009*** (0.001)
Body Mass Index	-0.001 (0.001)	-0.027 (0.020)	-0.001 (0.001)	-0.001 (0.001)
Constant	8.81*** (0.086)	43.720*** (2.936)	14.809*** (0.236)	3.386*** (0.057)
N	4,729	4,775	876	4,663
P-value	0.000	0.000	0.002	0.000
R <sup>2</sup>	0.006	0.030	0.014	0.023

**Table 6:** Multiple Regression Results.

Standard errors in parentheses. \*0.1 \*\* 0.05 \*\*\* p<0.01 significance levels.

age had a statistically significant negative effect on glycohemoglobin levels by age,  $p < 0.05$ . BMI had no statistically significant impact on glycohemoglobin levels. Age had a statistically significant ( $P < 0.05$ ) positive effect on creatinine levels, while BMI had an insignificant ( $p > 0.05$ ) impact on creatinine levels. Age had a statistically significant negative effect on hemoglobin levels and low-density lipoprotein,  $p < 0.05$ . BMI had an insignificant effect on hemoglobin levels and low-density lipoprotein,  $p > 0.05$ .

## Discussion

The deliberated multidimensional and distinct studies to exhaust different dimensions taken by diabetes in the Saudi Arabia community. The studies extensively aimed at elucidating gender-status connection, new or follow up cases, gender-schedule status connections for newly registered instances and others, and gender-diabetic type to determine the specific type affecting either males or females. The studies aimed at the gender-patient follow-up association within six months of diagnosis and the effects of Body Mass Index (BMI) and/or age on glycohemoglobin test results. The latter investigation aimed at determining variations regarding age, low-density lipoprotein, and haemoglobin tests within the study population. Unlike females, males are less likely to be diagnosed with the disorder because they do not visit medical facilities for such services. The diabetes epidemiological profile's bottom line captures the disease's incidence and prevalence, morbidity, and mortality, alongside the study group's history. Because the condition varies based on geographical factors, deploying global demographical and geographical details in the development of preventive and management measures can be misleading. With the disease rapidly increasing in Saudi Arabia, a local study, focusing on the Hail Region, was done to establish the disorder's landscape to inform specific preventive and management frameworks affected Saudi's. The latter cannot be accurate based on demographical differences constraining the disorders landscape across the global population. Age, gender, and ethnicity are fundamental demographical factors considered articulating diabetes epidemiology, full information for developing

potent prophylactic and management measures. Age, race, and gender, coupled with etiological factors, provide an insight into the landscape of the disorder globally. The most profound trigger to such research and investigations regards population differences, the dynamic nature of the etiological factors across the domains as mentioned above of population, and etiology. Diabetes incidences rose to 8.5%, from 4.7% in 1980, in 2014, and the current prevalence ratio is 1:11. The Saudi based study established a dynamic profile of information related to the disorder. Even so, factors like age and underlying conditions like hypertension do not discriminate or vary across males and females. Such factors trigger a nondiscriminatory incidence of the disease among both males and females. The literature among males and females indicate that age is a prominent factor predisposing both males and females to T2DM. The study established that the various types of Diabetes, Type 1 (T1DM), Type 2 (T2DM), gestational and other forms, manifest differently across the population. The global and demographic dynamics of T2DM indicate high prevalence in middle-income and low-income countries, especially in sub-Saharan regions of Africa. The latter can be attributed to poor lifestyle behaviours and habits like dietary practices and obesity. Likewise, middle and low-income families and individuals are less likely to observe self-care practices. The latter informs high mortality rates related to the disorder. Considering the appropriation of a healthy lifestyle and dietary patterns, such individuals can neither support nor afford proper lifestyle and eating habits, a phenomenon informing the incidence and high prevalence of the disorder among them. Even though the high majority has been registered among individuals aged between 0 to 14 years, T1DM depends on the aforementioned demographical factors and can occur to anyone. T1DM's peak has been noted at puberty, and the incidence has been found to increase steadily from birth to 15 years. Unlike T2DM, T1DM is common in European nations. Statistics show that Europe registers a 3.9% annual increase as other non-European countries register between 2.8% to 3%, demonstrating its racial landscape. Arguably, Saudi Arabians are less likely to suffer from all forms of Diabetes than Europeans. weather patterns like summer and

autumn in which the disease is more likely to invade most people, the Asian community is undoubtedly predisposed to the disorder's environmental factor. According to Alanazi et al. (2., 2018), there is low awareness of the metabolic disorder, alongside its risk factors among the Saudi population. The study established that medical students and other health workers are not conversant with insulin injection, one of the most profound management frameworks for the disorder. Public awareness, coupled with awareness among the medical fraternity, is an essential prophylactic strategy. Successive generations of the study group are likely to learn from their predecessor's unhealthy lifestyle practices. Consequently, they would avoid such habits and consider healthy lifestyle behaviors. On the other hand, the medical fraternity will learn the art of appreciating insulin injection, an approach that will enhance patients' recovery. Therefore, the creation of awareness of management practices and DM's risk factors enhances the prophylaxis and management of the disorder in the country. Findings from another study corroborated the same by indicating that Western cultures' adoption has predisposed the Saudi Arabian population, alongside other Asian communities, to DM. Socio-economic factors have been cited as the major contributing factor as many Asian communities embrace unhealthy western lifestyle habits. Awareness factor can be tied to both gender issues related to the disorder. Table 1 shows treatment traits-patient demographics relationships, and females seemingly outdo males in both walk-in and follow up medical activities. With few men considering and making decisions to seek medical assistance and observing medical follow-up for their condition, females are more likely to reprieve from medical aid. Males succumb to the disorder more than females. Descriptive retrospective research established that DM is a severe illness that affects pregnant women and unborn children. The disorder impedes the comprehensive and mature development of children's lungs, impairs renal arteries, and is an agent to dystocia. A better part of diabetic women was infertile as a small section of affected women successfully conceived and maintained pregnancy. They presented with many health complications during pregnancy, and many other factors have been linked with the disorder among pregnant women. 30-year-old women are more affected than their younger counterparts, a phenomenon indicated and asserted statistically. Over half of 134 pregnant women affected by the metabolic disorder were over 30 years. The other portion presented with DM-related illnesses like hypertension, depression, and stress, alongside poor dietary practices; the latter supports the argument that T2DM can be attributed to multiple demographical features, particularly age, in this case. Unlike males, females are more likely to suffer from the disease. Likewise, unborn children might suffer more from the disorder than male adults because of the disease's etiological aspects among pregnant women. The latter spells the epidemiological profile of the condition based on both gender and age [8]. Study established that 15% of the entire diabetic population controlled their sugar levels; with males and low-income individuals at the top of the list of individuals who hardly observed self-care activities, the study informs the variance in practicing DM management and prophylaxis. Poor execution of self-care practices is a profound contributor to the disorder's exacerbation in the given population. Females are likely to deploy self-care medical practices than their male counterparts, indicating that males are not as safe as females. The study established the landscape of T1DM in the Saudi population. Safi confirmed that 15.88% prevalence of the disease in seropositive-CD, coupled with high heterogenicity, and 12% prevalence in biopsy-proven CD. Unlike the globe's 6.0%, CD's spread among biopsy-proven CD in Saudi Arabia was 12%, and the female-

male ratio rate stood at 2:1 among the CD patients. Serological differences, as indicated by the biopsy study that showed a rate of  $p=0.093$ . The study also established the links between the disorder and nutritional habits. In Ha'il city, Kingdom of Saudi Arabia, a place known for robust social structures, was found to be the hotbed of poor dietary practices. This phenomenon suggested and affirmed that the population is likely to suffer from metabolic disorders. Much of the poor nutritional practices were attributed to their social life [6-8] further contend that education is a crucial instrument for controlling diabetes through health nutritional practices. The preference and value of social life over education that would equip them with skills necessary for healthy lifestyle practices have led to a high prevalence and worsening of the city's disorder. The study has established approximately all the factors to which the incidence and exacerbation of Diabetes in Saudi Arabia can be attributed. Primary sources postulate that all forms of diabetes are patient and environmentally-specific. The disorder will present in different ways within a population or across multiple individuals, preferably across cultures and ethnic groups. Likewise, the other individual is likely to react to the disorder differently or behave in specific ways account for the disorder's prevalence or incidence.

## Conclusion

The study established several aspects of the disorder concerning the study group, like unawareness of insulin injection, ignorance of health practices and unhealthy dietary habits, gender-related disparities, the inheritance of genes through which the disorder manifests, and exposure to environmental factors triggering and exacerbating the condition. Even though males and females are likely to contract the condition as their ages advance, women are more likely to seek solutions in medical facilities than men. While females consider walk-in and follow-up medical services on the illness, males are more reluctant and hesitant. The study's results provide historical and current information that can adequately inform the development of more efficacious treatment and preventive measures. The creation of mass awareness on the importance of preventative measures like healthy lifestyle behaviours and dietary practices is paramount even though the challenge of resources and facilities to sustain such actions are imminent.

## References

1. World Health Organization (2020). <https://www.who.int/health-topics/diabetes>
2. Forouhi NG, Wareham, NJ (2014). Epidemiology of Diabetes. *Medicine (Abingdon) J diabetes*. 12: 698-702.
3. Baynes HW (2015). Classification, pathophysiology, diagnosis, and management of diabetes mellitus. *J Diabetes Metab*. 6(5):1-9.
4. International Diabetes Federation (2013). *IDF Diabetes Atlas 6th edition*.
5. Al Johani, KA, Kendall GE, Snider PD (2015). Self-Management Practices among Type 2 Diabetes Patients Attending Primary Health-Care Centers in Medina, Saudi Arabia. *Eastern Mediterranean Health J*. 21;9:621-628.
6. Alanazi, FK, Alotaibi JS, Paliadelis P, Alqarawi N, Alsharari A, et al. (2018) Knowledge and Awareness of Diabetes Mellitus and Its Risk Factors in Saudi Arabia. *Saudi Medical J*. 39(10):981-989.
7. Safi MAA (2019). Celiac Disease in Type 1 Diabetes Mellitus in the Kingdom of Saudi Arabia Characterization and Meta-Analysis. *Saudi Medical J*. 40(7):647-656.
8. Alqahtani AS, Alsharif SA, Garman MA, Tashani M, Bindhim NF, et al (2020). The Impact of Receiving Pretravel Health Advice on the Prevention of Hajj-Related Illnesses among Australian pilgrims: Cohort Study. *JMIR Public Health and Surveil*. 6(3):e109-519.