Effect of Web Causation Epidemiological Model on Preventive Behaviors of Diabetic Females with Genitourinary Tract Infection

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ABSTRACT

Context: Genitourinary tract infection becomes a silent epidemic that devastated female life. It is closely interrelated with hyperglycemia, diabetes, and lack of awareness about personal hygiene care. All increase the susceptibility to various types of infections.
Aim: To assess the effect of web causation epidemiological model on preventive behaviors of diabetic females with genitourinary tract infection.
Methods: The study was conducted at a diabetic outpatient clinic in El Demerdash Hospital because it received clients from different areas and a high population rate. This study encompasses a purposive sample of 100 females. A quasi-experimental research design was selected. Data were collected using a structured interviewing questionnaire and preventive practice checklists to assess the knowledge and practices of the diabetic female.
Results: 69% of diabetic females had a family history of diabetes mellitus. 39% of them had satisfactory knowledge about causes that increased blood glucose in diabetic females shift to 81% at post-intervention. 35% of diabetic females had satisfactory knowledge about the function of the reproductive system at preprogram shift to 93% at post-program implementation. 34% of diabetic females had satisfactory knowledge about entry urinary tract infection methods at preprogram shift to 81% at post-program implementation. A highly statistically significant association between the presence of urine infection and application of web causation model (causative factors) such as lack of hygiene during menstruation, lack of hygiene before and after sexual intercourse, using mechanical contraceptive methods, increase the intake of salty foods, poor glycemic control and lack of personal hygiene with the results of urine analysis for infection.
Conclusions: Females exposed to the web causation epidemiological model exhibited better knowledge and preventive practices after exposure than their pre-intervention level. Apply the web-causation model at high population areas as slum areas on a large group of participants to improve awareness and practices regarding diabetes mellitus and genitourinary tract infection. Replicate the current study on a representative sample to improve the generalizability.

Keywords: Web Causation Epidemiological Model, genitourinary tract infection, diabetic females

1. Introduction

Genitourinary tract infection, known as "urinary tract infection or genital infection or both," is caused by bacteria that typically live around the urethra or vagina. Urinary tract infections are the most frequent bacterial infection in females. Urinary tract infections are more common and carry worse outcomes in diabetic females. They are also more often caused by resistant pathogens. Numerous impairments in the immune system reduced metabolic control, and incomplete bladder emptying due to autonomic neuropathy may contribute to the higher risk of urinary tract infections in these patients *(Harlow et al., 2018)*.

Genital infections are an important female's health problem associated with harmful influences on sexual and family lives and increasing prevalence worldwide. Normally, females may have a vaginal discharge, the amount and consistency of which vary during the menstrual cycle; whatever, the genital infection causes the asymptomatic increased vaginal discharge. Other symptoms associated with this condition are dyspareunia and bad odor. It is currently among the important causes that lead females to seek medical attention. Every year, approximately 100 million females worldwide are wide-open to genital infections, including urinary tract infections and bacterial vaginosis, and 75.0% of females have a history of a genital infection *(El Atrash et al., 2014)*.

Urinary tract infection could mark differently depending on the location of the infection and length of time involved; those that affect the lower urinary tract are called cystitis. It involves the bladder alone with symptoms including painful urination, burning sensation, whatever frequency or urge to urinate (or both), while those that

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affect the upper urinary tract are pyelonephritis, including the kidney and other organs. The upper urinary tract symptoms include fever and flank pain through urination *(Pillieri, 2014).*

Diabetes mellitus (DM) was first recognized as a disease around 3000 years ago by the ancient Egyptians and Indians. Globally, diabetes mellitus is considered one of the most common diseases. The etiology of diabetes mellitus is difficult and is associated with permanent risk factors such as age, genetic, race, ethnicity, and changeable factors such as diet, physical activity, and smoking. Nutritional habits and an inactive lifestyle are the major factors for the rapidly rising prevalence of diabetes mellitus among developing countries. Globally, diabetes mellitus is considered one of the most common diseases among developing countries *(Sami et al., 2017).*

Epidemiology is the study of factors affecting the health and illness of populations and serves as the foundation of interventions made in the interest of public health and preventive medicine. Epidemiology is the study of populations to determine the frequency and distribution of disease and measure risks. It is concerned with factors that influence the distribution of illness and injuries *(Medicineamigo.com, 2011).*

Epidemiology and community health are two inseparable words in a public health system because they deal with disease prevention, health promotion, and efficiency through organized community efforts. Epidemiology deals with the incidences and types of illnesses and injuries that affect people, while community health deals with the services that aim to care for the community's health. *(Woodward, 2013).*

Epidemiological models are a tool essential for disease investigation, health surveillance, and research. It examines the factors that influence health and illness in the population and explains how and why health and illness occur in human populations, enabling health professionals to address the health problem more successfully *(Carter, 2017*). Epidemiological models are considered a cornerstone methodology of public health research and are highly regarded in evidence-based medicine to identify risk factors for disease and determine optimal treatment approaches to clinical practice *(Russo & Williamson, 2011).*

2. Significance of the study

In Egyptian society nowadays, diabetes is common in many families, closely 10.4% of the Egyptian population (aged 10-79 years) have diabetes as it is mainly inherited in Egyptian families; furthermore, Egyptians unhealthy nutrition may lead to diabetes spread too *(Soliman et al., 2018).* Autonomic neuropathy involving the genitourinary tract causes dysfunctional voiding and urinary retention, which leads to decreased bacterial clearance by micturition, thus facilitating bacterial growth. Bladder dysfunction may be found in 26%-85% of diabetic females in Egypt *(Alrwithey et al., 2017).*

The female's prevalence of genital infection is not calculated because of many causes. However, the vaginal environment is affected by several different factors, including a female's health, personal hygiene, drugs, hormones (particularly estrogen), and spouse's health. Generally, females with self-reported gynecological morbidities symptoms do not seek management because of existing taboos and shyness regarding sexual and reproductive health. They hesitate to discuss the reproductive problem due to shame and embarrassment *(Ahmed & Omar 2017*). This study aimed to evaluate an epidemiological model on genitourinary tract infection among Egyptian diabetic females.

3. Aim of the study

The study aims to assess the effect of the web causation epidemiological model on genitourinary tract infection among diabetic females through:

- Assessing female's knowledge regarding genitourinary tract infection and diabetes mellitus.
- Identifying female practices related to genitourinary tract infection.
- Developing and implementing an intervention program for diabetic females related to the prevention of genitourinary tract infection.
- Evaluating the effect of an intervention program on diabetic female's knowledge and practices.

3.1. Operational definition

Preventive behaviors are the females' knowledge and preventive practice regarding diabetes, genitourinary tract infection.

3.2. Research Hypothesis

Diabetic females exposed to the web causation epidemiological model will exhibit better knowledge and preventive behaviors after exposure compared to the pre-intervention level.

4. Subjects and Methods

4.1. Research design

A quasi-experimental research (pre/post-test) design is utilized to fulfill the study's aim and answer the research questions. According to the article by *Sousa et al. (2007)*, the design can be used to examine the cause-and-effect relation between independent and dependent variables. Therefore, the design is most appropriate to investigate the effect of applying the web causation epidemiological model to prevent genitourinary tract infection among diabetic females.

4.2. Research Setting

The study was conducted at a diabetic outpatient clinic in El Demerdash Hospital, Ain Shams University because it receives patients from different and remote areas and has a high patient flow rate.

4.3. Subjects

Purposive sample technique used in the current study (included 100 diabetic females), the total number of study

sample 100 selected according to inclusion criteria. The inclusion criteria were able to read and write, diagnosed with DM from five years, not pregnant at the time of the study, participant free from other chronic diseases, and their age group between 25-45 years.

El-Demerdash Hospital estimated that the total number of female patients at the diabetic clinic around 1000 patients in 2013. According to hospital documentation and records, the study sample was 10% of the total number of cases to detect those with genitourinary tract infection symptoms.

4.4. Tools of data collection

Data were collected using the following tools:

4.4.1. Structure Interview Questionnaire

The investigator designed the structured interview questionnaire in simple Arabic language, after revising the related current and previous literature, to gather data that cover the aim of the study. It consisted of five parts as follow:

Part 1 is concerned with the socio-demographic characteristic of diabetic females. It included eight questions between multiple-choice and open-end questions, for asking about age, educational level, occupation, marital status, crowding index, family monthly income.

Part 2 is concerned with females' medical and family history regarding diabetes mellitus and genitourinary tract infection among diabetic females. Family history of diabetes mellitus among diabetic females included three questions between multiple-choice and open-end questions, as diabetic family history, duration of occurrence of DM, and family relation with a diabetic patient. This part also concerned with present history regarding genitourinary tract infection among diabetic females included three multiple-choice questions regarding family history, relation with a family member with GUTI, and recurrence of genitourinary tract infection.

Part 3 assesses the diabetic females' knowledge of diabetes mellitus and genitourinary tract infection. Female knowledge toward diabetes mellitus included eight close-ended questions regarding concept, function, normal range for fasting and postprandial, risk factor, causes, signs and symptoms, and DM complications.

Female's knowledge regarding genitourinary tract infection consisted of 16 close-ended questions, divided into two parts; first part consists of 7 items to assess female's knowledge about anatomy and physiology of the reproductive system, the concept of genital infection, methods of entry, predisposing factors, signs and symptoms, complications of diabetes mellitus on the reproductive system. The second part consists of 9 items to assess the female's knowledge about anatomy and physiology of the reproductive system, concept, methods of entry, predisposing factors, signs and symptoms, complications, dietary prevention of the urinary system infection, and normal fluid intake per day.

Scoring System of knowledge:

A correct answer was scored "1" and the incorrect "0" for the knowledge items. These scores were changed into a percent score. Total knowledge was reflected satisfactory if the percent score was 50% or more and unsatisfactory if less than 50%.

4.4.2. Self-reported Preventive Practice Checklists

Preventive practices' checklists were adapted to assess the female competent practices toward applying their preventive practice of genitourinary tract infection. It included the following:

- Hand hygiene checklist. It was modified from *(Steed et al., 2011).*
- Perineal care checklist. It was modified from *(Rajan 2008).*
- Urine analysis. It was modified from *(Pillieri 2014).*

Scoring system for practices:

Similarly, for practices, the items reported to be done correctly were scored "1," and the items not done or incorrectly done were scored "0". For each area, the items' scores were summed-up, and the total was divided by the number of the items, giving a mean score for the part. The practice was considered competent if the percent score was 50% or more and incompetent if less than 50%.

4.4.3. Urine analysis

Samples of urine analysis were collected according to a private laboratory *Pillieri (2014)* and sent to a private laboratory to test for the presence of infection**.** The results were recorded as either negative or positive for the presence of pathogens.

4.5. Procedures

Authorized letters, including the title and purpose of the study, were submitted from the Dean of Faculty of Nursing, Ain Shams University, to the administration of El-Demerdash Hospital, Ain Shams University, to take approval from authorities. It includes the study aims, tool of data collection, and criteria of study sample selection.

Content validity: Five experts revised tools in community health nursing specialty to assess the tool content validity regarding clarity and applicability. The necessary modifications were done accordingly.

Written informed consent was obtained from each participant. Participants assured about the anonymity of data, confidentiality, and their right to withdraw from the study at any time were guaranteed.

A pilot study was carried out on ten diabetic females (10%) of the pre-designated sample size (diabetic females) to evaluate the clarity of questions and statements, content applicability, research feasibility, and the time required to fill the tool. Modifications were carried out based on the pilot study outcomes to develop the final form of the tools. The pilot study members were excluded from the last sample size.

Field Work: The researcher completed the tools by interviewing each participant. The data collected according to inclusion criteria until the sample size was completed. At

two days per week (Saturday & Wednesday) from 9:00 am to 1:00 pm throughout the program phases (Preparatory, assessment, planning, implementing, and evaluating phase). The method of data collection consumed six months from September 2016 completed by February 2017. Contact information includes telephone numbers, were collected to facilitate contact with participants.

The program included the preparatory, assessment, planning, implementing, and evaluating phase. Program sessions usually consumed 60 minutes per session and were conducted in a comfortable place in the outpatient clinic's waiting area within the dedicated time. Issues of confidentiality were confirmed. The total number of sessions was four sessions. Three sessions for theory and one session for practice. Each session took about one hour (about 3-hour theory and 1-hour practice. The program (four phases) lasted six months.

Preparatory phase: The researcher established a professional relationship with the diabetic females through an outpatient clinic interview to emphasize the program's objective and benefits. The researcher was reassuring and helping participants while filling the interviewing sheets, and the result of the test will be confidential.

The planning phase includes:

- Determine learning objectives of the program.
- Determine the learning contents of the program.
- Choose teaching methods as discussion, lecture, and demonstration.
- Select educational media as a laptop, video, pictures, and written materials (booklet) as mechanisms to gain information and facilitate discussion.
- Determine evaluation materials by the study tools.

Implementation phase: The investigator discusses with the diabetic female the following items:

- Identify diabetes mellitus.
- Describe physiology and pathophysiology of diabetes mellitus.
- Recognize risk factors of diabetes mellitus, clinical manifestation, complications, and follow-up.
- Clarify risk factors and the relationship between diabetes mellitus and female genitourinary tract infections.
- Describe the anatomy and physiology of the female urinary system
- Define urinary tract infections.
- Recognize different causative factors that might lead to urinary tract infections.
- Describe signs and symptoms related to urinary tract infections.
- Describe the anatomy and physiology of the female reproductive system.
- Define genital tract infections.
- Recognize different causative factors that might lead to genital tract infections.
- Describe signs and symptoms related to genital tract infections.
- List complications of genitourinary tract infections.
- Appreciate the importance of hygienic practice for the genitourinary system daily.
- Clarify general preventive measures about hygienic daily practice and during menstruation.
- Demonstrate the proper technique of genital hygienic care practice by using a perineal care checklist.
- Explain correct steps to obtain urine analysis.

Evaluation of program: This phase aimed to evaluate implementing the intervention program to prevent genitourinary tract infection among diabetic females by applying the same data collection tools and urine analysis. The evaluation was conducted after three months after program implementation.

4.6. Data Analysis

The collected data were organized, coded, tabulated, and analyzed using the statistical package for social science SPSS version 23. Quantitative data were described using numbers and percentages. Association between categorical variables tested using Chi-square test. When more than 25% of the cells have an expected count less than 5, Fisher exact test used. Continuous variables were presented as mean±SD (standard deviation). Comparison of means using paired t-test (parametric data). Analysis of Variance (ANOVA, f test) was used to compare means of more than two groups. The significant level value was considered when $p \leq 0.05$. The results were considered:

- Significant when the probability of error is less than 5% ($p < 0.05$).
- Non-significant when the probability of error is more than 5% ($p > 0.05$).
- Highly significant when the probability of error is less than 1% ($p < 0.01$).
- The smaller the p-value obtained, the more significant are the result.

5. Results

Table 1 shows that the mean age in the study group was 40±4.409, where 50% of their age between 40-<45 years followed by 35% of their age between 35-<40 years. Concerning diabetic female education level, 64% of them had basic education, while a minority, 8% of them had a university education. Regarding their occupation, 62% of them were housewives. About the crowding index, 68% of them were >5. Related to monthly income, 86% of them had insufficient income.

Table 2 reports that 69% of diabetic females had a family history of diabetes mellitus. 52.2% of their mothers had diabetes mellitus. Regarding the duration of diabetes mellitus, 53% of them had a duration between 11-15 years. This table also shows that 86% of them had no family history of genitourinary tract infection. Regarding recurrence of genitourinary tract infections per year, 54% of them had between 4-6 times/year.

Table 3 shows 32% of diabetic females have satisfactory knowledge regarding the concept of diabetes shift to 92% at post-program implementation. Regarding the risk factor of diabetes, 22% of diabetic females have a satisfactory knowledge shift to 75% at post-program implementation. Additionally, 47% have satisfactory

knowledge about signs and symptoms of diabetes mellitus shift to 86% at post-program implementation.

Moreover, 28% of the participants have satisfactory knowledge level regarding the diabetic complications, increased to 76% post-program. A highly statistically significant difference reveals between pre/post-test scores of female knowledge regarding all diabetic knowledge.

Table 4 reveals that 35% of the participants have satisfactory knowledge regarding the function of the reproductive system, 25% of them have satisfactory knowledge regarding the concept of genital infection. Additionally, 32% have satisfactory knowledge regarding methods of entry genital infection at preprogram shift to 93%, 74%, and 93% of them had satisfactory knowledge at post-program implementation, respectively.

Also, the table shows that 26%, 25% of the participants have unsatisfactory knowledge related to the signs and symptoms of genital infection, and complications of DM on the reproductive system improved to 82% and 69% post-implementation. A highly statistically significant difference between pre/post-test scores of females' knowledge regarding genital infection was revealed.

Table 5 reports a highly statistically significant difference between pre/post-test scores of female knowledge regarding urinary tract infection.

Fig 1 reveals that 22% of diabetic females had competent hand hygiene, 18% perineal care, and 9% follow urine analysis steps in preprogram implementation shift to 83% of them had competent hand hygiene,75% follow perineal care steps, and 72% follow urine analysis steps at post-program implementation.

Table 6 reveals the comparison of total female practice toward their hand hygiene, perineal care, and urine analysis steps. Statistically significant differences were observed regarding hand hygiene, perineal care, and urine analysis post-intervention compared to preintervention at p=0.000.

Table 7 illustrates a highly statistically significant association between the presence of urine infection and application of web causation model (causative factors) such as lack of hygiene during menstruation, lack of hygiene before and after sexual intercourse, using mechanical contraceptive methods, increase the intake of salty foods, poor glycemic control and lack of personal hygiene with the results of urine analysis for infection.

Table (1): Frequency and percentage distribution of diabetic females' socio-demographic characteristics (n=100).

Socio-demographic characteristics	N	%
Age (years)		
25-<30	8	8.0
30-<35	7	7.0
35-<40	35	35.0
40-<45	50	50.0
Mean ±SD	40± 4.409	
Level of education		
Basic education	64	64.0
Secondary education	17	17.0
Above secondary education	11	11.0
University	8	8.0
Occupation		
Housewife	62	62.0
Worker	38	38.0
Marital status		
Married	100	100
Crowding index		
<5	32	32.0
>5	68	68.0
Family income/month		
Sufficient	14	14.0
Insufficient	86	86.0

Table (2): Frequency and percentage distribution of diabetic females' medical and family history of diabetes mellitus and genitourinary tract infection (n=100).

Items	N	%
Family history of diabetes mellitus		
Yes	69	69.0
No	31	31.0
Duration of occurrence diabetes mellitus		
5-10 years	25	25.0
11-15 years	53	53.0
16-20 years	22	22.0
Relation of family members' history an incidence of diabetes mellitus among diabetic female (N=69)		
Father	24	34.8
Mother	36	52.2
Father/ Mother	9	13.0
Family history of genitourinary tract infection		
Yes	14	14.0
No	86	86.0
Relation to a family member with genitourinary tract infection (n=14)		
Husband	6	42.9
Son	2	14.2
Daughter	6	42.9
Recurrence of genitourinary tract infection per year for diabetic females:		
3 ≥ times /yearly	13	13.0
4-6 times/yearly	54	54.0
More than 6 times / yearly	33	33.0

Table (3): Comparison of diabetic females' satisfactory knowledge regarding diabetes mellitus pre/post-intervention (n=100).

Knowledge domains	Pre		Post		χ^2	P - Value
	N	%	N	%		
Concept of diabetes mellitus	32	32.0	92	92.0	21.008	0.000
Responsible organ to secrete insulin in the body	21	21.0	89	89.0	27.452	0.000
The normal range of fasting blood sugar	43	43.0	83	83.0	18.621	0.000
The normal range of postprandial	54	54.0	78	78.0	14.431	0.000
The risk factor of diabetes mellitus	22	22.0	75	75.0	19.563	0.000
Causes that lead to increase blood glucose with the diabetic patient	39	39.0	81	81.0	16.080	0.000
Signs and symptoms of diabetes mellitus	47	47.0	86	86.0	18.588	0.000
Complications of diabetes mellitus	28	28.0	76	76.0	24.212	0.000

Table (4): Comparison of diabetic females' satisfactory knowledge regarding genital infection pre/post-intervention (n=100).

Knowledge domains	Pre		Post		χ^2	P - Value
	N	%	N	%		
Anatomy of the reproductive system	12	12.0	79	79.0	28.868	0.000
The function of the reproductive system	35	35.0	93	93.0	22.091	0.000
Concept of genital infection	25	25.0	74	74.0	19.858	0.000
Methods of entry genital infection	32	32.0	93	93.0	20.645	0.000
Predisposing factors for genital infection	23	23.0	78	78.0	24.888	0.000
Signs and symptoms of genital infection	26	26.0	82	82.0	24.106	0.000
Complications of diabetes mellitus on the reproductive system	25	25.0	69	69.0	19.106	0.000

Table (5): Comparison of diabetic females' satisfactory knowledge regarding urinary tract infection pre/post-intervention (n=100).

Knowledge domains	Pre		Post		χ^2	P - Value
	N	%	N	%		
Anatomy of the urinary system	7	7.0	51	51.0	15.962	0.000
The function of the urinary system	12	12.0	62	62.0	22.842	0.000
Concept of urinary tract infection	19	19.0	73	73.0	12.222	0.000
Method of entry urinary tract infection	34	34.0	81	81.0	38.624	0.000
Predisposing factors for urinary tract infection	38	38.0	78	78.0	17.868	0.000
Signs and symptoms of urinary tract infection	42	42.0	71	71.0	14.255	0.000
The complication of diabetes mellitus on the urinary system	33	33.0	83	83.0	36.686	0.000
Dietary Prevention	32	32.0	73	73. 0	25.066	0.000
Normal fluid intake per day	27	27.0	69	69.0	22.091	0.000

Table (6): Comparison of diabetic female's total practice score of their hand hygiene, perineal care, and urine analysis steps (n=100).

Items	Pre		Post		T Test	P - Value
	Mean	SD	Mean	SD		
Hand hygiene	38.58	30.71	79.42	9.88	-4.384	0.000
Perineal care	28.43	14.51	86.57	7.81	-9.335	0.000
Urine analysis	52.17	28.72	94.00	4.47	-3.525	0.005
Total	39.00	27.07	84.92	10.03	-7.952	0.000

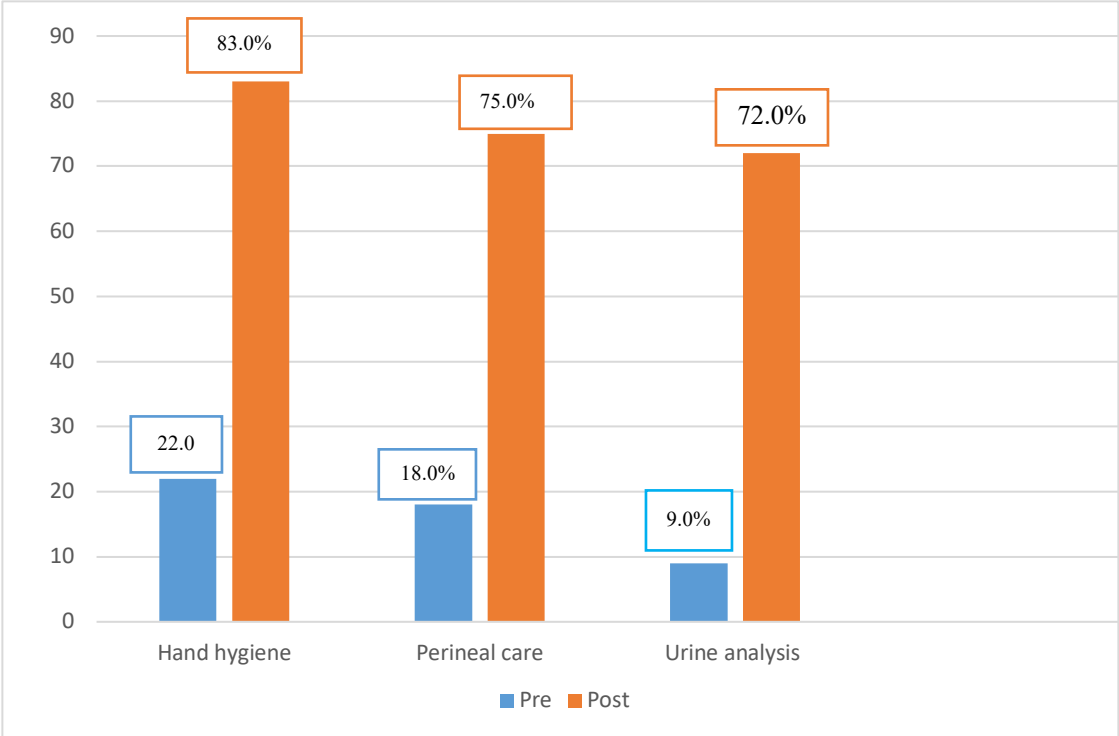

Fig (1): Distribution of diabetic females' competent practices toward applying their preventive practice of genitourinary tract infection (n=100).

Table (7): Relation between the application of Web Causation Epidemiological Model and urine analysis results for infection among diabetic females (n=100).

Web Causation Epidemiological Model	Urine Analysis Test		χ^2	P-value
	+Ve	-Ve		
Lack of hygiene during menstruation				
Yes	12	80	640.15	0.000
No	2	6		
Lack of hygiene before and after sexual intercourse				
Yes	9	77	600.84	0.000
No	5	8		
Use mechanical contraceptive methods.				
Yes	7	79	607.21	0.000
No	7	4		
Increase the intake of salty foods				
Yes	10	45	388.94	0.000
No	4	41		
Poor glycemic control				
Yes	8	45	370.34	0.000
No	6	41		
Lack of personal hygienic care				
Yes	10	46	395.46	0.000
No	4	40		

6. Discussion

Diabetic females are at higher risk for developing vaginal infections than females without diabetes. Besides, if the diabetic female is not well-controlled, their blood sugar creates an environment of high sugar in the mucous membranes, including the vagina, which creates a good environment for the overgrowth of both bacteria yeast. Those are the two main areas of infection. The two main causes of vaginal infection in females are bacteria and yeast *(Nyirjesy & Sobel, 2013).* The study aims to assess the effect of the web causation epidemiological model on genitourinary tract infection among diabetic females.

The current study displays the socio-demographic characteristics of diabetic females. The present study reveals that the mean age of diabetic females was 40±4.409, and half of them between 40-<45 years, followed by more than one-third of their age between 35-<40 years old**.** There is a clear association between increasing age and greater diabetes prevalence.

Concerning diabetic females' education, this study reveals that about two-thirds of them had basic education, while the minority of them had a university education. The result of this study agrees with *Saydah and Lochner (2010),* who reported in a study about socioeconomic status and risk of diabetes-related mortality in the USA, the result showed that a socioeconomic gradient exists in diabetes-related mortality in the US, with both education and income being essential determinants of the risk of mortality associated with this disease. which is evident by the present study results that most of the diabetic females reported insufficient income

This study supported by another study aimed to assess the impact of education on disease knowledge and blood glucose level control among type 2 diabetic females in family practice conducted by *Herenda et al. (2007).* Herenda's study highlighted a poor basic knowledge about diabetes among diabetic females. The study also emphasized that special attention should be given to sensitizing diabetic female, especially with low educational level, shorter duration of illness, and younger patients (under 50 years) who must be closely monitored for control of sugar level in blood and avoid liability to increase the chance of exposure to complication.

The present study finding indicates that less than two-thirds of them were housewives. The current study result may be explained by that working for a diabetic female could affect the health either positively or negatively according to the level of education and work characteristics. Positively, if diabetic female works outside the home, it lets her become more experienced and aware of lifestyle and care with diabetes; and negatively, when a diabetic female becomes overwhelmed with family and life circumstances to omit herself and diabetic care.

Low level of education, no working status, and insufficient income reported by the studied diabetic females could explain the low income or low socioeconomic status, which might be linked to the absence or decrease follow up, added to the low education level of the diabetic female led to decrease awareness about management of diabetes, how to adapt with her lifestyle and avoid complications.

The study finding agrees with other studies in India about the association between socioeconomic status and diabetes in rural settings. The study conducted by *Rathinavelu et al. (2017)* stated that, regarding the association between socioeconomic status (SES) and diabetes in rural settings of India, the study findings demonstrated that participants with low income have a higher incidence of diabetes than wealthy members.

Regarding the crowding index, more than two-thirds of them had more than five members in their homes. Increasing family size leads to increased liability to catch infection easily due to over-crowded people and poor physical infrastructure. This result is supported by a study done in Egypt about socioeconomic determinants affecting diabetic and hypertensive patients' quality of life in a rural area. It was conducted by *El Shazly and Hegazy (2017),* who reported that the low socioeconomic condition and physical infrastructure in the home might influence the incidence of genitourinary infections.

Regarding family history among diabetic females, the current study illustrated that more than two-thirds of the studied females had a family history of diabetes mellitus related to the relationship of the diabetic female with family members; more than half of them had diabetic mothers, and more than half had diabetic fathers, plus thirteen percent had diabetic parents. The results show that individuals with a family history of diabetes with first-degree family members were at higher risk of diabetes mellitus. The study contradicted other studies about the association between family history and risk of type 2 diabetes that is not described by anthropometric, lifestyle, or genetic risk factors conducted by *Interact Consortium (2013).*

Regarding the duration of diabetes mellitus, more than half of the diabetic females had diabetic Mellitus from the duration of 11-15 years. This study agrees with the study done in Canada about the association between diabetes mellitus and the incidence of infections by *Abu-Ashour et al. (2017),* who stated that long-standing diabetes is often convoyed by impaired cell-mediated immunity, which raises the risk to more severe and widespread infections.

Another study conducted in Egypt about urinary tract infection in patients with diabetes mellitus by *Alrwithey et al. (2017),* who reported that asymptomatic bacteriuria was reported to have an increased prevalence in people with diabetes by about 8% to 25% and was also found to have amplified occurrence within patients with longer duration of diabetes.

More than half of them had between 4-6 times/year regarding recurrence of genitourinary tract infection. These findings were highly supported by *Hassanine, et al. (2018),* who reported that In Egypt, UTIs' recurrence rate among diabetic females is 25–45%, which is significantly higher than in nondiabetic. It is even though people with diabetes tend to receive longer and more potent initial treatment. Recurrent UTIs may be difficult to treat and may need the use of prophylactic antibiotics.

This study also supported Canada's study about the association between diabetes mellitus and incident infections conducted by *Abu-Ashour et al. (2017),* who stated that genitourinary tract infections might be associated with certain potential diabetes mechanisms. It is well established that yeasts thrive in a sugar-rich environment. Therefore, it is logical to hypothesize that high glucose concentrations in females with diabetes may be responsible for promoting candidiasis occurrence and recurrence. Candida albicans virulence is shown to flourish in a hyperglycemic environment.

In the current study, less than one-third of them had satisfactory knowledge regarding the concept of diabetes shift to most at post-program implementation. The risk factor of diabetes shows that more than two-fifth of diabetic females' satisfactory knowledge shifted to three quarters at post-program implementation. Also, less than half of them had satisfactory knowledge about signs and symptoms of diabetes mellitus shift to the majority at post-program implementation. All knowledge elements show a statistically significant difference between pre/post-test levels.

This study's result disagrees with a study done at South East Ethiopia about knowledge, attitude, practices, and their associated factors towards diabetes mellitus among non-diabetes community members conduct by *Kassahun and Mekonen (2017),* who stated that 52.5% of participants were knowledgeable about diabetes mellitus. Almost 52% of participants were not knowledgeable regarding risk factors, signs, and symptoms of diabetes, and more than half were knowledgeable in diabetic concept (54.5%), control and management (52.5%), and its complication (51.5%).

Regarding complication of diabetes mellitus, less than one-third of them had satisfactory knowledge shift to around three quarters at post-program implementation. This finding supported by a study done in Ghana about knowledge of complications of diabetes mellitus among patients visiting the diabetes clinic, conducted by *Obirikorang et al. (2016),* who stated that level of knowledge on the complications showed that the majority (60.0%) of T2D patients did not know diabetes complications, (26.9%) had inadequate knowledge on diabetic's complication while (13.1%) had adequate knowledge.

This study reveals that diabetic females had unsatisfactory knowledge related to the function of the reproductive system, the concept of genital infection, methods of entry genital infection at preprogram shift to the majority of them had satisfactory knowledge at post-program implementation. This result agrees with *Santoso et al. (2018),* about the awareness of urinary tract infection management in pregnant women: A qualitative study. The study reported unsatisfactory knowledge about vulvovaginitis in the study sample pretest (definition, risk factors, causes, and management) and satisfactory knowledge in the post-test after three months from instructional module implementation.

The current study reveals that more than one-quarter of diabetic females had satisfactory knowledge about signs and symptoms of genital infection at preprogram shift to the majority at post-program implementation. A different study conducted by *Ahmed and Omar (2017)* in Egypt about the effectiveness of planned educational programs on vaginitis and its preventive measures on adolescent female nursing students' knowledge. The study identified that most participants had unsatisfactory knowledge level regarding the genital tract infection, which is improved after program implementation, that most of the participants had satisfactory knowledge.

This study illustrates that one-quarter of diabetic females had satisfactory knowledge about complications of diabetes mellitus on the reproductive system at preprogram shift to around two-thirds at post-program implementation with a highly statistically significant difference. This result disagrees with a study done in Oman to evaluate T2DM related knowledge and practices of Omani patients. The study conducted by *Al bimani et al. (2015)* reported that 65.1% knew that diabetes could affect other body organs and lead to multiple complications. Most of them were able to identify the acute and chronic complications of diabetes, such as kidney disease, eye disease, heart disease, and foot ulcer.

Related level of knowledge regarding urinary tract infection, the study reports that one-third of them had satisfactory knowledge about entry urinary tract infection methods at preprogram shift to the majority at post-program implementation**.** Most UTIs are caused by ascending entry of bacteria from the periurethral area, emphasizing the importance of host factors contributing to entry. Bacteria move in the bladder through the short female urethra even with its high-pressure zone and the presence of urethral mucus. There is evidence that bacteria can pass up the female urethra during urination and that sexual activity may be a significant causal factor *(Larcombe, 2015).*

As for predisposing factors for urinary tract infection such as diabetes mellitus and personal hygiene, more than one-third of them had satisfactory knowledge shifts to more than three quarters at post-program implementation. This study agrees with another study done in India by *Najar et al. (2009)* about the approach to urinary tract infections. The study reported that the predisposing factors that increase UTI risk include diet, tampons, clothing, and personal hygiene, including wiping after defecation and bathing practices. Sexually active females have a seriously increased risk of cystitis.

All types of UTI are more frequent in patients with type 2 diabetes. Another observational study about urinary tract infections in patients with type 2 diabetes mellitus, applied in the UK and conducted by *Nitzan et al. (2015)*, reported that of all patients with type 2 diabetes in the UK general practice research database found that the incidence rate of UTI was 46.9 per 1,000 person-years among diabetic patients and 29.9 for patients without diabetes.

Another American database study reported by *Nitzan et al. (2015)* found that a UTI diagnosis was more common in men and women with diabetes than in those without

diabetes (9.4% vs. 5.7%, respectively) among 89,790 matched pairs of patients with and without type 2 diabetes mellitus.

More than two-fifths of them had satisfactory knowledge at preprogram shift to less than three quarters at post-program implementation regarding signs and symptoms of urinary tract infection. This finding supported with other studies done in Egypt about assessing sexual dysfunction in Egyptian women with lower urinary tract symptoms conducted by *El Atrash et al. (2014),* who mentions that there is a positive relationship between female sexual dysfunction (FSD) and urinary tract infection (UTI) and also the effect of urinary tract infection on the quality of life of affected females, especially with several having coital incontinence, which might be an obstacle to a satisfactory sexual life. The relationship between sexual dysfunction (FSD) and urinary tract infection (UTI) was suggested to be a consequence of an overactive bladder, urinary incontinence, and pelvic prolapse, apart from the hormonal deficiencies that affect the pelvic organs.

The current study reveals that around two-thirds of diabetic females had satisfactory knowledge about preventing urinary tract infection preventive foods shift to the majority at post-program implementation. Less than three-quarters of them know normal fluid intake per day shift to more than two-thirds post-program implementation**.** This study supported by a study about the impact of fluid intake in the prevention of urinary system diseases, conducted by *Lotan et al. (2013),* who reported that health benefits of a high fluid intake have all pointed towards a lack of data to support the widely cited recommendation that we should all be drinking at least eight glasses of water per day (excluding caffeinated or alcoholic drinks), from these studies, inadequate fluid intake appears to be an important factor in several chronic diseases of the urinary tract.

Regards diabetic female competence toward their application of hand hygiene, perineal care, and urine analysis to prevent genitourinary tract infection, the study reveals that more than one-fifth of diabetic females had competent hand hygiene, less than one-fifth of diabetic female had competent practice regarding self-reported perineal care. The minority of them followed their infectious status by urine analysis in preprogram implementation shift to the majority of them had competent hand hygiene, three-quarters of them follow perineal care steps, and around three-quarters of them follow urine analysis steps at post-program implementation. The previous findings might be referred to as adopting the web causation epidemiological model in targeting the diabetic females' poor knowledge and incompetent practice as an approach for preventing genital tract infection.

These findings agree with *Hamed (2015),* who reported that incorrect perineal hygiene practices (i.e., back to forward) might cause infections due to the transfer of microorganisms from the anus to the vagina. Genital infection is shown to be seen 4-5 times more frequent in females who clean their genital area with their hands. Females who use this method should give special importance to their handwash and dry up with toilette paper afterward. Using cloths for cleansing after urination and/or defecation leads to a high risk for infection. These findings are supporting the current research hypothesis.

The current study demonstrates a highly statistically significant association between the presence of urine infection and application of web causation model (causative factors) such as lack of hygiene during menstruation, lack of hygiene before and after sexual intercourse, using mechanical contraceptive methods, increase the intake of salty foods, poor glycemic control and lack of personal hygiene with the results of urine analysis for infection. These findings may be referred to low socioeconomic standards of the participated diabetic females, evidenced in the present study as most of them had insufficient income and low educational level. The current study finding is supported by a study of Genital infections in patients with diabetes. It was conducted by *Nyirjesy and Sobel (2013),* who reported that more common vaginal infections among females with poor socioeconomic status while sufficient income makes it easier to meet hygiene requirements and helps females to conveniently utilize healthcare institutions if they experience any problems with their health.

This finding is supported with a study done in Brazil about nursing diagnoses of diabetic patient medical charts: A descriptive study conducted by *Silva et al. (2013),* who stated that there is a highly significant relation between genitourinary tract infections and poor personal hygiene, there was a higher risk of infections, especially when the cervix opens up and creates a pathway for bacteria to enter the uterus and pelvic cavity. In scientific terms, the pH in the vagina is less acidic, which creates a good environment for yeast infections such as Candidiasis during this period. There is a clear link between the incorrect technique of perineal care, keeping the area moist or using cloth for drying it, using reusable cloth, and using intra-vaginal cleaning and genitourinary tract infections.

The result is also supported by the study done at Delhi about urinary tract infection and its risk factors in women conducted by *Singh (2014),* who reported that lack of personal hygienic care as cleanliness of the underwear and the regularity with which it is changed is important causes regarding the risk of receiving a urinary infection. Nylon and synthetic underwear do not absorb sweat and discharge as much as cotton underwear does, causing the perineum to stay humid and increased the risk of genital tract infections**.**

7. Conclusion

Generally, Diabetic females exposed to the web causation epidemiological model exhibited better knowledge and preventive behaviors after exposure compared to the pre-intervention level.

8. Recommendations

- Improving diabetic knowledge and practices among diabetic females by developing patient family education to avoid genitourinary tract infection.

- Apply this study to a high population area with different gender and age groups to improve awareness and practices regarding diabetes mellitus and genitourinary tract infection.
- Developed diabetic sheet assessment applied with each visit includes early signs and symptoms and early detection to prevent genitourinary tract infection.

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