Health Guidelines for slaughter house workers about brucellosis in Port Said city

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ABSTRACT

Background: Brucellosis is an occupational hazard for slaughter house workers. Community health nurses have an important role in training them in safe practices for prevention. **Aim of the study**: to evaluate the effect of health guidelines for slaughter house workers about brucellosis in Port Said. **Subjects and methods**: The study was conducted on all 70 workers employed at Port Said slaughter house. It is located in El Gabbouti Al-Gadeed at AL-Ganoob district by using a one-group quasi-experimental research design with pre-post assessment. Data were collected using a structured interview questionnaire form for worker's knowledge of brucellosis, observation checklists for safe practices and hand washing, and a laboratory sheet for the results of brucellosis blood tests. Based on the information obtained from the initial assessment, the researchers designed the health guidelines and implemented it. **Results**: All workers were males with median age 42 years. Overall, 83.1% of the tested samples (n=65) demonstrated sero-positivity. Only 2 (2.9%) workers had satisfactory knowledge before the intervention, which increased to 70.0% after the intervention ($p<0.001$). Moreover, 32.9% had adequate practice before the intervention, which rose to 92.9% after the intervention ($p<0.001$), with significant improvement in hand washing practice ($p<0.001$). In multivariate analysis, the study intervention was the main significant independent positive predictor of the scores of knowledge, hand washing practice, and total practice; the knowledge score was a significant positive predictor of the score of hand washing practice. **Conclusion and recommendations**: The implementation of health guidelines can be effective in remedying the deficiencies in slaughterhouse workers' knowledge and practices. Therefore, the guidelines should be implemented in the setting and similar ones.

Keywords: Brucellosis, Slaughterhouse, Sero-positivity, Knowledge, Practice

Introduction

Brucellosis is a common zoonotic disease especially in developing countries and is considered an important neglected endemic zoonosis due to lack of public awareness ***(Al Anazi et al, 2019; Elelu et al., 2019)***.According to the reports of the World Health Organization, more than 70 cases per 100,000 are estimated in Middle East States***(Pal, 2017***).The Egyptian Ministry of Health recorded a substantial increase in the number of patients with brucellosis, from 24 cases in 2010 to 1429 in 2016 ***(Meky et al, 2017)***. However, the actual reporting is estimated to be 20 to 25 times greater than the official reports (***Mohamed et al., 2019)***.

Brucellosis infection can be transmit to humans through contact with blood or tissues from infected animals, consumption of unpasteurized milk and milk products, or the entry of the bacteria through skin lesions, conjunctiva, and inhalation ***(Casallas et al,2018; Elelu et al., 2019)***. Its incubation period varies between 1 and 3 weeks, but can be several months. According to duration and intensity of symptoms, the illness can have an acute form (<2 months), sub-acute form (2-12 months), and chronic (>1 year) ***(Roushan et al, 2014; Lagadinou et al., 2019).***Chronic brucellosis can cause spondylitis, chronic fatigue syndrome, musculoskeletal pain, depression and anxiety ***(Singh et al, 2018)***.

Brucellosis constitutes an occupational hazard for veterinarians, slaughterhouse workers, laboratory technicians, and farmers ***(Proch et al., 2018)***. The disease has an enormous economic burden due to reduced productivity of the workers, as well as the risks of abortions, weak

offspring and low milk production in livestock ***(Boral et al, 2016 and Alkahtani et al,2020)***.Brucellosis control needs the collaboration of veterinary, medical, public health, cultural, economic and social experts. However, human brucellosis control begins with the control of disease in animals***(Franc, 2018)***.Vaccination of healthy as well as suspicious animals in high prevalence areas play an important role in elimination of the disease***(Hasanjani-Roushan et al, 2014; Steven, 2018 and Fero et al,2020)***.

Community health nurses have an important role in the prevention and control of brucellosis through providing health education to the population at risk about the nature of the disease, its causes, modes of transmission, signs and symptoms, and methods of prevention and control. Moreover, as the Brucella organism is easily killed by common disinfectants and heat, the importance of milk pasteurization and thorough cooking of meat products should be emphasized in such educational efforts ***(El Hameed et al, 2012)***. As for slaughterhouse workers, the community health nurse role involves in addition training them in safe practices as hand hygiene and use of personal protective equipment ***(Heavey, 2019)***. Nevertheless, further research has been recommended to cover the gap of data about the risks among slaughterhouse workers and the effect of educational endeavors on them ***(Ntirandekura et al, 2018)***. Moreover, a recent systematic review concluded that the awareness and knowledge of brucellosis was deficient in most studies carried out in Asia and Africa ***(Zhang et al, 2019)***.

Significance of the study:

In Egypt since 1939 the estimated annual economic losses due to brucellosis were about 60 million Egyptian pounds yearly ***(Abdel-Fattah, 2014)***. In the Nile delta region, the incidence was estimated at 18 cases/ 100,000 populations .The distribution pattern of human cases of brucellosis the infection rate was generally was marked increases in numbers of cases. This was clearly observed in Alexandria and Menofiya, and also in Giza and Damietta. ***(Meky et al.2007)***.

Since brucellosis is often misdiagnosed, resulting in mistreatment and under reporting. Moreover acute infection if not adequately treated may progress to chronic infections. Also, slaughterhouse workers have a high prevalence to brucella owing to their close contact with animals. Furthermore, Brucellosis has great impact on human health and economic, so the study will be conducted to evaluate the effect of health guidelines for slaughter house workers about brucellosis in Port Said.

Aim of study

This study aimed to evaluate the effect of health guidelines for slaughterhouse workers about brucellosis in Port Said City through 1) assessing workers' knowledge and practice about brucellosis to identify their needs; developing and implementing a health guideline program according to identified needs, and 3) evaluating the effect of the health guidelines program on workers to knowledge and practice prevent brucellosis infection.

Research hypothesis

The implementation of the health guideline program will improve workers' knowledge and practice related to brucellosis.

Subjects and Methods

Research design and setting: A one-group quasi-experimental research design with pre-post assessment was used in carrying out the study at the Port Said City. It is located in El Gabbouti Al-Gadeed at AL-Ganoob district, and is the only slaughterhouse in Port Said Governorate. The slaughterhouse consists of seven buildings, namely an administrative building, the first and second manual buildings, the half automation building (not working yet), the boiler building, the animals culling oven building and the leather storage building. The safety measures include clearly marked emergency exits and suitable fire extinguishers. However, there is no medical clinic on the premises. The slaughterhouse is open 24 hours/day, 6 days a week. Animal slaughtering is done only during the morning shift only except for emergency cases and after slaughterhouse director´s opinion.

Study sample: All the workers in the setting were included in the study. Thus, no sample size calculation or sampling technique

was applied. The total number included was 70 all workers.

Data collection tools: Three tools were used to collect data, namely a structured interview questionnaire form, an observation checklist, and a laboratory sheet.

- **Tool I**: *Structured interview questionnaire*: This was in Arabic language and comprised three parts as following:
  - *Part I*: This was worker's personal characteristics as age, educational level, job type, marital status, place of residence, and monthly income.
  - *Part II*: This part asked about workers' medical and family history with emphasis on the history of present or past brucellosis infection, family history, raising animals at home, as well as the history of chronic diseases.
  - *Part III*: This was intended to assess worker's knowledge of brucellosis before and after the study intervention. It was adapted from ***Abdel-Fattah (2014)*** and ***Ahmed (2014)*** and modified by the researchers based on extensive review of the literature. It included questions related brucellosis in human and animals such as meaning, persons at risk, risky animals, incubation period, transmission (man and animal), symptoms/signs (man and animal), complications (man and animal), and prevention.

    Scoring: For each question, a correct answer was scored "1" and the incorrect "0." For each area of knowledge and for the total tool, the scores of the items were summed-up and the total divided by the number of the items, giving mean scores, which were converted into percent scores. The knowledge was considered satisfactory if the percent score was 60% or higher and unsatisfactory if less than 60%.

- **Tools II**: *Observation checklists*: These were adapted from ***Abdel-Fattah (2014)*** and modified by the researcher. It included a checklist for safe practices, and another one for hand washing.
  - *Checklist for safe practices*: intended to assess the practices of the workers at the three stages of the slaughtering process to avoid infection with brucellosis. It comprised 6 items for the "before stage" assessing the preparation for the process such as wearing protective clothing and cleaning knives; 5 items for the "during stage" assessing compliance with avoiding eating, drinking, smoking, putting knife in mouth, etc.; and 6 items for the "after stage" concerned with washing hands, garments, and cleanup. Each item was checked as "done" or "not done."

    Scoring: Each item observed to be done was scored "1" and the not-done "0." For each stage of the process for the total checklist, the scores of the items were summed-up and the total divided by the number of the items, giving mean scores, which were converted into percent scores. The practice was considered adequate if the percent score was 60% or higher and inadequate if less than 60%.
  - *Checklist for hand washing*: to assess worker's hand washing practices. It involved 10 items to evaluate the practice the steps of proper hand washing including opening the water tap, adjusting water flow, pouring liquid or soap in hands, moving soap between fingers and hands, rubbing, friction of interlocking fingers, cleaning between nails separately, circular motion is used to scrubs the thump , circular motion is used to the rest of the hand , rinse hands under running water and hands are dried after washing .

    Scoring: Each item observed to be done was scored "1" and the not-done "0." For the total checklist, the scores of the items were summed-up and the total divided by the number of the items, giving a mean score, which was converted into a percent score. The hand washing practice was considered adequate if the percent score was 60% or higher and inadequate if less than 60%.

- **Tool III:** *Laboratory sheet*: This was used to record the results of blood analysis for brucellosis among study workers.

Tools validity and reliability: Once prepared, the tools were presented to a panel of seven experts in Community Health Nursing from the Faculty of Nursing, Port-Said University for face and content validation. They examined the tools for format, layout, and consistency as well as their relevance, appropriateness, comprehensiveness, and clarity. The necessary modifications were done accordingly. The reliability for the hand washing and total practices scales was assessed by examining their internal consistency. They showed very good levels of reliability with Spearman-Brown coefficients 0.76 and 0.73 respectively.

Pilot study: A pilot study was carried out on seven workers representing 10% of the total sample to test the applicability and clarity of the tools and to estimate the time needed to fill them. It also helped to find out any problems and obstacles that might interfere with the data collection process. Since no changes were done in any of the tools, these workers were included in the main study sample.

Fieldwork: The study was implemented through assessment, planning, implementation, and evaluation phases. The data have been collected over a period of three months. The actual field of work was carried out from the beginning of November (2019) to the end of January (2020). The setting was visited three days/week from the beginning to the end of the morning shift.

Assessment phase: After finalization of the tools and obtaining necessary permissions, the researchers started to assess workers' knowledge and practices as baseline or pretest data. They visited the setting, met with the workers to explain the aim of the study and its maneuvers and to obtain their verbal informed consent to participate. Then, interviews were carried out individually and privately; it took 25-35 minutes with each worker. Then, the worker's practices were assessed during routine work using the hand washing and total practice observation checklists.

Then, the researchers with an assistance of three laboratory technicians collected a blood sample from each worker. Venipuncture was done using sterile disposable syringes, and a blood sample of 3-5 ml was obtained. Blood samples were clearly labeled with names, a specific code and date. They were kept in icebox and transported to the laboratory at Manzala city. Sera were extracted immediately and tested for the presence of Brucella antibodies using Rose Bengal Plate Test (RBPT). The sera of sero-positive individuals to RBPT antigen were then stored at -20ºC to be confirmed by Serum Agglutination Test (SAT) used to detect Brucella antibodies. A positive reaction was determined by observing agglutination at 1:160 or more. All workers agreed to be tested for brucellosis except five workers, four of them refused to perform blood analysis and one had severely injured arms.

Planning phase: Based on the information obtained from the initial assessment, the researchers designed the health guidelines. It was aimed at improving worker's knowledge and practices regarding brucellosis. A simple handout pamphlet was prepared by the researchers in Arabic language with illustrative colored pictures to enhance the learning process and facilitate understanding. It included a brief introduction about brucellosis definition, prevalence, causative agents, modes of transmission, incubation period, high risk group of people and animals, signs and symptoms, complications, diagnosis, treatment, and prevention. It also involved an overview of proper hand washing technique and related guidelines. The guidelines covered both the theoretical and practical aspects of the topic.

Implementation phase: The health guidelines were implemented in the slaughterhouse through small group theoretical and practical sessions. The workers were divided into seven small groups of 10 workers each. The guidelines were implemented for each group three days per week for two continuous weeks for a total of six one-hour sessions. The total allocated time for achieving guidelines objectives for all groups was 14 continuous weeks with a total 42 hours (7groups×6hours).

The first session was started with an orientation about the aim of the study and objectives of the guidelines and the work schedule. Each session started by a summary of the previous session and the objectives of the new one using very simple language, with use of motivation and reinforcement techniques. The theoretical sessions involved mini-lectures and small group discussions to enhance workers' knowledge related to brucellosis. The practical sessions included hands-on training, demonstration re-demonstration, as well as role playing. Instructional media included data show and lab models, pictures and the printed handout.

The researcher with an assistance of three laboratory specialists collected the blood sample. Each participant had his unique code; after vein puncture with sterile needle, blood sample of 3-5 ml was obtained from every participant and all blood samples were clearly labeled with names, a specific code and date. The blood specimens were kept in ice box and transported to laboratory. All workers who included in study agreed to be investigated and tested for brucellosis except five workers, four of them refused to perform blood analysis and one had severe injured arms. After receiving the results from laboratory, the researchers had interviewed and informed the workers whose results were positive concerned on the importance of seeking medical consultation as early as possible.

The present study consumed about 10 months as following, one month for obtaining official permission, one month for panel expert and modification of the tool. The next four months consumed for data collection and pilot study (2 weeks for pilot study and 14 weeks for data collection) while the last four months were data entry and statistical analysis.

Evaluation phase: After completion of the six sessions, the effectiveness of implemented guidelines was tested through assessing the improvement in workers' knowledge and practices. This was achieved through posttests using the same data collection tools and comparing the results with the pretests.

Administrative and ethical considerations: A permission to carry out the study was obtained from responsible authorities using official channels. The study maneuvers were carried in compliance with Helsinki Declaration. All participants were informed about the purpose of the study and its procedures. Informed verbal consents were obtained after briefing them with their rights to refuse or withdraw, and after reassuring them about anonymity and confidentiality. Venipuncture was carried out with strictly aseptic precautions. The workers who tested positive were discretely informed and counseled.

Statistical analysis: Data entry and statistical analysis were done using Stands for Statistical Product and Service Solutions (SPSS) program version 20. Data were presented using descriptive statistics in the form of frequencies and percentages for qualitative variables, means and standard deviations and medians for quantitative variables. Qualitative categorical variables were compared using chi-square test. Whenever the expected values in one or more of the cells in a 2x2 tables was less than 5, Fisher exact test was used instead. Spearman rank correlation was used for assessment of the inter-relationships among quantitative variables and ranked ones. In order to identify the independent predictors of the scores of knowledge, hand washing, and practice multiple linear regression analysis was used and analysis of variance for the full regression models was done. Statistical significance was considered at p-value <0.05.

Results

The study sample consisted of 70 male slaughterhouse workers whose median age was 42 years (Table 1). Slightly less than half of them (47.1%) had secondary or institutional level education. The majority of them were butchers, married, residing in urban areas, and having sufficient income.

Table 2 illustrated that 5.7% of the workers in the sample reported having brucellosis, or gave a history of having had it. However, according to laboratory results, around one-fourth of the sample demonstrated sero-positivity for either Brucella abortus (24.6%), melitensis (29.2%) or both (29.2%). Overall, 83.1% of the tested samples (n=65)

demonstrated sero-positivity, with 95% CI 71.7-91.2. Meanwhile, 35.7% reported raising animals at home.

As presented in Table 3, workers' knowledge of brucellosis was very deficient before the intervention. The best areas of knowledge were those related to risky animals (31.4%), symptoms and signs in man (21.4%), and persons at risk (11.4%). In total, only 2 (2.9%) of them had satisfactory knowledge. At the post-intervention phase, there were statistically significant improvements in all areas of knowledge ($p<0.001$). Overall, 70.0% of them had total satisfactory knowledge ($p<0.001$).

Concerning workers' practices at the pre-intervention phase, Table 4 points to many deficiencies at the different stages of the slaughtering process. This was most evident in wearing aprons (3.0%) and rubber gloves (1.5%) before the process, and not carrying cigarettes during the process (16.0%). On the other hand, all of them buried contaminated organs. In total, the worst practices were in the "before" stage of the process, and the best in the "after" stage of the process. The implementation of the study intervention led to statistically significant improvements in almost all areas of practice. The only exceptions were those in the practices that were highly applied at the pre-intervention phase. Overall, only 32.9% of them had total adequate practice before the intervention, and this rose to 92.9% after the intervention ($p<0.001$). The table also shows a statistically significant improvement in workers' practice of appropriate hand washing from 37.1% before the intervention to 97.1% after the intervention ($p<0.001$).

Table 5 indicates the presence of statistically significant moderate to strong positive correlations among workers' scores of knowledge, hand washing, and total practice. The strongest correlation was between the scores of knowledge and hand washing practice ($r=0.708$).

Concerning the correlations between workers' scores of knowledge, hand washing, and total practice and their personal characteristics, Table 6 demonstrated statistically significant weak positive correlations between the level of education and the scores of knowledge ($r=0.179$) and hand washing practice ($r=0.199$).

The multivariate analysis (Table 7) identified the study intervention as the main statistically significant independent positive predictor of the scores of knowledge, hand washing practice, and total practice. Additionally, the level of education was a significant positive predictor of the scores of knowledge and hand washing practice. Meanwhile, the knowledge score was a significant positive predictor of the score of hand washing practice. Lastly, worker's age and hand washing score were significant independent positive predictors of the score of total practice. The three models explain more than 50% of the variation in these scores as indicated by their respective r-square values.

Table 1: Socio-demographic characteristics of slaughterhouse workers in the study sample (n=70)

	Frequency	Percent
Age:		
<40	29	41.4
40+	41	58.6
Range	16-70	
Mean±SD	42.8±13.5	
Median	42.0	
Education:		
Illiterate/Read/write	25	35.7
Basic	12	17.1
Secondary/institution	33	47.1
Job type:		
Butcher	50	71.4
Worker	12	17.1
Skinner	8	11.4
Marital status:		
Unmarried	10	14.3
Married	60	85.7
Residence:		
Urban	64	91.4
Rural	6	8.6
Income:		
Sufficient	47	67.1
Insufficient	23	32.9

Table 2: Medical and family history of slaughterhouse workers in the study sample (n=70)

	Frequency	% (95% CI)[@]
Prevalence of Brucellosis:		
Reported present	4	5.7 (1.6-14.0)
Reported past	4	5.7 (1.6-14.0)
Laboratory sero-positivity:[#]		
Abortus	16	24.6 (14.8-36.9)
Melitensis	19	29.2 (18.6-41.8)
Both	19	29.2 (18.6-41.8)
Total positive	54	83.1 (71.7-91.2)
Family history of brucellosis	4	5.7
Have chronic diseases	12	17.1
Raise animals at home	25	35.7

(#) 5 missing due to refusal *(@) Fisher exact 95% Confidence Interval*

Table 3: Pre-post-intervention knowledge of brucellosis among slaughterhouse workers

Correct knowledge of Brucellosis:	Time				X^2test	p-value
	Pre		Post			
	No.	%	No.	%		
Definition	3	4.3	58	82.9	87.88	<0.001*
Persons at risk	8	11.4	50	71.4	51.93	<0.001*
Risky animals	22	31.4	68	97.1	65.83	<0.001*
Incubation period	3	4.3	31	44.3	30.46	<0.001*
Transmission (man)	2	2.9	52	74.3	75.37	<0.001*
Transmission (animal)	5	7.1	50	71.4	60.64	<0.001*
Symptoms/signs (man)	15	21.4	63	90.0	66.70	<0.001*
Symptoms/signs (animal)	3	4.3	46	65.7	58.05	<0.001*
Complications (man)	3	4.3	46	65.7	58.05	<0.001*
Complications (animal)	4	5.7	44	62.9	50.72	<0.001*
Prevention	5	7.1	61	87.1	89.89	<0.001*
Total knowledge:						
Satisfactory (60%+)	2	2.9	49	70.0		
Unsatisfactory (<60%)	68	97.1	21	30.0	68.13	<0.001*

(*) Statistically significant at p<0.05

Table4: Pre-post-intervention practices among slaughterhouse workers

Correct practices in slaughtering	Time				X^2test	p-value
	Pre		Post			
	No.	%	No.	%		
Before:						
▪ Clothing are dark type and color	68	97.1	67	95.7	Fisher	1.00
▪ Apron is worn	2	3.0	4	80.0	Fisher	<0.001*
▪ Wash before slaughter	54	77.1	67	95.7	10.29	0.001*
▪ Wear rubber gloves	1	1.5	4	66.7	Fisher	<0.001*
▪ Wear special shoes	58	82.9	68	97.1	7.94	0.005*
▪ Clean knives using hot water and soap with special disinfectants after each sacrifice	11	15.7	45	64.3	34.40	<0.001*
Total adequate before	7	10.0	63	90.0	89.60	<0.001*
During:						
▪ Avoid putting knife in mouth while working	32	45.7	63	90.0	31.47	<0.001*
▪ Remove accessories during slaughter	24	42.1	52	91.2	30.95	<0.001*
▪ Wash hands and arm after contact with skin or fur	38	54.3	63	90.0	22.21	<0.001*
▪ No eating or drinking during work	21	30.0	63	90.0	52.50	<0.001*
▪ No cigarettes carried during work	8	16.0	49	92.5	60.85	<0.001*
Total adequate during	29	41.4	64	91.4	39.24	<0.001*
After:						
▪ Wash hands with soap and water	57	81.4	69	98.6	11.43	0.001*
▪ Change shoes	56	80.0	68	97.1	10.16	0.001*
▪ Change clothes and wash them daily	30	42.9	48	68.6	9.38	0.002*
▪ Clean walls and floors with special disinfectants	56	80.0	58	82.9	0.19	0.66
▪ Bury contaminated organs	70	100.0	70	100.0	0.00	1.00
▪ Wash and disinfect tools and carcasses	61	87.1	66	94.3	2.12	0.15
Total adequate after	60	85.7	68	97.1	5.83	0.02*
Total practice:						
Adequate (60%+)	23	32.9	65	92.9		
Inadequate (<60%)	47	67.1	5	7.1	53.97	<0.001*
Hand washing practice:						
Adequate (60%+)	26	37.1	68	97.1		
Inadequate (<60%)	44	62.9	2	2.9	57.11	<0.001*

(*) Statistically significant at p<0.05

Table5: Correlation matrix of knowledge, hand washing, and total practice scores

Scores	Spearman's rank correlation coefficient (r)		
	Knowledge	Hand wash	Total practice
Knowledge			
Hand wash	.708**		
Total practice	.602**	.602**	

(*) Statistically significant at p<0.05 *(**) Statistically significant at p<0.01*

Table 6: Correlationsbetween workers' knowledge, hand washing, and total practice scores and their characteristics

	Spearman's rank correlation coefficient (r)		
	Knowledge	Hand wash	Total practice
Age	-.090	-.090	.102
Education	.179*	.199*	.035
Income	-.071	-.078	.040
No. of chronic diseases	-.135	-.067	-.017

(*) Statistically significant at p<0.05

Table 7: Best fitting multiple linear regression model for the knowledge, hand washing, and total practice scores

	Unstandardized Coefficients		Standardized Coefficients	t-test	p-value	95% Confidence Interval for B	
	B	Std. Error				Lower	Upper
Knowledge score							
Constant	-31.29	5.71		-5.479	<0.001	-42.58	-20.00
Intervention	39.71	2.72	0.77	14.616	<0.001	34.34	45.09
Education	2.43	1.00	0.13	2.425	0.017	0.45	4.41
r-square=0.61 Model ANOVA: F=109.76, p<0.001 Variables entered and excluded: age, residence, marital status, income, job, diseases, family history							
Hand washing practice score							
Constant	22.28	4.83		4.608	<0.001	12.72	31.84
Intervention	18.50	3.33	0.45	5.552	<0.001	11.91	25.10
Education	2.29	0.78	0.15	2.919	0.004	0.74	3.84
Knowledge score	0.30	0.07	0.38	4.638	<0.001	0.17	0.43
r-square=0.64 Model ANOVA: F=84.13, p<0.001 Variables entered and excluded: age, residence, marital status, income, job, diseases, family history							
Total practice score							
Constant	.80	7.67		.104	.918	-14.38	15.97
Intervention	21.33	3.43	.55	6.218	<0.001	14.55	28.12
Age	.17	.08	.12	2.010	.046	.00	.33
Hand washing score	.17	.08	.17	2.032	.044	.00	.33
r-square=0.56 Model ANOVA: F=44.87, p<0.001 Variables entered and excluded: residence, marital status, education, income, job, diseases, family history							

Discussion

Slaughter houses or abattoirs often lack suitable protective measures and facilities that protect workers from exposure to occupational health hazards ***(Johnson and Etokidem, 2019)***. These workers are often exposed to carcasses, viscera, body fluids and organs of potentially infected animals and thus are at high risk of brucellosis ***(Luwumba et al., 2019)***. The associated complications could lead to loss of productivity and associated economic losses among these workers ***(Lagadinou et al.,2019)***.

The present study tested the hypothesis that the implementation of health guidelines will lead to significant improvements in slaughterhouse workers' knowledge and practices related to Brucella infection. The results of the study actually demonstrated such significant improvement, which was predicted by the implementation of the guidelines. Hence, the study findings lead to acceptance of the research hypothesis.

The current study assessed the prevalence of Brucella infection among the slaughterhouse workers through history taking as well as through sero-prevalence. The results demonstrated a very wide discrepancy between the two approaches, where only four workers reported having the disease either presently or in the past. On the other hand, the sero-positivity for Brucella was as high as 83.1%. This vast difference could be attributed, at least in part, to workers' knowledge deficiency about the disease and its symptoms and signs.

The rate of Brucella sero-positivity in the current study is quite high when compared with rates reported either locally or internationally. Thus, in Egypt, ***Abdel-Fattah (2014)*** reported a rate of 22.4% of participants. In The Iran, a rate of 31.8% was reported among abattoir workers ***(Esmaeili et al, 2019)***. The rates in Sudan varied between 32.1% in South Sudan by ***(Madut et al., 2019)*** and 65% in North Sudan ***(Abdel-Rahman, 2015)***. Meanwhile, rates as low as 4.9% were reported in Nigeria ***(Adeyemi, 2018)***, 6.7% in South Korea ***(Acharya et al, 2018)***, and 8.1% in India ***(Karunanayake et al., 2019)***. Such wide discrepancies in the sero-positivity rates among various studies are undoubtedly related to the differences in the application of safety and occupational health measures in the different workplaces. In agreement with this, a study in Brazil demonstrated the effect of workplace surveillance and compliance with safety rules on the rates of Brucella sero-positivity in workers ***(de Souza Ribeiro Mioni et al, 2018 and Pereira et al, 2020)***.

According to the current study results, slaughterhouse workers had a clear deficiency in their knowledge about brucellosis before implementation of the intervention. This was particularly evident regarding the nature of the disease, its mode of transmission, incubation period, and the symptoms and signs especially in animals, as well as the prevention. This is undoubtedly due to the lack of health education programs and occupational health services in the workplace. In agreement with this, studies in Egypt reported deficient knowledge about brucellosis in the majority of participants ***(Safaan and Mohsen, 2016; El-Wahab et al., 2019)***. Similar low rates of satisfactory knowledge were reported internationally such as ***Adeyemi (2018)*** in Nigeria, ***Al-Hakami et al,(2019***) in southern Saudi Arabia ***,Pateel et al. (2019)***in India, and ***Akhtar et al,(2020)***in Bangladesh.

After implementation of the health guidelines, significant improvements were revealed in slaughterhouse workers' knowledge. This was demonstrated in all the knowledge areas tested. Moreover, the multivariate analysis identified the study intervention as the main predictor of the workers' scores of knowledge, which confirms its effectiveness. This could be explained by the simplicity of the guidelines and its emphasis on applied and practical knowledge areas needed by the workers. In line with this finding, ***Fan et al. (2018)*** in an intervention study in China reported significant improvements in workers' total knowledge after the health education sessions. Similar results were also reported in a study in Iran ***(Oruoji et al., 2012)***.

As regards slaughterhouse workers' practices, the current study results have also demonstrated many areas of deficiency as observed at the different stages of the slaughtering process before implementation of

the intervention. The most deficient practices were related to the use of personal protective equipment such as the aprons and gloves. This could be due to the lack of availability of such equipment, and/or the lack of workers' awareness of their importance in self-protection, or due to their negligence. In agreement with this, ***Holt et al. (2011)***in a study in Egypt found that all participants had poor practices regarding the use of personal protective equipment. On the same line, ***Musallam et al. (2015)***in Jordan and ***Tsegay et al. (2017)*** in Ethiopia , ***Al-Aidarous (2018)*** in Saudi Arabia and ***Ciambronea et al ,(2020)***in Brazil reported inadequate practices among the majority of participants.

Another area of deficient practices revealed among the current study slaughterhouse workers' before implementation of the intervention is that related to abstinence from eating, drinking, or smoking during the process of slaughtering. This could be explained by their lack of knowledge about the mode of transmission of the disease. It also could be attributed to the lack of supervision and strict application of safety procedures in the setting. In line with this, a study in Kenya revealed the prevalence and high risk of infection associated with eating, drinking, and smoking among slaughterhouse workers ***(Cook et al, 2017)***.

However, the present study results demonstrated significant improvements in slaughterhouse workers' practices after implementation of the study intervention. This was shown in almost all the areas of practice observed, and the effect of the guidelines was confirmed through multivariate analysis. The improvements were directly related to the effect of the practical part of the guidelines and the process of training during its implementation. Similar effectiveness of educational interventions in improving slaughterhouse workers' practices were documented in studies from Egypt (***Abdel-Fattah, 2014)***, United Arab Emirates ***(Bushra, 2014)***, and Iran ***(Aligol et al., 2014)***.

Moreover, the implementation of the present study intervention had a positive effect on the specific practice of hand washing among the slaughterhouse workers. In fact, at the pre-intervention phase, only around one-third of these workers had adequate hand washing practice. However, after implementation of the intervention, this practice demonstrated significant improvements and almost of the workers' had adequate practice of hand washing, and the intervention was identified as a main predictor of hand washing score. In congruence with this, ***Ntirandekuraet al. (2018)*** in a study in Tanzania demonstrated an improvement in participants' practices related to brucellosis after a health education program was implemented.

In addition, the level of education and the knowledge score were also positive predictors of the hand washing scores, which indicates that the deficient practice was mainly due to lack of knowledge, especially among those workers with low level of education. In fact, the level of education had positive correlations with workers' scores of knowledge and hand washing practice. A similar positive effect of knowledge on practice was found by ***Jahangiry et al. (2019)*** in a study in Iran.

Conclusion and Recommendations

The study findings lead to the conclusion that the implementation of health guidelines can be effective in remedying the deficiencies in slaughterhouse workers' knowledge and practices. Therefore, the guidelines should be implemented in the setting and similar ones.

In the light of the findings of the present study, the following recommendations are suggested:

For slaughter house workers and Community Health Nurse:

- Designing of health educational program with follow up phase for slaughterhouse workers and farmers.
- Training courses and educational sessions for those workers and other people who are high risk about zoonotic disease, transmission and prevention using colorful and updated brochures and posters to increase their awareness about disease.
- Education and regular health teaching and counseling programs should be provided by CHN in setting and veterinary units.

Ministry of Health:

- Collaboration between public health and veterinary services for the better management of brucellosis.
- Provision of medical care unit with heath team (doctors and nurses) in this setting for giving education and managing any emergency situation as knife injury.
- Provision of essential protective personal equipment (PPE) in setting.
- Teaching, counseling and preventive campaigns to all community through mass media, TV, radio and internet to limit the disease borders.
- Periodic examination for people who are at high risk to accurate recording and repotting as brucellosis still under reported and facilitate this examination for free to those workers for detection of brucellosis.
- Conduct community campaigns using various educational programs to rural setting for increasing farmers' awareness and adequate behaviors.

Further Study:

- Further additional studies may be needed using a wider geographic scope and a larger sample size that should include young girls and their mothers emphasizing cultural variations in order to provide sufficient and comprehensive information in all Egyptian governorates.

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