An-Najah National University

Faculty of Graduate studies

Prevalence and Risk Factors of Brucellosis among Veterinary Health Care Professionals in Northern West Bank- Palestine

By
Muhammed Yousef Younes Abu Helal

Supervisor
Dr. Ibrahim Alzuheir
Co-Supervisor
Dr. Hamzeh Al Zabadi

This Thesis is Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Public health, Faculty of Graduate Studies, at An-Najah National University,Nablus-Palestine.

2021

Prevalence and Risk Factors of Brucellosis among Veterinary Health Care Professionals in Northern West Bank- Palestine

By
Muhammed Yousef Younes Abu Helal

This Thesis was Defended Successfully on 5/5/2021 and approved by:

Defense Committee Members	Signature
1. Dr. Ibrahim Alzuheir /Supervisor	.....
2. Dr Hamzeh Al Zabadi /Co-Supervisor	.....
3. Dr. Abdalsalam Khayyat /Internal Examiner	.....
4. Dr.Mohammad Gharaibeh /External Examiner	.....

Dedication

To my homeland Palestine, which I redeem with my soul.

To the soul of my father, may Allah have mercy on him, how I wished you were beside me at this moment to be proud.

To my mother (my soul), the most precious thing in existence, I owe you everything, everything, I pray to Allah to give your health and wellness, thank you for everything.

To my dear wife, my paradise, and my spiritual partner in this life, I appreciate your effort and your labor with me in this achievement. Thank you very much, I will love you forever.

To my children, butterflies dance in my heart, the most beautiful thing for me is your presence in my life, I am sorry for my constant preoccupation with this research, I promise you that you will be proud of your father, I love you so much.

To my brothers and sisters, you are the supporter and pillar, I thank you for my support, I love you and respect you

Acknowledgments

First, I thank Allah Almighty for being able to complete this work.

All thanks to my supervisor Dr. Ibrahim Alzuheir, all the respect and appreciation, you have never given up on me for any information or guidance, I am honored you have been my supervisor for this thesis to obtain a master's degree.

My sincere thanks and appreciation to Dr. Hamzah Al Zabadi, the owner of the magic touches in this thesis. I am honored you have been my Co-supervisor for this master's thesis.

Dr. Bilal Abu Hilal (my dear brother) I thank you twice: once as the President of the Veterinarians/Jerusalem Branch, for the Syndicate's cooperation and facilitating access to information about the veterinarians participating in the research, and secondly, I thank you for your guidance, support and participation in the effort, with every step in which the meaning of brotherhood was embodied, for you have all thanks and respect.

Special thanks to all my professors in the Department of Public Health at An-Najah National University.

I thank all the veterinarians and research participants for their cooperation, as well as all the institutions and companies that have cooperated with me: Dana Medical Products Company represented by Dr. Abdel Rahim and Omar Al-Hanbali, Palestine Poultry Company, College of Veterinary Medicine represented by Dean Dr. Heba Al-Faris and the teaching staff,

colleagues in the Zoo / Qalqilya, the Ministry of Agriculture represented by the veterinary directorates in the northern governorates.

All thanks and gratitude to the skilled nurse Abdul Rahim Barakat, who accompanied me at every step during the collection of all samples.

All thanks to those who contributed to this research and were not inadvertently mentioned. To you all, my full appreciation and respect.

الإقرار

أنا الموقع أدناه مقدم الرسالة التي تحمل العنوان:

Prevalence and Risk Factors of Brucellosis among Veterinary Health Care Professionals in Northern West Bank- Palestine

انتشار وعوامل الخطر لمرض البروسيلا بين العاملين في مجال الرعاية الصحية البيطرية في شمال فلسطين أقر بأن ما اشتملت عليه هذه الرسالة إنما هي نتاج جهدي الخاص، باستثناء ما تمت الإشارة إليه حيثما ورد، وأن هذه الرسالة ككل، أو أي جزء منها لم يقدم لنيل أية درجة أو لقب علمي أو بحثي لدى أية مؤسسة تعليمية أو بحثية أخرى.

Declaration

The work provided in this thesis, unless otherwise referenced, is the researcher's own work and has not been submitted elsewhere for any other degree or qualification.

Student's Name: محمد يوسف يونس أبو هلال — **اسم الطالب:**

Signature: — **التوقيع:**

Date: 5.5.2021 — **التاريخ:**

Table of Contents

List of Figures

List of Tables

List of Indexes

List of Abbreviation

Symbol	Abbreviation
B. abortus	*Brucella abortus*
B canis	*Brucella canis*
B.melitensis	*Brucella melitensis*
Bp	Base pair
BPAT	buffered antigen plate agglutination test
B. suis	*Brucella suis*
ºC	Degree Celsius
CFT	complement fixation test
CFU	Colony-forming units
DNA	Deoxyribonucleic acid
dNTP	Deoxynucleotide
ELISA	enzyme-linked immunosorbent assay
Fig	Figure
G	Gram
hrs.	Hours
M	Molar
µg	Microgram
µl	Micro liter
Mg	Milligram
Ml	Milliliter
Min	Minute
MRT	Milk Ring test
N	Number
N	Number
NaCl	Sodium Chloride
P	P-value
PCBS	Palestinian Central Bureau of Statistics
PCR	Polymerase chain reaction
pH	a scale of acidity from 0 to 14
PSI	Palestinian Standards Institution
Ppm	Part per million
RBT	*Rose-Bengal test*

Rpm	Round Per Minute
Sec	Second
Seq	Sequence
Spp.	Species
SPSS	Statistical Package for the Social Sciences
Taq	*Taq* polymerase

Prevalence and Risk Factors of Brucellosis among Veterinary Health Care Professionals in Northern West Bank- Palestine

By
Muhammed Yousef Younes Abu Helal
Supervisor
Dr. Ibrahim Alzuheir
Co-Supervisor
Dr Hamzeh Al Zabadi

Abstract

Background: Few studies are investigating human brucellosis in Palestine. This study was conducted in 2020 to investigate the prevalence of brucellosis as a high-risk occupational disease for the veterinary profession in the northern governorates of the West Bank - Palestine.

Aim: To estimate Brucella seropositivity among veterinary healthcare professionals in northern Palestine, and to assess the risk factors associated with seropositivity to Brucella.

Materials and Methods: A cross-sectional study was conducted in four governorates in the northern West Bank (Jenin, Nablus, Qalqylia, and Tulkarm). A sample of 100 veterinarians and animal-producing professionals was collected. Participants were interviewed face to face using a structured questionnaire to assess risk factors. Blood samples were collected to be screened for the presence of anti-Brucella IgG using the Enzyme-Linked Immunosorbent Assay (ELISA) technique and Rose Bengal Test (RBT). Data management and analysis were performed using SPSS (statistical package for social sciences) version 20th (SPSS Inc, USA). Chi-square test.

Results: The seroprevalence of Brucellosis by ELISA and RBPT was 76% and 29% respectively. Risk factors in veterinarians and animal producing professionals were age, work sector, interaction with animal species, animals' vaccination, disinfectant do not use, previous infection, and use of protective equipment during animal vaccination.

Conclusion: Brucellosis is a high-risk occupational disease among veterinarians. Its prevalence rate among veterinary health care workers in the northern West Bank-Palestine was very high compared to neighboring countries and internationally**.**

Chapter I

1.1 Introduction

Most of the human infectious pathogens are zoonotic, the source of human infection resides from domestic or wild animal reservoirs (Godfroid *et al.*, 2005). Brucellosis is one of the widespread zoonosis worldwide caused by bacteria belonging to the genus *Brucella* (Brown 2004, Franco *et al.*, 2007). Currently, 12 recognized *Brucella* species were known, of them *Brucella melitensis*, *Brucella suis*, and *Brucella abortus* are the major human pathogens resulting in considerable disability and morbidity(Franco *et al.*, 2007). Infected animals excrete *Brucella* through the body secretions and execrations; e.g. urine, milk, placenta, and the products of miscarriages. In this way, the bacteria are disseminated and infect other animals and humans. Also, *Brucella* can be survived outside the animal for up to 80 days (Brachman and Abrutyn 2009). For this, brucellosis is an occupational risk for veterinary health care professionals, farmers, abattoir workers, and laboratory personnel. The rate of infection in the developed countries has fallen as a result of disease control in animals, while it is still high in the Middle East, Asia, Africa, Central America, South America and the Mediterranean (Hotez *et al.*, 2012).

Routes .of transmission of the infection to humans include direct contact with infected animals and their secretions through cuts and abrasions in the skin, by way of infected aerosols inhaled or inoculated into the conjunctiva of the eyes, or via the ingestion of unpasteurized dairy products (Doganay

and Aygen 2003). In humans, the incubation period varies between 1 and 5 weeks. The disease may be asymptomatic or symptomatic. The onset of symptoms is classified as acute (less than 8 weeks), subacute (from 8 to 52 weeks), or chronic (more than 1 year). The main clinical findings are fever, sweats, malaise, anorexia, headache, arthralgia, and back-ache (Doganay and Aygen 2003). In developing countries, the disease is misdiagnosed due to extra-label antibiotics on their initiative, or at the suggestion of the pharmacist, this has lowered the rate of positive blood culture. Brucellosis is endemic in developing countries due to a lack of effective public health measures, domestic animal health programs, and appropriate diagnostic facilities, in addition to the incorrect diagnosis and lack of reporting of the disease add some references.

Several studies were performed in the Middle East to estimate the prevalence and risk factors of human brucellosis. For example, the seroprevalence of brucellosis in Jordan was significantly higher among sheep farmers and meat handlers than in other occupations (Abo-Shehada *et al.,* 1996). In West Bank, Ramlawi 1998 reported a $139.9/10^4$ incidence rate in Jericho (Ramlawi 1998). The direct loss in livestock in Palestine in 1994 was estimated at more than 10 million dollars (Husseini and Ramlawi 2004). The risk factors for brucellosis infection are the direct contact with animals and animal products, (Husseini and Ramlawi 2004) showed 57.7 % (86/149) of the positive case in animal owners and 58% (87/150) in human contacts with the animals. These findings include the unprofessional non trained persons that handle animals and animal products. Veterinarians and

veterinary health care professionals as exposures associated with brucellosis should have the training and arsenals to reduce Brucellosis incidence rate. For this, in this study, the prevalence rate of Brucellosis in veterinarians and veterinary health care professionals will be investigated and correlated with the effect of professional handling and protective measures with animals. The results of this study will be evaluated to identify the risk factors for brucellosis in this sector of Northern Palestine and estimate their association with the disease and recommend appropriate prevention measures. to our knowledge, there are two studies concerning human brucellosis in Palestine, one in the West Bank in 2004 by Husseini and Ramlawi (Husseini and Ramlawi 2004), and the second in the Gaza Strip in 1996 by R. Awad (Awad 1998).

1.2 Statement of the problem

Brucellosis is most common in Mediterranean countries, including Palestine. as it spreads in all areas of Palestine, including the governorates of the northern West Bank, as a result of the difficult conditions that Palestine is going through, studies on brucellosis, which are related to the Palestinian areas, are very rare, this makes the facts about this disease hazy and poorly clear.

Since brucellosis is a zoonotic disease and is considered an occupational disease in the first place, it affects certain occupational groups of people more than others. To our knowledge, this is the first study in Palestine that investigates the relationship between brucellosis and a professional group,

namely, veterinarians working in veterinary health care in four governorates of the northern West Bank.

Through this serological study, we can answer the questions: What is the prevalence of brucellosis among veterinarians in northern Palestine? And what are the risk factors that increase the risk of developing brucellosis among veterinarians in the northern West Bank?

1.3 Aims of the study

1.3.1 General objective:

This study aims to investigate the occurrence and associated risk factors of brucellosis in veterinary health care professionals in Northern Palestine.

1.3.2 Specific objectives of the study:

1- To determination the seroprevalence of brucellosis in veterinary health care professionals in Northern Palestine.

2- To evaluate the history of clinical symptoms in the previously infected person.

3- To assess the risk factors for brucellosis in veterinary health care professionals in Northern Palestine.

4- To investigate the professional handling and protective measures of veterinary health care professionals with direct animals' exposures.

Chapter II

Literature Review

2.1 Historical aspect for brucellosis

Brucellosis is one of the oldest zoonotic diseases, brucellosis, as a name synonymous with Malta fever, was named by the American microbiologist Alice Evans in 1918 as it was known. Brucella bacteria were isolated for the first time in 1887 by the British microbiologist (David Bruce) on the realistic island of Malta in the Mediterranean Sea, where the island was occupied in 1799 by the British army, the number of British soldiers and sailors reached nearly 25,000, brucellosis had a great impact on the health of the British forces stationed on the island, which caused great concern in the British government, approximately 82,119 cases of brucellosis were recorded among civilians, sailors and soldiers between (1901_1907) (Madkour 2001).

There are many synonymous or derivative names for brucellosis depending on the nature of the disease or similarity with other diseases or according to the nature of the geographical spread, Mediterranean gastric remittent fever, undulant fever, Mediterranean fever, Rock or Gibraltar fever, Malta fever, Neapolitan fever, Cyprus fever, typho-malarial fever, the Corps disease, Malta fever(Madkour 2001).

Brucella is capable of infecting a wide variety of mammals, including humans and some amphibians. it is a small, gram-negative bacillary

bacteria within an immobile cell, intracellular coccobacilli, where human infection occurs through exposure to four types: *Brucella abortus, B melitensis, B suis and B canis* (Rubach *et al.*, 2013, Hull and Schumaker 2018).

2.2 Global epidemiological prevalence of brucellosis

Brucellosis is transmitted from an infected animal to another animal or human through direct and indirect contact or contaminated animal products. it affects humans of both sexes of all age groups(Corbel 2006).

According to the World Health Organization, brucellosis is the most prevalent disease of animal origin in the world, with approximately 500,000 cases of brucellosis per year. 5 - 12.5 million cases annually. Brucella is classified as one of the seven neglected diseases. According to the World Health Organization, the speed of spread and infection lies in the low infectious dose between (10 - 100) bacterial cells through the air or intradermal, the disease spreads in all continents of the world except Antarctica.

The rate of infection in developed countries is low, according to reports from health institutes, for example, in the United States of America the disease is classified as rare, where the rate of infection in developed countries is low 4/ per million people, unlike developing countries, the infection rate is much higher, for example, Syria 1603,4 / million people, Iraq 268.8 / million people, Mongolia 3910 / million people, Saudi Arabia

149.0 per one million people, and Iran 141.6 per one million people. As for Turkey and Kyrgyzstan, they recorded an infection rate of over 200 per million people, but the rate decreased in the past decade until it reached 88,49.5 / million, respectively. In some European Union countries, the brucellosis-free case has been granted, while in some countries where human brucellosis is endemic, it is (no data) due to lack of monitoring and reporting to the World Health Organization (Corbel 2006, Hull and Schumaker 2018).

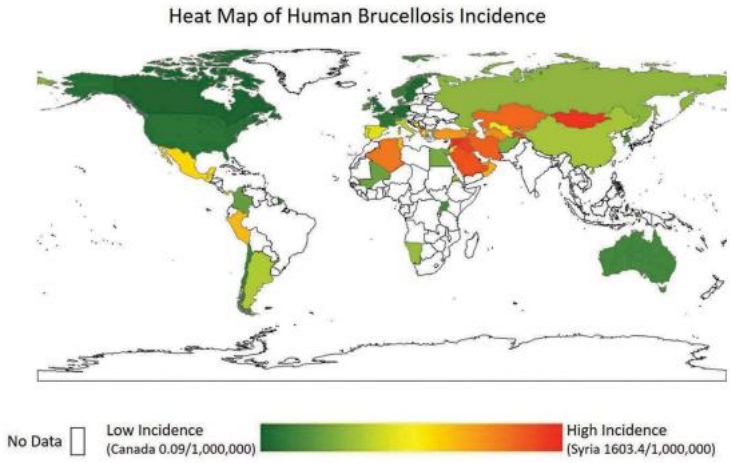


Figure 1: Global heat map of human incidence. White space indicates no data. Adapted from (Pappas, Papadimitriou et al. 2006)

2.3 Brucellosis in Palestine

In the Palestinian territories occupied in 1948 by the Israeli occupation, which are located in the Middle East, and it is one of the areas where the disease is endemic, the incidence rate increased, as it was in 2009 (1.9) per 100,000 and reached 7.3 per 100,000 in 2014, the incidence rate of brucellosis between the Arabs were the highest in these lands, and the increase in the infection rate among Arabs in the occupied territories in

1948 was the highest, as the rate of infection in 2009 was 10 per 100,000, and the rate reached 33.5 cases per 100,000 in 2014 according to Internal report of epidemiology division published in 2015(Ghanem-Zoubi *et al.*, 2019).

Brucellosis is considered an endemic disease in Palestine of the main zoonotic diseases. The first case was recorded in 1973 in the Hebron area. In general, the incidence of brucellosis in the southern West Bank is the highest among other regions. In 1998 the Palestinian Ministry of Health recorded 837, of these, 546 cases were from the Hebron area, where the infection rate was 139.9 per 100,000 people, followed by Jericho and Bethlehem (Husseini and Ramlawi 2004). As for the Gaza Strip, which is located on the Mediterranean coast between Egypt and Israel, a study of brucellosis was conducted by Riad Awad, and This study showed that the average annual number of cases of brucellosis among the population of the Gaza Strip between 1986 and 1996 was 75 and that the rate of infection for the year 1996 was 8 cases per 100,000 inhabitants (Awad 1998)

Table 1: Reported human brucellosis incidence from 1986 to 1996 in the Gaza Strip by district (Awad 1998)

Area	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
North	2	34	73	13	18	20	30	30	10	3	4
Gaza City	3	17	17	13	48	32	52	70	61	22	33
Mid-zone				5	2					2	17
South	5	51	20	12	60	53	17	6	7	6	15
Total			110	43	128	105	99	106	79	33	69

In 1998, the incidence rate in Palestine was 32.4 / 100,000, which is one of the highest rates of brucellosis in the countries of the Mediterranean basin, and in this year 1998, the disease control and control program in the Palestinian territories was implemented in cooperation with the World Health Organization and the United Nations Development Program. In 2000, the infection rate decreased to 10 per 100,000 of the population. In 2016, a remarkable increase in cases of brucellosis was recorded, as the number reached 1191 cases in Palestine at a rate of 26.2 per 100,000 inhabitants. The West Bank had 1,187 cases, and Gaza had 4cases at a rate of 44.4 per 100,000 inhabitants in West Bank and 0.2 per 100,000 in the Gaza Strip, In 2017, 894 cases were recorded in West Bank and 7 cases in the Gaza Strip. In 2018, 700 cases were recorded in Palestine, at a rate of 15.3 per 100,000 population, 691 in the West Bank, with an infection rate of 26.2 per 100,000 residents, and 9 cases in the Gaza Strip at a rate. 0.47 per 100,000 residents, the losses of livestock farmers in 1994 as a result of brucellosis amounted to about $ 10 million. The disease affects Palestinians on the health and economic level (Husseini and Ramlawi 2004, PHIC 2019).

2.4 Disease transmission

The infection can be transmitted to humans through another person in specific circumstances or through occupational exposure resulting from direct contact with infected animals. The infection can be transmitted to

humans through food and an environment contaminated with Brucella bacteria (Brachman and Abrutyn 2009).

There is circumstantial evidence indicating that the disease is transmitted from one person to another through personal or sexual contact, and this is extremely rare, the disease can be transmitted through blood donation or tissue transplantation, also, laboratory workers examining samples of the disease are at high risk of infection (Doganay and Aygen 2003). There are environmental hazards that can infect humans with brucellosis by inhaling polluted dust and dried dung and through the skin or conjunctiva when touching surfaces contaminated with tissues, fluids, and aborting infected animals, when infected animals pass from populated areas or remain close to housing, they pollute streets and squares Markets, wells, and water sources may be contaminated by newly aborted animals and by a rainwater runoff, Brucella can survive for long periods in the dust, dung, water, mud, soil, aborted paradise, meat, and dairy products according to many variables, and the following table shows some examples:

Table 2. Survival periods of *B. abortus* or *B. melitensis* in various substrates.

Medium	Temperature or environment	Survival
B. abortus **Solid surfaces**	<31 °C, sunlight	4–5 hours
Tap water	–4 °C	114 days
Lake water	37 °C, pH 7.5	<1 day
Lake water	8 °C, pH 6.5	>57 days
Soil – dried	~20 °C	<4 days
Soil – wet	<10 °C	66 days
Manure	Summer	1 day
Manure	Winter	53 days
Farm slurry animal waste	ambient-temperature tank	7 weeks
Farm slurry animal waste	12 °C tank	>8 months
B. melitensis: **Broth**	pH>5.5	>4 weeks
Broth	pH 5	<3 weeks
Broth	pH 4	1 day
Broth	pH <4	<1 day
Soft cheese	37 °C	48–72 hours
Yogurt	37 °C	48–72 hours
Milk	37 °C	7–24 hours

2.5 Occupational exposure to brucellosis

Most of the brucellosis infections are related to occupational exposure, as these groups of people are exposed for long and continuous periods. Infected animals increase the possibility of occupational groups contracting the disease more than other people. These groups include workers in livestock, sheep, goats, and pigs, farmers and dealers of animals and their products, herders and workers in shearing wool for sheep, veterinarians, and workers in vaccination programs (Agasthya *et al.*, 2007). The only infection occurs to these groups of people through direct contact with

infected animals or through exposure to a highly contaminated environment with Brucella, through inhalation, conjunctival contamination, skin contamination, accidental ingestion, wounds, and abrasions, or accidentally self-injection During vaccination against brucellosis, people who work in the manufacture of animal products are a group at high risk of contracting brucellosis, such as those working in slaughterhouses and butchers, meat packing, semen collectors for artificial insemination, and manufacturers of dairy products. They are at risk through inhalation, ingestion, mucous contamination, skin contact, or penetration, Humans are infected with brucellosis by eating food products of infected animals. This method is the main source of disease among urban residents, as drinking fresh milk and eating dairy products prepared from unboiled or pasteurized milk are the main source of infection among the population. Soft cheese prepared from Sheep and goat milk with the addition of rennet is a common source of infection with brucellosis in the countries of the Mediterranean and the Middle East (Corbel 2006).

2.6 Occupational groups at risk of disease

Brucella is primarily an occupational disease and is a public health problem in many developing countries, Accordingly, direct contact between infected animals and humans professionally means that the risk of contracting brucellosis is greater, such as workers in livestock farms, sheep, goats, pigs, and dealers of these animals, butchers, and workers in cattle

slaughterhouses and meat production lines, processing and packaging, and workers in the dairy industry.

Veterinarians have a higher risk of developing brucellosis than other groups of people and professions. A veterinarian can become infected through direct contact with infected animals through vaginal secretions, uterine fluids, fetuses, aborted tissues, blood, urine, and infected stool of the animals. Through the skin or mucous membranes, or by inhalation in an environment contaminated with Brucella bacteria, or by drinking unboiled milk or one of its products (Corbel 2006, Saddique *et al.*, 2019).

A cross-sectional study in India in 2006 conducted in Tumkur, Paglacton and Bidar districts, Karnataka state, India by AS Agasthya et al., measure the incidence of brucellosis in the risk occupational groups, it was found that 88 samples had a positive result out of 505 samples taken from veterinarians of different nature of their work 17.4%, while the positive rate for owners of other professions (butchers, livestock breeders, and butchers) was 7.9%, 9 positive samples from a total of 113 samples were taken from this category. Many reports are indicating that the prevalence of brucellosis among veterinarians working in the Indian states producing milk ranges between 34% -2.26% (Agasthya *et al.*, 2007).

A multicenter retrospective survey was conducted in Turkey, it was found that 84 veterinary workers had brucellosis out of 712 from whom samples were taken, i.e., 11.8%. Between the years 2006-2004, a study was conducted in the Kars region in Turkey, which investigated the prevalence

of brucellosis in cows, farmers and veterinarians, it was found that 13 samples were positive out of 28 samples taken from veterinarians, where the incidence rate was recorded 46,42 %. In a cross-sectional study conducted in Hamadan, western Iran between 2014-2015, aiming to measure the spread of brucellosis among butchers, veterinarians, and slaughterhouse workers, it was found that the incidence of brucellosis among veterinarians was 17%. In Jordan, a study investigating the prevalence of brucellosis among veterinarians was conducted in different regions in the Kingdom. Samples were taken from 66 veterinarians showing infection of 10.6% clinically and they were subjected to medical supervision, while the rate of subclinical infection was 43.94% (Abo-Shehada *et al.*, 1991, Otlu *et al.*, 2008, Kutlu *et al.*, 2014, Mamani *et al.*, 2018).

Chapter III

Conceptual framework

3.1 Clinical manifestation of human brucellosis

Human brucellosis is often caused by Brucella abortus which is usually associated with cattle, *B. melitensis* which is associated with sheep and goats, and *B suis* which is associated with the pig, the direct contact with Infected cows, sheep, goats, and pigs, or directly through the consumption of products for these types of infected animals the brucellosis occurs, The most important clinical signs of human brucellosis. It is an acute or subacute febrile disease characterized by intermittent fever accompanied by malaise, loss of appetite and prostration, it may last for weeks or months, the disease may develop From the acute phase to the chronic stage, causing enlargement of the liver, spleen and lymph nodes, which is a chronic stage of relapse that is similar in symptoms to (chronic fatigue syndrome). The incubation period of the disease is 2-3 weeks, the clinical signs increase with the advancement of time and it is varied and unspecified such as fever, loss of appetite and weight, headache, sweating, fatigue, and distress, back and joint pain, after hours of rest the patient feels better and then the condition worsens little by little As the hours' pass, the sufferer tends to become depressed, and a strong desire for rest.

Brucella lives and multiplies inside the host's macrophage cells, which is an advantage to protect itself. After a time, *Brucella* becomes isolated inside

monocytes and macrophages which in the reticuloendothelial system such as the liver, spleen, lymph nodes, and bone marrow. The clinical picture of the disease is still not clear, so it must be supported by laboratory tests of the diagnosis below is a table that records symptoms and signs of 500 brucellosis patients due to B meltiness.

Table 3: Symptoms and signs in 500 patients due to *B.melitensis*

Symptoms and signs	Number of patients	%
Fever	464	93
Chills	410	82
Sweats	437	87
Aches	457	91
Lack of energy	473	95
Joint and back pain	431	86
Arthritis	202	40
Spinal tenderness	241	48
Headache	403	81
Loss of appetite	388	78
Weight loss	326	65
Constipation	234	47
Abdominal pain	225	45
Diarrhoea	34	7
Cough	122	24
Testicular pain/epididymo-orchitis	62	21[a]
Rash	72	14
Sleep disturbance	185	37
Ill appearance	127	25
Pallor	110	22
Lymphadenopathy	160	32
Splenomegaly	125	25
Hepatomegaly	97	19
Jaundice	6	1
Central nervous system abnormalities	20	4
Cardiac murmur	17	3
Pneumonia	7	1

Adapted from MM Madkour. *Brucellosis Overview*. In: Madkour's Brucellosis, 2nd edition. Springer, Berlin

[a] Among 290 males

3.1.1 Osteoarticular complications

Injury to the bones and joints is one of the most common complications of brucellosis, as it causes sacroiliac joint inflammation, spondylitis, peripheral arthritis, osteomyelitis, bursitis, and tendinitis. Fever is associated with pain in the back and it spreads down the legs. Between 2004_2005, a prospective study was conducted in Hamadan, western Iran, which recorded the highest incidence of human brucellosis 130/100000 people to determine the frequency and characteristics of the joint bone complications of brucellosis, where the study included 245 patients with brucellosis, it was found that 78.4% Of the patients suffer arthralgia, and 28.6% of patients suffer from osteoarthritis. There is a study conducted by Gonzalez et al. to assess the recurrence and clinical manifestations of osteoarthritis brucellosis in the Atlantic region of Spain, the study included 158 patients between 1979-1997 who were diagnosed with active brucellosis, it was found that 44 patients suffering from osteoarthritis complications, and they constitute 27.8% of patients, And 20 patients out of 44 (44/20) 45.5% have spondylitis, septic iliac arthritis (González-Gay *et al.*, 1999, Hashemi *et al.*, 2007).

3.1.2 Gastrointestinal complications

Human infection with brucellosis through food is common, and some symptoms appear on the digestive system such as nausea, vomiting, abdominal discomfort, diarrhea, and symptoms may multiply and become more dangerous such as complications in the liver, spleen, and gallbladder,

and rarely causes some symptoms dangerous to life such as colitis Pancreatitis, peritonitis, intestinal obstruction. Hepatomegaly is one of the most common clinical signs in the digestive system. Some patients may experience mild jaundice. liver with brucella may cause nonspecific hepatitis with infiltration of mononuclear cells, granulomatous hepatitis, and liver abscesses are associated with *B suis.* Cirrhosis may occur in rare cases. 29%-56.6% was recorded of the affected cases that suffer from an enlarged spleen, granulomas and abscesses may form, and calcified lesions may occur inside the spleen.22.4% of people with brucellosis may suffer from loss of appetite and thus weight loss in patients, which is also attributed to the energy needs of the cause of persistent inflammatory responses inside the body, vomiting occurs in 7.18% of infected people and the exact cause is unknown, while about 91.7% of patients suffer from abdominal pain, inflammation due to mesenteric lymphadenitis, hepatitis, splenitis, cholecystitis, pancreatitis, splenic abscess and colitis, constipation occurs in 12.2% of patients with brucellosis, While diarrhea occurs 3_6% of the infected people may be due to ulceration of the intestinal mucosa, as for colitis and pancreatitis, cholecystitis is a rare complication of brucellosis, tonsillitis is a well-known sign of a brucellosis patient, and peritonitis, ascites and intestinal obstruction are rare signs as well as brucellosis (Corbel 2006), (Aziz *et al.,* 2005).

3.1.3 Respiratory complications

Inhalation of air contaminated with Brucella is a known method for the occurrence of brucellosis, especially in environments containing infected animals or their products or secretions. Pulmonary complications may occur in the form of interstitial pneumonitis, hilar and paratracheal lymphadenopathy, bronchopneumonia, lung nodules, pleural effusion, and empyema. A retrospective study was investigated through 450 cases of brucellosis diagnosed in 3 hospitals in the Balkan Peninsula during 3 years between 1999-2002, the study was carried out by Georgios Pappas et al. It was found through the study that 31 patients suffering from respiratory symptoms, and through an archive Hospitals, 6 additional cases were discovered with brucellosis suffering from respiratory complications, 25 patients suffered from a cough out of 37, 15 patients suffered from a cough accompanied by sputum, 15 patients suffered from dry cough, 8 patients suffered from shortness of breath, 12 patients suffered from inflammation Typical Lobar Pulmonary. A retrospective, 15-year, descriptive study was conducted in 27 medical centers in Turkey for all illnesses with brucellosis to monitor the recurrence of respiratory symptoms, and their number was 133 patients. It was found that 91 patients out of 133 (68.4%) suffer from lobal pneumonia which was diagnosed by radiologic pattern, 41 patients suffering from pleura effusion (30.8%), 23 patients suffering from bronchitis (17.3%) and 10 patients had nodular lung lesion (7.5%) (Pappas *et al.,* 2003, Erdem *et al.,* 2014).

3.1.4 Genitourinary complications

The genitourinary system is affected with brucellosis, the most common in men, and unilateral orchitis is the most common and somewhat similar to tuberculosis or testicular cancer, as epididymitis is common. The disease can be transmitted through sex as a result of the presence of the germ in stored sperm (Ruben *et al.*, 1991). Salpingitis, pelvic abscesses and kidney injury in females have been reported, but their occurrence is rare. Genitourinary complications form in patients with brucellosis2-10%, and this percentage was confirmed by M. Metin Bayram between 1992-1996, where 246 patients with brucellosis were examined by ultrasound, it was found that 26 patients with brucellosis had complications in the genitourinary system, 15 with orchitis One-sided, 6 had diffuse orchitis, and 5 had focal hypoechoic testis. Prostatitis may be continuously caused by brucellosis, especially in endemic areas, and the incidence of complications in the genitourinary system may reach 1.6-20% of the total disease with brucellosis (Madkour 2001), (Bayram and Kervancğlu 1997), (Memish and Pappas).

3.1.5 Cardiovascular complications

1.5%-2% of brucellosis patients suffer from cardiovascular complications, and endocarditis is the most common. Cardiovascular complications are an uncommon complication of brucellosis. It is also the most common cause of death complications from brucellosis and is usually associated with B. suis (Corbel 2006, Abid *et al.*, 2012).

3.1.6 Neurologic complications

Infection of the central nervous system occurs in about 5% of the disease with brucellosis, which leads to several neurological complications that are usually associated with *B.meltiness* encephalitis, meningitis may be acute or chronic the most frequent, patients with brucellosis suffer from myelitis and peripheral neuritis, it is noted that it is rare to report these complications for two reasons, the first is that these complications are rare and the second reason is difficult to diagnose, especially since these complications occur at a late stage in the course of the disease (Larbrisseau *et al.,* 1978).

3.1.7 Pregnancy with brucellosis

Abortion is a frequent complication of brucellosis in animals due to the presence of erythritol, which is considered as a growth-stimulating agent for Brucella abortus, Despite the absence of this substance in the human placenta, the risk of spontaneous abortion is present in pregnant women, most likely due to bacteremia, especially in the first three months of pregnancy, it is more likely that bacteremia causes abortion with Brucella than with other types of bacteria.

The relationship between abortion and brucellosis has been linked since the first decade of the last century. These cases were subsequently reported by many internists and scientists. Until 1954, the first large series on the causal relationship between abortion in humans and brucellosis were

reported by Cris Cuolo and Carlo, where a study was conducted on 200 pregnant women who had an abortion of 52 women, the estimated incidence of miscarriage with brucellosis was 26%. In a study conducted by Sharif and et.al in 1990 in Saudi Arabia, 34 cases of brucellosis were observed out of a total of 537 among pregnant women, 6 cases of abortion associated with brucellosis were recorded, or 17.6%, while non-brucellosis abortion accounted for 7.7% (Madkour 2001).

3.1.8 Cutaneous complications

Skin complications are rare in patients with brucellosis and constitute a rate of 3.8%--17% in various published studies. These complications are represented by skin rash, nodules, papules, Erythematous nodules, Eczematous lesions, psoriatic lesions, Petechiae, while skin sores, abscesses, and purulent lymphangitis are associated with *B. suis* (Karaali *et al.*, 2011).

3.1.9 Ophthalmic complications

Ocular lesions and complications of brucellosis patients are rare, occurring in the late stages of the disease. Uveitis is the most common ocular complication that appears in the form of iridocyclitis or nummular keratitis or multifocal choroiditis or optic neuritis. A group study was launched in Turkey 1992-2006 at the Ankara Teaching and Research Hospital, Department of Ophthalmology, which included 132 patients with brucellosis. It was found that 21% of patients suffer from visual effects and

the complications are anterior uveitis, choroiditis, panuveitis, papilledema, and retinal hemorrhages, these complications occur in the acute and chronic stages of the disease, and they may be slightly more likely in the chronic phase of the disease than in the acute phase (Sungur *et al.*, 2009).

3.1.10 Chronic Brucellosis

Chronic brucellosis is a different term that is defined globally to some extent, but most competent authorities agree to define it as the persistence of clinical symptoms in patients with brucellosis for at least 12 months from the time of diagnosis. Based on the previous definition, the disease can be divided into 3 categories, Relapse, chronic localized infection, and delayed convalescence. Relapse is defined as the recurrence of the clinical signs and the striking symptoms regardless of the result of the diagnosis, either positive or negative, the main symptoms are fever and elevation of IgG in the serum, these symptoms occur within 6 months after stopping treatment, as for chronic localized infection, it is the recurrence of signs and symptoms such as osteomyelitis or deep tissue abscesses and is characterized by the continuous proliferation of IgG in the serum, In delayed convalescence, symptoms other than local signs of infection persist after treatment, decrease or disappearance of IgG from their serum, meaning there is no objective evidence that proves the presence of brucellosis in an active shape, and complications in this group of patients are in the form of general weakness and vague pain, fatigue, nervousness and mental depression (Castaño and Solera 2009).

3.1.11 Childhood Brucellosis

In conjunction with the prevention and control programs for brucellosis in animals, recording a small number of cases and considering the disease unusual in children, the pediatrician may not be aware of the clinical signs of the disease in childhood, recently, brucellosis can affect people of all ages and the incidence rate and complications are similar, especially in areas endemic with *B. melitensis* (Ulug *et al.*, 2011).

3.2 Diagnosis of Brucella

Diagnosing of Brucella is still world challenging since brucellosis considered to be major transmittable disease to human with a high incidence of acquiring infection through laboratory manipulation, The clinical manifestation of brucella show great variability, bacteriological and serological testing are the keystone in diagnosing brucella, culturing of the organism is a danger to laboratory personnel, serological diagnostic tests are easy, more safe, short time and need a short time in comparison with culturing (Al Dahouk *et al.,* 2003),(Raghava and Umesha 2018), (Ohtsuki *et al.,* 2008).

3.2.1 Culture-based methods

Considered to be the original standard technique with accuracy and trustworthiness, but take time around two weeks and need lab biosafety level three (Al Dahouk *et al.,* 2003), (Nielsen 2002).

3.2.2 Serological tests:

The serological test depends on species of brucella, the most important species of brucella (*B. abortus, B. melitensis* and *B. suis*) which contain apart of lipopolysaccharide called O-polysaccharide and absent in other species (*B. ovis* and *B. canis*). The majority of serological tests using either lipopolysaccharide or whole-cell antigen for diagnosing, the difference of isotypes in Brucella species make the serological tests vary in their ability to diagnose brucella (Ohtsuki *et al.,* 2008), (Nielsen 2002).

In the agglutination test, the Rose-Bengal test (RBT) and the buffered antigen plate agglutination test (BPAT) are considered to be the two common tests used. The difference between the two tests is the staining of whole cells, The RBT uses B. abortus stained with rose-Bengal while the BPAT uses B. abortus SI 119.3 whole cells stained with crystal violet or brilliant green dyes (Raghava and Umesha 2018), (Muma *et al.,* 2009).

An adaptation of the agglutination test is the Milk Ring Test (MRT) were used milk to screening the bovine brucellosis, MRT was influenced by numerous milk conditions such as mastitis, colostrum sand milk at the end of the lactating cycle leading to incorrect interpretation and relatively insensitive test (Nielsen 2002), (Junaidu *et al.,* 2011).

On complement fixation test (CFT) basis is that dilutions of serum, antigen (usually whole cell), and pre-titrated amount of complement (guinea pig serum) are added together. If the antibody is present in the serum, it will

bind to the antigen; and providing the antibody is IgGl isotype, the complement will be activated. The indicator system consists of sheep erythrocyte sensitized with rabbit antibody. If the test serum contains antibodies, the complement will not be available and lysis of erythrocytes will not take place. Alternatively, if no antibody was present, the available complement activated by interaction with the Fc receptor portion of the rabbit antibody will lyse the erythrocytes, releasing hemoglobin, which can be assessed visually or using a spectrophotometer (Nielsen 2002), (Yohannes *et al.,* 2012).

Indirect enzyme-linked immunosorbent assay. At present, the application of the ELISA technique is considered a better test in early detection of infection than the complement fixation test. Indirect enzyme-linked immunosorbent assays (I-ELISAs) have been developed and used in various countries for serodiagnosis of brucellosis in humans and animals. the diagnosis of brucellosis by enzyme-linked immunosorbent assay (ELISA) which is reported to be a sensitive and specific test (Munir *et al.,* 2008).

3.2.3 Molecular diagnosis

Polymerase Chain Reaction (PCR) and its variants, are an important test for diagnosis and epidemiologic studies, allowing differentiation between virulent and vaccine strains, based on the amplification of specific genomic sequences of the genus, species, or even biotypes of Brucella spp., are the

most broadly used molecular technique for brucellosis diagnosis (da Silva Mol *et al.,* 2012).

3.3 Control of brucellosis

Since there is no human vaccine available against brucellosis, and the fact that the disease is transmitted from one person to another is very low, the control of animal brucellosis is through comprehensive vaccination of livestock against this disease, and the provision of healthy food products of animal origin free of brucellosis bacteria by applying Health measures and protocols that ensure this is the only options to reduce the incidence of disease in humans (Ducrotoy *et al.*, 2017).

In 1998, the incidence rate of brucellosis in Palestine was 32.4 per 100,000 people, and this rate is one of the highest in the countries of Mediterranean basin, this year, the disease control program was implemented in cooperation with the World Health Organization and the United Nations Development Program, as this program aims to reduce the incidence of brucellosis among humans and animals alike. In the year 2000, the rate of infection among the population was recorded as it reached 10 / 100,000 people (PHIC 2019).

Chapter IV

Materials and Methods

4.1 Study area

This cross-sectional study was conducted in February 2020. The study targets the veterinarians and veterinary health care workers in four governorates in the northern West Bank, Jenin Governorate, Nablus Governorate, Qalqilya Governorate, and Tulkarm Governorate. The area of these four governorates is about 1594 square kilometers, and they constitute 28% of the area of the West Bank. The population of these governorates is 1002347 people, according to the population census in 2017 and 35% of the total population of the West Bank (PCBS 2017). According to the Veterinarians Association / Jerusalem branch, the number of veterinarians who practicing for the profession in the four governorates is 171, they represent a percentage of 47% of the total number of veterinarians working in the West Bank.

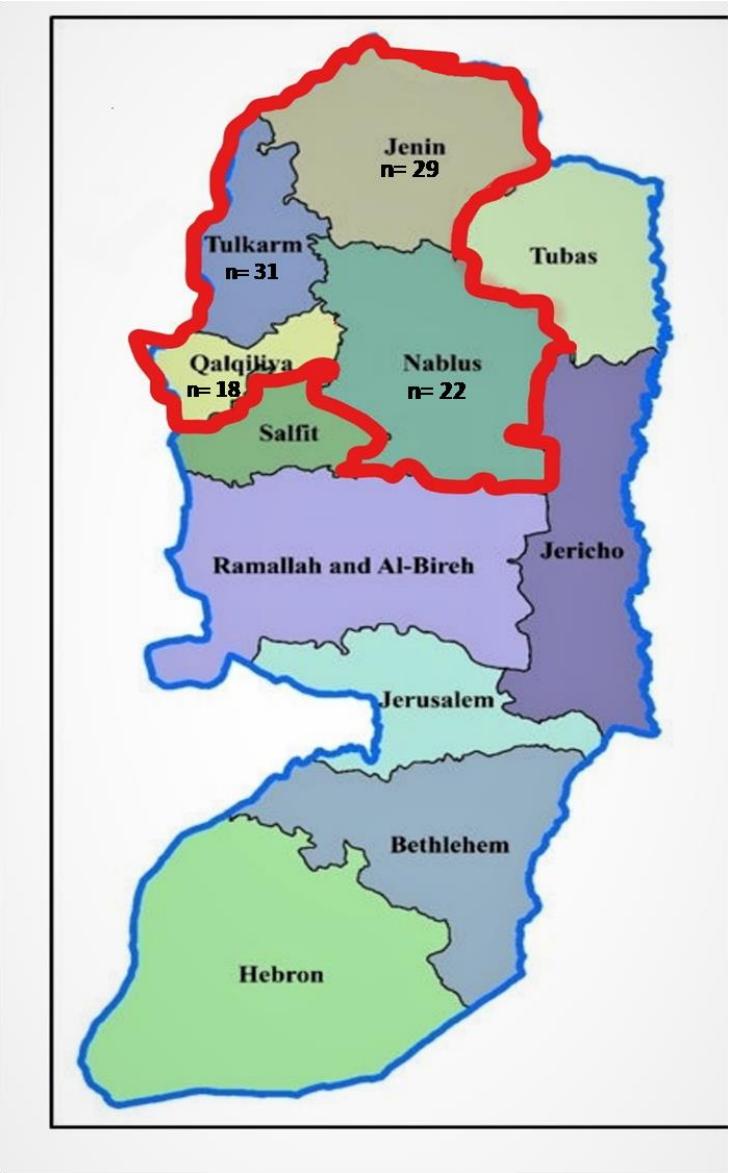


Figure 2: Map of the West Bank, the targeted cities and number of samples are surrounded by a bold red line

4.2 Study questionnaire

A questionnaire was prepared to participate in the research after obtaining approval from the Institutional Review Board at An-Najah National University. The questionnaire consists of four papers, and the first paper contained the name of the university, college, and department, the title of the study, the names of the researcher and the supervisors (Index 1).

As for the second paper in which the researcher shows the participants the nature of the study and information about participating in the study so that the participant expresses his opinion in the study, after the written approval of the subscriber, the answer is answered when the questionnaire questions in writing face-to-face and then gives a sample of his blood of an amount of 3 ml. Then it was taken by an experienced nurse and licensed by the responsible official authorities, medical protocols were used.

As for the third and fourth papers, they contain 25 questions divided into 3 sections A, B, and c.

Section A questions about information common to the participant such as (gender, workplace, age, level of education, specialization, infection with Brucellosis in advance).

Section B (Nature of work) private sector, public sector, working in a veterinary pharmacy, field supervision, and treatment, slaughterhouse of ruminants, the animals you deal with, number of birth deliveries, dealing with fetuses and aborted tissues, doing vaccination and dealing with the vaccine.

Section C questions about safety during work, manual handling of fetuses and aborted tissues and their number, inquiries from the owner of the herd was vaccinated against brucellosis before the medical intervention, use of clothing and protective equipment such as gloves, gag, long sleeve, taking preventive measures when diagnostic anatomy of animals, and when

surgical operations, the use of sterilizers after medical interventions and their type, contact with the skin and mucous membranes during the vaccination.

The questionnaire was revised and audited by Dr. Belal Abu Helal (Instructor at Department of Veterinary Medicine - Faculty of Agriculture and Veterinary Medicine at An Najah National University, President Veterinary association / Al-Quds Center) and Dr. Nasr Jalboush (Instructor at Department of Veterinary Medicine - Faculty of Agriculture and Veterinary Medicine at An Najah National University)

4.3 Sample collection

Blood samples were collected and the questionnaire was filled out from the participants in the study between 20.2.2020 to 11.6.2020. The length of the sample collection period was due to the quarantine of cities and governorates due to the Corona pandemic for approximately 70 days, the number of blood samples collected is 100 and filled out the same number from the questionnaire, veterinarians have been particularly targeted from the public and private sectors on the various nature of their work, veterinarian pharmacies and field supervision, vaccination programs, artificial insemination, livestock slaughterhouse inspectors on products of animal origin, academics of the College of Veterinary Medicine, some animal production engineers, and technical staff in veterinary departments who working in immunization programs have also been targeted.

Taking samples from the participant after reading the terms of participation in the questionnaire and writing agreeing to participate in the study. The questionnaire was filled out in writing and face to face, where 3 ml of blood was taken by a practicing nurse practicing according to the medical protocols used. Number of samples by governorates in the following table:

Table 4: Numbers and distribution of samples involved in this study.

Governorate	Number of samples
Jenin	29
Nablus	22
Qalqilya	18
Tulkarm	31
Total	100

The number of veterinarians working in the four governorates is about 171 veterinarians, according to the Veterinarians Syndicate, when taking the blood samples, it is written on the (tube) governorate code, sample number, date and is identical to the questionnaire paper for the same participant who granted a sample the blood, Where the code was J# of Jenin Governorate, Nablus N#, Qalqilya Q#, and Tulkarem T#, the sampling date differs for each governorate, meaning that each province was assigned a separate day.

After taking the sample and coding, the samples were placed in an icebox between the frozen gel plates and then transferred directly to the laboratory of the Faculty of Veterinary Medicine / An-Najah National University in Tulkarm.

Blood samples were kept inside the laboratory at a maximum temperature of 4C then centrifugation of samples at 5000 rpm for 10 minutes. The floating liquid was stored in a sterile tube under temperature -20 C.

4.4 Detection of Anti-brucella IgG

4.4.1 Rose-Bengal Test

The RBT was performed according to standard procedures, Rose Bengal test commonly used tests for diagnosing Brucella, due to its simplicity, speed, and sensitivity, the inactivated Brucella cells stained with Rose Bengal and suspended with acid buffer are used to detect agglutinating antibodies. An amount of each sample is placed in a circle on the test card, then the same amount of (Rose Bengal) was added and then mixed until covering the entire surface of the sample, the card was shaked carefully for 4 minutes after which we observed whether agglutination occurred or not [6].

4.4.2 ELISA

The qualitative immunoenzymatic (NovaLisa® Brucella IgG – ELISA, IMMUNODIAGNOSTICA, Germany) is based on the ELISA (Enzyme-linked Immunosorbent Assay) technique. Microtiter strip wells are precoated with Brucella antigens to bind corresponding antibodies of the sample. After washing the wells to remove all unbound sample material horseradish peroxidase (HRP) labeled anti-human IgG conjugate was added. This conjugate binds to the captured Brucella-specific antibodies.

The immune complex formed by the bound conjugate is visualized by adding Tetramethylbenzidine (TMB) substrate which gave a blue reaction product. The intensity of this product is proportional to the amount of Brucella-specific IgG antibodies in the specimen. Sulphuric acid was added to stop the reaction. This produces a yellow endpoint color. Absorbance at 450 nm was read using an ELISA microwell plate reader.

4.5 Ethical Consideration

The study proposal was approved by the Institutional Review Board (IRB) and the scientific research committee of the Master of Public Health Program as well as the faculty of graduate studies scientific research board council at An-Najah National University (Index 2).

The Directorate of Veterinary Services / Ministry of Agriculture and the private companies in which the participants donating blood samples work were addressed by official letters from An-Najah National University (Index 3). An explanatory sheet was attached within the questionnaire in which a full explanation of the research includes the purpose, nature of the study, and the importance of participation. To ensure the confidentiality of information; a declaration agreeing to participate in the study and give the blood sample was included in each questionnaire.

4.6 Data collection and analysis

Data were analyzed with statistical software SPSS version 20th (SPSS Inc, USA). A Chi-square test was used to determine the association between the

prevalence of Brucella specific IgG antibodies and the other investigated factors. P-value < 0.05 was always considered statistically significant.

Chapter V
Results

5.1 Rose Bengal

In this study, using the Rose Bengal test, 26 variables were analyzed as risk factors associated with the prevalence of brucellosis among veterinarians and animal production engineers in the northern West Bank-Palestine. Chi-square test resulted in 5 variables as significant occupational risk factors as shown in table 5, the overall prevalence rate was 29% (29, n= 100). According to age, all participants were categorized into five age groups. The result of the Rose Bengal test showed that the prevalence rate was higher in the older participants (> 45 years) with 10 positive samples (n = 20) and the prevalence rate was 50%, followed by participants with age (36 -40 years) with 4 positive samples (n = 10) with a rate of 40%, (30 -35) years 8 positive samples (n=25) were positive with a rate of 32%, (24-29 years), 7 samples (n = 40) were positive with a rate of 17.5%. All samples from participants with age group (41 – 45 years) (n=5) were negative. There was a significant difference between the five age groups. (P = 0. 048).

The participants were divided into two groups according to their knowledge of a previous infection with Brucellosis. The prevalence rate of the brucellosis was 60% (9, n=15) in the group with previous knowledge, which significantly higher than the 23.5 % rate of participant that don't know about the previous infection (20, n=85) (P = 0.004)

Concerning the work sector, participants in the public sector had a higher prevalence rate of 47.1% (16, n=34) than those in the private sector19.7% (13, n= 66). There was a significant difference between the two groups (P=0.004).

The participants were grouped if they work directly in vaccinating animals against brucellosis or not. The prevalence rate of brucellosis among working participants was 40.0 % (16, n = 40), compared to 21.7% (13, n = 60) in the participants not dealing with the vaccine. There was a significant difference between the two groups (P = 0.048).

Based on the necessary protective gear used when carrying out the vaccination against brucellosis, the participants were categorized into two groups if they use it or not. The prevalence rate was significantly higher in the group who wear the necessary protective clothes with 38.5% (20, n = 52) compared to 18.8% in the group of participants who don't (9, n = 48) (P = 0.03).

The gender, education level, specialization, previous family members ever suffer from brucellosis, work nature, animals you interact with, take blood samples from animals, work period in years, annual birth intervention rate, deal with aborted fetuses and tissues to take Samples to the laboratory, work to clean the uterus when retention manual placenta and uterine tissue and times to be repeated, ask the owner if the animal is vaccinated against brucellosis before intervening when giving birth or cleaning the uterus from the placenta and fetal membranes, use the appropriate protective

equipment when interfering with childbirth and intrauterine cleansing of the placenta and fetal tissue, the diagnostic autopsy of dead animal corpses held, wear protective clothing When performing the diagnostic autopsy of dead animals, some sterilizers be used to wash and sterilize hands after interventions in obstetrics and uterine cleaning of the retained placenta and fetal membranes, type of disinfectant you use, the vaccine happen to come into contact with the skin, or did a needle prick During the vaccination process against brucellosis and blood samples taken for laboratory diagnosis and notified to the concerned authorities When diagnosis and suspicion of animal's infection with brucellosis to be tested for brucellosis were not significantly associated with Rose Bengal result (see the results for these factors in the tables 9,10 and 11 on index 3.

Table 5: Results of the RBT test and P-value for significant risk factors for Brucellosis among veterinarians working in veterinary health care in the northern West Bank.

Risk Factor		+ve	-ve	P value
Age (years)	(24-29)	7	33	0.048*
	(30-35)	8	17	
	(36-40)	4	6	
	(41 – 45)	0	5	
	45<	10	10	
Previous infection	Yes	9	6	0.004*
	No	20	65	
Sector	Public	16	18	0.004*
	Private	13	53	
Work directly in livestock Brucellosis vaccination programs	Yes	16	24	0.048*
	No	13	47	
The necessary protective clothes are worn during vaccination	Yes	9	32	0.033*
	No	20	39	

5.2 ELISA

5.2.1: Social factors.

In this study, 100 blood samples were analyzed by the ELISA test, representing the target governorates (Table 6). The overall prevalence rate was 76%. Out of 29 samples collected from Jenin, 22 (75.8 %) were positive. In Nablus 18 samples (n= 22) were positive with a rate of 81.8%. In Qalqiliya, 16 positive samples (n=18), with a rate of 88.9%. Finally, 20 positive samples (n= 31) Tulkarm were recorded with a prevalence rate of 64.5%. There were no significant differences between the four

governorates (P = 0.195). According to gender, 75 positive samples out of 98 investigated males with a rate of 76.5%. One sample of the two collected from female participants was positive with a rate of 50%. There was no significant difference between males and females (P= 0.654). Concerning age, the participants were divided into five age groups. The prevalence rate was 100% in both a > 45 years, (20, n=20), and 36 – 40 years (10, n=10). 80% rate was detected in the age group 41 -45 years (4, n=5). The age group 24 -29 years rate was 70%, (28, n=40), 56% in (30-35 years) age group (14, n=25). There was a significant difference between the five age groups. (P = 0. 024).

The participants were divided into four groups according to the educational level, it was found that the prevalence rate of brucellosis according to each group is as follows: participants with Bachelor (n = 86) 63 samples were positive with a rate of 73.3%%, the participants with the Master level (n = 8) 7 samples were positive with a rate of 87.5%, the participants with Ph.D. (n = 2) 2 samples were positive with a rate of 100%, finally, participants with Diploma (n = 4) 4 samples were positive. There was no significant difference between groups according to the level of education (P = 0.827). Based on professional specialty, participants were divided into two groups: veterinary medicine (n = 89), and animal production (n = 11). Our findings showed that the prevalence rate of brucellosis in veterinary medicine was 74.2% (66, n = 89), and animal production 90.9% (10, n = 11). There was no significant difference between the two groups according to professional specialty (P = 0.467). Regarding the participant's

knowledge of a previous infection with brucellosis; the prevalence rate of the brucellosis was 100% (15, n=15) in the grope with previous knowledge, which higher than the 71.8 % rate of participant that don't know about the previous infection (61, n=85). There was no significant difference between the two groups (P = 0.062). The prevalence rate in the participants with knowledge about previous family infection was 75% (3, n=4) compared to 76% with participants that did not know (73, n=96). There was no significant difference between the two groups (P = 0.976).

Table 6: The results of the ELISA brucellosis test and P-value for social risk factors for veterinarians working in veterinary health care in the northern West Bank.

Risk factors		+ve	-ve	P value
Gender (sex)	Male	75	23	0.654
	Female	1	1	
Workplace (City)	Jenine	22	7	0.195
	Nablus	18	4	
	Qalqylia	16	2	
	Tulkarm	20	11	
Age (years)	(24-29)	28	12	0.024*
	(30-35)	14	11	
	(36-40)	10	0	
	(41-45)	4	1	
	(45<)	20	0	
	Diploma	4	0	

Education level	Bachelor	63	23	0.827
	Master	7	1	
	PhD	2	0	
Specialization	Veterinary Medicine	66	23	0.467
	Animals Production	10	1	
you ever had brucellosis	Yes	15	0	0.062
	No	61	24	
your family members ever suffer from brucellosis	Yes	3	1	0.976
	No	73	26	

5.2.2: Work Nature and Sector

Concerning the work sector, participants in the public sector had a higher prevalence rate of 94.1% (32, n=34) than those in the private sector66.7% (44, n= 66). There was a significant difference between the two groups (P = 0.010).

Based on the nature of work, the participants in the office and administrative type 63.6% (7, n=11) while in the field supervision and treatment was 77.5% (69, n=89). There was no significant difference between the two groups (P = 0.514).

According to the animal species that participants deal with, they were divided into two groups: Food animals, pets' animals. The prevalence rate

of brucellosis in the participants dealing with food animals was 77.6 % (76, n=98) while the two samples of the participants dealing with pets' animals were negative. There was no significant difference between the three groups (P = 0.033).

According to taking blood samples from animals to be tested with brucellosis or not, the participant's answers were categorized into two groups if they do or not. The prevalence rate of brucellosis among the participants in the first group was 77.6% (52, n=67) compared to 72.7% (24, n=33) in the participants who didn't take a blood sample. Also, there were no significant differences between the two groups (P = 0.621).

The participants were grouped if they work directly in vaccinating animals against brucellosis or not. The prevalence rate of brucellosis among working participants was 82.5 % (33, n = 40), compared to 71.7% (43, n = 60) in the participants not dealing with the vaccine. There were no significant differences between the two groups (P = 0.155).

Table 7: Results of the ELISA brucellosis test and P-value for work nature risk factors for veterinarians working in veterinary health care in the northern West Bank.

Risk factors		+ve	-ve	P value
Sector	Public	32	2	0.010*
	Private	44	22	
Work nature	Administrative	7	4	0.514
	Field supervision and treatment	69	20	
Animals you interact with	Food animals	76	22	0.033*
	Pets	0	2	
Take blood samples from animals to be tested for brucellosis.	Yes	52	15	0.621
	No	24	9	
Work in Brucellosis vaccination program	Yes	33	7	0.155
	No	43	17	

5. 2. 3 Exposure factors

Regarding the length of the work period in years, the participants have divided into five groups; the prevalence rates were 67.6%in the participants with work length of (1- 5) years (25, n=37), 10 positive samples (n = 20) were detected in the participants with work length of (6-10) years with a rate of 50%. 15 positive samples were detected in the participants with (11 -15) years of experience (n = 15) with a rate of 100%, in (16-20) years of work experience, 7 samples were positive (n = 8) with a rate of 87.5%, 19 positive samples were detected in the participants with>20 years of experience (n=20) with a rate of 95%. There was a significant difference between the five work length groups (P = 0.008).

According to the number of annual medical interventions in the delivery of animals, the participants were grouped into five categories, no intervention, <5, 6-10, 11-15, and >15 times. The prevalence rate in the participant had no intervention was 76.9% (10, n=13), the participants with (< 5) annual delivery interventions with a rate of 70.6% (12, n=17), the (6-10) times with a rate of 62.5% (5, n= 8). The participants with (11-15) times annual intervention had a rate of 71.4% (10, n = 14). 81.2% rate detected in (> 15) times (39, n=48). There were no significant differences between the five groups (P = 0.890).

Based on the participants' handling of the aborted embryos and tissues and taking samples for the laboratory, the participants were divided into two groups if they do or not. The prevalence of brucellosis was higher in the group that practice with 77.8% (49, n=63) compared to 73% in the participants that didn’t practice (27, n= 37). There were no significant differences between the two groups (P = 0.585).

The participants were categorized into two groups based on the interfering with uterine lavage and retained placenta. The prevalence of brucellosis was equal in the two groups who interfere with 76% (57, n=75) and76% in the participants that didn’t (19, n=25). However, there was no significant difference between the two groups (P= 0.840). Besides, the participants were divided into two groups according to how many times their interference to: <5 and> 5 times. The prevalence rate in the first group was 78.4% (40, n=51) compared to 73.5% in the participants who had less than

5 times (36, n=49). There was no significant difference between the two groups (P =0.458). Participants were divided into two groups based on asking the owner of the animal is vaccinated against brucellosis before intervening. The prevalence rate of brucellosis was 74.5% (38, n=51) in the group who don't ask compared to 77.6% in the group who do (38, n=49). There was no significant difference between the two groups (P = 0.605).

According to using the appropriate protective equipment when interfering with parturition and intrauterine cleaning the placenta and fetal tissues, all participants were divided into 13 groups. The result of the ELISA showed that the prevalence rate was higher with a rate of 100% in the each groups of participants who use the (plastic overall), (long sleave + plastic overall), (gloves + long sleave + plastic overall), (gloves + gown + mask), (gloves + gown + long sleave + plastic overall), and (gloves + long sleave + mask + plastic overall) as protective equipment's((1, n=1), (1, n=1), (4, n = 4), (1, n = 1), (1, n = 1) and (2, n = 2) respectively, followed by participants use (gloves) with 14 positive samples (n=17) with a rate of 82,4%, 24 positive samples were detected in the participant who use (gloves + long sleave) as protective equipment (n = 30) with a rate of 80% , the group who not use (any protective) equipment with 10 positive samples (n=13) with prevalence rate was 76.9%, the prevalence rate was 65.4% in group who use (long sleave) (n=26) as a protective equipment with 17 positive samples, the rate was 50% in the group who use (gloves + long sleave + mask) with 1 positive sample (n = 2),finally all samples from participants with use (gloves + gown) (n=1) and (gloves + long sleave + gown) (n=1)

were negative respectively. There were no significant differences between 13 groups (P = 0.922).

Based on the necessary protective gear used when carrying out the vaccination against brucellosis, the participants were categorized into two groups if they use it or not. The prevalence rate was in the group who wear the necessary protective clothes with 78.8% (41, n = 52) compared to 72.9% in the group of participants who don't (35, n = 48), there were no significant differences between the two groups (P = 0.507).

According to the place where is the necropsy of dead animals performed; participants were categorized into three groups: Field, PM lab, and both of them. ELISA results showed that the prevalence rate was 100% (11, n = 11) in both field and PM lab group followed by the group who do that in the field with (57, n = 77) with a prevalence rate was 74%, finally, 66.7% in the PM lab group (8, n = 12). There was no significant difference between the three groups (P= 0.344).

The participants were categorized into two groups based on wearing protective clothes when performing the diagnostic autopsy of dead animals, the prevalence rate in the participant who does was 78.1% (50, n= 64) compared in the participant's group who did not 72.2% (26, n= 36), There was no significant difference between the two groups (P= 0.371).

All participants were divided into two groups according to using sterilizers to wash and sterilize hands after intervention in obstetrics and uterine

cleaning of the retained placenta and fetal membranes. The prevalence rate of brucellosis in the group who use sterilizers was higher (72, n = 93) with a rate of 77.4%compared by a group of participants who don't use (4, n= 7) with a rate of 57.1%. There was no significant difference between the two groups (P = 0.424).

All samples from participants categorized into 13 groups based on the type of disinfectants use, the results of ELISA showed that the prevalence rate was higher in the following each groups with a rate of 100% who do not use (any disinfectants), (chlorin, quarter ammonia), (alcohol + iodine), (water + soap + alcohol), (alcohol + potassium permanganate) and (alcohol +iodin +water +soap + Dettol) ((5, n = 5), (1, n = 1), (1, n = 1), (8, n = 8), (2, n = 2), (2, n = 2) and (1, n = 1) respectively), followed by the rate of 81.8% in the group who use (alcohol) as disinfectant with 36 samples were positive (n = 44), the prevalence rate was 75% in the both groups who use (iodine) and (Dettol) (3, n = 4) and (3, n = 4) respectively), the group who use (potassium permanganate) with 2 positive samples (n = 3) with a rate of 66.7%, the prevalence rate in the group who use the (water + soap) was 50% with 12 samples were positive (n = 24), finally all samples in the group who use the (chlorin + detol) as disinfectant were negative . There were significant differences between the 13 groups (P= 0.006).

The participants were divided into two groups according to the accidental vaccine contact during the vaccination against brucellosis. The prevalence rate of brucellosis was 87.9% in the group with contact (29, n = 33) and

70.1% in the group without contact (47, n = 67). There was no significant difference between the two groups (P= 0.139).

Participants were categorized into two groups based on blood samples taken for laboratory diagnosis and notified to the concerned authorities when diagnosis and suspicion of an animal infected with brucellosis. Our findings showed that the prevalence rate in the group who practice was higher with a rate of 76.1% with (67, n = 88) compared to the other group 75% (9, n = 12). There were no significant differences between the two groups (P =0.922).

Table 8: Results of the Elisa test and P-value for risk factors for veterinarians working in veterinary health care in the northern West Bank (Exposure factors).

Risk factors		+ ve	-ve	*P*-value
Work period in years	(1-5)	25	12	0.008*
	(6-10)	10	10	
	(11-15)	15	0	
	(16-20)	7	1	
	(>20)	19	1	
Annual birth intervention rate	(0)	10	3	0.890
	(< 5)	12	5	
	(6-10)	5	3	
	(11-15)	10	4	
	(> 15)	39	9	
Deal with aborted fetuses and tissues	Yes	49	14	0.585
	No	27	10	
Work to clean the uterus when placenta retention	Yes	57	18	0.840
	No	19	6	
How many	(5 = >)	36	13	0.458
	(5<)	40	11	
Ask the owner of the animal is vaccinated against brucellosis Before	Yes	38	11	0.605
	No	38	13	

reproductive intervention				
Use the appropriate protective equipment When interfering with childbirth and intrauterine cleansing of the placenta and fetal tissue.	Not use	10	3	0.922
	Gloves	14	3	
	Long sleeve	17	9	
	Plastic overall	1	0	
	Gloves+ gown	0	1	
	Gloves+ long sleave	24	6	
	Long sleave+ plastic overall	1	0	
	Gloves+ gown+ long sleave	0	1	
	Gloves+ long sleave+ mask	1	1	
	Gloves+ long sleave+ plastic overall	4	0	
	Gloves+ gown+ mask	1	0	
	Gloves+ gown+ long sleave+ plastic overall.	1	0	
	Gloves+ long sleeves+ mask+ plastic overall	2	0	
The necessary protective clothes are worn when carrying out the vaccination against Brucella.	Yes	41	11	0.507
	No	35	13	
The diagnostic autopsy of dead animal corpses held	In Field	57	20	0.334
	In PM lab	8	4	
	both of them	11	0	
Wear protective clothing	Yes	50	14	

when performing the diagnostic autopsy of dead animals.	No	26	10	0.371
Some sterilizers are used to wash and sterilize hands after interventions in stetrics.	Yes	72	21	0.424
	No	4	3	
Type of disinfectant you use.	Alcohol.	36	8	0.006*
	Iodine	3	1	
	Water+ soap	12	12	
	Not use	5	0	
	Potassium permanganate	2	1	
	Chlorin	1	0	
	Dettol	3	1	
	Quarter ammonia.	1	0	
	Alcohol + Iodine	8	0	
	Water+Soap+ Alcohol	2	0	
	Alcohol + Potassium permanganate	2	0	
	Chlorine + Dettol	0	1	
	Alcohol + Iodine +Water+ Soap+ Dettol.	1	0	
The vaccine happens to come into contact with skin or did a needle prick During the vaccination process against brucellosis.	Yes	29	4	0.139
	No	47	20	
Blood samples were taken for laboratory diagnosis and notified to the concerned authorities When diagnosis and suspicion of animal's infection with brucellosis	Yes	67	21	0.922
	No	**9**	**3**	

Chapter VI
Discussion

6.1 Study main findings

In this work, we investigate the prevalence of human brucellosis as an occupational disease in the animal health caretaker and related risk factors. We analyzed 100 blood samples collected from veterinarians and par-veterinarians from four target governorates in the north West Bank using the ELISA test. The prevalence of brucellosis among veterinarians in the target governorates in the northern West Bank was 76%. this rate is higher compared to the neighboring countries in the Middle East and Developed countries worldwide. In Jordan, a study investigating the prevalence of brucellosis among veterinarians was conducted in different regions in the country. Samples were taken from 66 veterinarians showing infection of 10.6% clinically and they were subjected to medical supervision, while the rate of subclinical infection was 43.94% (Abo-Shehada *et al.,* 1991). In Turkey, the incidence of occupational brucellosis was 11.8% (Kutlu *et al.*, 2014). In a cross-sectional study conducted in Hamadan, western Iran between 2014-2015, it was found that the prevalence rate of brucellosis among veterinarians was 17% (Mamani *et al.,* 2018). The prevalence of brucellosis among veterinarians working in the Indian states ranges between 34% -2.26% (Agasthya *et al.,* 2007). The prevalence of brucellosis among veterinarians in Ismailia Governorate, Egypt is 44.2% (Farghaly *et al.*, 2018). The variation of brucellosis prevalence may be attributed to the endemic nature of the disease in animals in Palestine (Awwad *et al.,* 2017)

and the diversification and mixed farming of livestock make animal health care workers vulnerable to the disease (statistics 2014). Besides, the insufficient staff and their higher involvement in animal health care activities as well as the cost and availability of resources and equipment (Shome *et al.,* 2017).

In our current study, seropositivity was higher in males 76.5% compared to 50% in females. Although there was a difference in seropositivity between the sexes, it was not statistically significant, significantly, high-risk occupations for brucellosis are men (Ali *et al.*, 2013), (Ramos *et al.*, 2008). Especially the profession of veterinary medicine, as it is considered one of the male professions in the Middle East, unlike in developed countries (Kutlu *et al.*, 2014), possibly due to the small number of female participants (Mangalgi *et al.*, 2016). Male gender-related higher seroprevalence has been reported from many countries, India (Thakur and Thapliyal 2002), Bangladesh (Rahman *et al.*, 2017), Turkey (Kutlu *et al.*, 2014), and Pakistan (Ali *et al.*, 2013).

In our current study, seropositivity was highest in the age group over 45 years at a rate of 100%, followed by the age group 36-40 at a rate of 80%. There were Significant statistical differences indication that advancing age increases the risk of brucellosis among veterinarians. These results agree with previous studies stating that the advanced age of veterinarians is associated with an increased risk of developing brucellosis (Abo-Shehada *et al.*, 1991). This may be since people in this age group are more at risk for

brucellosis due to the longer exposure period (Mukhtar 2010), (Ramos *et al.*, 2008). The results of our current study are in line with Ramos et al, as he stated that seropositivity is the highest for the age group above 41 years and that there is a significant association between this age group and brucellosis seropositivity (Ramos *et al.*, 2008). Likewise, Nikokar et al., 2011 found that the highest seropositivity was observed in the oldest age group older than 45 years, at 30.5%, and showed that seroprevalence increased with advanced age (Nikokar *et al.*, 2011), perhaps this result explains the fact that a longer period of exposure to the disease means more frequent exposure to the disease through more veterinary practices during a longer life span.

In our current study, seropositivity in the category, Ph.D. level, was 100%, Masters category, 87.5%, there was no statistically significant indication, but the results were in contrast to previous studies, where we found that the risk of developing brucellosis increases in the groups with a higher educational level among veterinarians. in previous studies, the relationship between education level and the risk of brucellosis was investigated. These studies found that there is no significant association between these two variables, although these studies have found that the risk of the prevalence of brucellosis increases in groups with a lower educational level (Mamani *et al.*, 2018), (Rahman *et al.*, 2017), (Shome *et al.*, 2017), (Mukhtar 2010) and (Sofian *et al.*, 2008). Perhaps what explains this result is that most of the participants in our study have a higher level of education and specialists compared to the participants in other similar studies, in addition to the fact

that the master's and Ph.D. degrees mean longer life, more practices, and greater disease exposure.

We have investigated the relationship between specialization in the profession and the risk of infection with brucellosis. Veterinarian samples accounted for 89% while for animal production specialists 11%, the seropositivity of the animal production category is the highest 90.9% while for veterinarians 74.2%, there is no significant statistical for this relationship. In a study conducted in Korea, the prevalence of brucellosis among veterinarians was relatively low at 0.4%. This may be attributed to the fact that the vets have a deep knowledge of the spread of zoonotic diseases and therefore they are keen to apply preventive measures more (Ali *et al.*, 2013) and (Lim *et al.*, 2011). In a study by (Mangalgi *et al.*, 2016), the rate of brucellosis seropositivity among veterinarians was lower than in some other professions.

On the other hand, other studies do not agree with the previous opinions, as they found that the prevalence of brucellosis among veterinarians is higher compared to other high-risk occupations (Lytras *et al.*, 2016). Agasthya et al. found a significant relationship between the veterinary profession and the risk of the prevalence of brucellosis compared to other high-risk professions (Agasthya *et al.*, 2007). This may be attributed to the fact that unique veterinary practices make humans in close contact with different types of sick animals, which makes them more vulnerable to pathogens of animal origin, including Brucella (Abd El Hameed *et al.*, 2012), perhaps

this result can be explained in our study that the number of participants specialized in animal production is small and constitutes only 11% in addition to the fact that most of them work in animal immunization programs against brucellosis.

We investigated the relationship between the personal history of brucellosis and the risk of the prevalence of brucellosis among veterinarians. The seropositivity was the highest for the group with a history of brucellosis 100% compared to the group that did not 71.8%. There is no statistical significance. These results coincide with the Mamani et al study, where it was reported that seropositivity in individuals with a history of brucellosis is much higher, possibly due to the individuals 'continued contact with infected animals and contaminated products(Mamani *et al.*, 2018).

We also investigated the relationship between the participants whose families have a previous history of brucellosis and the prevalence of brucellosis, the seropositivity of the participants whose families have a previous history of brucellosis is 75%, while the participants whose families do not have a previous history of brucellosis, the seropositivity is 76%, there was no statistical significance for considering the previous family history of brucellosis as a risk factor that increases the prevalence of brucellosis (Mamani *et al.*, 2018). There are previous studies that are inconsistent with finding statistically significant differences between brucellosis and a positive family history of brucellosis (Sofian *et al.*, 2008) and (Almuneef *et al.*, 2004). It should be noted that exposure of family

members to the same risk factors leads to the infection of one or more individuals with the disease (Sofian *et al.,* 2008). Perhaps this result can be explained by the fact that the participants in this study are specialists and they are considered one of the most high-risk groups to be infected with brucellosis, mainly because of the profession, which is more important than the common family living factors.

In this study, the relationship between the type of the work sector and the prevalence of brucellosis among veterinarians was investigated. We found a strong statistically significant relationship to the seropositivity of veterinarians working in the public sector 94.1%, while for veterinarians in the private sector it was 66.7%. In a previous study, the results were on the contrary, as the seropositivity of veterinarians working in the private sector was higher. Perhaps this interpretation is that veterinarians in the private sector have more contact with sick animal species in general, on the other hand, that veterinarians in the public sector often work in Healthier environments and more preventive measures (Kutlu *et al.,* 2014), Perhaps the result in our study explains that the process of vaccinating animals against brucellosis is carried out by veterinarians from the public sector only according to the policies and decisions of the Palestinian Ministry of Agriculture, in addition to the veterinary practices that are carried out by veterinarians in the public sector in particular for them.

Many previous studies investigated the relationship between the nature of work and the prevalence of brucellosis. In our study, we found the

seropositivity of field practicing veterinarians 77.5% higher than that of administrative veterinarians 63.6%. There is no statistically significant relationship between these two variables, the results of Shome et al, where he found in his study that those who interact with farm animals directly and continuously are at a high risk of infection with brucellosis compared to individuals who are not in direct and continuous contact with farm animals (Shome *et al.,* 2017), the veterinarians who vaccinate against Brucella in food-producing animals, and handle embryos, fetal membranes and aborted fetal fluids are more susceptible to brucellosis than veterinarians who do not undertake these activities (Kutlu *et al.*, 2014),(Mukhtar 2010), (Mishal *et al.,* 1999) and (Farghaly *et al.,* 2018). Perhaps this result can be explained in our study that field practitioners are more susceptible to disease due to the frequency of special veterinary practices in quantity and quality such as dealing with vaccination, dealing with infected animals through intervention in the process of animal birth, cleaning the uterus from confined fetal waste, surgical interventions and many practices.

Some studies and researches look at zoonotic diseases, especially brucellosis, which give importance to the occurrence of disease in animals and its transmission to humans, whose focus is on food-producing animals, (Sofian *et al.,* 2008), (Shome *et al.,* 2017). This may be explained by the fact that the vast majority of human brucellosis infections are related to Brucella strains associated with food-producing animals such as B. abortus associated with cows, *B. melitenses* associated with goats and sheep, *B. suis* associated with pigs (Mukhtar 2010), (Shome *et al.*, 2017).

In this study, the seropositivity was higher for veterinarians who deal with food-producing animals 77.6%, while no seropositivity was recorded for veterinarians who deal with pets. These differences are statistically significant, meaning that dealing with food-producing animals is a risk factor that increases infection with brucellosis, that is, there are higher risks associated with the type of animal someone is dealing with (Mukhtar 2010). The return to the emergence of new foci of brucellosis and the change in the epidemiological pattern of the disease during the past 25 years was due to large-scale livestock farming (Shome *et al.*, 2017). Omer et al, report contact with animals and especially sheep (Omer *et al.*, 2002) and exposure to cows and/or buffaloes/goats (Mangalgi *et al.*, 2016) as a risk factor for the prevalence of brucellosis (Omer *et al.*, 2002). The raising of livestock and their vaccination against brucellosis were significant risk factors (Sofian *et al.*, 2008). Perhaps this result can be explained in our current study that the common Brucella species that infect animals and are transmitted to humans are associated with food-producing animals such as B.abortus are associated with cows and B. melitensis in goats and sheep, in addition to that veterinary practices in food-producing animals have associated with exposure to disease more compared to pets.

This study showed through its results that taking blood samples from animals by veterinarians to test for brucellosis is not an important risk factor that increases brucellosis as the seropositivity was 77.6%, and 72.7% for veterinarians who do not do so, these differences do not a significant statistical indication. Veterinarians practice special medical practices that

bring them into direct and strong contact with sick animals, which exposes them directly to pathogens of animal origin (Abd El Hameed *et al.*, 2012). It is a scientifically proven fact that quality and quantity contact with animals infected with brucellosis is an important source of human infection with this disease (Shome *et al.,* 2017). Veterinarians usually take blood samples from animals to ensure that brucellosis is diagnosed when suspected of the disease, Mishal et al reported that 43.8% of people who had contact with cows' blood were infected with brucellosis (Mishal *et al.,* 1999).

Many studies have investigated the relationship between the process of vaccinating animals against brucellosis and the prevalence of this disease, as well as in this study, the seropositivity of veterinarians who practice vaccinating animals against brucellosis was 82.5% higher compared to the veterinarians who do not do so 71.7%, these rates It does not give a statistically significant difference, several previous studies do not agree with this view to some extent its finding that the most important occupational risk factors that increase the risk of brucellosis in veterinarians, one of which is the vaccination of against brucellosis (Farghaly *et al.,* 2018), keeping cattle and cattle vaccination were significant risk factors (Sofian *et al.,* 2008), and the vaccine did cause brucellosis in some humans that were accidentally exposed (Ashford *et al.,* 2004). Kutlua explains this opinion in his study, where he explained the risks of dealing with the vaccine against Brucella, which can cause a brucellosis infection to veterinarians either by needle prick or conjunctiva

or through the mucous membranes of the nose and mouth (Kutlu *et al.*, 2014). There may be some agreement between our study and other similar studies, the difference may be slightly due to the high seropositivity rate of the disease among the participants in our study, 76%, which plays some role by making the ratios more convergent between the variables.

In this study, one of the risk factors of exposure was investigated, which is the length of work in the profession and the prevalence of brucellosis. We obtained seropositivity which is the highest in the groups that worked for more years. This relationship has a strong correlation that gave a statistically significant difference, (Abo-Shehada *et al.*, 1991), (Mukhtar 2010). Dealing with animals and contacting them for a longer period is significantly associated with seropositive brucellosis in humans (Rahman *et al.*, 2017). Perhaps this result can be explained by the fact that a longer period of work means more frequent special veterinary practices, which leads to repeated exposure to the disease more quantitatively and qualitatively.

In the current study, the extent of the relationship between the annual intervention rate in the animal parturition process and the prevalence of brucellosis was investigated, the seropositivity of those who intervened in the process of parturition of animals was more than 15 times 81.2%, and the seropositivity of the individuals who did not interfere at all was 71.4%, these rates do not give a statistically significant difference. In her study, Mukhtar mentioned that there is a statistically significant difference

between individuals who intervene in parturition and those who did not (Mukhtar 2010) the professional risk increases among veterinarians during the birth or abortion of animals (Farghaly *et al.,* 2018) infected cowshed workers tend to assistance more in calf parturition (Mishal *et al.,* 1999). It was found that an increased number of performing parturition was associated with an increased risk of prevalence occupational brucellosis (Kutlu *et al.,* 2014). There may be some agreement between our study and other similar studies, the difference may be slightly due to the high seropositivity rate of the disease among the participants in our study, 76%, which plays some role by making the ratios more convergent between the variables.

In the present study, the extent of the relationship between cleaning the uterus from the placenta and retained tissue, the number of recurrences, the aborted tissue and fetal biopsy, and the prevalence of brucellosis was investigated. We found that these factors did not give a statistically significant difference. The vet performs some medical practices in the field that may bring him into close contact with animals and increase his exposure to pathogens (Abd El Hameed *et al.,* 2012). These results were inconsistent with some previous studies which reported that interacting with infected animals during miscarriage or parturition and contact with laboring fetuses and the placenta is a risk occupational factor that increases the prevalence of brucellosis (Abo-Shehada *et al.,* 1991). Lim et al found that handling the placenta of an affected animal is one of the routes for brucellosis (Lim *et al.,* 2011). Mishal et al indicate in their study that

brucellosis is more common among individuals who have had contact with the placenta (Mishal *et al.*, 1999). The placenta and fetal membranes resulting from a sick animal are contaminated with Brucella, which is one of the sources of infection for other animals and humans(Doganay and Aygen 2003).

Previous studies have proven that veterinary practices like intervening when giving birth or cleaning the uterus from the placenta and fetal membranes the main occupational risk factors that increase the prevalence of brucellosis, (Mukhtar 2010), (Abd El Hameed *et al.*, 2012) (Lim *et al.*, 2011). Therefore, the aim of finding out whether animals are immune to brucellosis is to take appropriate preventive measures during veterinary medical interventions to reduce the risk of developing brucellosis (Kutlu *et al.*, 2014), in this study, the knowledge that animals are immune to brucellosis did not give any statistical significance as the seropositivity was close. Among veterinarians who know an animal's medical history is 77.6% and veterinarians who do not know the animal medical history are 74.5%. Farghaly et al stated in their study that veterinarians who deal with animals not immunized against brucellosis are 3.4 times more likely to contract brucellosis than veterinarians who do not interact with these animals (Farghaly *et al.*, 2018).

Our results showed that the use of appropriate preventive equipment during the obstetrics intervention and performing the autopsy on dead animals were not associated with a decrease the brucella seropositivity. These

results are in line with Abd El Hameed et al, who indicated that the relationship between veterinarians' practices and personal protective equipment is weak, they explain this with improper or efficient use of these types of equipment or providing inaccurate data during the interview (Abd El Hameed *et al.,* 2012). On the contrary, in a previous study conducted by Nabukenya et al, it was found that seropositivity in individuals who did not use the protective equipment was 2.5 times more than in individuals who adhered to the protective equipment (Nubukenya et al., 2013). Use of personal protective equipment as a preventive factor against brucellosis (Acharya *et al.,* 2018). Kutlue et al and Farghaly et al, where they indicated that not using appropriate equipment and protective clothing is an important factor that increases the risk of brucellosis (Farghaly *et al.,* 2018),(Kutlu *et al.,* 2014).

The vet performs a diagnostic autopsy of the dead animals to spot the gross lesions and take tissue samples to the laboratory to find out the cause of the death, In our current study, we tried to find the relationship between the application of diagnostic autopsy in certain places (field, laboratory, or both) and its association with the risk of brucellosis. The seropositivity of those who perform the diagnostic autopsy in the laboratory and the field was recorded 100%, in the field 74%, in the laboratory 66.7%. These rates indicate To a weakly correlated relationship between the location of the diagnostic autopsy and the risk of brucellosis.

Our study showed that the seropositivity of veterinarians who do not use sterilizers is 100%, while the seropositivity of those who use one or more sterilizers is much less than it. These differences have a strong relationship between the use of sterilizers and the risk of infection with brucellosis. On the contrary Abd El Hameed et al, showed that there is no significant difference between those who use sterilizers and those who don’t use them (Abd El Hameed *et al.*, 2012). As indicated in the results of Acharya et al .'s study, washing and taking a shower after work does not make a significant difference to the risk of brucellosis (Acharya *et al.*, 2018). Disinfectants and sterilizers play an important role in microbial control (Coelho *et al.*, 2015).

One of the basic veterinary practices is vaccination against brucellosis. In the current study, we tried to find the relationship between direct contact of the vaccine by veterinarians as a result of an accident and the risk of infection with brucellosis. the seropositivity of veterinarians who came into contact with the vaccine was 87.9% higher than that of veterinarians who had no contact with the vaccine, 70.1%. These rates do not indicate statistical significance, these results are in line with a previous study by Farghaly et al, who mentioned Needlestick Injury on Brucella vaccine administration as non-significant (Farghaly *et al.*, 2018). As for Abd El Hameed et al., In the results of her study, it was indicated the carrying out vaccination of animals against brucellosis has no significance(Abd El Hameed *et al.*, 2012).

The results of the Kutlue et al. Study came to the contrary, as they indicated that veterinary personnel have a high risk for occupational brucellosis because of the increased probability of exposure to Brucella livestock vaccines, and mentioned that needlestick injuries are the most frequent type of exposure to the vaccine, and exposure may occur due to scattering of the vaccine material and contact with the conjunctiva, often while removing the syringe from the vaccine bottle (Kutlu *et al.*, 2014). In a previous study, it was proved that accidental exposure to animal brucellosis vaccine, whether needle stick injuries, contact with conjunctiva, or open wounds in humans, is associated with adverse local and systemic clinical symptoms (Ashford *et al.,* 2004). There may be some agreement between our study and other similar studies, the difference may be slightly due to the high seropositivity rate of the disease among the participants in our study, 76%, which plays some role by making the ratios more convergent between the variables.

Conclusion

Our current study showed that the prevalence rate of brucellosis among veterinarians working in veterinary health care in the northern West Bank/Palestine was very high (76%) compared to neighboring countries and globally and that it represents a significant occupational risk, veterinarians working in the public sector have a higher prevalence of disease than veterinarians working in the private sector, handling of food-producing animals, aging, long working period are occupational risk factors that increase the prevalence of brucellosis among veterinarians, the use of disinfectants and sterilizers during veterinary practices reduces the spread of brucellosis.

Recommendations

1. At the official and institutional level

- Increase the number of staff assigned to immunize animals against brucellosis in all veterinary directorates in all governorates to reduce the amount of exposure and contact with animals of individuals, in addition to raising the logistical level necessary to vaccinate the largest possible number of animals in all regions.
- Providing brucellosis vaccine in sufficient quantity at the appropriate time, i.e. before the animal mating season, to ensure the vaccination of the largest possible number of animals in all areas to limit the spread of the disease among animals and its transmission to humans.
- Increase coordination between veterinarians in the private sector and veterinarians in the public sector to report new cases, increase veterinary laboratories by regions to monitor cases of brucellosis among animals, and reduce disease spread as soon as possible
- Encouraging and financing studies and research investigating brucellosis, whether at the animal or human level, to find out more precisely the disease problem, especially since studies in this field are few and rare in Palestine.
- Conducting other studies similar to ours in all Palestinian areas, including workers in high-risk professions affected by brucellosis, such as veterinarians, butchers, workers in slaughterhouses, workers in food processing lines of animal origin, and breeders.

2. At the personal level

- The commitment by veterinarians to equipment and personal precautions and the use of sterilizers and disinfectants when veterinary practices reduce the risk of brucellosis.
- Dealing more carefully with the vaccine while vaccinating animals against brucellosis to reduce accidental infections

References

1 Abd El Hameed, H. S., L. T. Abd El Hameed and K. A. Zayan. "***Awareness of personnel in direct contact with animals regarding brucellosis***." J Am Sci. 2012; 8(6): 790-796.

2 Abid, L., Z. Frikha, S. Kallel, Z. Chokri, B. Ismahen, B. Amin, R. Hammami, D. Abid, M. Akrout and M. Hentati. "***Brucella myocarditis: a rare and life-threatening cardiac complication of brucellosis***." Internal Medicine. 2012; 51(8): 901-904.

3 Abo-Shehada, M. N., J. S. Odeh, M. Abu-Essud and N. Abuharfeil. "***Seroprevalence of brucellosis among high risk people in northern Jordan***." International journal of epidemiology. 1996; 25(2): 450-454.

4 Abo-Shehada, M. N., A. Z. Rabi and N. Abuharfeil. "***The prevalence of brucellosis among veterinarians in Jordan***." Annals of Saudi medicine. 1991; 11(3): 356-357.

5 Acharya, D., S. D. Hwang and J.-H. Park. "***Seroreactivity and Risk Factors Associated with Human Brucellosis among Cattle Slaughterhouse Workers in South Korea***." International Journal of Environmental Research and Public Health. 2018; 15(11): 2396.

6 Agasthya, A., S. Isloor and K. Prabhudas. "***Brucellosis in high risk group individuals***." Indian journal of medical microbiology. 2007; 25(1): 28.

7 Al Dahouk, S., H. Tomaso, K. Nöckler, H. Neubauer and D. Frangoulidis. "***Laboratory-based diagnosis of brucellosis--a review of the literature. Part I: Techniques for direct detection and identification of Brucella spp***." Clinical laboratory. 2003; 49(9-10): 487.

8 Al Dahouk, S., H. Tomaso, K. Nöckler, H. Neubauer and D. Frangoulidis. "***Laboratory-based diagnosis of brucellosis--a review of the literature. Part II: serological tests for brucellosis***." Clinical laboratory. 2003; 49(11-12): 577-589.

9 Ali, S., Q. Ali, H. Neubauer, F. Melzer, M. Elschner, I. Khan, E. N. Abatih, N. Ullah, M. Irfan and S. Akhter. "***Seroprevalence and risk factors associated with brucellosis as a professional hazard in Pakistan***." Foodborne pathogens and disease. 2013; 10(6): 500-505.

10 Almuneef, M., Z. Memish, H. Balkhy, B. Alotaibi, S. Algoda, M. Abbas and S. Alsubaie. "***Importance of screening household members of acute brucellosis cases in endemic areas***." Epidemiology & Infection. 2004; 132(3): 533-540.

11 Ashford, D. A., J. di Pietra, J. Lingappa, C. Woods, H. Noll, B. Neville, R. Weyant, S. L. Bragg, R. A. Spiegel and J. Tappero. "***Adverse events in humans associated with accidental exposure to the livestock brucellosis vaccine RB51***." Vaccine. 2004; 22(25-26): 3435-3439.

12 Awad, R. "***Human brucellosis in Gaza Strip, Palestine***." EMHJ-Eastern Mediterranean Health Journal, 4 (2), 225-233, 1998. 1998.

13 Awwad, E., O. Awwad, M. Farraj, T. Essawi, K. Adwan, A. Manasra, S. Baraitareanu, M. R. Gurau and D. Danes. "***An investigation of brucellosis knowledge, attitude and practice among livestock owners in the West Bank***." CBU International Conference Proceedings. 2017; 5: 1042-1047.

14 Aziz, S., A. R. Al-Anazi and A. I. Al-Aska. "***A review of gastrointestinal manifestations of Brucellosis***." Saudi J Gastroenterol. 2005; 11(1): 20-27.

15 Bayram, M. M. and R. Kervancğlu. "***Scrotal gray-scale and color Doppler sonographic findings in genitourinary Brucellosis***." Journal of clinical ultrasound. 1997; 25(8): 443-447.

16 Brachman, P. S. and E. Abrutyn. "***Bacterial infections of humans: epidemiology and control***." 2009.

17 Brown, C. "***Emerging zoonoses and pathogens of public health significance--an overview***." Revue scientifique et technique-office international des epizooties. 2004; 23(2): 435-442.

18 Castaño, M. J. and J. Solera. "***Chronic brucellosis and persistence of Brucella melitensis DNA***." J Clin Microbiol. 2009; 47(7): 2084-2089.

19 Coelho, A. C., J. G. Díez and A. M. Coelho. "***Risk factors for brucella spp. In domestic and wild animals***." Updates on brucellosis. 2015.

20 Corbel, M. J. "***Brucellosis in humans and animals***." 2006.

21 da Silva Mol, J. P., S. de Araújo França, T. A. Da Paixão and R. L. Santos. "***Laboratorial diagnosis of animal brucellosis***." Revista Brasileira de Ciência Veterinária. 2012; 19(3): 117-126.

22 Doganay, M. and B. Aygen. "***Human brucellosis: an overview***." International journal of infectious diseases. 2003; 7(3): 173-182.

23 Ducrotoy, M., W. J. Bertu, G. Matope, S. Cadmus, R. Conde-Álvarez, A. M. Gusi, S. Welburn, R. Ocholi, J. Blasco and I. Moriyón. "***Brucellosis in Sub-Saharan Africa: Current challenges for management, diagnosis and control***." Acta tropica. 2017; 165: 179-193.

24 Erdem, H., A. Inan, N. Elaldi, R. Tekin, S. Gulsun, C. Ataman-Hatipoglu, N. Beeching, Ö. Deveci, A. Yalci, S. Bolukcu and O. Dagli. "***Respiratory System Involvement in Brucellosis: The Results of the Kardelen Study***." Chest. 2014; 145(1): 87-94.

25 Farghaly, R., F. Amer, F. AE, K. RM and A. MF. "***Predictors of brucellosis seropositivity among exposed workers***." Egyptian Journal of Occupational Medicine. 2018; 42(2): 209-226.

26 Franco, M. P., M. Mulder, R. H. Gilman and H. L. Smits. "***Human brucellosis***." The Lancet infectious diseases. 2007; 7(12): 775-786.

27 Ghanem-Zoubi, N., S. P. Eljay, E. Anis and M. Paul. "***Reemergence of human brucellosis in Israel***." The Israel Medical Association Journal: IMAJ. 2019; 21(1): 10-12.

28 Godfroid, J., A. Cloeckaert, J.-P. Liautard, S. Kohler, D. Fretin, K. Walravens, B. Garin-Bastuji and J.-J. Letesson. "***From the discovery of the Malta fever's agent to the discovery of a marine mammal reservoir, brucellosis has continuously been a re-emerging zoonosis***." Veterinary research. 2005; 36(3): 313-326.

29 González-Gay, M. A., C. García-Porrúa, D. Ibañez and M. J. García-País. "***Osteoarticular complications of brucellosis in an Atlantic area of Spain***." J Rheumatol. 1999; 26(1): 141-145.

30 Hashemi, S. H., F. Keramat, M. Ranjbar, M. Mamani, A. Farzam and S. Jamal-Omidi. "***Osteoarticular complications of brucellosis in Hamedan, an endemic area in the west of Iran***." International Journal of Infectious Diseases. 2007; 11(6): 496-500.

31 Hotez, P. J., L. Savioli and A. Fenwick. "***Neglected tropical diseases of the Middle East and North Africa: review of their prevalence, distribution, and opportunities for control***." PLoS neglected tropical diseases. 2012; 6(2): e1475.

32 Hull, N. C. and B. A. Schumaker. "***Comparisons of brucellosis between human and veterinary medicine***." Infection ecology & epidemiology. 2018; 8(1): 1500846.

33 Husseini, A. and A. a. M. Ramlawi. "***Brucellosis in the West Bank, Palestine***." 2004.

34 Junaidu, A., S. I. Oboegbulem and M. Salihu. "***Serological survey of Brucella antibodies in breeding herds***." 2011.

35 Karaali, Z., B. Baysal, S. Poturoglu and M. Kendir. "***Cutaneous manifestations in Brucellosis***." Indian journal of dermatology. 2011; 56(3): 339.

36 Kutlu, M., O. Ergonul, S. Sayin-Kutlu, T. Guven, C. Ustun, S. Alp-Cavus, S. B. Ozturk, O. Acicbe, S. Akalin and R. Tekin. "***Risk factors for occupational brucellosis among veterinary personnel in Turkey***." Preventive Veterinary Medicine. 2014; 117(1): 52-58.

37 Larbrisseau, A., E. Maravi, F. Aguilera and J. Martinez-Lage. "***The neurological complications of brucellosis***." Canadian Journal of Neurological Sciences. 1978; 5(4): 369-376.

38 Lim, H.-S., K. Lee, S.-J. Yoo, M. Y. Park, S. H. Park, H. Chu and C. J. Lee. "***Seroprevalence of brucellosis and Q fever among the veterinarians in veterinary service laboratories in Korea***." Epidemiology. 2011; 22(1): S145-S146.

39 Lytras, T., K. Danis and G. Dounias. "***Incidence patterns and occupational risk factors of human brucellosis in Greece, 2004–2015***." The international journal of occupational and environmental medicine. 2016; 7(4): 221.

40 Madkour, M. M. "***Brucellosis: overview***." Madkour's Brucellosis. 2001: 1-14.

41 Madkour, M. M. "***Historical aspects of brucellosis***." Madkour's Brucellosis. 2001: 15-20.

42 Madkour, M. M. "***Pregnancy and brucellosis***." Madkour's Brucellosis. 2001: 187-192.

43 Mamani, M., M. M. Majzoobi, F. Keramat, N. Varmaghani and A. Moghimbeigi. "***Seroprevalence of brucellosis in butchers, veterinarians and slaughterhouse workers in Hamadan, western Iran***." Journal of Research in Health Sciences. 2018; 18(1): 406.

44 Mangalgi, S. S., A. G. Sajjan, S. T. Mohite and S. Gajul. "***Brucellosis in occupationally exposed groups***." Journal of clinical and diagnostic research: JCDR. 2016; 10(4): DC24.

45 Memish, Z. A. and G. Pappas. "***Brucellosis: genitourinary involvement***." Urogenital Infections. 959.

46 Mishal, J., N. Ben-Israel, Y. Levin, S. Sherf, J. Jafari, E. Embon and Y. Sherer. "***Brucellosis outbreak: analysis of risk factors and serologic***

screening." International journal of molecular medicine. 1999; 4(6): 655-663.

47 Mukhtar, F. "***Brucellosis in a high risk occupational group: seroprevalence and analysis of risk factors***." JPMA-Journal of the Pakistan Medical Association. 2010; 60(12): 1031.

48 Muma, J., A. Lund, K. Nielsen, G. Matope, M. Munyeme, K. Mwacalimba and E. Skjerve. "***Effectiveness of Rose Bengal test and fluorescence polarization assay in the diagnosis of Brucella spp. infections in free range cattle reared in endemic areas in Zambia***." Tropical animal health and production. 2009; 41(5): 723-729.

49 Munir, R., S. Rehman, R. Kausar, S. Naqvi and U. Farooq. "***Indirect Enzyme Linked Immunosorbent Assay for diagnosis of brucellosis in buffaloes***." Acta Veterinaria Brno. 2008; 77(3): 401-406.

50 Nielsen, K. "***Diagnosis of brucellosis by serology***." Veterinary microbiology. 2002; 90(1-4): 447-459.

51 Nikokar, I., M. Hosseinpour, M. Asmar, S. Pirmohbatei, F. Hakeimei and M. T. Razavei. "***Seroprevalence of Brucellosis among high risk individuals in Guilan, Iran***." Journal of research in medical sciences : the official journal of Isfahan University of Medical Sciences. 2011; 16(10): 1366-1371.

52 Ohtsuki, R., K. Kawamoto, Y. Kato, M. Shah, T. Ezaki and S. I. Makino. "***Rapid detection of Brucella spp. by the loop-mediated isothermal amplification method***." Journal of Applied Microbiology. 2008; 104(6): 1815-1823.

53 Omer, M., T. Assefaw, E. Skjerve, T. Tekleghiorghis and Z. Woldehiwet. "***Prevalence of antibodies to Brucella spp. and risk factors related to high-risk occupational groups in Eritrea***." Epidemiology & Infection. 2002; 129(1): 85-91.

54 Otlu, S., M. Sahin, H. Atabay and A. Unver. "***Serological investigations of brucellosis in cattle, farmers and veterinarians in the kars district of Turkey***." Acta Veterinaria Brno. 2008; 77(1): 117-121.

55 Pappas, G., M. Bosilkovski, N. Akritidis, M. Mastora, L. Krteva and E. Tsianos. "***Brucellosis and the Respiratory System***." Clinical Infectious Diseases. 2003; 37(7): e95-e99.

56 PCBS. "***Livestock Survey, 2013 - Main Results***." Series Livestock Survey, 2013 - Main Results. 2017;Â Access 2017:Â Description.

57 PHIC. "***Health Status, Palestine, 2018***." Series Health Status, Palestine, 2018. 2019;Â Access 2019:Â Description.

58 Raghava, S. and S. Umesha. "***Brucellosis a review on the diagnostic techniques and medical plants used in the management of the***

brucellosis." J World Pharmacy Pharmaceutical Sci. 2018; 7(6): 2278-4357.

59 Rahman, A. A., C. Saegerman, D. Berkvens, F. Melzer, H. Neubauer, D. Fretin, E. Abatih, N. Dhand and M. Ward. "***Brucella abortus is prevalent in both humans and animals in Bangladesh***." Zoonoses and public health. 2017; 64(5): 394-399.

60 Ramlawi, A. a. M. "***Brucellosis prevention and control program annual report***." Series Brucellosis prevention and control program annual report. 1998;Â Access 1998:Â Description.

61 Ramos, T. R. R., J. W. Pinheiro Junior, P. A. d. Moura Sobrinho, V. L. d. A. Santana, N. R. Guerra, L. E. H. d. Melo and R. A. Mota. "***Epidemiological aspects of an infection by Brucella abortus in risk occupational groups in the microregion of Araguaina, Tocantins***." Brazilian Journal of Infectious Diseases. 2008; 12(2): 133-138.

62 Rubach, M. P., J. E. Halliday, S. Cleaveland and J. A. Crump. "***Brucellosis in low-income and middle-income countries***." Current opinion in infectious diseases. 2013; 26(5): 404.

63 Ruben, B., J. Band, P. Wong and J. Colville. "***Person-to-person transmission of Brucella melitensis***." The Lancet. 1991; 337(8732): 14-15.

64 Saddique, A., S. Ali, S. Akhter, I. Khan, H. Neubauer, F. Melzer, A. U. Khan, A. Azam and H. El-Adawy. "***Acute febrile illness caused by Brucella abortus infection in humans in Pakistan***." International journal of environmental research and public health. 2019; 16(21): 4071.

65 Shome, R., T. Kalleshamurthy, P. B. Shankaranarayana, P. Giribattanvar, N. Chandrashekar, N. Mohandoss, B. R. Shome, A. Kumar, S. B. Barbuddhe and H. Rahman. "***Prevalence and risk factors of brucellosis among veterinary health care professionals***." Pathogens and global health. 2017; 111(5): 234-239.

66 Sofian, M., A. Aghakhani, A. A. Velayati, M. Banifazl, A. Eslamifar and A. Ramezani. "***Risk factors for human brucellosis in Iran: a case–control study***." International journal of infectious diseases. 2008; 12(2): 157-161.

67 statistics, P. c. b. o. "***Livestock Survey, 2013 - Main Results***." Series Livestock Survey, 2013 - Main Results. 2014;Â Access 2014:Â Description.

68 Sungur, G. K., D. Hazirolan, Y. Gurbuz, N. Unlu, S. Duran and S. Duman. "***Ocular involvement in brucellosis***." Canadian Journal of Ophthalmology. 2009; 44(5): 598-601.

69 Thakur, S. and D. Thapliyal. "***Seroprevalence of brucellosis in man***." Journal of communicable diseases. 2002; 34(2): 106-109.

70 Ulug, M., Y. Yaman, F. Yapici and N. Can-Ulug. "***Clinical and laboratory features, complications and treatment outcome of brucellosis in childhood and review of the literature***." Turk J Pediatr. 2011; 53(4): 413-424.

71 Yohannes, M., J. Gill, S. Ghatak, D. Singh and T. Tolosa. "***Comparative evaluation of the Rose Bengal plate test, standard tube agglutination test and complement fixation test for the diagnosis of human brucellosis***." Rev. sci. tech. Off. int. Epiz. 2012; 31(3): 979-984.

Indexes

Index 1: Study Questionnaire

بسم الله الرحمن الرحيم

استبيان خاص بالمشتركين ضمن دراسة علمية للتحقيق في حدوث وعوامل الخطر المرتبطة من داء البروسيلات البشرية في المتخصصين في الرعاية الصحية البيطرية في شمال فلسطين ،

هذا البحث عبارة عن رسالة لنيل درجة الماجستير / برنامج الصحة العامة /جامعة النجاح الوطنية (فلسطين)

الباحث : محمد يوسف ابو هلال

المشرف الرئيسي: د. ابراهيم الزهير

المشرف المساعد: د.حمزة الزبدي

المشاركة في دراسية علمية

انا الباحث: محمد ابو هلال من كلية الدراسات العليا في جامعة النجاح الوطنية،أعمل على دراسة لبحث التحقيق في حدوث وعوامل الخطرالمرتبطة بداء البروسيلات البشرية في المتخصصين في الرعاية الصحية البيطرية في شمال فلسطين.

الرجاء أن تأخذ(ي) الوقت الكافي لقراءة المعلومات التالية بتأنّي قبل أن تقرر(ي) إذا كنت تريد(ين) الاشتراك في الدراسة العلمية، بإمكانك طلب إيضاحات أو معلومات إضافية عن أي شيء مذكور في هذه الاستمارة أو عن هذه الدراسة ككل.

يهدف هذا البحث إلى التحقيق في حدوث داء البروسيلات البشرية في المتخصصين في الرعاية الصحية البيطرية في شمال فلسطين. إضافة الى إيجاد العلاقة بين عدد من عوامل الخطورة التي قد تؤدي إلى حدوث المرض.

معلومات عن الاشتراك بالدراسة:

- من أجل اجراء الفحص للاجسام المناعية لبكتيريا البروسيلا سيقوم **ممرض مدرب ومرخص** بسحب عينة دم من الوريد. يمكن لعملية السحب ان تؤدي لالتهاب وقتا في حالات نادرة. سيتم فحص مكان السحب للتأكد من عدم احداث الاعراض.
- لا يوجد تأثيرات سلبية يمكن أن يسببها الاشتراك في هذا البحث. فقد تم إجراء دراسة مثيلة سابقا في دول أخرى ولم تكن له أية تأثيرات سلبية.
- ستساعدنا في هذا البحث إلى الوصول لإجابات وتفسيرات عن مدى انتشار مرض البروسيلا بين المتخصصين في الرعاية الصحية البيطرية في شمال فلسطين
- **سيتم حفظ المعلومات على شكل أرشيف خاص لتجنب ذكر أسماء المشاركين والحفاظ على الخصوصية.**
- في حال وافقت/ي على الاشتراك في هذه الدراسة سيبقى اسم حضرتك طي الكتمان .ولن يكون لأي شخص، ما لم ينص القانون على ذلك، حق الاطلاع على نتيجة البحث المتعلقة بك شخصيا باستثناء الطبيب المسئول عن الدراسة ومعاونيه، ولجان الأخلاق المهنية المستقلة، ومفتشين من الإدارات الحكومية المنظمة.

لقد شرحت بالتفصيل للمشترك في البحث الطبي _____ (اسم المشترك) طبيعة البحث ومجرياته وتأثيراته السلبية. ولقد أجبت على كل أسئلته بوضوح على خير ما أستطيع. وسوف أعلم المشترك بأي تغييرات في مجريات هذا البحث أو تأثيراته السلبية أو فوائده في حال حصولها أثناء البحث.

مع العلم أن هذه الاستمارة تضمن وتحفظ حقوق الباحثين المذكورة أسمائهم أدناه :

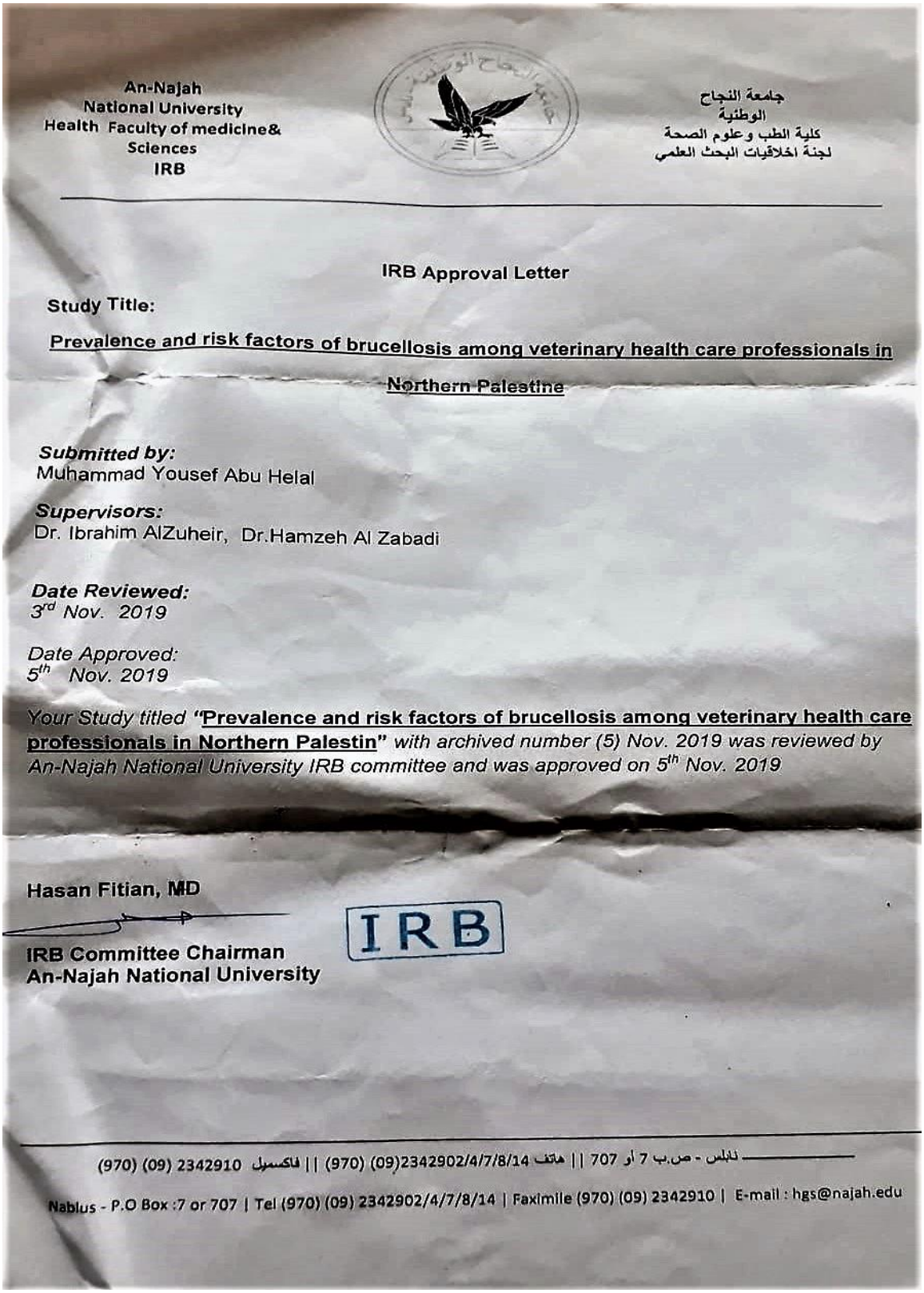
د.ابراهيم زهير. د. حمزة الزبدي. محمد ابو هلال

الرمز			
معلومات عامة			
1	**الـ جـ نس**	ذكر	انثى
2	**مكان العمل**	طولكرم	قلقيلية
		جنين.	نابلس
3	**العمر**	29-24	35-30
		40-36-	40-45	45<
4	**ـفترة العمل بالسنوات؟**	سنة -5.	- 6- 10.
		15-11	20-16
		اكثر من 20 سنة	
5	**مستوى التعليم**	دبلوم او اقل	بكالوريوس
		ماجستير	دكتوراة
6	**التخصص**	طب بيطري	انتاج حيواني
7	**هل سبق وان اصبت بداء البروسلات**	نعم	متى
		لا اعرف	لا
8	**هل حدث وان اصيب احد افراد عائلتك بداء البروسلات؟**	نعم	متى
		لا اعرف	لا
ب طبيعة العمل			
1	**قطاع العمل**	عام	خاص
2	**طبيعة العمل**	اداري	اشراف وعلاج حقلي.
3	**الحيوانات التي تتعامل معها**	ابقار، اغنام وماعز	كلاب ، قطط
4	**معدل التدخل في الولادات سنويا**	0	اقل من 5
		10-6	15-11
		اكثر من 15	
5	**هل تتعامل مع الاجنة والانسجة المجهضة لاخذ عينات الى المختبر ؟**	نعم	لا
6	**هل تأخذ عينات الدم من الماشية لفحص داء لبروسلات ؟**	نعم	لا
7	**هل تعمل في برامج تطعيم الماشية بشكل مباشر ضد داء لبروسلات؟**	نعم	لا
ج- الاجراءات خلال العمل			
1	**هل تعمل على تنظيف الرحم عند انحباس الشيمة والانسجة الرحمية بشكل يدوي ؟.**	نعم	لا

2	**اذا كان الجواب نعم كم معدل هذه الحالات سنويا**	اقل من 5	اكثر من 5
3	**قبل التدخل عند ولادة أو تنظيف الرحم من المشيمة والاغشية الجنينية هل تسأل المالك اذا كان الحيوان مطعم ضد داء البروسلات ؟**	نعم	لا
4	**عند التدخل والتعامل مع حالات الولادة والتنظيف الرحمي من المشيمة والانسجة الجنينية هل تستخدم المعدات الوقائية المناسبة ؟**	نعم	لا
		الكفوف	الجاون
		الكفوف الطويلة	الكمامات
		زي بلاستيكي يغطي الجسم كاملا	اي شيْ اخر
5	**عند عملية التطعيم ضد البروسلات هل يتم ارتداء الملابس الوقائية اللازمة**	نعم	لا
6	**اين تقوم بالتشريح التشخيصي لجثة الحيوانات النافقة؟**	حقل	مختبر تشريح
7	**عند القيام بالتشريح التشخيصي لجثة الحيوانات النافقة هل ترتدي الالبسة الوقائية**	نعم	لا
8	**بعد التدخلات في عمليات التوليد والتنظيف الرحمي من المشيمة والاغشية الجنينية المحتبسة هل تستخم بعض المعقمات لغسيل الايدي وتعقيمها ؟**	نعم (اسم المادة).....	لا
9	**عند التشخيص والشك بإصابة الماشية بداء البروسلات هل يتم سحب عينات دم للتشخيص المختبري و ابلاغ الجهات المعنية ؟**	نعم	لا
10	**اثناء عملية التطعيم ضد داء البروسلات هل صدف وان لامس اللقاح الجلد او حدث وخز بالابرة**	نعم	لا

Index 2

Institutional Review Board (IRB) and the scientific research committee of the Master of Public Health Program as well as the faculty of graduate studies scientific research board council at An-Najah National University



An-Najah
National University
Health Faculty of medicine&
Sciences
IRB

جامعة النجاح
الوطنية
كلية الطب وعلوم الصحة
لجنة اخلاقيات البحث العلمي

IRB Approval Letter

Study Title:

Prevalence and risk factors of brucellosis among veterinary health care professionals in Northern Palestine

Submitted by:
Muhammad Yousef Abu Helal

Supervisors:
Dr. Ibrahim AlZuheir, Dr.Hamzeh Al Zabadi

Date Reviewed:
3rd Nov. 2019

Date Approved:
5th Nov. 2019

*Your Study titled "**Prevalence and risk factors of brucellosis among veterinary health care professionals in Northern Palestin**" with archived number (5) Nov. 2019 was reviewed by An-Najah National University IRB committee and was approved on 5th Nov. 2019*

Hasan Fitian, MD

IRB Committee Chairman
An-Najah National University

IRB

نابلس - ص.ب 7 أو 707 || هاتف 2342902/4/7/8/14 (09) (970) || فاكسميل 2342910 (09) (970)

Nablus - P.O Box :7 or 707 | Tel (970) (09) 2342902/4/7/8/14 | Faximile (970) (09) 2342910 | E-mail : hgs@najah.edu

Index 3

Results of the Rose Bengal test for no significant risk factors of brucellosis for veterinarians working in veterinary health care in the northern West Bank: Social factors

Risk factors		+ve	-ve	P value
Gender (sex)	**Male**	29	69	0.361
	Female	0	2	
Workplace (cities)	**Jenin**	11	18	0.106
	Nablus	5	17	
	Qalqylia	8	10	
	Tulkarm	5	26	
Education level	**Diploma**	2	2	0.620
	Bachelor	23	63	
	Master	3	5	
	PhD	1	1	
Specialization	**Veterinary Medicine**	24	65	0.202
	Animals Production	5	6	
your family members ever suffer from brucellosis	**Yes**	2	2	0.345
	No	27	69	

Index 4

Results of the Rose Bengal test for no significant risk factors of brucellosis for veterinarians working in veterinary health care in the northern West Bank: factors related work nature

Risk factors		+ve	-ve	P value
Work nature	Administrative	2	9	0.402
	Field supervision and treatment	27	62	
Animals you interact with	Food animals	29	69	0.361
	Pets.	0	2	
Take blood samples from animals.to be tested for brucellosis	Yes	21	46	0.462
	No	8	25	

Index 5

Results of the Rose Bengal test for no significant risk factors of brucellosis for veterinarians working in veterinary health care in the northern West Bank Exposure factors.

Risk factors		+ve	-ve	P value
Work period in years.	**(1 – 5)**	7	30	0.365
	(6 – 10)	5	15	
	(11 – 15)	6	9	
	(16 -20)	3	5	
	>20	8	12	
Annual birth intervention rate.	**(0)**	5	8	0.401
	(< 5)	3	14	
	(6 – 10)	1	7	
	(11 – 15)	3	11	
	(> 15)	17	31	
Deal with aborted fetuses and tissues to take Samples to the laboratory	**Yes**	20	43	0.430
	No	9	28	
Work to clean the uterus when retention manual placenta and uterine tissue	**Yes**	22	53	0.899
	No	7	18	
How many	**(5 = > 0)**	12	17	0.330
	(5 <)	37	34	
Ask the owner if the animal is vaccinated against brucellosis Before intervening when giving birth or cleaning the uterus from the placenta and fetal membranes.	**Yes**	12	17	0.330
	No	37	34	
Use the appropriate protective equipment When interfering with childbirth and intrauterine cleansing of the placenta and fetal tissue.	**Not Use**	4	9	0.903
	Gloves	7	10	
	Long sleeve	6	20	
	Plastic overall	0	1	
	Gloves+ gown.	0	1	
	Gloves+ long sleave	9	21	
	Long sleave+plastic overall	0	1	
	Gloves+ gown+ long sleave.	0	1	
	Gloves+ long sleave+ mask	0	2	
	Gloves+ long sleave+ plastic overall.	2	2	
	Gloves+ gown+mask.	0	1	
	Gloves+ gown+ long sleave+ plastic overall	0	1	

	Gloves+ long sleaves +mask+ plastic overall	1	1	
The diagnostic autopsy of dead animal corpses held	**In Field**	21	56	
	In PM lab	3	9	0.438
	Both of them	5	6	
Wear protective clothing When performing the diagnostic autopsy of dead animals.	**Yes**	21	43	0.371
	No	8	28	
Some sterilizers are used to wash and sterilize hands after interventions in obstetrics and uterine cleaning of the retained placenta and fetal membranes.	**Yes**	28	65	0.37
	No	1	6	
Type of disinfectant you use	**Alcohol.**	14	30	0.340
	Iodine.	0	4	
	water+ soap	5	19	
	not use	3	2	
	Potassium permanganate	0	3	
	chlorin	1	0	
	Dettol	1	3	
	quarter ammonia.	0	1	
	Alcohol + Iodine	3	5	
	Water+ Soap+ Alcohol	0	2	
	Alcohol + Potassium permanganate	1	1	
	Chlorine + Dettol	0	1	
	Alcohol + Iodine +Water+ Soap+ Detol.	1	0	
The vaccine happens to come into contact with the skin or did a needle prick During the vaccination process against brucellosis	**Yes**	13	20	0.108
	No	16	51	
Blood samples were taken for laboratory diagnosis and notified to the concerned authorities When the diagnosis and suspicion of animal's infection with brucellosis	**Yes**	27	61	0.922
	No	2	10	

جامعة النجاح الوطنية

كلية الدراسات العليا

انتشار وعوامل الخطر لمرض البروسيلا بين العاملين في الرعاية الصحية البيطرية في شمال فلسطين

إعداد

محمد يوسف يونس ابو هلال

إشراف

د. إبراهيم الزهير

د. حمزة الزبدي

قدمت هذه الاطروحة استكمالاً لمتطلبات الحصول على درجة الماجستير في الصحة العامة، بكلية الدراسات العليا، في جامعة النجاح الوطنية، نابلس- فلسطين.

2021

انتشار وعوامل الخطر لمرض البروسيلا بين العاملين في الرعاية الصحية البيطرية في شمال فلسطين

إعداد

محمد يوسف يونس ابو هلال

إشراف

د. إبراهيم الزهير

د. حمزة الزبيدي

الملخص

المقدمة: هناك القليل من الدراسات التي تبحث في مرض البروسيلا البشري في فلسطين. انطلقت هذه الدراسة في عام 2020 للتحري عن مرض البروسيلا كمرض مهني عالي الخطورة لمهنة الطب البيطري ومختصين بالانتاج الحيواني في محافظات شمال الضفة الغربية / فلسطين.

الهدف: لتقدير الإيجابية المصلية للبروسيلا بين المتخصصين في الرعاية الصحية البيطرية في شمال فلسطين ، وتحديد عوامل الخطر المرتبطة بالإيجابية المصلية للبروسيل.

الطرق والمواد المستخدمة: خلال عام 2020 اجريت دراسة مقطعية في اربع محافظات شمال الضفة الغربية /فلسطين هي جنين، نابلس، قلقيلية وطولكرم، اخذت 100 عبنة من الاطباء البيطريين ومختصين بالانتاج الحيواني، تمت مقابلة المشاركين وجها لوجه باستخدام استبيان للحصول على عوامل الخطر، تم جمع المعلومات وعينات الدم لفحصها بحثا عن وجود مضاد للبروسيلا باستخدام تقنية الفحص المناعي المرتبط بالانزيم (الاليزا) واختبار روز بنغال، تم اجراء ادارة البيانات وتحليلها.

النتائج: كان معدل انتشار داء البروسيلات من خلال تقنية الاليزا واختبار روز بنغال 76% و29% على التوالي، وكانت عوامل الخطر الرئيسية في الأطباء البيطريين ومختصي الانتاج الحيواني هي العمر وقطاع العمل والتفاعل مع الأنواع الحيوانية وتطعيم الحيوانات وعدم استخدام المطهرات والعدوى السابقة واستخدام معدات الحماية أثناء تطعيم الحيوانات.

الاستنتاج: الحمى المالطية من الأمراض المهنية عالية الخطورة بين الأطباء البيطريين. معدل انتشاره بين العاملين في مجال الرعاية الصحية البيطرية في شمال الضفة الغربية / فلسطين مرتفع للغاية مقارنة بالدول المجاورة وعلى الصعيد الدولي.