KNOWLEDGE, ATTITUDE AND PRACTICE TOWARDS TUBERCULOSIS AND THE EFFECTIVENESS OF A TUBERCULOSIS EDUCATION PROGRAM AMONG NURSES EMPLOYED IN TUBERCULOSIS CENTERS IN LIBYA

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ABSTRACT

Nurses make up by far the largest group of healthcare workers in any part of the world, playing an important role in the direct management of tuberculosis (TB) patients and facing a high risk of infection. Therefore, this study was conducted to explore the knowledge, attitude, and practice towards TB among professional nurses in Libya and the impact of an educational intervention on their knowledge, attitude and practice.

A cross-sectional design using self-administered validated questionnaire was conducted to explore the nurses' KAP towards TB. A total of 384 nurses in tuberculosis centres in Libya participated in the study. TB education intervention was carried out from February to August 2017. A sample of 100 TB nurses was randomly allocated into intervention and control groups. The intervention group received health education regarding tuberculosis using a developed module, while the control group did not receive any education. Knowledge and attitude scores for both groups were evaluated using a self-administered validated questionnaire at baseline, immediate after intervention, three, and six months. Practice score was assessed only at baseline, three, and six months. For the KAP survey, 384 nurses were included. Eighty four (21.9%) were males and 300 (78.1%) were females. Majority of them (85.2%) had low level of knowledge on TB; only 80 (20.8%) had positive attitude towards TB and 326 (84.9%) had unsatisfactory level of practice regarding TB.

The knowledge level was found to be significantly associated with age, educational level, work experiences and residence ($p = < 0.05$). The attitude of nurses towards TB was significantly ($p = < 0.05$) associated with gender, residence and work experience only.

There were significant associations of gender, education level and work experience with practice among the nurses. Knowledge was significantly associated with practice among the nurses towards TB ($p < 0.001$).

The TB educational intervention program was found to be effective immediately after intervention, as the knowledge score improved by 40.08 (95% CI 41.77, 38.39) ($p <$ 0.001) among the intervention group. The knowledge scores remained stable at 3-month and 6-month follow-up. Likewise, there was significant improvement in attitude score with a mean difference of 1.769 (95% CI 1.88, 1.65) ($p < 0.001$). The attitude scores remained stable at 3-month and 6-month follow-up. Similarly, there was improvement in practice score with a mean difference of 18.23 (95% CI 16.12, 0.17.43) ($p < 0.001$). The practice scores remained stable at 6-month follow-up. In Conclusions, most of nurses in tuberculosis centres in Libya had low levels of knowledge, negative attitude and unsatisfactory practice towards TB. Knowledge was found to be associated with practice. The educational intervention carried out was effective in improving the nurses' knowledge, attitude and practice towards TB over time. Within the control group, there were no significant differences in mean scores of knowledge, attitude and practice over time. There were significant differences in knowledge, attitude and practice scores between intervention and control groups over time ($p < 0.001$).

Key Words: Nurses, Libya, Knowledge, Attitude, Practice, Effectiveness, Tuberculosis

(483 Words)

ABSTRAK

Jururawat merangkumi jumlah yang paling ramai didalam perkhidmatan kesihatan disetiap negara didunia ini. Mereka memain peranan yang penting dalam pengurusan

secara langsung pesakit-pesakit tuberculosis, dan oleh itu, terdedah kepada risiko yang tinggi kepada jangkitan penyakit ini. Tujuan penyelidikan ini adalah untuk mengenalpasti pengetahuan, sikap dan amalan terhadap TB di kalangan jururawat-jururawat di Libya, dan impak atau kesan yang boleh diperolehi daripada intervensi/pencelahan terhadap pengetahuan, sikap dan amalan mereka. Penyelidikan ini dijalankan di Libya dimana 384 jururawat dari 14 pusat tuberkulosis di kenalpasti dan diguna bagi tujuan kajian ini. Satu soal selidik yang diberi secara persendirian dan yang telah disahkan (*self-administered validated questionnaire)* telah digunapakai untuk menyelidik pengetahuan, sikap dan amalan jururawat ini terhadap penyakit TB. Intervensi pembelajaran telah dijalankan dari Februari hingga Ogos 2017. Satu sampel terdiri daripada 100 jururawat TB telah di bahagikan secara rambang kepada kumpulan. Intervensi dan kumpulan kontrol. Kumpulan intervensi menerima pendidikan kesihatan mengenai tuberculosis, sementara kumpulan control tidak menerima apa-apa pendidikan. Skor bagi pengetahuan dan sikap peserta dinilai dengan mengunakan satu soal selidik yang diberi secara persendirian dan yang telah disahkan (*self-administered validated questionnaire)* pada peringkat sebelum intervensi, selepas intervensi dan pada 3 bulan dan 6 bulan selepas intervensi.Skor untuk amalan hanya di nilai sebelum intervensi, 3-bulan dan 6-bulan kemudian.

Untuk kaji selidik KAP, 384 jururawat direkrut. Lapan puluh empat 84 (21.9%) terdiri daripada jururawat lelaki dan 300 (78.1%) daripada jururawat wanita. Kebanyakan dari jumlah ini, 32 (85.2%) mempunyai tahap pengetahuan yang rendah berkenaan penyakit TB; hanya 80 (20.8%) mempunyai sikap positif terhadap TB dan 326 (84.9%) mempunyai tahap amalan yang tidak memuaskan terhadap TB.

Tahap pengetahuan mempunyai kaitan secara signifikan dengan umur, tahap pendidikan, pengalaman pekerjaan dan penempatan (p = <0.05). Sikap jururawat-jururawat terhadap TB didapati berkaitan secara signifikan dengan gender dan pengalaman pekerjaan. Terdapat kaitan yang signifikan antara gender, tahap pendidikan dan pengalaman

pekerjaan dengan amalan di kalangan jururawat. Pengetahuan didapati berkaitan secara signifikan dengan amalan terhadap TB di kalangan jururawat (< 0.001).

Intervensi pendidikan TB didapati berkesan selapasintervensi dengan skor pendidikan melibihi 40.08 (95% CI 41.77, 38.39, *p*-<0.001), pada kumpulan intervensi. Skor pengetahuan kekal stabil pada 3-bulan dan 6-bulan susulan. Begitu juga wujud penambahbaikan yang signifikan pada skor sikap, dengan perbezaan min skor 1.76 (95% CI 1.88, 1.6 $p < 0.001$). Skor bagi sikap kekal stabil pada 3-bulan dan 6-bulan susulan. Begitu juga terdapat penambahbaikkan yang signifikan dalam amalan dengan perbezaan min skor sebanyak 18.23 (95% CI 16.12, 0.17.43, $p < 0.001$). Skor amalan kekal stabil pada 6-bulan susulan. Sacara kesimpulan, kebanyakan jururawat TB di Libya mempunyai tahap pengetahuan yang rendah mengenai TB. Pengetahuan mempunyai kaitan dengan amalan. Intervensi pendidikan yang dijalankan telah didapati berkesan dalam penambahbaikan pengetahuan, sikap dan amalan jururawat-jururawat terhadap TB dalam tempoh masa yang diberi. Dalam kumpulan kontrol, tidak terdapat perbezaan pada min skor yang signifikan pada pengetahuan, sikap dan amalan dalam tempoh masa yang terlibat. Terdapat perbezaan-perbezaan yang signifikan pada skor pengetahuan, sikap, dan amalan, antara kumpulan intervensi dan kumpulan control, pada jangkamasa yang terlibat ($p < 0.001$).

Kata Kunci: Jururawat, Libya, Pengetahuan, Sikap, Amalan, Keberkesanan, Tuberculosis

(491) Patah perkataan

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LIST OF ABBREVIATIONS

ACSM	Advocacy, Communication and Social Mobilization
AIDS	Acquired Immune Deficiency Syndrome
ANOVA	Analysis of Variance
AOR	Adjusted odd ratio
CDC	Center of Disease Control
DOTS	Directly Observed Treatment Short Course
HCW	Health Care Worker
HBCs	High Burden Countries
HIV	Human Immunodeficiency Virus
KAP	Knowledge, Attitude, and Practice
MDGs	Millennium Development Goals
MDR-TB	Multidrug Resistant Tuberculosis

NTP	National TB Program
n	Sample size
OR	Odd ratio
SPSS	Statistical Package of Social Sciences
TB	Tuberculosis
WHO	World Health Organization

LIST OF APPENDICES

CHAPTER 1: INTRODUCTION

1.1 Introduction

Tuberculosis (TB) is still considered a major public health problem. It is an airborne disease caused by the bacterium *Mycobacterium tuberculosis***.** This bacteria is carried in airborne droplet nuclei and forming a source of infection to the exposed people. A person who is infected by TB usually suffers from repeated coughs with blood-stained sputum, fever, night sweating, anorexia and weight and mild chest pain. It is not only restricted to lungs, but it can be spread through the blood to the brain, larynx, lymph node, spine, bone, or kidney (Long & Schwartzman, 2014).

According to World Health Organization (WHO) report, in 2016 there were an estimated 10.4 million new cases of TB. This number is equivalent to 140 cases per 100,000 populations globally. Most of the cases reported in South-East Asia (45%) and Africa (25%) in the year. A small number of cases reported in the Mediterranean region (7%), European region (3%), and the American region (3% (WHO, 2018).

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In 2016, the largest numbers of cases were reported in five countries, namely, India, China, South Africa, Indonesia and Pakistan. Individually, India and China, reported 26% and 12% of worldwide cases, respectively. Out of total new cases in 2016, (10%) were HIV/AIDS-infected people (WHO, 2018).

According to World Health Organization (WHO) report the prevalence rate has globally decreased by 36% according to the report released by the six regions of world health organization (WHO, 2018).

World Health Organization (WHO) stated that people who are HIV-negative are less likely to develop the TB disease than those who are HIV positive. Because of HIV epidemic, there was a surge in cases and mortality of TB in beginning of 1980's. In 2016, there were 1.3 million deaths from TB among HIV-negative and 374 000 deaths from TB among HIV-positive people (WHO, 2018).

Globally, for the last five years, TB was ranked in the ninth position above HIV/AIDS as a leader cause of death. In 2016, there were an estimated 1.3 million deaths from TB among HIV-negative people and an additional 374 000 deaths from TB among HIV-positive people (WHO, 2018).

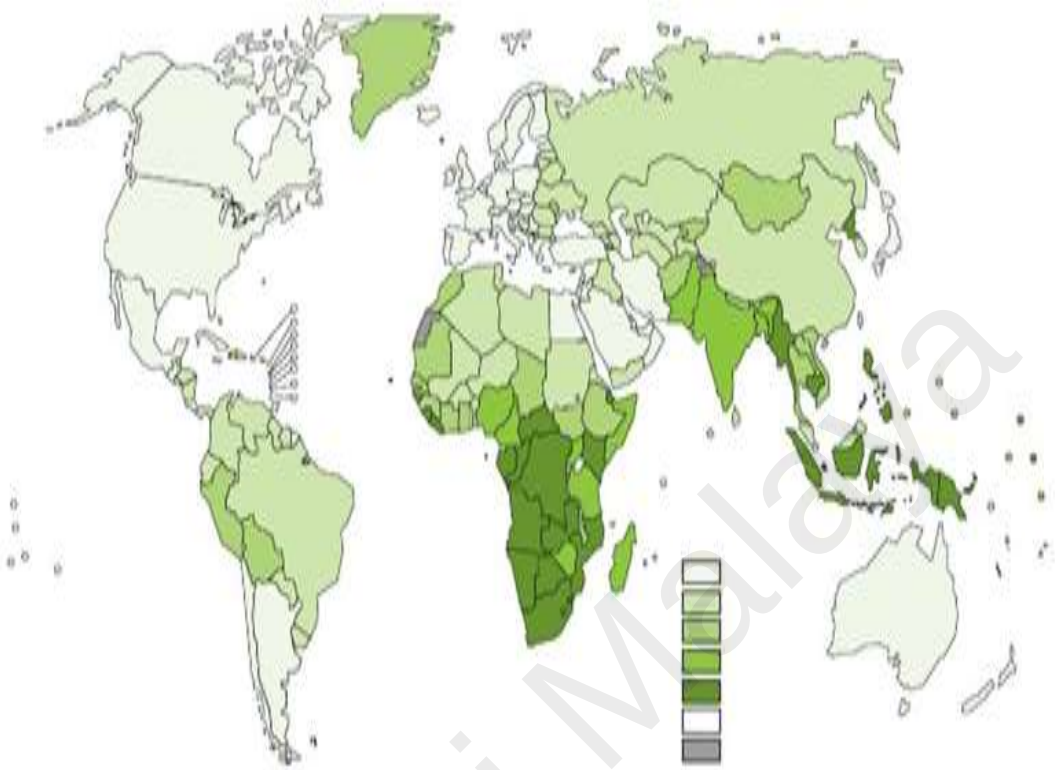


Figure 1.1: Estimated global TB incidence rates, 2017

1.2 Tuberculosis in Libya

The total notified cases in Libya according to World Health Organization (WHO) report in 2018 were 1176 .60% of cases occurring in the productive age group of 15–56 years.

According to report of national center of disease control and prevention in Libya, there were 100-1500 new cases occurring each year. However, according to the global tuberculosis report released by World Health Organization, there were more than 1500 new notifications of TB including 80 children in 6102-2017 (WHO, 2018).

World Health Organization (WHO)-recommended DOTS treatment strategy was implemented as a national tuberculosis program in 1998, and achieved the regional targets of nationwide coverage of the strategy in 2000. In the year 2008, 871 cases (621 nationals, 250 foreigners) of TB were notified in public facilities, working under the DOTS strategy. In 2010 and according to national annual statistical and health report, 792 pulmonary tuberculosis cases and 730 extra-pulmonary tuberculosis cases had been reported in Libya. The success rate of the DOTS treatment was 63.5% in 2007. The national strategy to fight tuberculosis has three main goals:

1) The implementation of the DOTS strategy according to WHO guidelines.
2) Revision and updating of the medical faculties' curricula.
3) Improvement of tuberculosis laboratories by the establishment of a multiple drug resistance laboratory and use of advanced techniques in diagnosis (WHO, 2010).

1.3 Tuberculosis among healthcare workers

Health care workers are at high risk of acquiring tuberculosis through occupational exposure. Previously conducted individual studies and systematic reviews revealed that the burden of latent tuberculosis infection (LTBI) is still enduring among healthcare workers in low and high burden countries. Global healthcare has an estimated 35 million nurses and midwives

that make up the greater part of the work force. The nurses make a substantial contribution to health delivery systems in primary care, acute care, and community care settings. The first group who were identified to be at an increased risk for TB and probably had the highest rate of infection and disease of all health care workers were the nurses. This finding is not surprising, in view of the prolonged and often close contact between hospital nurses and patients. TB has become a serious occupational hazard for health care workers worldwide due to increase in multidrug-resistant TB and poor hospital infection control practices (Baussano et al., 2011).

1.4 Role of nurses in TB Control

Nurses make up by far the largest group of health care workers in any part of the world and as in most areas of health care they often undertake the bulk of the work in TB control. Nurses are well-placed within communities, working closely with patients (Abdullah et al., 2014) and their families, to play a crucial role in providing a caring environment for all patients suffering from TB. The vital activates such as, patient care, treatment, observation, follow-up, health education of patient, family and community, TB cases reporting and documentation are essential for any successful TB control programs, which need to offer good access to effective diagnostic and treatment facilities. (Ghebrehiwet, 2006).

1.5 Rationale of the study

Nurses face a very high risk of being infected with tuberculosis since they represent the largest group of frontline healthcare providers playing the central role in management of TB patients. If infected, they may therefore themselves become a source of the disease. This is especially true in Libya, where TB nurses are at risk of being infected, with new cases of TB

being reported yearly. Knowledge about any disease is fundamental to optimize the care of patients and ensure safe practice. Lack of knowledge and a negative attitude towards TB is one of the major barriers in preventing TB (Luba et al., 2019). Poor knowledge promotes transmission of the infectious disease to the nurses, their relatives and their community (Park, 2018; Viney et al., 2014). Several studies have reported that, poor practice on TB infection control measures is likely contributing factor in increasing the risk of infection among the healthcare workers (Farley et al., 2012; He et al., 2010; Kanjee et al., 2011; Park, 2018; Sissolak et al., 2011). However, studies documented a positive association between TB knowledge, care seeking and treatment adherence (Cramm et al., 2010; Storla et al., 2008).

Libyans are still at continues risk of contracting tuberculosis due to unlawful entry of undocumented immigrants and smugglers from high TB-prevalent Sub-Sahara Africa who have to pass through it when they want to enter the country. According to the rational model, effective practice will be achieved when the people have high level of knowledge and positive attitude towards behavior (WHO, 2012). World Health Organization (WHO) also has stated that, conduction of studies regarding knowledge about TB is needed to achieve control of the disease through educational actions (Viney et al., 2014). Hence, the study which will be carried out among TB nurses is the first of its kind in Libya and the finding will hopefully serve as baseline data on the knowledge, attitude and practice of the nurses, and also on the factors that could significantly affect their knowledge, attitude and practice. Given a high level of knowledge reveals a favourable process in health education that contributes in the early detection, reduce the transmission and control the disease. In addition, in order to achieve more systematic nursing care approach to patients with TB, there is a need of satisfactory long-term outcome from effective education intervention.

1.6. Research questions

The research questions in this study are:

1) What are the levels of knowledge, attitude and practice towards TB among the nurses working at TB centers in Libya?
2) What are the associations of age, gender, education level, work period and residence with knowledge, attitude and practice towards TB among the nurses working at TB centers in Libya?
3) What are the associations of knowledge and attitude with practice towards TB among nurses working at TB centers in Libya?
4) How effective is a tuberculosis education program in improving the knowledge, attitude and practice towards TB among nurses working at TB centers in Libya?

1.7 Objectives of the study

1.7.1 General objectives

To assess the tuberculosis related knowledge, attitude, and practice among nurses working at tuberculosis centers in Libya and the effectiveness of a tuberculosis education program.

1.7.2 Specific objectives

The specific objectives in this study are:

1. To validate the questionnaire of knowledge, attitude and practice among nurses on tuberculosis.
2. To determine the levels of knowledge, attitude and practice toward tuberculosis among the nurses working in tuberculosis centers in Libya.

3. To determine the associations of age, gender, education level, work period and residence with knowledge, attitude and practice on TB among the nurses in Libya.
4. To determine the associations of knowledge and attitude with practice towards TB among nurses working at TB centers in Libya.
5. To develop a TB educational module and evaluate its effectiveness towards knowledge, attitude and practice among TB nurses in Libya.

CHAPTER 2: LITRATUTRE REVIEW

About this chapter

This chapter provides short demographical and geographical description of Libya and structure of educational nursing programs in Libya. In addition to introduction to TB, studies

related to knowledge, attitudes and practices of TB and the effectiveness of TB educational programs.

2.1 Description of Libya

With a total land area of 1,665,000 km^2, Libya is located in the north of Africa. It borders Algeria, Chad, Egypt, Niger, Sudan, and Tunisia with 1900 km of coastline along the Mediterranean Sea. The seven largest cities are Tripoli, Benghazi, Alzawia, Misurata, Dernna, Sirte, and Sabha. The country has a relatively decentralized administrative system. The country has 24 districts, each of which consists of a number of people's congresses. A functional secretariat of health is in each district, responsible for health services within that district and under the supervision of ministry of health (WHO, 2006).

2.1.1 Geographical and administrative profile of Libya

With a total land area of 1,665,000 km^2, Libya is located in the north of Africa. It borders Algeria, Chad, Egypt, Niger, Sudan, and Tunisia with 1900 km of coastline along the Mediterranean Sea. The seven largest cities are Tripoli, Benghazi, Alzawia, Misurata, Dernna, Sirte, and Sabha. The country has a relatively decentralized administrative system. The country has 24 districts, each of which consists of a number of people's congresses. A functional secretariat of health is in each district, responsible for health services within that district and under the supervision of ministry of health (WHO, 2006).

2.1.2 Demographic profile

In midyear 2011 the estimated population of Libya was 6.4 million, with a population density of 3.3 persons per km^2. The most popular part of the country is the northern part with 85% of the population on 10% of the land area. Similarly, the percentage of population under 15 years of age decreased from 39% in 1995 to 32% in 2006. The proportion of the population that is over 60 years is 6%. The population living in urban areas consists of 86% of the population and the annual growth rate in urban areas is much higher than in rural areas. The scattered population, vast geographical area, and the influx of a substantial number of immigrants strain existing health and social services, creating potential risks of spreading communicable diseases (WHO, 2006).

2.1.3 Libyan healthcare system

In accordance with public health law no106 of 1973, the People's Congress and its People's Committees guarantee the right of citizens to health care. Since March 2006, there has been a move towards centralization and synchronization at various levels. The country has been divided into 24 districts and General People's Congress decided to re-establish the secretariat of health under the name of General Peoples Committee for Health and Environment (GPCHE) and give it the authority to inspect and supervise the central institutions and the secretariats of health at the district level.

The GPCHE is currently responsible for:

- Proposing national health policies and plans.
- Supervision and inspection of district health committees.
- Establishing standards and regulations for both public and private healthcare providers.

- Supervision of central health institutions including hospitals, research and training. (WHO, 2006).

2.1.4 Nursing programs in Libya

According to World Health Organization (WHO) nursing educational programs in Libya have been established for nationals to meet the increasing demand. In Libya there are 14 nursing schools (eight nursing faculties and six nursing institution) (WHO, 2007)

2.1.4.1 A Three -years diploma of nursing program

A Three -year diploma course after secondary school has been established, but many difficulties remain. Curricula are not up-to-date and attraction to the profession remains low. However, attempts are being made to challenge most of these areas. World Health Organization (WHO) is assisting in the revision of curricula, establishing bachelor's degree in nursing and improving management (WHO, 2007).

2.1.4.2 Bachelor's degree of nursing

A fully accredited bachelor's degree of nursing program has been established in 2004 to manage the performance of the nurses in clinical practice. Despite that, and according to the report which was released by World Health Organization (WHO) for Libyan health service capacity, the standard of nursing care of Libya is still inadequate due to poor quality nursing education. Nursing is not taught to degree level, and curricula are out of date (WHO, 2007).

The nursing curriculum of College of Nursing in Libyan Universities combines theoretical and practical instruction. The basic sciences and nursing subjects are mostly completed in the first two years of education. Upon entering their third year, however, nursing students choose from four areas of specialisation: operating theater and anaesthesia nursing, intensive and emergency nursing, maternal, neonatal nursing and public health of nursing. Their choice determines the nursing specialisation subjects and clinical exposure areas. Students are required to complete a competency-based intensive nursing practicum (INP) during the 3rd and 4th years of nursing education. This hospital or clinic-based exposure serves as the practicum component of the nursing course.

The acute shortage of nurses in Libya puts pressure on nursing education programs to increase the number of nursing students among the entire regions. With the expected nursing shortage comes hospitals' increased hiring of new graduates with minimal knowledge. Unfortunately, new graduates often prove to lack competence to perform in the real nursing environment.

According to international medical corps report during the Libyan revolution in 2011, the majority of the expatriate nurses had left the country**;** the national capacity for Libyans to address these shortages will be vital to the recovery of fragile health systems and its ability to meet future needs. (Buhat-Mendoza et al., 2014).

2.1.4.3 Six -months nursing training course program

As longer term programs will be needed to provide professional nurses, and also due to the high demand coupled with the aim to cover the critical shortage of nursing staff among entire

healthcare facilities in Libya, a short and very tight six-month nursing training program has been established, in according to Libyan ministry of health plan in 2012 to produce professional nurses among the entire Libyan cities (Buhat-Mendoza et al., 2014).

2.2 Tuberculosis as a disease

2.2.1 Transmission and pathogenesis of tuberculosis

Tuberculosis is an airborne disease caused by the bacterium *Mycobacterium tuberculosis* (*M. tuberculosis*)**.** *M. tuberculosis* is carried in airborne particles, called droplet nuclei, of 1–5 microns in diameter. When people with pulmonary or laryngeal TB disease cough, sneeze, shout, or sing, the infectious droplet nuclei are generated and became source of infection to the exposed person.

Infection occurs after a person inhales bacilli-containing droplet nuclei that reach the alveoli of the lungs. These tubercle bacilli are engulfed by alveolar macrophages. A few numbers of them multiply inside the macrophages and presented to the white blood cells. This activates the white blood cells in immune system which forming granuloma when they kill or encapsulate most available bacilli. However, these bacilli may spread through lymphatic channels or the bloodstream to reach other places and organs on the body such as, bone, brain, kidney and lymph nodes (Long & Schwartzman, 2014)

2.2.2 Latent tuberculosis infection

Latent tuberculosis infection occurs when the persons having the bacilli in their bodies but don't have the active contagious disease to infect the others. Latent tuberculosis can be detected during

sudden screening or medical check-up by TST, IGRA and chest X –ray. This occurs when the small amount of bacilli controlled by immune system preventing further progression of the disease. However, this latent status of tuberculosis may be reactivated and became active contagious TB (WHO, 2018).

2.2.3 Multidrugs resisitant tuberculosis (MDR TB)

According to World Health Organization (WHO), the resistance of bacteria to isoniazid and rifampin during treatment of TB due to many factors such as, misuse of drugs by patients, wrong prescription of drugs by healthcare providers or poor quality of drugs. This condition is commonly seen in people who:

- Irregular taking of TB drugs.
- Do not finish the course of treatment.
- Recurrence of TB infection.
- Are from regions of where drug-resistant TB is endemic.
- Gained the disease from person who already infected by drug-resistant TB (WHO, 2018).

2.2.4 Risk factors of tuberculosis

The risk of contracting tuberculosis is increased by endogenous factors such as immunodeficiency virus (HIV) infection, diabetes or cancers, poor nutritional status, and age of less than five years and exogenous where the behavioral and socioeconomic factors play a vital role in increasing of vulnerability to TB at both individual and community level such as alcohol, use of immunosuppressive drugs, tobacco smokers, overcrowding and spaces with poor ventilation (WHO, 2018).

2.2.5 Prevalence and risk factors of tuberculosis among healthcare workers

Healthcare providers are essential and active members in TB management and control. The World Health Organization (WHO) provided effective, inexpensive and can be easily applied guidelines among the countries with limited sources. These guidelines work not only to prevent TB transmission from patient to healthcare providers, but also prevent transmission of TB from patient to patients. Compared with the general population, healthcare providers are still at increased risk of TB despite to the efforts to emphasize infection control of TB and reducing its nosocomial transmission. Some factors are still playing role in making HCWs at risk of TB such as emerging of multi-drug resistant TB (MDRTB), high prevalence of HIV, lack of effective control measures especially among low and middle income countries and frequent exposure of medical staff to incompletely healed TB patient (Granich et al., 1999).

There were several studies conducted to explore the vulnerability of healthcare workers to TB in different countries; United States of America (1) (Alonso-Echanove et al., 2001), Turkey (1) (Cuhadaroglu et al., 2002), Spain(1) (Alvarez-León et al., 2009), Canada (2) (Xu & Schwartzman, 2010; Zwerling et al., 2012) , Malaysia (1) ((Rafiza et al., 2011), Italy (1) (Durando et al., 2013), Norway (1) (Gran et al., 2013), South Africa(1) (McCarthy et al., 2015). Screened tests such as interferon-gamma release assay (IGAR), Quantiferon TB Gold in tube and tuberculin skin test (TST) were used in majority of these studies to detect the latent TB infection among the healthcare workers. The results of these studies showed that the healthcare workers are still at higher risk of TB particularly in the higher endemic countries.

A systematic review including 21 published studies with 30 961 healthcare workers across 16 countries (Uden et al., 2017) was done to report the prevalence or incidence of TB among HCWs. This systematic review showed that the prevalence and the risk of latent tuberculosis among healthcare workers were 37%, and (OR), 2.27; 95% (CI), 1.61–3.20) respectively. The incidence rate of active TB was 97/100 000 per year.

Another systematic review including 52 published studies was conducted to identify the prevalence and incidence of latent TB infection among healthcare workers in low and middle income countries (Joshi et al., 2006). The result showed that among HCWs the prevalence of latent tuberculosis was 54% (range 33% to 79%), while the incidence rate of TB ranged from 69 to 5,780 per 100,000. The risk of tuberculosis among HCWs compared to the risk in the general population, ranged from 25 to 5,361 per 100,000 per year.

2.5.5.1 Association between work location, job categories and employment duration with risk of tuberculosis among healthcare workers

A systematic review of 51 studies (Joshi et al., 2006) was conducted to explore the association of work location, job category and work duration in healthcare facilities with risk of HCWs to TB . The results revealed that the incidence rate ratio IRR of latent TB was higher among those who working in TB-treating center (IRR ranged from 14.6 to 99.0) laboratory (IRR =78.6), internal medicinal departments (IRR ranged from 3.9 to 36.6) and emergency localities (IRR ranged from 26.6 to 31.9) compared to the other job locations in healthcare facilities.

With respect to job category, eight independent studies were conducted over period of 6 years (1999-2005) in different settings; Uganda (1) (Kayanja et al., 2005), Brazil (1) (Roth et al., 2005), India (1) (Pai et al., 2005), Turkey (1) (Keskiner et al., 2004), Thailand (2) (Do et al., 1999; Yanai et al., 2003), Côte d'Ivoire (1) (Kassim et al., 2000), Trinidad (1) (Orrett, 2000). The results of these studies reported that the prevalence of latent tuberculosis infection was higher among the nurses (43%-87%) compared to the other HCWs due to frequent, prolonged and direct exposure to TB –infected patients.

With regard to employment duration, each extra year of working period increased the prevalence of latent tuberculosis infection (LTBI) among the HCWs. The prevalence was higher among seniors employee compared to juniors (Silva et al., 2000; Teixeira et al., 2005).The risk increased by 1.5 to 2.2 times with each extra year of work duration (Alonso-Echanove et al., 2001; Kayanja et al., 2005). This prevalence increased by 3-fold with above 10 years of employment (Pai et al., 2005).

In conclusion, over the globe, despite marked decline of TB prevalence, the healthcare workers remain at high risk of active and latent tuberculosis infection compared with the general people. These indicator should inspires greater care to screening and prevention measures for healthcare workers in all settings to achieve the target of World Health Organization (WHO) that aiming to eradicate TB globally by 2030.

2.3 Tuberculosis in Libya

The total notified cases in Libya according to World Health Organization report in 2017 were 1176 (Table 2.1). The detection rate in Libya was on a gradual rise as the number of the cases increased each year due to increase the number of immigrants and workers from highly

prevalent country of TB such as Sub-Sahar Africa, India, and Bangladesh. 60% of cases occur in the productive age group of 15–56 years (Table 2.2). Based on reports of national center of disease control and prevention in Libya, there were 100-1500 new cases each year (Table 2.4). However, according to the global tuberculosis report released by World Health Organization, there were more than 1500 new notifications of TB including 80 children in 6102-2017 (WHO, 2018).

According to World health organization (WHO), DOTS treatment strategy was implemented as a national tuberculosis program in 1998 and achieved the regional targets of nationwide coverage of the strategy in 2000. The success rate of the DOTS treatment was 63.5% in 2007. An implementation of the DOTS strategy, review and updating the curricula of medical faculties and establishment of a multiple drug resistance laboratory were the main goals in national strategy to fight the tuberculosis (WHO, 2010).

According to the infectious disease section of health information department belongs to ministry of health, nurses working in tuberculosis centers in Libya are still at risk of acquiring tuberculosis infections as new cases of infected nurses reported each year. Table 2.3 shows the number of reported cases of TB-infected nurses from year 1995 to 2017.

Table 2.1: Total TB case notifications in Libya (2017)

Total cases notified	1176
Total new and relapse	1131
- % with known HIV status	100%
- % pulmonary	63%
- % bacteriologically confirmed among pulmonary	71%

Estimated % of new and old TB cases with MDR -TB	14 %
Universal health coverage and social protection	
TB treatment coverage (notified/estimated incidence), 2017	54% (37–85)
TB case fatality ratio (estimated mortality/estimated incidence), 2017	0.23 (0.11–0.38)

Source: (WHOTB Report 2016) Data: www.who.int/tb/data

Table 2.2: Estimated TB incidence by age and sex in Libya (2017)

	0-14 years	>14 years	Total
Female	0.12 (0.044–0.2)	0.95 (0.35–1.6)	1.1 (0.46–1.7)
Male	0.13 (0.049–0.22)	1.3 (0.49–2.2)	1.5 (0.63–2.3)
Total	0.26 (0.14–0.37)	2.3 (1.2–3.3)	2.5 (1.6–3.7)

Source: (WHO TB Report 2017) Data: www.who.int/tb/data

Table 2.3: Estimated number of newly diagnosed TB cases of nurses in Libya

NO	Year	Number of New Cases	Total TB Nurses	Libyan/non	Male	Female
1	1995	3	_	Libyan	3	0
2	1996	4	_	Libyan	4	0
3	1997	0	_	Libyan	0	0
4	1998	6	_	Libyan	5	1

5	2000	4	_	Libyan	2	2
6	2001	3	_	Libyan	3	0
7	2002	5	_	Libyan	4	1
8	2003	4	_	Libyan	4	0
9	2004	2	_	Libyan	0	0
10	2005	6	_	Libyan	6	0
11	2006	0	_	Libyan	0	0
12	2007	3	_	Libyan	3	0
13	2008	4	_	Libyan	4	0
14	2009	6	_	Libyan	5	1
15	2010	4	_	Libyan	3	1
16	2011	1	_	Libyan	1	0
17	2012	6	_	Libyan	6	0
18	2013	5	_	Libyan	4	1
19	2014	6	_	Libyan	5	1
20	2015	4	_	Libyan	3	1
21	2016	5	582	Libyan	5	0
22	2017	4	644	Libyan	0	4
Total		86				

Total number of TB Centers in Libya = 28
Total number of TB nurses in Libya =582 (year 2016)
Year (1995- 2017)

Source: ministry of health Libya (common infectious disease file)

Table 2.4: Estimated Number of Newly Diagnosed TB-Cases in Libya (2006-2017)

Source: NCDC section in Libya. https://ncdc.org.ly/Ar/

No.	Year	Pulmonary TB	Non- pulmonary TB
1	2006	745	804
2	2007	722	824

3	2008	871	749
4	2009	935	696
5	2010	792	730
6	2011	731	462
7	2012	644	533
8	2013	632	437
9	2014	511	387
10	2015	723	243
11	2016	743	433
12	2017	534	201
	Total	8456	6504

2.4 Knowledge, attitude, and practice (KAP) Survey and health education intervention: a systematic review

2.4.1 Introduction

2.4.1.1 Knowledge, attitude and practice (KAP) Survey

Knowledge, Attitude and Practices (KAP) survey is a quantitative method used to:

- Identify what is known, felt and done regarding different health – related issues.
- Provide baseline used as reference for comparison and assessments in future.
- Suggest and evaluate the effectiveness of health education interventions to change health-related behaviours(du Monde, 2011).

Knowledge is the first term of KAP and it was defined as "gaining, retaining and use information"(Kaliyaperumal, 2004). In this study, knowledge is defined as acknowledged information about tuberculosis by the participants regarding cause, transmission, clinical

features, diagnosis, treatment and prevention of TB. Attitude was defined as "feelings to respond in a certain way to certain conditions (Kaliyaperumal, 2004). In our KAP survey of TB, attitude is the reactions of nurses when assessed in an affective or cognitive manner regarding phobia and stigma of TB. Practice was defined as "application of knowledge and skills that lead to action in ethical manner" (Kaliyaperumal, 2004). In this study practice is application of knowledge and tasks of nurses on initial dealing with TB patient for collection of sputum sample in hygienic manner, TB treatment, application of infection control and prevention measures of TB as well as patient education about TB.

According to KAP model (rational model) any practices are affected by the two factors, the attitude and knowledge. The practice would be predicted or determined by knowledge and attitude towards that practice. Hence, effective practice will be achieved when the people have high level of knowledge and positive attitude towards behaviour (WHO, 2012).

The knowledge, attitude and practice about TB among health care workers are fundamental in their ability to diagnose, taking care for individuals with TB and control of TB. There are some factors may affect them, such as training, cultural, and practice situation as well, information sources. In particular, front-line staffs like nurses are highly linked to success of TB prevention and control via their participation in patient treatment, support and supervision (the three elements of WHO's DOTS approach) (Noé et al., 2017). The knowledge insufficiency and poor practices of infection control are the main barriers among healthcare workers to implement the infection control measures resulting in an increased risk of TB among them (Shrestha et al., 2017).

2.4.1.2 Health education

Health education is a critical factor for improving and promoting the health of populations. It was defined by World Health Organization (WHO) as dissemination and communication of health -related information, motivation and skills to create action in health improvement. Based on health promotion model (Figure 2.1), the health education provides people with the knowledge, beliefs and skills that inspire effective action for health (Hou, 2014).

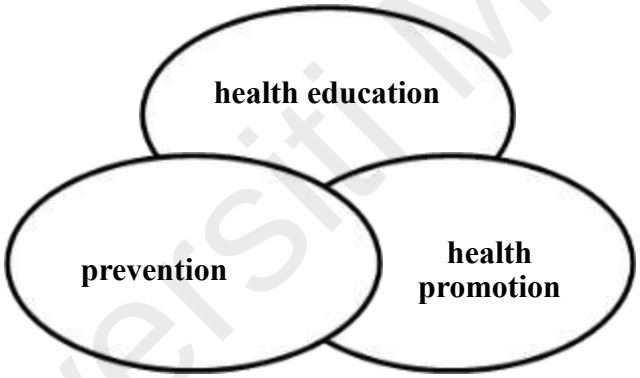


Figure 2.1: **A model of health promotion**

Source: (WHO, 2012)

In our study, this model describes rational actions and relationship between knowledge, attitude and practice (KAP) and the effectiveness TB health educational program in improving the knowledge, attitude and the practice on TB among nurses to emphasize the prevention and control of tuberculosis.

2.4.1.3 Health education planning model

This model illustrates the six elements that usually applied in any health education program (Figure 2.2). Through application of this model the educators can schedule, deliver, and assess an effective program for health education (Hou, 2014).

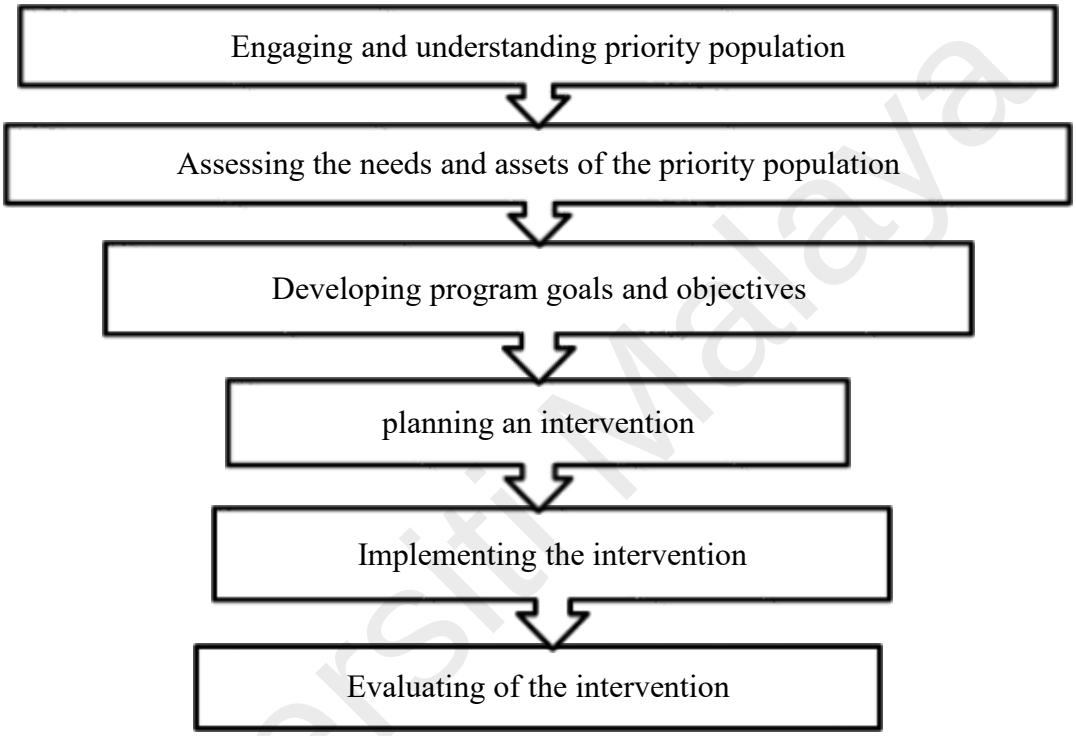


Figure 2.2: Common components of health education planning model
Source: Health education: theoretical concepts, effective strategies and core competencies (WHO, 2012)

2.4.2 Methods

A systematic approach was conducted to retrieve the relevant research studies (Figure 2.3) using PRISMA checklist (Moher et al., 2009)

2.4.2.1 Study eligibility

Published studies eligible for inclusion in this review that measured the knowledge, attitude and practice (KAP) twords TB among nurses working in TB -treating centers from different

regions in world. However, majority of published studies were entitled as KAP on TB among healthcare workers. Moreover, few studies were entitled as KAP on TB among nurses employed in TB centers. Furthermore, we have focused only on data reported about the nurse working in TB-centers as they are the target population in our study. Besides that, studies that measured the effectiveness of a health education program in improving the knowledge, attitude and practice on TB among nurses in TB health facilities were included in the literature. In addition to that, studies with title of KAP on TB among HCWs but have reported data about nurses in TB care facilities were also included.

Majority of studies in this review were observational cross-sectional design which have reported knowledge, attitude and practice (KAP), knowledge only (K), knowledge and attitude (KA), attitude and practice (AP). Studies that reported levels of KAP and the factors that affect the KAP on TB among nurses in TB-treating facilities such as age, gender, education status, residence and employment duration are the inclusion criteria also the factors were included.

2.4.2.2 Search strategy

A systematic search was conducted to find English language documents (full articles or thesis) published in relation to TB-KAP survey among nurses or healthcare workers up to year 2019. Local and international reports on tuberculosis control were reviewed first in aim to get valid statistical data that would support the rationale and public health importance of this thesis. The electronically published reports on TB and TB-KAP were obtained official website of the Center for Disease Control and Prevention (CDC) and World Health Organization (WHO). Afterward, University of Malaya's online library was utilized as more

search was run among the Academic Health databases, i.e. ProQuest, Pub Med, Science Direct and Elsevier database with the following keywords, ‘'Tuberculosis AND knowledge, attitudes, practices (KAP), and educational intervention” as the first step in search strategy. In the next step our search focused on the reference list for further relevant studies.

2.4.2.3 Study selection

The obtained full text papers for all potentially eligible studies were reviewed and evaluated by karutan China (supervisor). All the clearly irrelevant publications were excluded based on the agreement between Muftah Abdusalam (researcher) and karutan China (supervisor). A log of rejected reviews along with the reason of their rejection was recorded and saved.

2.4.2.4 Data extraction

After identification and revising of relevant papers, the data extracted from each paper by the researcher based on the following items: year of study; country and setting; sociodemographic characteristics of the participants (age, sex, and education level work/employment duration); reported level of knowledge, attitude and practice and effectiveness of TB equational module/course post intervention in improving KAP on TB.

2.4.2.5 Assessment of methodological quality

A seven items-contained validated Newcastle –Ottawa assessment scale (NOS) adapted for observational cross- sectional was used as a quality assessment tool for all included studies in this literature (Herzog et al., 2013). This assessment scale contained seven items: (1) representativeness of the sample; (2) justification and satisfaction of sample size; (3)

comparability of response rate and participant is satisfactory; (4) ascertainment of exposure (risk factor); (5) confounders are controlled;(6) assessment of result with valid tool ; (7) appropriate and clear applied statistical test. These seven items were group into three main groups: items (1) to (4) were grouped as selection of study population; item (5) attributed to comparability of study group while items (6) and (7) were included in ascertainment outcome of interest groups. Calculation of quality score was based on these three major groups: selection of study groups (0-5 points), comparability of study groups (0 - 2 points), and ascertainment outcome of interest groups (0- 3- point). Thereafter, the given total score ranged from 0 to 10. Articles that had score equal or more than five were considered as good quality; while articles gained four or less point were considered fair or poor quality (Sabbagh et al., 2015). However, articles with poor methodological quality were not excluded.

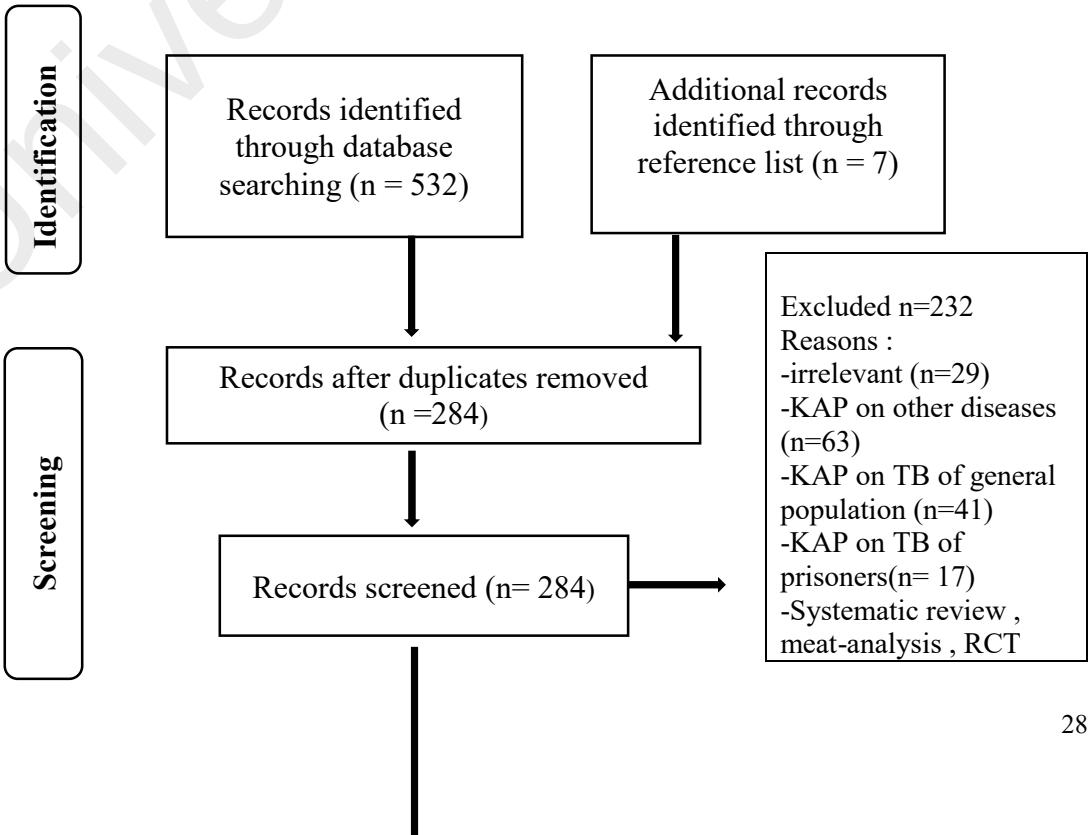
2.4.3 Results

2.4.3.1 Study selection

The process of study selection was illustrated in a PRISMA flow chart in Figure 2.3. The process was started by 532 articles retrieved from database and two articles were retrieved from references of published studies. After removing duplicates, 284 articles remained. Posts screening the titles and abstracts, 232 were excluded due to various reasons. Therefore 52 full texts articles were evaluated based on eligible criteria, a more 34 articles were excluded. Finally, only 18 full text articles were included in this literature review.

2.4.3.2 Quality assessment

Figure 2.4 shows the quality assessment outcome of the selected studies based on the seven items of validated Newcastle-Ottawa assessment scale (NOS). The result revealed that all studies fulfilled representativeness of the sample, comparability of response rate and participant is satisfactory and assessment of result with valid tool. All studies were of good quality and they ranged from five to 10 points (Figure 2.5). There were two studies with ten points (Singh, 2014; Yükseltürk & Dinç, 2013), seven studies with eight points (Adebanjo, 2011; Bisallah et al., 2018; Hng et al., 2018; Naidoo et al., 2011; Shrestha et al., 2017; Wang, 1995; Wu et al., 2009), six studies with six points (Bhebhe et al., 2014; Kaushal et al., 2015; Singla et al., 1998; Tudor et al., 2013; Ukwaja et al., 2013; Woith et al., 2010) and two studies with five points (Hagag et al., 2012; Ibrahim et al., 2014) and one with four points (Avelar et al., 2006)



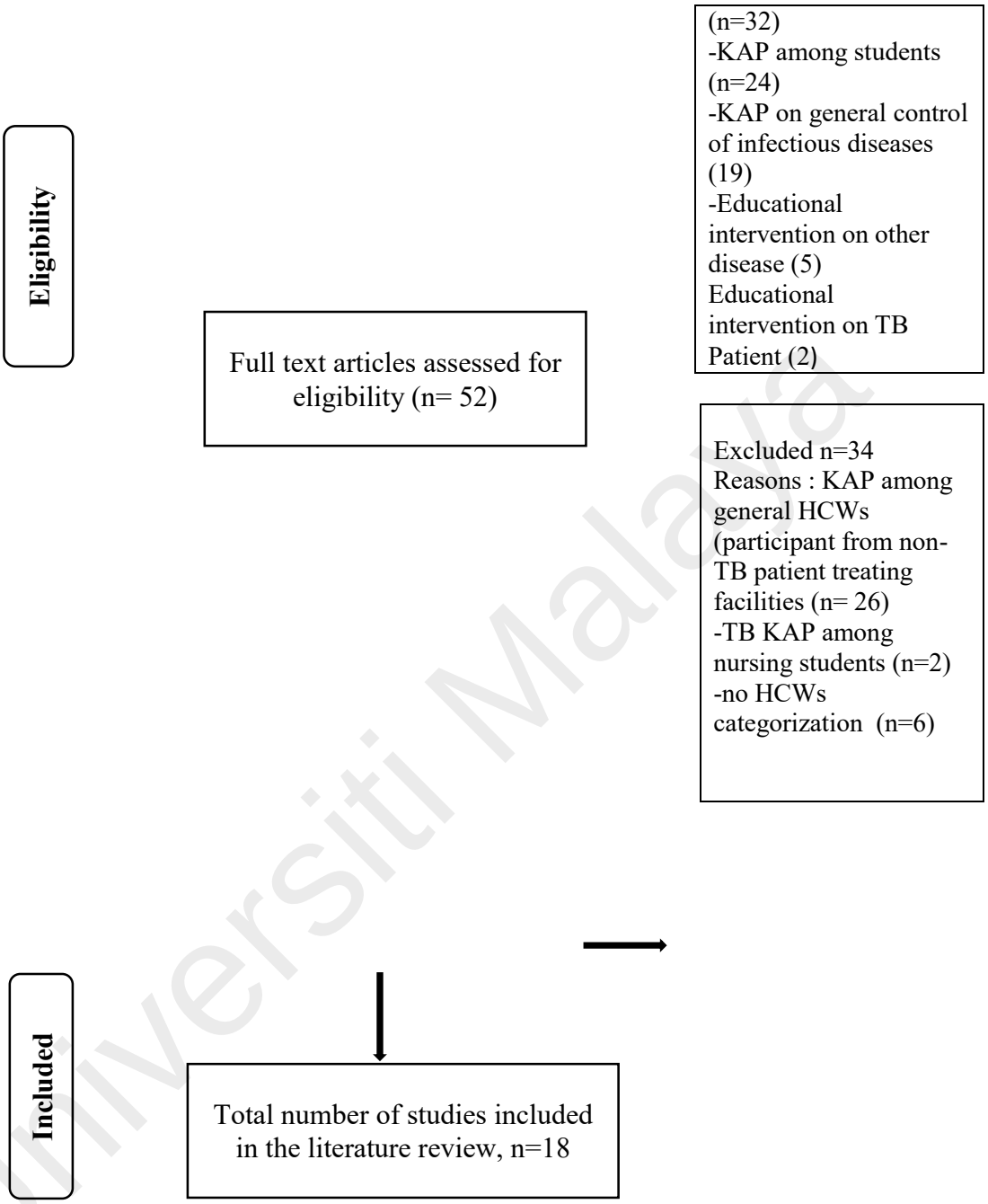
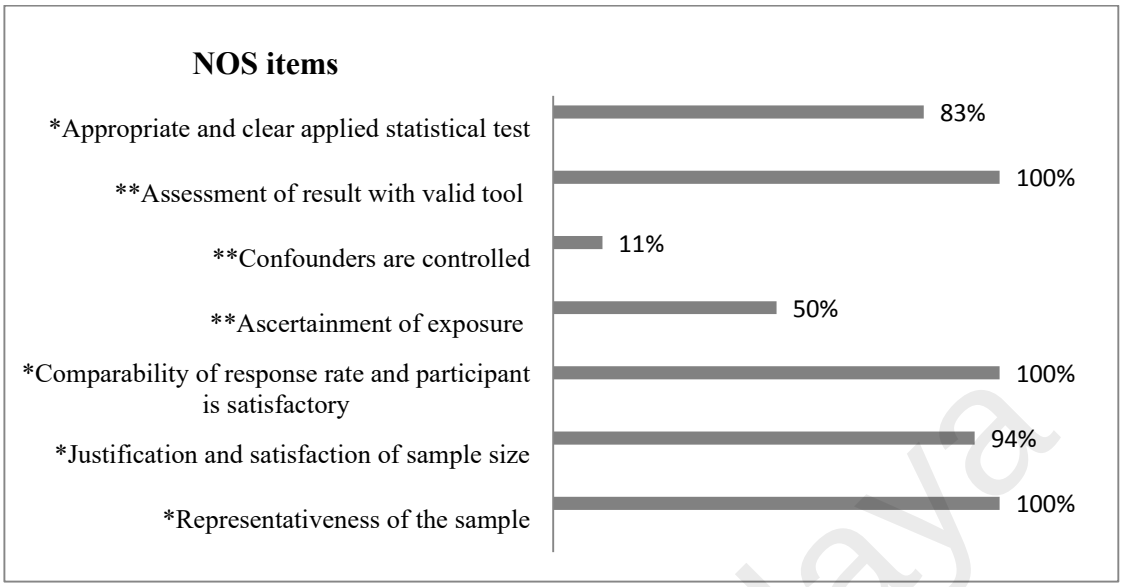


Figure 2.3: Study selection



*maximum 1 point
**maximum2 points

Figure 2.4: Quality assessment graph

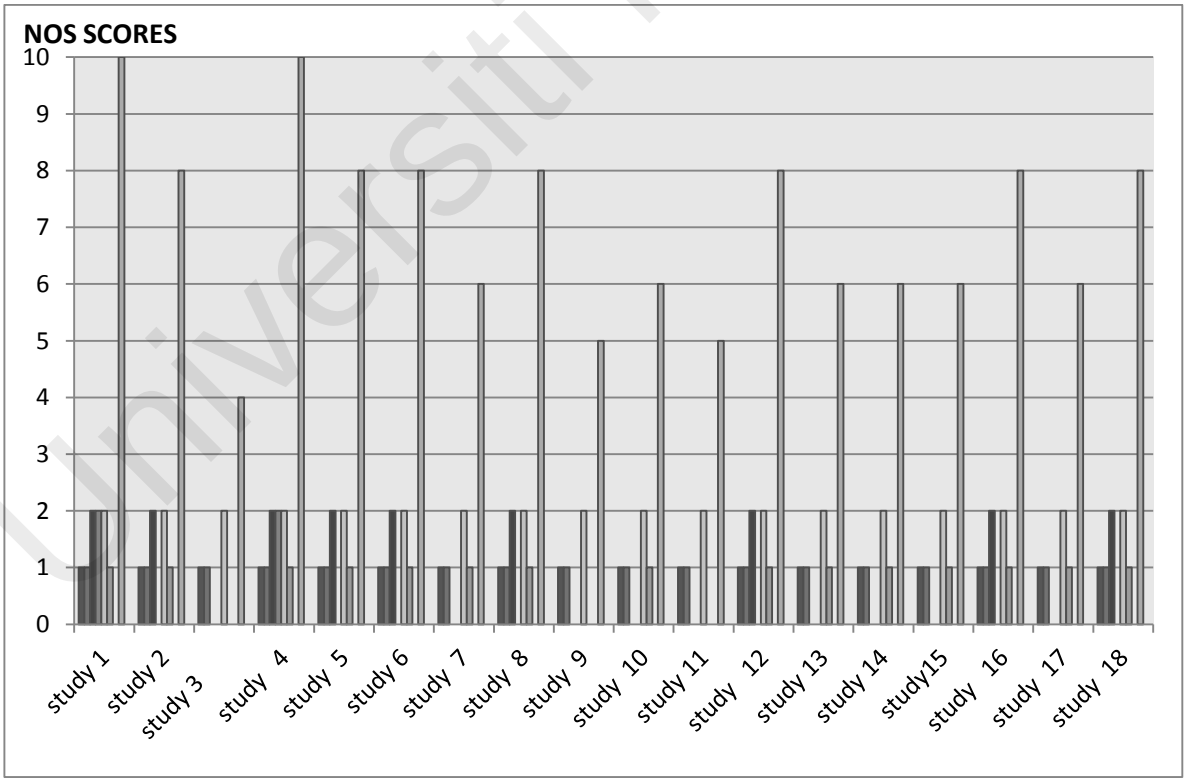


Figure 2.5: Graph of total NOS scores for selected studies

2.4.4 Discussion

2.4.4.1 Knowledge level on tuberculosis and associated factors

(*a*) Knowledge level

Twelve studies were conducted between the years 1995 to 2019 to assess the knowledge on various aspects of TB among nurses working in TB serving centers across nine countries: Malaysia (1) (Hng et al., 2018), (Nepal (1) (Shrestha et al., 2017), Nigeria (2) (Ukwaja et al, 2013; Ibrahim et al., 2014), South Africa (2) (Naidoo et al., 2011; Singh, 2014;) Turkey (1) (Yükseltürk & Dinç, 2013), Lesotho (2) (Bhebhe, et al., 2014; Adebanjo, 2011), Brazil (1) (Avelar et al., 2006), India (1) (Singla et al., 1998) and United State of America (1) (Wang, 1995). These studies reported that overall knowledge level on TB among the nurses was unsatisfactory except four studies (Wang, 1995; Yükseltürk & Dinç, 2013; Bhebhe, et al., 2014; Hng et al., 2018) which reported high knowledge on TB (Table 2.5).

Table 2.5: Characteristics of selected studies and proportions of knowledge level

No	Author (year); Country	Method		Knowledge Level	
		Design/Tool	Sample Size (response rate)	Low	High
1	Hng et al. (2018); Malaysia	Cross-section/ Questionnaire	275 (86.8%)	25%	75%
2	Shrestha et al. (2017); Nepal	Cross-section/ questionnaire	190 (NA)	46%	54%
3	Bhebhe, et al. (2014); Lesotho	Cross-section/ Questionnaire	129 (92%)	11.8%	89.2%
4	Singh. (2014); South Africa	Cross-section/ Questionnaire	32 (100%)	39%	61%
5	Ibrahim et al. (2014); Nigeria	Cross-section/ Questionnaire	76 (NA)	57%	43%
6	Ukwaja et al. (2013) Nigeria	Cross-section/ Questionnaire	52 (NA)	73%	27%

Table 2.5: Characteristics of selected studies and proportions of knowledge level

7	Yükseltürk & Dinç, (2013); Turkey	Cross-section Questionnaire	226 (85.9%)	23%	77%
8	Adebanjo. (2011); Lesotho	Cross-section/ Questionnaire	130 (84.6%)	53%	47%
9	Naidoo et al. (2011); Lesotho	Cross-section/ Questionnaire	818 (71%)	41%	59.5%
10	Avelar et al. (2006); Brazil	Cross-section/ Questionnaire	280 (88%)	NA	NA
11	Singla et al. (1998); India	Cross-section/ Questionnaire	213 (NA)	60%	40 %
12	Wang. (1995); USA	Cross-section/ Questionnaire	30 (60 %%)	20%	80%

Regarding knowledge of bacteria as the cause of TB, a good level of knowledge was found in two studies (Hashim et al., 2003; Bhebhe, et al., 2014), in 78% to 97% of the respondents respectively.

With respect to knowledge on transmission of TB , a high level of knowledge was observed in two studies conducted in two different countries; South Africa (Bhebhe, et al., 2014) and Greece (Vassilopoulos, 2010), in which the levels of knowledge regarding transmission of TB infection were 89.2% and 59.1%, respectively. An inappropriate way of TB transmission, for example, by contaminated water, as a mean of TB transmission was reported by Bhebhe, et al. (2014). About knowledge on TB risk factors, a high level of knowledge was reported in two studies (Hashim et a,. 2003; Singla et al., 1998).

A higher proportion of good knowledge on symptoms of TB was reported in a study conducted in Nepal (Shrestha et al., 2017). However, low levels of knowledge were reported in other studies (Ukwaja et al, 2013; Woith, et al., 2010), where the participants incorrectly

stated that diarrhoea, vomiting, joint pain, eye pain and neck swelling were symptoms of TB. Moreover, a good proportion of correct response (71.6%), was obtained from a study conducted in Iraq (71%) (Hashim et al., 2003).

About knowledge on diagnostic tests of TB, a high proportion of knowledge on the importance of sputum microscopy and culture in diagnosis of TB was reported in two studies (Renuka & Dhar, 2012; Singla et al., 1998), (86.5%). However, low proportion of correct response regarding the fact that chest X-ray is an essential tool in the diagnosis of pulmonary tuberculosis was also reported by Singla et al. (1998).

With regards to knowledge on TB treatment and delivery of TB drugs, a high proportion (91%) and (95%) of nurses with a good level of knowledge in were found in two studies (Yükseltürk & Dinç 2013) and (Hashim et al., 2003), respectively. Two studies reported a low level of knowledge about standard length of treatment for a newly diagnosed case of TB (Singla et al., 1998; (White, 2011), while a high level of knowledge (87%) was reported in a study done by Hashim et al. (2003).

Regarding side effects and complications of drugs, a higher percentage (77.9%) of good level of knowledge regarding loss of vision as an adverse effect of ethambutol was reported in two studies (Yükseltürk & Dinç 2013; Singla et al., 1998).

Regarding the potential outcomes of an incomplete or inadequate treatment course, a low level of knowledge was reported in one study (White, 2011). However, comparable

proportions of participants giving correct answers to these questions of probable outcomes of incomplete treatment were also observed in another study (Minnery et al., 2013).

A high level of knowledge regarding preventive measures of TB was reported in a study done by Singh. (2014). In contrast, a low level of knowledge about TB prevention was found in other studies (Sodhi et al., 2013; Ukwaja et al., 2013; Woith et al., 2010).

(*b*) Association between knowledge and age

Two studies (Adebanjo, 2011; Yükseltürk & Dinç, 2013) reported that the level of knowledge was affected by age, as older nurses had a higher level of knowledge compared to younger nurses. Studies by Ukwaja et al, (2013); and Hng et al, (2018) however, reported that the level of knowledge was not affected by age (Table 2.6).

(*c*) Association between knowledge and gender

With regards to gender, the majority of the selected studies did not report the association between knowledge and gender. However, Adebanjo, (2011) reported that the female nurses were more knowledgeable on about TB than male nurses. Moreover, in other study, the knowledge was not significantly different between male and female nurses (Ukwaja et al, 2013).

(*d*) Association between knowledge and education

The bachelor's degree holders showed higher levels of knowledge of TB compared to diploma holders in two previous studies (Hng et al., 2018). However, (Minnery et al., 2013) and Ukwaja et al, (2013) found no association between the education level and the level of

knowledge on TB. Moreover, level of Knowledge was higher among diploma degree holders compared to bachelor and master degree holders (Yükseltürk & Dinç, 2013). Furthermore, it was found that students in the medical faculty had a higher level of knowledge on tuberculosis compared to the nursing staff (Bhandari & Bande, 2016).

(*e*) Association between knowledge and work experience

With regards to work experience and employment duration, few studies were reported the association between the level of knowledge and work experiences. Nurses with work experience of more than five years were more knowledgeable than nurses with less than five years of experience in the field (Yükseltürk & Dinç, 2013; Ukwaja et al, 2013). The knowledge level was higher among nurses with experience of more than eight service years than nurses with experience of less than eight years (Sodhi et al., 2013).

In another study, the level of knowledge on TB was not significantly different between nurses with experience of six to ten years and those with experiences of more than ten years (Wang, 1995). In contrast, an inverse relationship between the duration of work and the level of knowledge on TB was reported in a study, conducted in Malaysia (Hng et al., 2018). However, in another study, the knowledge was not influenced by the length of work duration (Singla et al., 1998).

Table 2.6: Association of knowledge with age, education and work experiences of the selected studies

Author (year)	Age groups (n)	*P*-value	Conclusion
Adebanjo. (2011)	< 30 years (46), ≥ 30 years (64)	0.63	Knowledge on TB was increased with age but not significant
Yükseltürk & Dinç. (2013)	21-30 ys (84) 31-40 ys (102) >40 ys (22)	0.0001	Knowledge on TB was significantly increased with age
Ukwaja et al. (2013)	<25 ys (9) 25-40 ys (32) >40 ys (11)	0.05	Knowledge on TB did not influence by age
Hng et al. (2018)	<30 ys (119) ≥ 30 ys (156)	0.693	Knowledge on TB did not influence by age
Author (year)	**Education level**	***P*-value**	**Conclusion**
Yükseltürk & Dinç. (2013)	Diploma (72) Bachelor Degree (59), Master (77)	0.003	Knowledge among diploma holders was significantly higher than bachelor
Ukwaja et al. (2013)	Secondary (9) Tertiary (43)	0. 9	Knowledge on TB did not influence by education
Hng et al. (2018)	Diploma (235) Bachelor Degree & master (35)	0.20	Knowledge on TB did not influence by education
Author (year)	**Work experince**	***P*-value**	**Conclusion**
Yükseltürk & Dinç. (2013)	0–4 years (106) 5–9 years (46) 10–14 years (32) ≥ 15 years (24)	0.001	Knowledge scores incraesd with lenght of experince
Ukwaja et al. (2013)	<5 years (19) ≥5 years (33)	0.001	Nurses with > 5 years work duration were more knowledgeable Knowledge on TB
Hng et al. (2018)	1-4 years (55) 5-9 years (78) 10-15 years (80) >15 years (62)	0.35	As the years of services increased more than 15 years, the score for good knowledge decreased
Singla et al. (1998)	<5 years (46) 5–10 years (8) 11–15 years (8) 16–20 years (4) 21–25 years (11) >25 years (5)	0.08	Knowledge on TB did not influence by lenght of work experince
Wang. (1995).	1-5 years (5) 6-10 years (5) >10 years (20)	0.38	Knowledge on TB did not influence by lenght of work experince

2.4.4.2 Attitude towards tuberculosis and associated factors

(*a*) Attitude level towards tuberculosis

Out of the eighteen selected studies, only seven studies reported data about the attitude of nurses working in TB health facilities toward TB or TB- patients across three countries: Nepal (1) (Shrestha et al., 2017), Lesotho (2) (Bhebhe, et al., 2014; Adebanjo, 2011), South Africa (1) (Tudor et al., 2013), Nigeria (1) (Ekuma & Oridota, 2016) and Thailand (1) (Lertkanokkun et al., 2013) (Table 2.9). However, there were some studies included knowledge and practice -related items under the attitude section of the questionnaires, and that might be due to misconception of attitude. Moreover, negative attitude towards TB was reported in two studies (Adebanjo, 2011; Tudor et al., 2013). In contrast, positive attitude was found in other three studies (Shrestha et al., 2017; Bhebhe, et al., 2014; Ekuma & Oridota, 2016).

The level of attitude was found to be poor among healthcare workers in three studies, (Wang, 1995; Adebanjo, 2011; Ibrahim et al., 2014). These findings are inconsistent with the findings of other studies where positive attitude towards TB were detected (Shrestha et al., 2017; Bhebhe et al., 2014). A study conducted to assess the causes of stigma and discrimination against TB infected people revealed that the causes were fear of contracting TB (58%), poverty (40%) and lack of knowledge (34%) (Auer, 2003). The finding of another study indicated that many factors were involved in causing the drop in the quality of HCWs service towards TB patients. These include fear of contracting TB, negative attitudes towards TB patients and losing their jobs as consequences to the factors stated earlier (Moloi, 2003).

Fear of the resulting prolonged hospital admission and complicated treatment course and isolation were reported in other study (Tudor et al., 2013). A similar finding was reported in another study (Bodur et al., 2018). Loss of self-esteem, feeling ashamed, and having less respect from others were the findings of other studies which assessed the stigma of TB among healthcare workers (Coreil et al., 2012; Tudor et al., 2013).

Table 2.9: Characteristics of selected studies and attitude

No	Author (year); Country	Method		Attitude	
		Design/Tool	Sample Size (response rate)	Negative	Positive
2	Shrestha et al. (2017); Nepal.	Cross-section/ questionnaire	190 (NA)	26.8%	73.2%
3	Bhebhe, et al. (2014); Lesotho.	Cross-section/ Questionnaire	129 (92%)	7%	93%
4	Tudor et al., (2013); South Africa.	Cross-section/ Questionnaire	363 (73%)	52%	48%
5	Lertkanokkun et al. (2013); Thiland.	Cross-section/ Questionnaire	212(89%)	44%	56 %
6	Ekuma & Oridota. (2016); Nigeria.	Cross-section/ Questionnaire	196(92.8%)	12%	88%
7	Adebanjo. (2011); Lesotho.	Cross-section/ Questionnaire	130 (84.6%)	85.5%	14.5%

(*b*) Association between attitudes and age

Tudor et al. (2013) Tudor et al., 2013 reported that, phobia of the TB treatment course and cost, was higher among aged nurses (>40 years) compared to that of the younger nurses. In contrast, younger nurses (<30 years) had a positive attitude towards TB compared to the older nurses (Lertkanokkun et al., 2013). However, there was no significant association fond between age and attitude toward TB (Adebanjo, 2011; Coreil et al., 2012). Moreover, there

was no data reported about this kind of association in the other studies (Shrestha et al., 2017; Bhebhe, et al., 2014). Table 2.10 shows the association between attitude and age.

Table 2.10: Association between attitude and age of the selected studies

Author (year)	Age groups (n)	P-value	Conclusion
Adebanjo. (2011)	< 30 years (46), ≥ 30 years (64)	0.63	Attitude was not influenced by age
Tudor et al. (2013)	Mean age (42 ± 11)	0.003	Nurses aged ≥41 years were more likely to express fear of TB than those aged <41 years
Lertkanokkun et al.(2013)	< years 30 (18) 31 – 40 years (43) > 40 years (27)	0.038	< 30 years had a positive attitude towards TB than other groups

(*c*) Association between attitude and gender

Adebanjo (2011) reported that female respondents had a more negative attitude towards TB than male respondents. Sensitivity to contact with co-workers of TB and stigma towards TB in the society were believed to be more among women than men (Johansson et al., 1999). However, in other studies, there was no significant difference between male and female nurses in their attitudes towards TB stigma (Coreil et al., 2012; Tudor et al., 2013).

(*d*) Association between attitude and education level

With regard to education level, nurses with low level of education had more negative attitude than nurses with higher education (Akin et al., 2011). However, both, phobia and stigma of TB were not influenced by the various educational levels (Musasa, 2011). Another study also found that the stigma of TB was not expressed by the participants despite the various education levels (Coreil et al., 2012). Moreover, there no data was reported regarding the

association between attitude and education in (Shrestha et al., 2017; Bhebhe et al., 2014; Adebanjo, 2011; Tudor et al., 2013).

(*e*) Association between attitude and work experience

With regard to work experience and employment duration, it was found that senior nurses with more than five years of experience had higher levels of attitude compared to those of nurses with less than five years of work duration (Adebanjo, 2011). In contrast, nurses who received frequent training on TB were found to have more positive attitude than nurses who did not receive training (Akin et al., 2011). However, in other studies, the attitude towards TB was not affected by the work duration (Tudor et al., 2013, Coreil, et al., 2012).

2.4.4.3 Practice level towards tuberculosis and associated factors

(*a*) Practice level on tuberculosis

Among the selected studies in this literature, we found that only six studies reported data about practice on TB among nurses employed in TB healthcare facilities (Table 2.11). Satisfactory level of practice on TB was reported in three studies (Hng et al., 2018; Lertkanokkun et al., 2013; Ekuma & Oridota. 2016). Regarding practice on preventive measures and patient education, satisfactory levels of practice on wearing of protective mask and patient education about TB were reported by (Shrestha et al., 2017; Adebanjo, 2011; Bhebhe, et al., 2014; Ekuma & Oridota. 2016; Lertkanokkun et al., 2013).

Bhebhe et al. (2014) reported unsatisfactory practice level on the method of collecting sputum from the patients. In contrast, Lertkanokkun et al. (2013), found good practice regarding the collection of sputum from TB patients. satisfactory practice levels on delivery

of TB drugs and monitoring of side effects of TB drugs were reported in two studies (Lertkanokkun et al., 2013; Noé et al., 2017). However, unsatisfactory practice on how to perform diagnostic tests of TB was reported in a study conducted in Iraq (Hashim et al., 2003).

Regarding education of TB patients about the disease, poor practice was reported in one study conducted in Lesotho (Adebanjo, 2011). In contrast, satisfactory practice was found in other study conducted in Turkey (Lertkanokkun et al. (2013).

Table 2.11: Characteristics of selected studies and practice level

No	Author (year); Country	Method		practice	
		Design/Tool	Sample Size (response rate)	Poor	Good
1	Shrestha et al. (2017); Nepal	Cross-section/ questionnaire	190 (NA)	NA	NA
2	Bhebhe, et al. (2014); Lesotho	Cross-section/ Questionnaire	129 (92%)	10%	90%
3	Lertkanokkun et al. (2013); Thiland	Cross-section/ Questionnaire	212(89%)	30%	70%
4	Ekuma & Oridota. (2016); Nigeria	Cross-section/ Questionnaire	196(92.8%)	25%	75%
5	Hng et al. (2018); Malaysia	Cross-section/ Questionnaire	275 (86.8%)	37%	63%
6	Adebanjo. (2011); Lesotho	Cross-section/ Questionnaire	130 (84.6%)	30%	70%

(*b*) Association between practice and age

Adebanjo (2011) reported that, younger participants (< 30 years) were found to be using ~~of~~ protective masks more frequently than older participants. However, in another study, the practice was not influenced by age (Hng et al. 2018).

(*c*) Association between practice and gender

Female nurses were found to have good levels of practice in infection control measures than male nurses (Adebanjo, 2011). Also he reported that female nurses were more involved in patients' education than males. He reported however, that male participants used the personal masks as protective measures during contact with TB patients more frequently than females.

(*d*) Association between practice and education level

It was found that increasing the proportion of bachelor's holders in nursing care in hospitals, was associated with improving levels of practice and patients' outcomes. (Rosseter, 2014). However, no significant association was found between education and practice (Hng et al 2018). Moreover, there was no data reported by (Shrestha et al., 2017; Bhebhe, et al., 2014 Adebanjo, 2011).

(*e*) Association between practice and work experience

Table 2.12 shows the association between practice and work experience. Nurses with more than five years of work experience were more involved in educating patients about TB and in using personal protective equipment, compared to those with less than five years of work experience in the field (Adebanjo, 2011; Lertkanokkun et al. 2013). Also, it was found that nurses with more than five years of work experience referred more to the TB treatment

guidelines, compared to junior nurses with less than five years of work experience (Malangu & Adebanjo, 2015). Hng et al. (2018) found that a good level of practice in TB was found to be associated with more than 10 years of work experience. Finally, nurses with more than 10 years' experience had more satisfactory practice compared to nurses with less than that (Alotaibi et al., 2019).

Table 2.12: Association between practice and work experience

Author (year)	Work experince	*P*-value	Conclusion
Alotaibi et al. (2019); Sauid Arabia.	<1 y: 30 (5.76%) 1–5 ys:177(33.97%) >5–10 ys 169(32.44%) >10ys 145 (27.83%)	0.0711	Nurses with lss than 1 year work experience had worst practice compared to those with >10 years work experience.
Adebanjo.(2011); Lesotho	≤ 5 ys 60 (54.5 %) > 5ys (50 (45.5 %)	>0.05	Practice was not significaltly affected by the work experince.
Lertkanokkun et al. (2013); Thiland.	≤ 2 ys 27 (13.30%) 3 – 5 ys 30 14.78 %) 6 – 10 ys 28 (13.79%) >10 ys 118 (58.13%)	0.031	Workers with less than 2 years work experience had poor prarctice on follow-up TB-guidline
&Adebanjo. (2015); South Africa.	≤ 5 ys 60 (54.5 %) > 5ys (50 (45.5 %)	<0.05	Nurses with > 5 years experience had more satisfactory practice
Hng et al. (2018); Malaysia.	<30 ys (119) ≥ 30 ys (156)	0.729	Practice was not significaltly affected by service year of the nurses.

2.4.4.4 Association of knowledge and attitude with practice

With respect to the association of knowledge and attitude with practice, Shrestha et al. (2017) reported that a high level of knowledge in tuberculosis, associated with a positive attitude,

ultimately resulted in satisfactory level of practice. A high level of knowledge about infection control and a positive attitude were found to be significantly correlated with the nurses' levels of practice (Sutiono et al., 2016). Satisfactory level of practice was demonstrated among those with a high level of knowledge (Hashim et al 2003; Adebanjo 2011). However, Hng et al. (2018) reported that the practice of preventive measures of TB was not affected by the level of knowledge. Moreover, studies documented a positive association between TB knowledge, care seeking and treatment adherence (Cramm et al., 2010; Storla et al., 2008).

2.4.4 .5 Effectiveness of tuberculosis education program

Some studies were included in this literature regarding effectiveness of tuberculosis education program in improving the knowledge, attitude and practice. These studies were conducted across five countries; Taiwan (1) (Wu et al., 2009), South Africa (1) (Naidoo et al., 2011), India (1) (Kaushal et al., 2015), Egypt (1) (Hagag et al., 2012) and Malaysia (1) (Bisallah et al., 2018). The changes were significant from pre-test to post-test in knowledge scores ($p < 0.001$) among the participants (Wu et al., 2009; Naidoo et al., 2011). Compared to doctors, nurses showed the lowest improvement in knowledge score at post-test Naidoo et al., 2011). However, Wu et al. (2009) reported that TB stigma was significantly reduced among the participants in post-test ($p = 0.003$) compared to pre-test ($p=0.024$). Moreover there was no data reported regarding practice among these two studies. Thereafter, it was found that knowledge, attitude, and practice were improved post education intervention (Bisallah et al., 2018; Kaushal et al., 2015).

With regard to gender and education status, older participant (> 40 years) showed higher significant changes in knowledge scores at post-test compared to those younger than them

(Wu et al., 2009). Wu et al., (2009) reported that significant changes in knowledge score at post- test were noted among participants with high level of education compared to those with low level.

Table 2.13: Effectiveness of a tuberculosis education program

No	Author (year); Country	Method		Result	Conclusion
		Design/Tool	Sample Size	Mean sores , *P*-value	
1	Wu et al. (2009); Taiwan	Quasi-experimental design of two groups/ questionnaire	1279	Pre=37± 8.7 Post= 34±8.9 p = 0.012	TB stigma was significantly reduced among the participants in post-test.
2	Naidoo etal. (2011); South Africa	One group design intervention/ questionnaire	818	Pre=56±18 Post= 63±20 p = <0.001	Knowledge was significantly improved post intervention.
3	(Kaushal et al. (2015); India	One group design intervention/ questionnaire	47	Pre-KAP= 25 Post KAP= 27 P= 0.04	Oveall KAP was significantly improved post intervention
4	Hagag et al. (2012); Egypt	One group design intervention/ questionnaire	254	Pre =4.9±1.8 Post = 7.7 ±0.9 p = <0.05	Knowledge was significantly improved post intervention.
5	Bisallah et al. (2018) Malaysia	Cluster RCT Two groups/ questionnaire	226	Mean knowledge scores in intervention versus control immediate postest, three, six and nine months (21.92 ± 2.06 vs.13.32 ± 2.92, p< 0.001, 21.82 ± 2.56 vs. 15.34 ± 3.60, p < 0.001, 22.95 ± 1.47 vs. 15.86 ± 4.84 p <0.001 and 22.70 ± 1.98 vs.15.19 ± 4.13, p<0.001) respectively.	there was significant Improvement in knowledge in the intervention group compared to the control group.

Table 2.13: Effectiveness of a tuberculosis education program; continued

	Method	Result

No	Author (year); Country	Design/Tool	Sample Size	Mean sores , *P*-value	Conclusion
5	Bisallah et al. (2018) Malaysia	Cluster RCT Two groups/ questionnaire	226	Mean attitudescores in intervention versus control group immediate post-intervention, three, six and nine months (33.14 ± 3.76 vs. 29.52 ± 4.67, p < 0.001, 33.12 ± 4.50 vs. 30.67 ± 5.34, p < 0.001, 32.86 ± 4.45 vs. 30.84 ± 4.97, p = 0.001) and (33.07 ± 4.06 vs.30.57 ± 4.47, p = 0.001) respectively Mean practice scores in intervention versus control group immediate post-intervention, three, six and nine months (7.87 ± 2.32 vs. 5.89 ± 1.62, p < 0.001, 7.79 ± 0.93 vs. 6.36 ± 1.64 p < 0.001, 8.22 ± 0.90 vs. 6.79 ± 1.40, p = 0.001 and 8.08 ± 1.13 vs. 6.69 ± 1.27, p-value 0.001) respectively	There was significant Improvement in attitude in the intervention group compared to the control group. There was significant Improvement in practicein the intervention group compared to the control group.

2.4.5 Conclusion

This systematic review has summarised available studies that dealt with nurses' knowledge, attitude, and practice regarding tuberculosis as well as the effectiveness of TB educational

intervention program. Knowledge is the foundation of any intervention. Most of studies reported that there was a significant knowledge gap among nurses regarding tuberculosis. Knowledge deficit among nurses can increase their risk to nosocomial infections particularly tuberculosis. TB-associated stigma and phobia continue to be global problems among the healthcare workers. Poor practice towards TB was also reported in some previous studies.

It was found that knowledge and attitude towards TB among nurses were significantly improved after TB educational intervention or training intervention, using the changes in knowledge scores reported post-intervention. Hence, the nurses need continuing education with special emphasis on tuberculosis to protect their selves, improve the practice, educate the patients and promote the health.

2.4.6 Gap discovered

This literature revealed that small number of studies was available regarding KAP among TB nurses compared to the large number of studies about KAP on TB among the other categories of healthcare workers. However, factors that could affect the KAP such as age, sex, education, work experience were not fully reported. Moreover, the practice was assessed mainly in protective measures with ignorance with other aspects of practice such as sputum collection, delivery of TB treatment and patient education. Thereafter, there was no study of this kind conducted in Libya previously. Furthermore, reasons behind the low knowledge, negative attitude and unsatisfactory practice were not clearly assessed in the previous studies.

2.5 Conceptual framework

Figure 2.6 shows the conceptual framework for this study. This structure was created based on KAP, health promotion and health education planning models as well as the reviewed literature. The first part of this framework is the baseline KAP regarding TB, and which could be affected by demographic factors such as age, gender, educational level and residence as well as work experience. The attitude and practice could be affected by the knowledge. This structure shows the rational action and relationship of knowledge with attitude and practice. If nurses are more knowledgeable about tuberculosis, the safety and effectiveness of nursing practice can be achieved more easily by cooperation of more positive attitudes and informed intervention. Subsequently, effective practice may result in reduction of TB spread and promotion of public health. The next portion in this conceptual framework is the delivery of TB educational intervention program followed by evaluatio

	Module 1 (cause, transmission, pathogenesis and clinical features of TB)

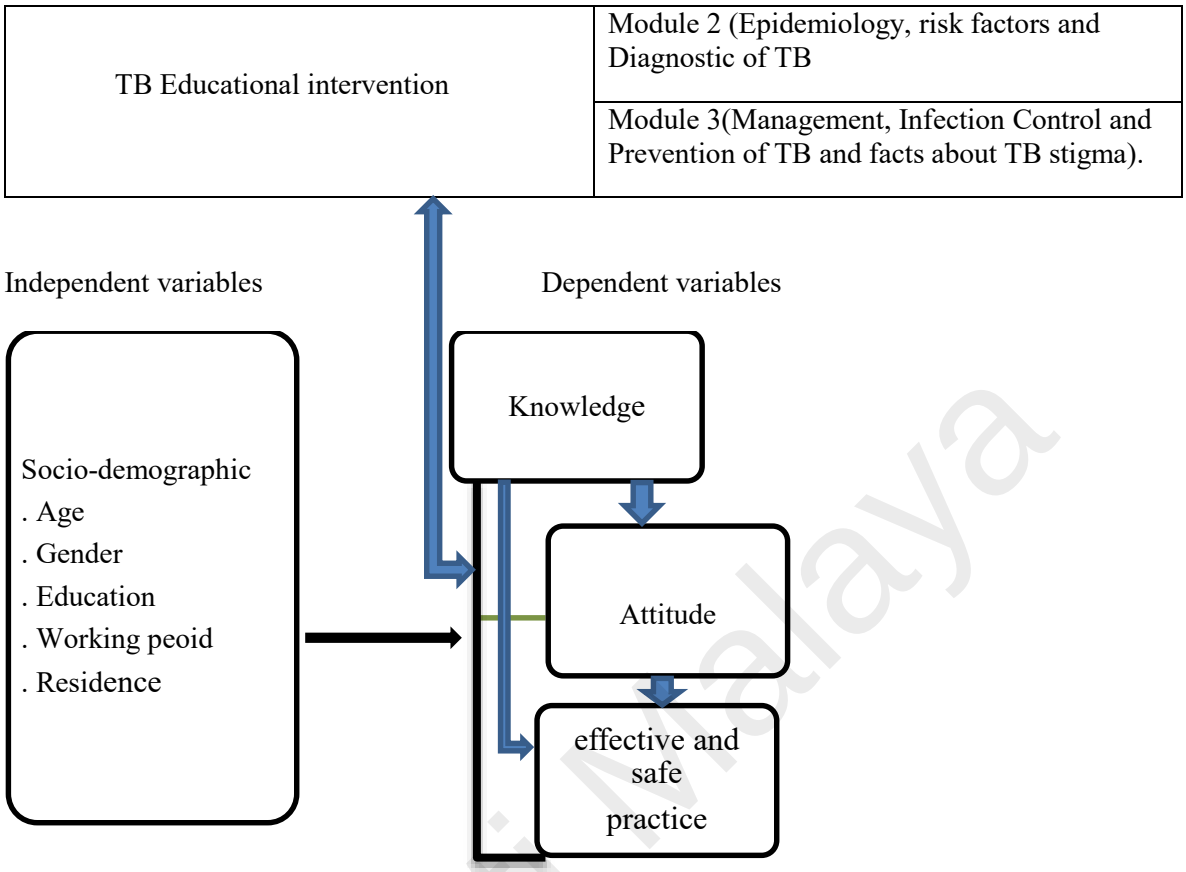


Figure 2.6: Conceptual framework of the study

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CHAPTER 3: METHODOLOGY

About this chapter

This chapter explains in detail the methodology of the three phases of the research; Phase 1: development and validation of TB-KAP questionnaire, Phase 2: knowledge, attitude and practice (KAP) toward tuberculosis and Phase 3: the effectiveness of TB educational modules intervention.

3.1 Phase 1: Development and validation of TB-KAP questionnaire

3.1.1 Development of the TB KAP questionnaire

The research questionnaire that was designed to assess the levels of knowledge, attitude and practice towards TB among Libyan nurses was initially developed in the English language (Appendix A). About 80% of the questions in the KAP parts of the questionnaire were extracted and adapted from questionnaires that had been used in previous studies related to TB KAP surveys. The knowledge questions were obtained from one study conducted in Turkey (Yükseltürk & Dinç 2013) and the World Health Organization (WHO)' KAP Guide (WHO, 2008). The attitude questions were extracted from previous studies on attitudes towards TB (Jurčev-Savičević, 2011) and (Suleiman et al., 2014)). The practice questions were extracted from practice guidelines for the prevention of multidrug-resistant TB among hospitalized adult patients in Bangladesh (Anowar et al., 2013). In addition to the socio-demographic questions, a few questions in the KAP parts were formulated by the researcher and supervisor. The questionnaire was divided into four parts as described below:

3.1.1.1 Socio-demographic

There were eight questions in this part that were formulated by the researcher and supervisor. Five questions were about the age, sex, marital status, education level, and residence of the participants. The other four questions were related to work experience period, previous attack of TB and source of TB-related information.

3.1.1.2 Knowledge on tuberculosis

There were 12 components with a total 82 items. The 12 components are as following:

1. Cause and infectivity of TB (4 items).
2. Modes of TB transmission (6 items).
3. Persons who at risk of TB (11 items).
4. Clinical features of TB (8 items).
5. Common sites in the body rather than the lung affected by TB (4 items).
6. Diagnostic tests of TB (2 items)
7. Interpretation of tuberculin skin test (5 items).
8. Advantages of Interferon-Gamma Release Assays (4 items).
9. TB treatment and delivery of anti-TB drugs (25 items).
10. Tests are used in monitoring of MDR-TB treatment (4 items).
11. Risk to the patient associated with incomplete or interrupted treatment (3items).
12. Preventive measures of TB (6 items).

The details are shown in Table 3.1.Theknowledge-related items were framed using three possible answers (1 = yes, 2 = no, and 3 = I don't know). A score of (1) was given to each correct answer and a score of (0) was given to incorrect and 'I don't know'.

Table 3.1: Knowledge components of the questionnaire

Knowledge Component 1 (TB-causes and infectivity)	
1	Bacteria are the microbe that causes TB.
2	Tuberculosis is considered a serious disease.
3	Tuberculosis is a contagious can be spread from one to other.
4	The people may become infected with TB more than once in their lifetime.
Knowledge Component 2 (mode of transmission)	
1	Through handshakes.
2	Through the air when a person with TB coughs.
3	Drinking unpasteurized and non-sterile Cow's milk.
4	Sharing the TB infected person the same plate during eating or cup during drinking
5	Through touching items in public places (doorknobs, handles in transportation).
6	Through sexual intercourse.
Knowledge Component 3 (Persons who at risk of TB)	
1	Person with HIV/AIDS.
2	Person with poor nutritional state.
3	Person who living in Crowding.
4	Homeless person.
5	Patient with Long hospital admission.
6	Health care workers.
7	Prison inmates.
8	Children under five- years.
9	Farmer.
10	Family members of a confirmed case.
11	Person with occupational lung disease.
Knowledge Component 4 (Clinical features of TB)	
1	Cough up blood
2	Coughing for over two weeks
3	Fever for over two weeks
4	Loss of appetite
5	Night sweating
6	Chest pain and shortness of breath
7	Total weakness
8	Weight loss
Knowledge Component 5 (common sites rather than the lung are affected by TB)	
1	Lymph node
2	Kidney
3	Brain
4	Spinal cord

Table 3.1: Knowledge components of the questionnaire (continued)

Knowledge Component 6 (Diagnostic tests of TB)	
1	Sputum Smear Microscopy and Culture is the gold test for TB-diagnosis
2	Chest X-ray is helpful test for diagnosis of pulmonary tuberculosis.
Knowledge Component 7 (interpretation of tuberculin skin test (TST)	
1	People living with HIV.
2	Recent close contacts of people with infectious TB.
3	People with chest x-ray findings of TB disease.
4	People with organ transplants.
5	Other immunosuppressed patients.
Knowledge Component 8 (advantages of Interferon-Gamma Release Assays)	
1	Results can be available in 24 hours.
2	Does not cause booster phenomenon.
3	Less likely to have incorrect reading of results as compared to TST.
4	BCG vaccination does not affect the results.
Knowledge Component 9 (TB treatment and delivery of anti-TB drugs)	
1	DOTS regimen is the recommended treatment of newly active TB.
2	The standard length of treatment for a newly diagnosed case of TB is ≥6 months.
3	Hearing loss and ototoxicity is considered side effect of Amikacin.
4	Hepatotoxicity is considered side effect of Ethambutol.
5	Ethambutol can be taken after meals because it does not interact with foods.
6	The nurse should monitor patients consuming ethambutol for vision changes and blurring
7	Dizziness, vertigo, tinnitus, disequilibrium and loss of hearing side-effects of streptomycin.
8	Isoniazid, rifampin, pyrazinamide and ethambutol are first-line drugs used in TB-treatment.
9	The second-line drug used to treat TB includes prednol, teofilin, ephedrine and isoniazid.
10	Direct Observation Therapy Strategy refers to observation of the patient by an educated person while properly consuming all the doses of the drugs.
11	Ethambutol can be used for tuberculosis prophylaxis in patients who are at risk.
12	Presence of acid-fast bacillus in the sputum samples of patients during the fifth month of medical treatment indicates multi-drug resistance.
13	If the patient did not consume the drug daily, the nurse cans double the dose the next day.
14	The nurse should administer streptomycin through an intramuscular.
15	MDR TB is caused by an organism resistant to both isoniazid and rifampicin.
16	The main reason of MDR during tuberculosis therapy is use of drug combinations.
17	Anti-tuberculosis treatment should be terminated in patients receiving haemodialysis.
18	The nurse should explain to women that rifampin might decrease the effects of oral hormone-based contraceptives.
19	Patients using rifampin should be monitored for anaemia and thrombocytopenia.
20	Diabetic patients on rifampin should be monitored for blood-urine glucose level during treatment course.
21	Isoniazid might be less effective when used with antacids containing aluminium hydroxide.
22	The nurse should explain to mothers to avoid breast-feeding while on isoniazid therapy.
23	In case of vomiting, tablets of rifampin can be given in divided doses at different times
24	In case of MDR-TB the therapy with the same treatment drugs for extra one (1) month.
25	Patient should stop treatment when the symptoms of TB subside or when they feel better.

Table 3.1: Knowledge components of the questionnaire (continued)

Knowledge Component 10 (tests are used in monitoring of MDR-TB treatment)	
1	Sputum smear and culture.
2	Liver Function Test.
3	Chest X-Ray.
4	Renal Function Test.
Knowledge Component 11(risk to the patient with incomplete or interrupted treatment)	
1	Worsening of symptoms and prolonged treatment course.
2	Development of drug-resistance.
3	Death.
Knowledge Component 12 (prevention of TB infection)	
1	Avoidance of direct contact of TB patient.
2	By taking a healthy diet and doing a lot of physical activities.
3	By avoiding alcohol and other drug abuse.
4	By wearing face mask as Personal protective Equipment (PPE).
5	By living in ventilated residences.
6	By vaccination against the disease.

3.1.1.3 Attitude towards tuberculosis

There were two major components consisting of a total eight questions in this part about attitude towards TB. In the first attitude component, there were four items about the phobia of TB, while the second contained four items about the social stigma of TB. A five-point Likert scale of agreement: (1 = strongly agree, 2 = agree, 3 = somewhat agree, 4 = disagree, 5 = strongly disagree). A cut-off point of (3) was used for this part of the questionnaire. For each of the two components, the mean was calculated and used to determine the level of attitude in relation to the cut-off point of the Likert scale. If the mean score of the component was lower than the cut-off point of the scale, the attitude was considered negative, while if it was equal to or higher than the cut-off point of scale, the level of attitude was considered positive and that was based on previous studies; (Barua, 2013) and (White, 2011). The details of these components are shown in Table 3.2.

3.1.1.4 Practice toward Tuberculosis

This part contained five major components that were comprised of a total of 22 questions that covered issues related to nursing practice with regards to TB. The 5 components are as following:

1. Practice on services regarding patient admission (4 items)
2. Practice towards TB infection control (5items)
3. Practice towards respiratory hygiene and collection of sputum (6 items)
4. Practice towards TB treatment and delivery of TB drugs (4 items)
5. Practice towards health education of patients and follow-up (3 items)

The questions on practice were framed using a three-option scale of performance (1 = never perform, 2 = sometimes perform, 3 = always perform) with (2) as the (cut-off point). The mean score was calculated for each practice component and if the mean was equal to or higher than the cut-off point of the scale, the level of practice was considered satisfactory, while if it was lower than the cut-off point of scale, the practice level was considered unsatisfactory and that was based on previous literature; (Barua, 2013) and (White, 2011). The details of these components are shown in Table 3.3.

Table 3.2: Attitude components of the questionnaires

Attitude	**Component 1 (phobia of tuberculosis)**
1	I wouldn't feel comfortable about being near to tuberculosis patient.
2	I wouldn't in prolonged contact with tuberculosis patient to be safe.
3	If I had TB, it would be a problem to find a partner for marriage.
4	I will leave my job if I got a TB.
Attitude	**Component 2 (social stigma of tuberculosis)**
1	If I found out had TB, I would feel a shamed and embarrassed.
2	If I had TB, the others would think less of my family.
3	I am worried that the others and hospital's staff may laugh at me if I got a TB.
4	I would hide my TB if I got it.

Table 3.3: Practice components of the questionnaire

Component 1 (tasks at the admission of TB patients)	
1	I ask the patients during admission about previous history of TB infection.
2	I ask patient about any close contact with household members or friends.
3	I check the patients' drugs that they have during admission.
4	I fill and send the disease notification form to the relevant registration unit.
Component 2 (tasks toward TB infection control measures)	
1	I ask the patients in the ward to always wear the protective mask.
2	I wear the protective face mask and gloves while handling the patients
3	I keep the infectious and non- infectious TB -patients in the separate rooms.
4	I use separate treating and testing devices for every individual patient.
5	I ask the patients to cover their mouth and nose during coughing, or talking.
Component 3 (tasks regarding respiratory hygiene and collection of sputum)	
1	I collect sputum specimens from patients in a separate ventilated space.
2	I collect the sputum in a pot with lid and then dispose properly.
3	I collect the THREE (3) samples of sputum for AFB with fully completed form.
4	I explain and follow the sputum collection procedures.
5	I explain to the patients how the test to be done and the reason for doing it.
6	I help the patients to collect sputum when they cannot produce sputum.
Component 4 (tasks regarding treatment of patient and delivery of drugs)	
1	I ensure the correct dosages of drugs during distribution of medications.
2	I ask and remind the patients to take their drugs regularly on time.
3	I take note of any appeared side effects or allergic reaction of drugs.
4	I monitor whether the patients have response or resistance to treatment.
Component 5 (tasks about patient education and follow-up)	
1	I teach the patients about the different aspects of the TB disease.
2	I explain to the patients the treatment at home and follow up during discharge
3	I call and remind the patients if they missed the follow-up appointment.

3.1.2 Validity and reliability

Validity is the extent of accuracy of an instrument to measure the construct which it is supposed to measure, in the context of the concepts being studied (Bolarinwa, 2015). In order to have confidence in the results of study, one must be assured that the questionnaire consistently measures what it purports to measure when properly administered. In short, the questionnaire must be both valid and reliable.

3.1.2.1 Content and face validity of KAP questionnaire

Face validity refers to whether the instrument appears to measure the variable that it claims to measure rather than what it actually measures (Singh, 2014).Face and content validity checks were conducted to ensure that the length and the wording of the questions and the appearance of the questionnaire overall were appropriate in terms of clarity and simplicity, as well as to get comments and suggestions regarding the technical qualities of the research instrument including the scaling and order of the questionnaire items.

First, the questionnaire was developed in the English language with the aid of the researcher's supervisor to ensure that it measured the desired variables. Then, it was submitted to a panel of six experts in order to determine the degree and to what extent each item was relevant and adequate enough to represent the main domains of the questionnaire in terms of knowledge, attitude and practice towards TB.

The relevancy of all the items in the knowledge, attitude and practice components were rated by the experts on a five-point ordinal scale of agreement: 1 = strongly disagree (not relevant), 2 = disagree (not relevant), 3 = somewhat agree (somewhat relevant), 4 = agree (relevant), 5 = strongly agree (highly relevant). The items that scored > 3 were accepted as eligible for inclusion in the questionnaire.

The content validity index for each item (I-CVI) was computed as the number of agreements among the experts (giving a rating of either 4 or 5) divided by the total number of experts Total agreements of all experts were equal to score 1 of I-ICV. However, I-CVI of score ≥0.6 considered as acceptable content validity. Since there was no item of all components of the

questionnaire scored < 0. 6 of I-ICV, all the items were considered eligible and retained. The details of I- ICVI and rating panel are shown in (Appendix B).

3.1.2.2 Reliability of the questionnaire

The reliability refers to the consistency of an instrument in terms of which it measures the target attribute and can be equated with a measure's stability, consistency or dependability (Bolarinwa, 2015). Internal consistency testing is used to address the correlation of various items within the instrument and examines the extent to which all the items in the instrument consistently measure a concept (Singh, 2014).

a) Internal consistency

Cronbach Alpha coefficient was the most appropriate measure of reliability when making use of Likert scales and most agree on a minimum internal consistency coefficient of 0.70 (Robinson, 2010). In our study Cronbach's alpha co-efficient was computed to explore the internal consistency of attitude and practice scales**.** Individual scores of all attitude and practice items were correlated with the overall scale score (*Corrected Item-Total Correlation r* was > 0.3)

b) Test-retest reliability study

Due to the limited number of TB-nurses in Libya and a large sample (> 400) would be needed to carry out the further phases of study (2 and 3), test-retest was carried out in time of two weeks interval among only 30 randomly selected nurses from Tarhona TB center using the TB-KAP questionnaire. However, if we had used a greater number of nurses in this test, this greater number of nurses would have to be excluded and would be no more sufficient sample

available to carry out the two further phases the study. Intraclass correlation coefficient (ICC) values were computed for the all items in the questionnaire and ICC values less than 0.5 are indicative of poor reliability, values between 0.5 and 0.75 indicate moderate reliability, values between 0.75 and 0.9 indicate good reliability, and values greater than 0.90 indicate excellent reliability (Koo & Li, 2016).

3.1.2.3 Factor analysis

Exploratory factor analysis is used when a researcher wants to discover how many and what factors influence a variable, to analyse which variables go together and to assemble common variables into descriptive categories. On the other hand, principal component analysis (PCA) is used to extract the maximum variance from the data set with each component, and to thereby reduce a large number of variables into a smaller number of components (Habing, 2003). In order to determine the construct validity of the questionnaire used in the current study, the principle component analysis (PCA) method was applied for component extraction. The components with eigenvalues that were higher than 1 were retained as components. Next, varimax rotation with Kaisar normalization was used in order to optimize the loading factor of each item on the extracted components. Items with a loading factor of ≥ 0.4 were considered as acceptable and were retained, whereas items with a loading factor of < 0.4 were deleted.

3.1.2.4 Translation of the questionnaire

After the validation of questionnaire, the final version was translated into Arabic (Appendix C). Forward" and backward" translation method was the translation process to validate the

linguistic concepts and to preserve the meaning of the developed questionnaire. Initially, the English version of the questionnaire was translated to Arabic by two experts at legal translation center in Libya with aid of the researcher to avoid any misconception. However, the translation process was not affected much by culture perspective as Libyan people are native speaker of classical Arabic language. Thereafter, the Arabic version of the questionnaire was translated back to English by three Arab native speakers who are holding a doctoral degree in English. Finally, the questionnaire was compared to the original English version and was found to be quite similar. The validated Arabic version was used in data collection. The details of the results are discussed in chapter 4.

3.1.3 Sampling method and sample size

The sampling method of phase 1 was similar to the sampling method of phase 2 which was descried in section 3.2.6.2. As the effective sample size for factor analysis should be at least 300 (Tabachnick & Fidel, 2001). To determine the validity of factor structure and individual items a large sample of study population is needed (Costello & Osborne, 2005). However, the calculated sample size for this study was 435.

3.1.4 Ethical approval

The ethical clearance was obtained from the approval authorities of the TB centres (Appendix E) and the NCDC section of Libya (Appendix F). Written consent was obtained from the nurses who agreed to participate in this study (Appendix G). In addition permission was obtained from the medical ethics committee at University Malaya Medical Center (UMMC) in Malaysia (Appendix H).

3.2 Phase 2: Knowledge, attitude and practice towards tuberculosis

3.2.1 Operational definitions of research variables

This section provides definitions of dependent variables in this study (knowledge, attitude, practice and effectiveness) and independent variables (age, gender, residence, education and work period)

1) **Validity** is the ability of KAP questionnaire to measure what it is intended to measure in study objectives regarding knowledge, attitude and practice toward tuberculosis.
2) **Reliability** is the ability of KAP questionnaire to provide stable and consist result of knowledge, attitude and practice toward tuberculosis
3) **Knowledge**: The knowledge that the respondents have regarding the causes, infectivity, clinical features, risk factor, diagnosis, treatment and prevention of tuberculosis.
4) **Attitude**: The feeling and beliefs of respondents toward tuberculosis.
5) **Practice**: The actions intended to do in order to provide safe healthcare in term of admission protocol, respiratory hygiene, sputum collection, delivery of TB-drugs and education of patient about tuberculosis.
6) **Effectiveness** is adequacy of TB- educational module to achieve the expected improvement of knowledge, attitude and practice among the target participants.

3.2.2 Study design

This was a cross – sectional study.

3.2.3 Inclusion and exclusion criteria

3.2.3.1 Inclusion criteria

Nurses who working at TB centers and provided informed consent form were included.

3.2.3.2 Exclusion criteria

Nurses who included in pilot study of questionnaire validation were excluded.

3.2.4 Study area

The study was conducted in Libya, which is located in North Africa, with total land area of1 665 000 km^2. The country borders Algeria, Chad, Egypt, Niger, Sudan and Tunisia and has 1900 km of coastline along the Mediterranean Sea. The country is divided into 24 provinces. There are 29 tuberculosis centres located in 23 provinces in Libya with total of 582 nurses. Due to the large population size, Misurata has 2 TB centres; Tripoli and Aljabel have 3 TB centres each. However, the TB center in Tarhona was excluded in this study as it had been selected for pilot study (Table 3.4).

3.2.5 Study instrument and procedures of data collection

A validated self – administered Arabic version of the questionnaire (Appendix C) was used in data collection. In addition to demographic data, the questionnaire covered twelve components about TB knowledge, two components for attitude toward TB and five components related to TB practice. The data was collected directly from employed nurses at selected tuberculosis centres in Libya after explanation the purpose of the study. Details of data collection procedure at study site are shown in Figure 3.4.

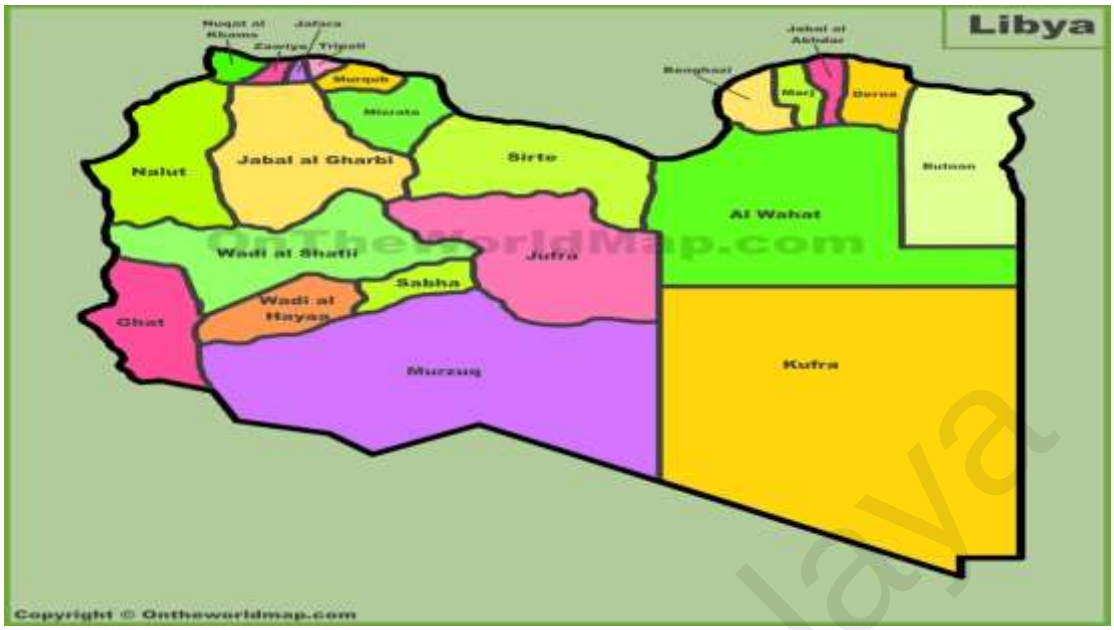


Figure 3.1: Map of Libya

Table 3.4: Distribution of TB centers in Libya

No	East		Central		West		South	
	Provinces	TB Centers	Provinces	TB Centres	Provinces	TB Centers	Provinces	TB Cent-ers
1	*Benghazi	1	*Sirt	1	Tripoli	3	*Sabha	1
2	*Albida	1	Misurata	2	*Tajora	1	Murzeg	1
3	Egdabia	1	Zeliten	1	*Alzawia	1	*Ghate	1
4	*Dernna	1	*Alkhoms	1	*Aljabel	3	Alkofra	1
5	Tubrug	1	*Emsilata	1	Subrata	1		
6	Almarge	1	**Tarhona	1	Zwara	1		
7	Shahat	1						
8	*Bengwad	1						
Total	8	8	6	7	6	10	4	4

*** selected provinces, ** selected for pilot study**

3.2.6 Sample size and sampling method

3.2.6.1 Sample size

The sample size was calculated based on the obtained odd ratios from previous study conducted to determine the association of KAP with gender and age (Chee & Ong, 2016). PS power and sample size calculation software was used in the calculation process. Since the larger the sample size is, the more reliable, and more precise is the result, and the smaller is the margin error, the odd ratio between attitude and gender (OR= 2.23, p <0.05), which was found to be the highest obtained significant association, was selected, and used in sample size determination. The sample size was thus taken to be 395 (Table 3.5) and 10% non-response rate, a total sample size of 435 was needed.

However, based on odd ratios obtained from the association between knowledge and age (OR = 1.52, p = 0.012, *n* = 211); knowledge and gender (OR = 0.743, p = 0.442, *n* =102); attitude and age (OR = 0.979, p = 0.89, *n* = 162); practice and gender (OR = 0.554, p = 0159, *n* =123) and practice and age (OR = 1.033, p = 083, *n* =169). Therefore the highest obtained significant association between attitude and gender (OR= 2.23, p <0.05) was preferred in the sample size determination (n=395).

Table 3.5: Estimated sample size based on odd ratio using PS software

z tests - Logistic regression Options: Large sample z-Test Analysis: A priori: Compute required sample size	
Input: Tail (s)	2
Odds ratio	2.23 Chee & Ong. (2016)
α err prob	0.05
Power (1-β err prob)	0.95
X distribution	Binomial
Pr(Y=1|X=1) H0	= 0.2
Critical z	=1.9599640
Total sample size	=
Actual power	= 0.9529354

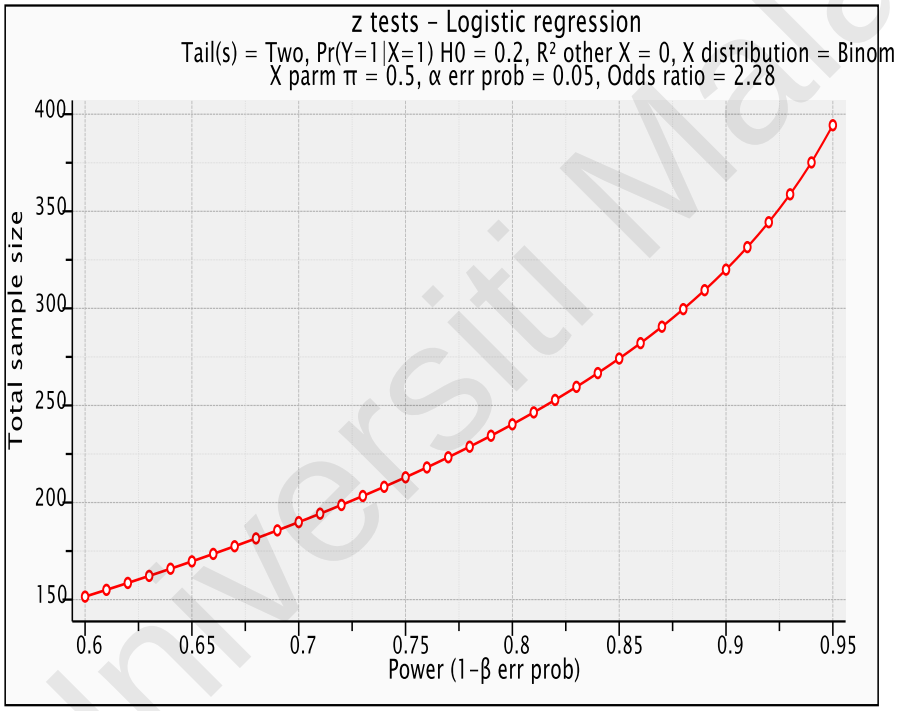


Figure 3.2: Graph shows the total calculated sample size

3.2.6.2 Sampling method

As the target participants of this study were scattered across a wide geographical area, a two stage sampling technique was used to draw the target sample of nurses from the entire population of TB nurses in Libya. The method consisted of the following two stages:

Stage 1: fifty percent of TB centres of each stratum were randomly selected.

Stage 2: proportionate random sampling (80%) of nurses as each stratum has the same sampling fraction in proportional stratified random sampling. This high fraction was used in aim to minimize the anticipated incomplete or inconsistent response rate from the small number of nurses in each TB centres. Therefore, sample sizes of 130, 98, 167, and 56 participants were allocated to the east, central, west and south provinces, respectively. Finally, the nurses were selected randomly from the selected hospitals (Figure 3.3).

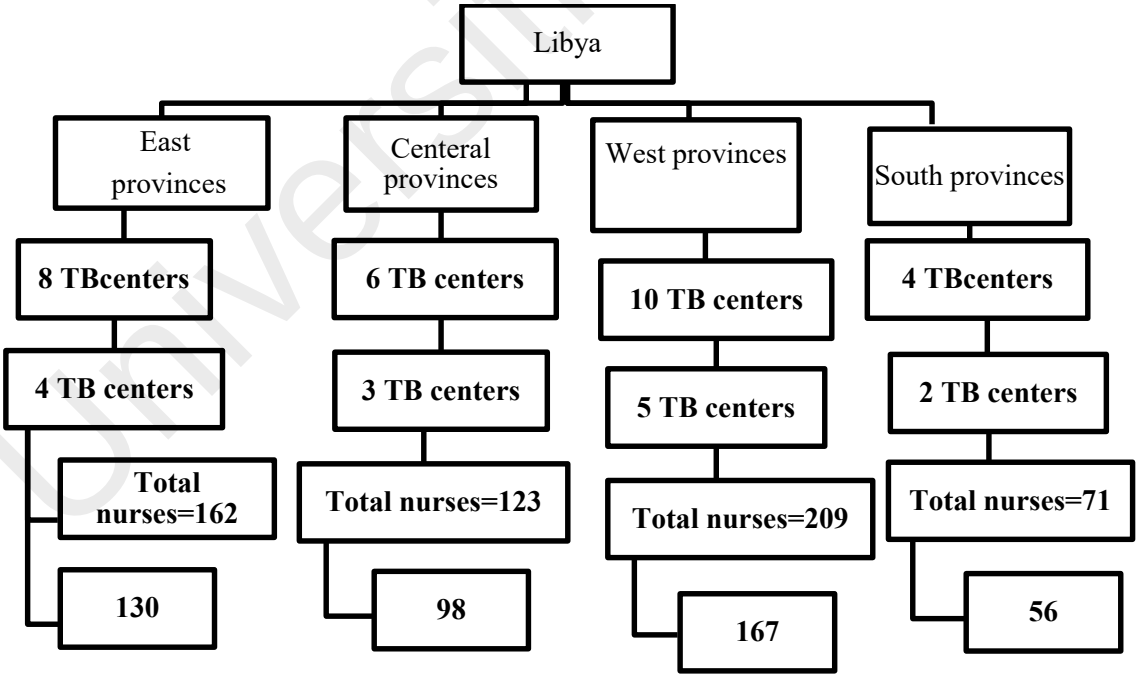


Figure 3.3: Sampling method of selected sample

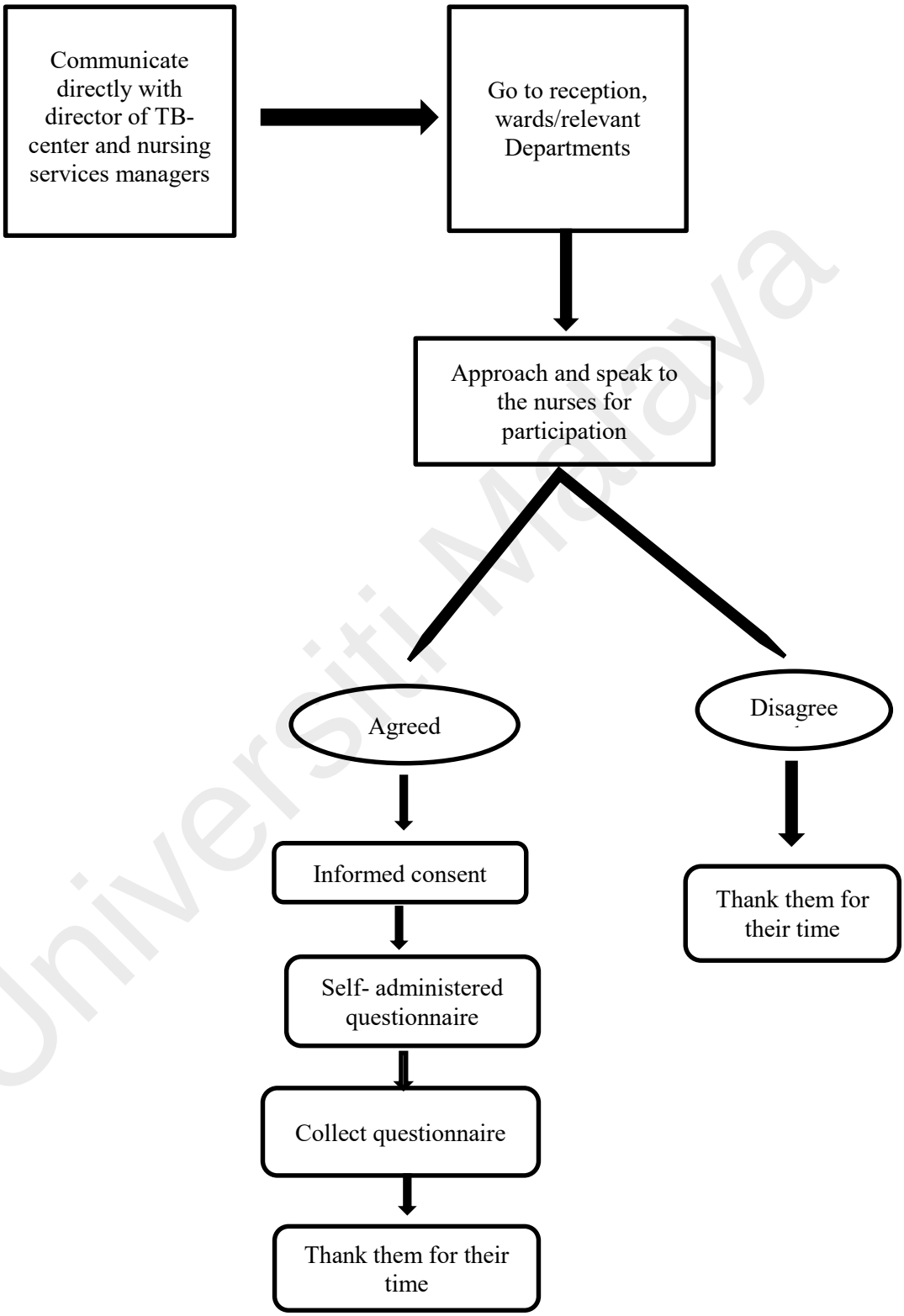


Figure 3.4: Flow chart of data collection procedures at study site

3.2.7 Study duration and work plan

The first part of the study was conducted over a period of one year, from January to December 2016 which covered the development and validation of the questionnaire as well as collection of data for phase 1 (KAP) survey. The finalization and writing the report took place in the remnant period. The details of work flow are shown in Gantt chart (Appendix D).

3.2.8 Ethical approval

The study protocol was officially approved and institutional ethical clearance was obtained from the approval authorities of the TB centers (Appendix E) and the NCDC section of Libya (Appendix F). Written consent was obtained from the nurses who agreed to participate in this study (Appendix G). In addition permission was obtained from the medical ethics committee at University Malaya Medical Center (UMMC) in Malaysia (Appendix H).

3.2.9 Minimization of Bias

3.2.9.1 Selection Bias

Selection bias was minimized by randomly selecting the health center that was targeted for participation from a comprehensive list of all TB centers within Libya. This strategy facilitated the inclusion of a wide range of TB centers, in terms of size and services offered, and minimized the preferential selection of a specific group of TB nurses.

3.2.9.2 Information Bias

The questionnaire was pretested on 30 nurses in Libya to refinement of the questions in order to minimize confusing questions. Social desirability of participants, sometimes referred to as

response bias, is another potential form of information bias that can occur. This happens when participants give responses in keeping with what they consider will be expected of them. This was minimized by collecting the data through anonymous self-administrated questionnaires, so that the data collector would not be able to associate individual responses to a particular individual, i.e. no personal identifying information will be recorded on the questionnaire at any time.

3.2.10 Data Entry and Processing

The study questionnaires were coded according to the standard codes to avoid overlapping or missing information. Each variable was named and coded with a number. Such procedures enhance and help data entry and analysis.

3.2.11 Data Analysis

SPSS version 20 software was used in data analysis and statistical significance was set as 0.05. Descriptive statistics were used to illustrate the demographic variables and responses of respondents in KAP survey. Multivariate logistic regression analysis was applied to determine the associations of KAP with demographic (age, gender, education levels, and residence) and work period. Regression analysis with three models was applied to explore the association of knowledge and attitude with practice.

3.3 Phase 3: Effectiveness of education intervention

3.3.1 Development of TB educational materials

As the effectiveness of educational intervention is one of the objective and part of this study and based on the assumption of knowledge, attitude, and practice (KAP) model, that, when somebody's knowledge increases, their behaviour will be different (WHO, 2012) ; face to face health education intervention was developed to improve the knowledge, attitude and practice among TB-nurses in Libya.

The modules contents were constructed based on results of baseline KAP of TB and adapted from Centers for Disease Control and Prevention (CDC)'s self-teaching TB modules (CDC, 1995) . However, information from World Health Organization' data base, Davidson textbook of internal medicine and official website of e- medicine were added.

3.3.1.1 Structure of the TB-modules

Three modules were formulated, based on the content, as following:

- Module 1: History, Cause, Transmission, Pathogenesis, and Clinical features.
- Module 2: Epidemiology, Risk factors, and Diagnosis of TB.
- Module 3: TB-Management, TB-Infection Control, role of nurse in TB- control and health education, facts about TB-stigmatization, phobias and Prevention of TB.

3.3.1.2 Feasibility of TB-modules

In order to obtain effective and understandable modules, before it was translated into the Arabic language, the final English-language version of the formulated modules was reviewed

by a panel of four experts in the field: a professor in medical education, two respiratory physicians and a public health specialist. The experts were asked to evaluate the module contents and their relevancy and applicability as well as to explore any difficulties of understanding by completing a questionnaire instrument of consisting of six items that was adapted from a previous study (Oliveira et al., 2014).

The experts rated the contents of the TB modules by indicating their level of agreement with the six items according to a five-point ordinal scale of agreement (1 = strongly disagree, 2 = disagree, 3 = somewhat agree, 4 = agree, 5 = strongly agree). Items that scored > 3 were considered good enough to reflect the relevancy, adequacy, readability, understanding and applicability of the modules. In addition, the I-CVI was computed for each item in the instrument (Table 3.6) and a score ≥ 0.7 was considered to denote agreement among the experts about the modules. Some modification and adjustments of modules were performed based on the comments of experts after completion of evaluation. Then, after the modified version was translated into the Arabic language, the modules were reviewed again by two experts for readability and feasibility.

Table 3.6: Agreements of experts about contents of TB-modules (n=4)

No	Items	ICV
1	The contents of modules have relevant information on TB	1
2	Texts are clear and comprehensive in all TB-modules	1
3	Illustrations used in all are suitable	1
4	Illustrations used are necessary for understanding the contents	1
5	Illustrations and texts used are meet the understand of proposed objectives	0.75
6	Applicability of modules is useful in everyday clinical practice	1

3.3.2 Study design

The TB educational intervention study was conducted using two groups quasi experimental design with follow-up of six months. One group received the education intervention, while the other did not (i.e., the control group), as shown in Figure 3.1. Both groups went through a pre-test using the same validated TB KAP questionnaire developed in Phase 1. It is also important to re-evaluate an intervention in order to track any changes in their impact as this helps, to determine its sustainability and whether improvements are needed to increase effectiveness with respect to the objective. Therefore, both groups were tested immediately after the education intervention and also at a 3-month and 6-month follow-up. Through this design, three different experiences among the two groups could be assessed:

1) Changes in the measures over time, that is, whether one, both or neither group improved over time between four time points (1 = pre-test, 2 = immediate post-test, 3 = 3- month follow-up and 4 = 6- month follow-up);
2) Scores between the intervention and control groups at pre-test, to ensure that the randomization process was effective; and
3) Post-test results between the two groups across all time points, to obtain an idea of the overall effectiveness of the intervention.

In this study, the aim of delivering the TB educational intervention was to measure its impact on the knowledge, attitude and practice among the participants. However, it was deemed unreliable to measure this impact on practice immediately at post-test as an adequate time period was needed for practice. Therefore, time periods of three and six months were given to the nurses in the intervention group as an opportunity to practise based on the knowledge

gained in the TB educational programme. Hence, the effectiveness of the intervention was assessed three times: at immediate post-test, 3-month follow-up and 6- month follow-up).

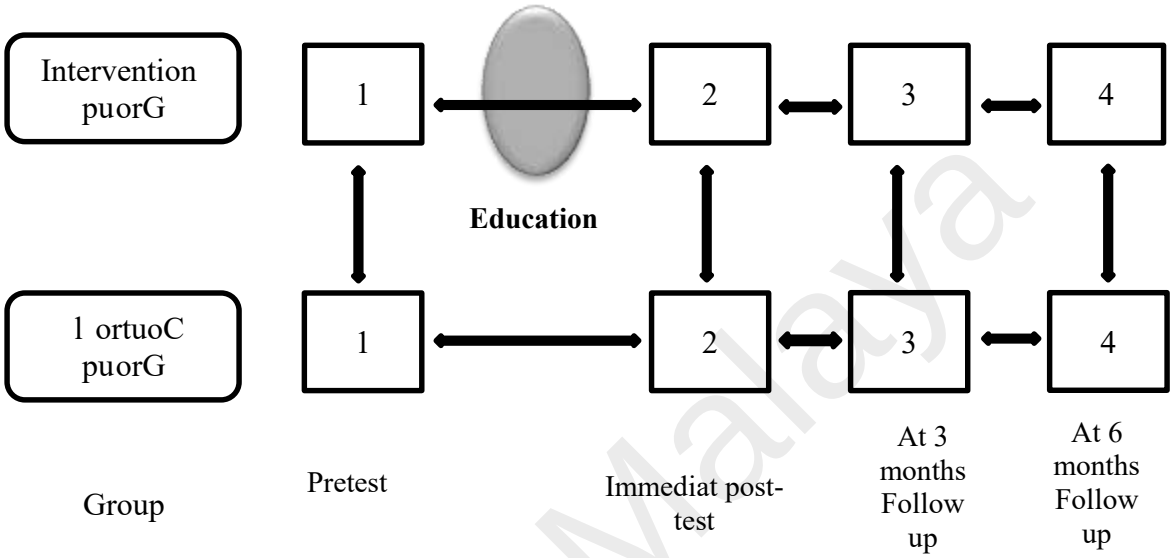


Figure 3.5: Quasi experimental two groups, pre, post, and follow-up design

3.3.3 Study area

The study participants were selected randomly from three different cities in Libya, namely Tripoli (the capital), Zeliten and Misurata. Tripoli is the largest city of Libya with a population of about 2.5 million as of 2015. There are three TB centres, 18 community health centres and five large public hospitals with different specialties in Tripoli. In addition, there are two faculties of nursing and two nursing institutes operating as nursing education facilities in Tripoli. Tripoli is where the TB educational intervention was conducted.

Misurata is considered the third biggest city in the country. It is situated 200 km east of Tripoli and has a total population of 400,000 according to the Libyan census of 2011. It is

known as a famous commercial area and attracts many foreign workers and employees, especially from African countries where the prevalence of tuberculosis is high. The Ministry of Health operates more than 20 different healthcare services within this city, including four large public hospitals with different specialties, two TB centres and 15 small community health centres. In terms of nursing education in Misurata, besides the Faculty of Nursing at Misurata University, there is one other institute of nursing education. Misurata is where the first control group was selected from.

Zeliten has a total population of 232,000 and is situated 160 km east of the capital, Tripoli, and about 65 km west of the city of Misurata. It is divided into seven districts. There are 13 different health centres in Zeliten, including one large public hospital with different specialties, one TB centre and 11 small community health centres. On the educational side, there are two educational institutes in Zeliten: the Faculty of Nursing at Almargib University and another nursing institute. Zeliten is where the second control group was selected from. Participants for control group were selected from two cities as the number of nurses in these TB centres was small.

3.3.4 Study population

Employed nurses working at tuberculosis centres in Tripoli, Misurata and Zeliten in Libya were the target population of the study.

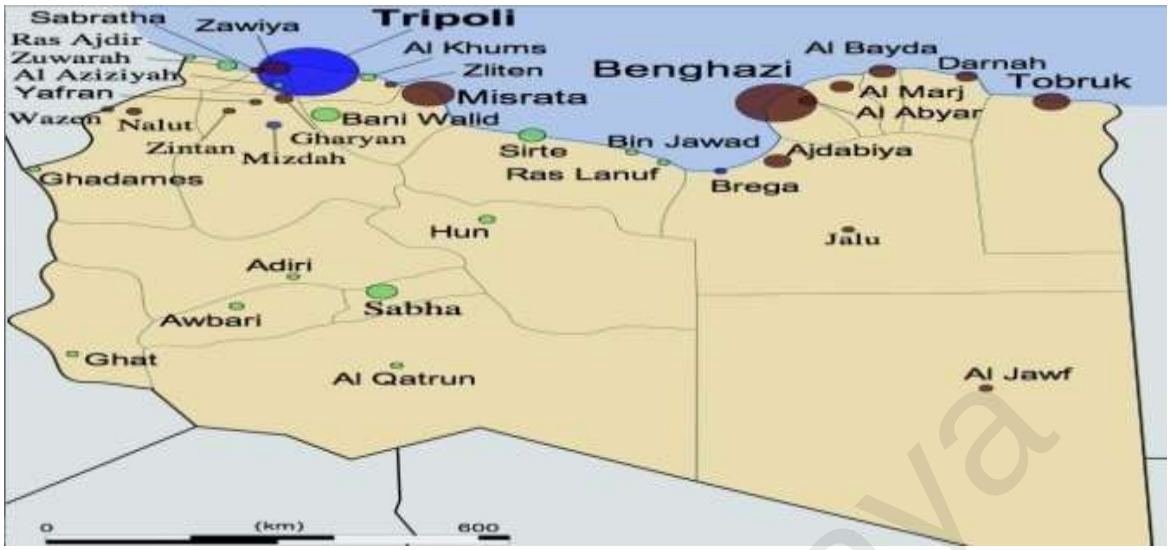


Figure 3.6: Map of Libya

3.3.5 Inclusion criteria

Employed nurses at selected TB centers in Libya who agreed to participate in the study after receiving information about their informed consent were included in the study.

3.3.6 Study period

The study was conducted in period from 16 February 2017 to 23 August 2017. TB-educational was delivered at multipurpose hall in Tripoli TB center over a period of 3 days, from 16 to 18 February 2017 among the treatment (intervention) group. Post three- months assessment was performed from 19-24 May, 2017. Three months later, the groups were post-tested gain from 18-23 August, 2017 as a at six month's assessment. More details are shown in Table 3.7.

Table 3.7: Study peroid of intervention study

Time	Intervention (Treatment) group	Control group
Pretest and	16/2/2017	16/02/2017
Intervention	16-18/2/2017	NA
Post-test	18-19/2/2017	Within the same peroid
At 3 months	19-24/5/2017	Within the same peroid
At 6 months	18-23/8/2017	Within the same peroid

3.3.7 Sample size and sampling method

3.3.7.1 Sample Size

The target sample size was calculated according differences in mean scores between pre-test and post-test which obtained from similar published study (Naidoo et al., 2011). The effect size was 0.165 and power of 0.95. PS power and sample size was used in the calculation process. Table 3.8 provides the F tests - ANOVA: Repeated measures, within-between interactions. The sample size calculated was 82. Because there will be two times follow up among the study groups, the adjustment with 15 % for anticipated drop out was done, therefore, the sample size was 95 and finally approximated to 100. Based on this sample size, 50 nurses were selected randomly for intervention and 50 nurses also randomly selected for control.

Table 3.8: Estimated sample size using PS software

Tests - ANOVA: Repeated measures, within-between interaction Analysis: A priori: Compute required sample size	
Input: Effect size f	= 0.165 ((Naidoo et al., 2011)
α err prob	= 0.05
Power (1-β err prob)	= 0.95
Number of groups	= 2
Number of measurements	= 4
Corr among rep measures	= 0.5
Nonsphericity correction ε	= 1
Output: Noncentrality parameter λ	= 17.8596000
Critical F	= 2.6422132
Numerator df	= 3.0000000
Denominator df	= 240
Total sample size	= 82
Actual power	= 0.9545866

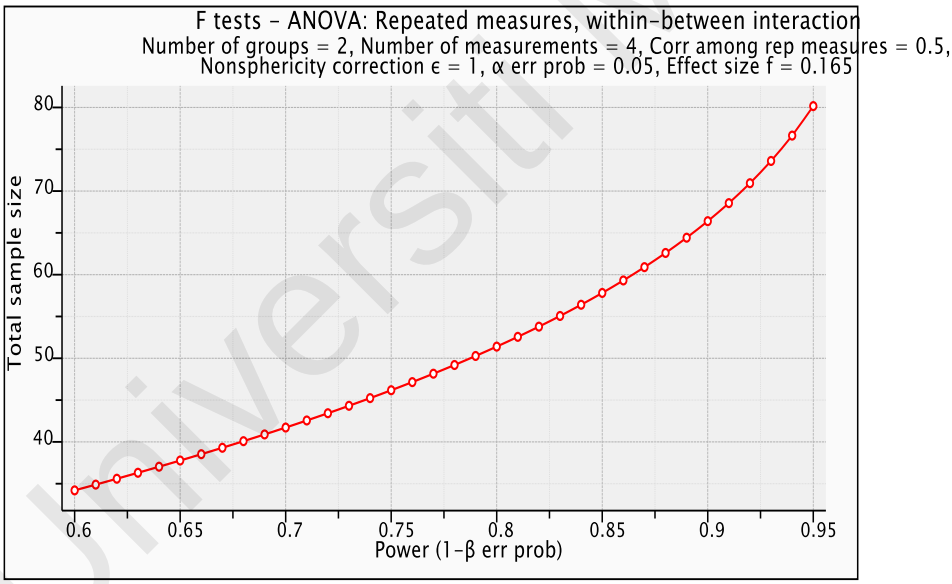


Figure 3.7: Graph of calculated sample size generated by PS software

3.3.7.2 Sampling method

In Libya, from central region, 2 centers out of 3 were selected; while from western area 2 centers out of 5 were selected. The 4 selected TB centers were randomly assigned to intervention and control group. There were 73 and 67 registered nurses in these intervention and control centers, respectively (Table 3.9). In accordance with the target sample size required for the study (n = 100).

Table 3.9: Distribution of selected nurses and site of TB education intervention

Study Groups	Distribution of Selected Nurses	Total Registered Nurses in Selected TB Centres	Total Selected Nurses	Intervention Places
Intervention Group	Tripoli TB Canter	41	30	Tripoli TB Centre
	Gargarish TB centre	32	20	
Total	2 TB centres	73	50	
Control Groups	Misurata TB centre	39	30	NA
	Zeliten TB centre	28	20	
Total	2 TB Centres	67	50	

3.3.8 Study instrument

A validated self – administered Arabic version TB-KAP questionnaire which has been used in KAP survey (phase 2) was used. In addition to demographic data, the questionnaire covered eleven components about TB- knowledge, two components for attitude toward TB and five components related to TB- practice.

3.3.9 Ethical clearance

Ethical clearance was obtained from the medical directors of the tuberculosis centers in Libya (Appendix I). In addition to the permission was obtained from medical ethics committee at University Malaya Medical Center (UMMC), Malaysia. However, written informed consents were obtained from the participant nurses (Appendix J).

3.3.10 Pre-test assessment for intervention and control groups

Pretest questionnaires were distributed among the participants in the both groups and collected back before starting of the program.

3.3.11 Educational intervention (delivery of TB modules)

Before the commencement of the programme, and according to the obtained contact information from the previously signed consent forms, the target participants in the intervention group were informed and reminded about the time and place of the study. The venue was prepared with the assistance of the staff at the Tripoli Tuberculosis Centre.

The 50 nurses who attended were asked to register and update their personal data and preferred communication method (i.e. email, mobile phone, office landline or Facebook) so any changes could be captured. The health education programme titled 'Nursing Education and Best Practice towards TB' was conducted over a period of three consecutive days from 16 to 18 February, 2017, in the multipurpose hall of the Tripoli Tuberculosis Centre.

The three TB modules were delivered in three sessions in the above-mentioned location. Teaching materials such as papers and pens as well as food and drink were provided during

the course. The duration of the first and second sessions was 150 minutes each, while the third session lasted 240 minutes. The content of the module in the first session covered the history, transmission, pathogenesis and clinical features of TB. In the second session, a talk was delivered about the epidemiology, risk factors and diagnostic tests for TB. In the third and last session, the nurses were trained on treatment, delivering of drugs, the role of the nurse in the control of TB and the facts about the stigmatization of TB. Regarding practice, some videos were used to demonstrate the skills for the collection of sputum samples. In addition, the nurses were trained in how to complete the disease notification form and how to ask the patient relevant questions about their previous history of TB and previously used TB drugs.

The lectures were interactive with a specific time allotted for a question and answer session. The medium of instruction was Arabic and PowerPoint slides as well as charts and pictures were used as teaching aids. The sessions were delivered by the researcher in his position as a public health specialist. The details of the delivered modules are provided in Appendix L.

3.3.11.1 Formative assessment during educational intervention

Formative assessment was part of the instructional process throughout the whole programme because evaluation of the progress made during the course of an intervention facilitates improvement of an intervention's effectiveness. Ongoing feedback was gathered from the participants during the course on issues such as the method of presentation, size of font used in the slides, use of a whiteboard and marker, clarity of the explanation when needed. In addition, questioning strategies and discussions were embedded in all the sessions to give an opportunity for deep thinking and more understanding. In order to facilitate the learning, nurses were advised to record short notes during the course. Also, in order to gain evidence

and clarification of the learning process among the nurses, the instructor employed the technique of walking around the room as well as observation. Gifts were given to the nurses at the end of programme to thank them for their participation.

3.3.12 Assessment for intervention and control groups

3.3.12.1 Immediate post-test assessment for intervention and control groups

After the last session, the participants were instructed to complete the immediate post-test questionnaire or, if this was not convenient, they were asked to do so within the next 24 hours and return it to the researcher. The assessment control group was asked to complete the same questionnaire at the same time (Figure 3.8).

3.3.12.2 3- months assessment for intervention and control groups

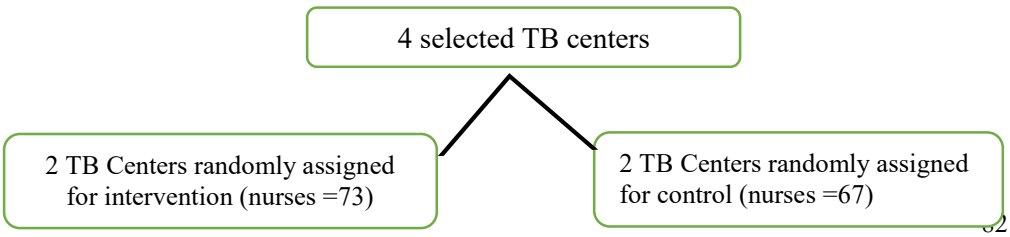
Three months later, a questionnaire was distributed among the participants in both groups.

3.3.12.3 6- months assessment for intervention and control groups

In order to determine the sustainability and effectiveness of the delivered modules and to obtain a reliable measurement of the practice level among the intervention (treated) group, a period of six months was given to them to provide them with an adequate opportunity to practise based on the knowledge gained in the TB educational programme. For this assessment, a questionnaire was administered among the participants in both groups and collected back.

3.3.13 Data analysis

Descriptive statistics were used to illustrate respondents' demographic variables. Testing of assumption for repeated measure ANOVA was also performed first, then two ways repeated measure ANOVA test was used to measure the changes of participants' response regarding knowledge, attitude and practice across the four time periods. Independent sample t-test was conducted separately to determine the differences of knowledge, attitude, and practice between intervention and control group at pre-test. Friedman test was used to determine the changes of scores per- item for knowledge attitude and practice items across 4 different points of time. One -way repeated measure ANOVA was conducted to compare the total mean scores of each component in knowledge, attitude and practice at four points in time. Two – way repeated measure ANOVA was used to compares the mean differences of knowledge, attitude and practice between groups. SPSS version 20 software was used in data analysis and statistical significance was set as 0.05.



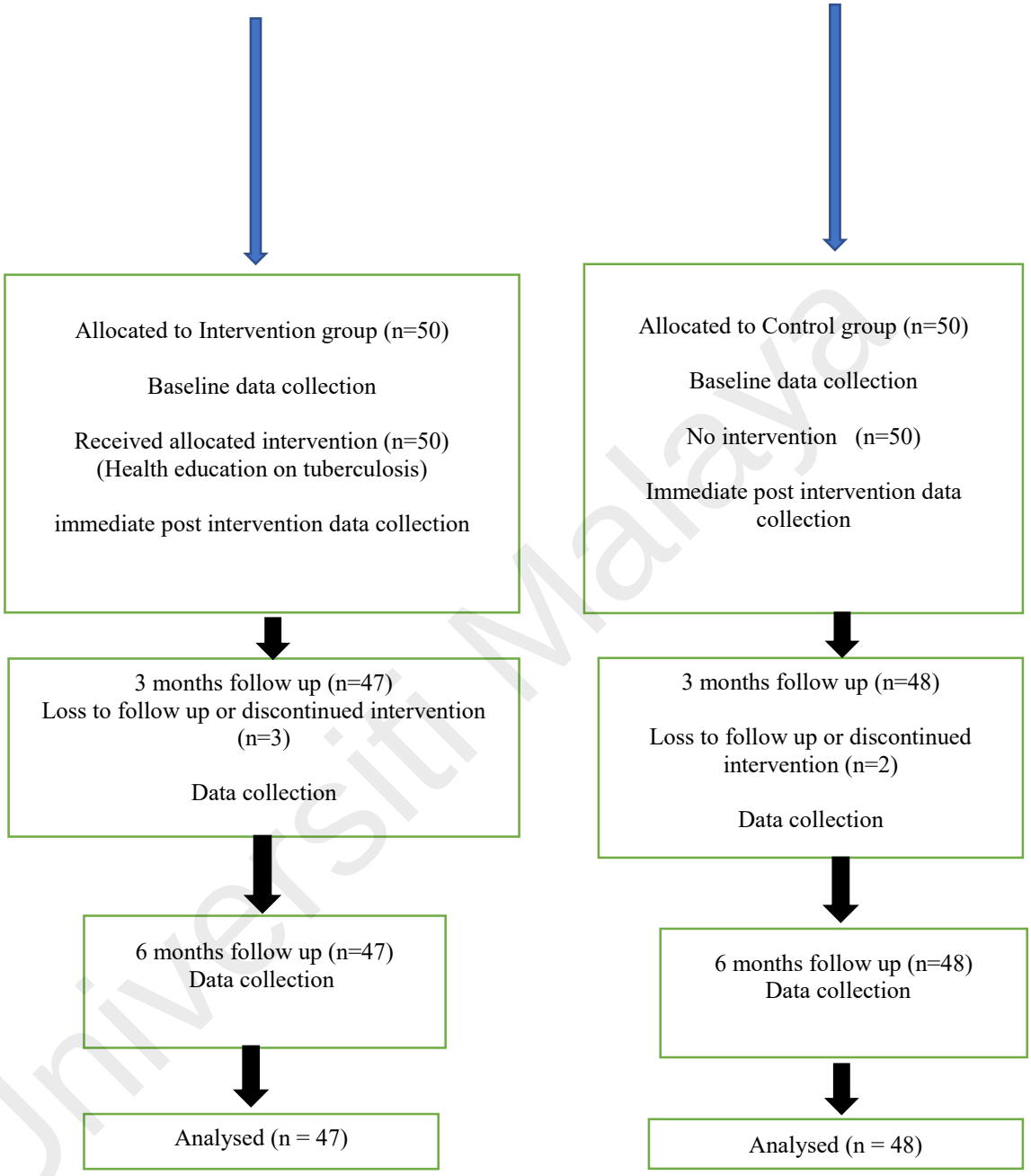


Figure 3.8: Flow chart of education intervention study among the selected nurses

CHAPTER 4: RESULTS

About this chapter

This chapter presents the results of the three phases of the study, validation of TB-KAP questionnaire (phase1), analysis of data collected from respondents through questionnaires in KAP survey (phase2), and TB- educational intervention study through two groups with follow up design (phase 3). The findings are reported according to the objectives of this study.

4.1 Phase 1: Validation of TB-KAP questionnaire

4.1.1 Content and face validity of TB- KAP questionnaire

Face and content validity checks were conducted to ensure that the length and the wording of the questions and the appearance of the questionnaire overall were appropriate in terms of clarity and simplicity, as well as to get comments and suggestions regarding the technical qualities of the research instrument including the scaling and order of the questionnaire items. First, the questionnaire was developed in the English language with the aid of the researcher's supervisor to ensure that it measured the desired variables. Then, it was submitted to a panel of six experts in order to determine the degree and to what extent each item was relevant and adequate enough to represent the main domains of the questionnaire in terms of knowledge, attitude and practice towards TB.

The relevancy of all the items in the knowledge, attitude and practice components were rated by the experts on a five-point ordinal scale of agreement: 1 = strongly disagree (not relevant), 2 = disagree (not relevant), 3 = somewhat agree (somewhat relevant), 4 = agree (relevant), 5 = strongly agree (highly relevant). The items that scored > 3 were accepted as eligible for

inclusion in the questionnaire. The content validity index for each item (I-CVI) was computed as the number of agreements among the experts (giving a rating of either 4 or 5) divided by the total number of experts. The total agreement of all experts was equal to an I-ICV score of 1 and an I-CVI score of ≥ 0.6 was considered acceptable content validity. No items had an I-ICV score of ≤ 0. 6, therefore all the items for all the components in the questionnaire were considered eligible and retained. The universal agreement rates for the knowledge, attitude and practice components were 0.89, 0.87 and 0.95, respectively. The details of the I-CVI results and the experts are shown in Appendix B.

4.1.2 Reliability of TB-KAP questionnaire

Reliability, or reproducibility, indicates whether a questionnaire performs consistently (Bolarinwa, 2015). In order to reach a high degree of reliability or consistency, a reliability test-retest was carried out using the Arabic version of the questionnaire among 30 randomly selected nurses where the questionnaire was administered at a 2-week interval. The intraclass correlation coefficient (ICC) was computed and a high degree of reliability was found between the items of the questionnaire. For the knowledge component items, the ICC was in the range of 0.63–0.961, while for the attitude component items it was in the range of 0.682–8.99 and for the practice component items it ranged from 0.659–0.981. The ICC, 95% CI, F test and p-value results for knowledge, attitude and practice items are shown in Table 4.1, Table 4.2, and Table 4.4, respectively. The Cronbach's alpha coefficient was computed to explore the internal consistency of the knowledge, attitude and practice items. The overall Cronbach's alpha values for knowledge, attitude and practice were.0.702, 0.776 and 0.752, respectively which indicated that the knowledge, attitude and practice items in the questionnaire were reliable. Reliability was further explored by correlating the individual

scores of attitude and practice items with the overall scale score. The Cronbach's alpha score of theses scales would drop if any attitude item was deleted, which indicated all the items should be retained (Table 4.3).

Table 4.1: Test- retest reliability for knowledge items (n=30)

Knowledge Item	ICC	95% CI	F test	*P*-value
K1	0.79	(0.56 - 0.90)	4.86	<0.001
K2	0.69	(0.36 - 0.85)	3.30	<0.001
K3	0.90	(0.80 - 0.95)	10.60	<0.001
K4	0.62	(0.20 - 0.82)	2.64	<0.004
K5	0.68	(0.34 - 0.85)	3.20	<0.001
K6	0.90	(0.8 - 0.95)	10.60	<0.001
K7	0.81	(0.61 - 0.91)	5.48	<0.001
K8	0.75	(0.48 - 0.88)	2.64	<0.004
K9	0.72	(0.42 - 08)	3.67	<0.001
K10	0.72	(0.42 - 0.87)	3.67	<0.001
K11	0.77	(0.53 - 0.89)	4.48	<0.001
K12	0.84	(0.67 - 0.92)	6.54	<0.001
K13	0.68	(0.34 - 08)	3.21	<0.001
K14	0.69	(0.36 - 0.85)	3.32	<0.001
K15	0.80	(0.58 - 0.90)	5.01	<0.001
K16	0.60	(0.17- 0.81)	2.53	<0.007
K17	0.69	(0.36 - 0.85)	3.32	<0.001
K18	0.68	(0.34 - 0.85)	3.20	<0.001
K19	0.66	(0.29 - 0.84)	2.96	<0.002
K20	0.77	(0.53 - 0.89)	4.48	<0.001
K21	0.81	(0.61 - 0.91)	5.41	<0.001
K22	0.74	(0.46 - 87)	3.94	<0.001
K23	0.69	(0.36 - 0.85)	3.32	<0.001
K24	0.74	(0.47 - 0.88)	3.96	<0.001
K25	0.72	(0.42 - 0.87)	3.67	<0.001
K26	0.78	(0.55 - 0.89)	4.72	<0.001
K27	0.81	(0.61 - 0.91)	5.41	<0.001
K28	0.66	(0. 29 - 0.84)	2.98	<0.002
K29	0.73	(0. 45 - 0.87)	3.82	<0.000
K30	0.74	(0.46 - 0.87)	3.90	<0.001
K31	0.87	(0.74 - 0.94)	8.23	<0.001

Table 4.1: Test- retest reliability for knowledge items (n=30) (continued)

Knowledge Item	ICC	95% CI	F test	*P*-value
K32	0.73	(0.44 - 0.87)	3.76	<0.001
K33	0.75	(0.49 - 0.88)	4.13	<0.001
K34	0.88	(0.88 - 0.94)	9.00	<0.001
K35	0.80	(0.59 - 0.90)	5.13	<0.001
K36	0.81	(0.61 - 0.91)	5.41	<0.001

K37	0.86	(0.70 - 0.93)	7.15	<0.001
K38	0.85	(0.70 - 0.93)	7.06	<0.001
K39	0.85	(0.70 - 0.93)	7.00	<0.001
K40	0.89	(0.76 - 0.94)	9.05	<0.001
K41	0.73	(0.43 - 0.87)	3.72	<0.001
K42	0.66	(0.28 - 0.83)	2.95	<0.002
K43	0.67	(0.31- 0.84)	3.06	<0.002
K44	0. 86	(0.70 - 0.93)	7.21	<0.001
K45	0.77	(0.52 - 0.89)	4.37	<0.001
K46	0. 89	(0.77 - 0.95)	9.52	<0.001
K47	0.84	(0.67 - 0.92)	6.36	<0.001
K48	0.81	(0.60 - 0.90)	5.25	<0.001
K49	0.76	(0.50 - 0.88)	4.22	<0.001
K50	0.91	(0.82 - 0.96)	11.84	<0.001
K51	0.75	(0.49 - 0.88)	4.12	<0.001
K52	0.80	(0.59 - 0.90)	5.23	<0.001
K52	0.80	(0.59 - 0.90)	5.23	<0.001
K53	0.87	(0.74 - 0.94)	8.12	<0.001
K54	0.88	(0.76 - 0.94)	8.84	<0.001
K55	0.93	(0.86 - 0.96)	15.52	<0.001
K56	0.89	(0.78 - 0.95)	9.81	<0.001
K57	0.72	(0.42 - 0.87)	3.64	<0.001
K58	0.96	(0.92 - 0.98)	27.96	<0.001
K59	0.80	(0.59 - 0.90)	5.16	<0.001
K60	0.78	(0.54 - 0.89)	4.62	<0.001
K61	0. 84	(0.67 - 0.92)	6.39	<0.001
K62	0.69	(0.35 - 0.85)	3.24	<0.001
K63	0.82	(0.63 - 0.91)	5.82	<0.001
K64	0.85	(0.68 - 0.92)	6.67	<0.001
K65	0.63	(0.22 - 0.82)	2.70	<0.005
K66	0.85	(0.68 - 0.92)	6.67	<0.001
K67	0.82	(0.62 - 0.91)	5.65	<0.001
K68	0.78	(0.55 - 0.89)	4.72	<0.001
K69	0.77	(0.52-0.89)	4.43	<0.001
K70	0.73	(0.45-0.87)	3.82	<0.000
K71	0.68	(0.34 - 0.85)	3.20	<0.001
K72	0.94	(0.8 - 0.97)	17.33	<0.001
K73	0.76	(0.50 - 0.88)	4.20	<0.001
K74	0.89	(0.77 - 0.94)	9.39	<0.001
K75	0.92	(0.83 - 0.96)	13.02	<0.001
K76	0.75	(0.47- 0.88)	4.00	<0.001
K77	0.96	(0.92 - 0.98)	27.96	<0.001

Tabl 4.1: Test- retest reliability for knowledge items (n=30) (continued)

Knowledge Item	**ICC**	**95% CI**	**F test**	***P*-value**
K78	0.80	(0.59 - 0.90)	5.13	<0.001
K79	0.65	(0.26 - 0.83)	2.86	<0.003
K80	0.86	(0.72 - 0.93)	7.50	<0.001
K81	0.75	(0.48 - 0.88)	4.06	<0.001

K82	0.92	(0.83 - 0.96)	12.59	<0.001

K = knowldeg

Table 4.2: Test-rest reliability for attitude items (n=30)

Attitude items	ICC	95% CI	F test	*P*-value
A 1	0.88	(0.75 - 0.95)	8.64	<0.001
A 2	0.88	(0.75 - 0.95)	8.73	<0.001
A 3	0.77	(0.531 - 0.89)	4.48	<0.001
A 4	0.69	(0.35 - 0.85)	3.24	<0.001
A 5	0.89	(0.78 - 0.95)	9.89	<0.001
A 6	0.71	(0.40 - 0.86)	3.55	<0.001
A7	0.68	(0.33 - 0.84)	3.16	<0.001
A 8	0.80	(0.5 - 0.90)	5.04	<0.001

A=Attitude

Table 4.3: Knowledge, Attitude and Practice items-reliability (n=384)

Variable	Overall Cronbach's alpha	Number of items
Knowledge	0.702	80
Attitude	0.766	8
Practice	0.752	22

Table 4.4: Test-rest reliability for practice items (n=30)

Practice Item	ICC	95% CI	F test	*P*-value
1	0.98	(0.96 - 99)	52.03	<.001
2	0.85	(0.69 - 0.93)	6.84	<.001
3	0.97	(0.95 - 0.99)	46.51	<.001

4	0.80	(0.59 - 0.90)	5.23	<.001
5	0.96	(0.93 - 0.98)	29.92	<.001
6	0.89	(0.78 - 0.95)	9.69	<.001
7	0.82	(0.62 - 0.91)	5.55	<.001
8	0.96	(0.93 - 0.98)	30.78	<.001
9	0.67	(0.32 - 0.84)	3.10	<.002
10	0.84	(0.66 - 0.92)	6.31	<.001
11	0.97	(0.95 - 0.98)	44.86	<.001
12	0.92	(0.84 - 0.96)	13.13	<.001
13	0.83	(0.65 - 0.92)	6.09	<.001
14	0.82	(0.62 - 0.91)	5.67	<.001
15	0.93	(0.85 - 0.96)	14.33	<.001
16	0.65	(0.28 - 0.87)	2.92	<.003
17	0.98	(0.96 - 0.99)	52.03	<.001
18	0.90	(0.80 - 0.95)	10.73	<.001
19	0.94	(0.87 - 0.97)	16.71	<.001
20	0.65	(0.28 - 0.38)	2.92	<.003
21	0.88	(0.76 - 0.94)	8.92	<.001
22	0.91	(0.82 - 0.96)	11.75	<.001

4.1.3 Factor analysis

4.1.3.1 Exploratory factor analysis on the knowledge components

In order to determine the structure and construct validity of the knowledge portion of the KAP questionnaire, the 82 knowledge items were subjected to principle component analysis (PCA) with varimax rotation and Kaiser Normalization as a method of exploratory factor analysis (EFA). Several well-known criteria for the factorability of a correlation were used. First, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.85, which was above the suggested value of 0.6, and Bartlett's test of sphericity was significant (χ^2 = 21400.87), ($p < 0.05$). Also, the diagonals of the anti-image correlation matrix were all over 0.5, supporting the inclusion of each item in the factor analysis. Furthermore, initial communalities are estimates of the variance in each variable accounted for by all components and small values (< 0.3) indicate that the variables do not fit well with the factor solution. In the current study, all the initial communalities were above the threshold.

Originally, there were 12 knowledge components in the questionnaire. However, the PCA revealed the presence of 11 knowledge components as two of the original components were merged together (components 5 and 11). The eigenvalues exceeded 1 for all components. Table 4.5 shows the new components structure. The first component included four items about the causes and infectivity of TB and explained 3.38% of the variance. The second component contained six items regarding TB transmission and explained 4.33% of the variance. The third component consisted of 11 items on TB risk factors and explained 7.48% of the variance. In the fourth component, which explained 4.70% of the variance, there were eight items about the clinical features of TB. The fifth component included seven items, four items regarding the sites of the body that are commonly affected by TB and three items about the possible outcomes of an incomplete treatment course, and explained 3.61% of the variance. The sixth component was comprised of two items about TB diagnostic tests and explained 2.80% of the variance.

Furthermore, the seventh component was formed by four items regarding the tuberculin skin test and explained 4.44% of the variance. The eighth component was comprised of four items on the Interferon-Gamma Release Assay (IGRA) test and explained 3.91% of the variance. The ninth and largest component contained 24 items about TB drugs and this component explained 15.04% of the variance. The tenth component consisted of three items about multidrug-resistant TB and explained 3.13% of the variance. The eleventh and last component, which consisted of six items about TB preventive measures, explained 4.52% of the variance. Thus, altogether, the 11 components explained 59% of the variance. After varimax rotation, the loading factors for all the extracted components were above 0.4, except for two items (69 and 73), which were below 0.4. In addition, cross-loadings occurred among

these two items. First, item 69 originally belonged to the component on drugs delivery and the treatment of TB, whereas after rotation it was included in the component on the risk factors of TB. Second, item 73 was initially in the component about the tests used in multidrug-resistant TB, whereas after varimax rotation it loaded into an independent and non-relative component. In light of the cross-loadings and loading factor values of less than 0.4, the researcher decided to delete them.

Table: 4.5: Factor loadings based on principal component analysis with varimax rotation for 82 knowledge items

Knowledge Items	Components		
	C1	C2	C3
KN1	0.83		
KN3	0.81		
KN2	0.69		
KN4	0.42		
KN7		0.68	
KN10		0.65	
KN9		0.58	
KN5		0.58	
KN6		0.57	
KN8		0.56	
KN14			0.74
KN21			0.72
KN12			0.72
KN17			0.70
KN19			0.68
KN20			0.66
KN15			0.65
KN16			0.64
KN13			0.57
KN18			0.57
KN11			0.54
KN69			0.35
Eigenvalues	2.77	3.55	6.13
% of Variance	3.38%	4.33%	7.48%

Table 4.5: Factor loadings based on principal component analysis with varimax rotation for 82 knowledge items (continued)

	Components

Knowledge Items	C4	C5	C6	C7
KN28	0.69			
KN27	0.69			
KN26	0.68			
KN29	0.66			
KN24	0.66			
KN25	0.60			
KN22	0.56			
KN23	0.56			
KN33		0.62		
KN74		0.59		
KN32		0.59		
KN76		0.59		
KN30		0.53		
KN31		0.51		
KN75		0.50		
KN35			0.67	
KN34			0.61	
KN38				0.79
KN39				0.74
KN36				0.74
KN40				0.62
KN37				0.62
KN73				0.33
Eigenvalues	3.85	2.96	2.30	3.64
% of Variance	4.70%	3.61%	2.80 %	4.44%

k=knowledge, C= component, refer to appendix A for knowledge items & components details, (Accepted loading factor>0.4)

,

Table 4.5: Factor loadings based on principal component analysis with varimax rotation for 82 knowledge items (continued)

Knowledge Items	Components

	C 8	C9
KN41	0.80	
KN43	0.76	
KN42	0.63	
KN44	0.53	
KN49		0.84
KN47		0.78
KN50		0.76
KN48		0.74
KN55		0.70
KN59		0.69
KN63		0.68
KN54		0.68
KN58		0.66
KN66		0.64
KN60		0.64
KN57		0.61
KN67		0.60
KN61		0.60
KN64		0.58
KN51		0.58
KN45		0.57
KN52		0.57
KN53		0.56
KN46		0.54
KN62		0.54
KN65		0.52
KN56		0.51
KN68		0.50
Kn69		0.38
Eigenvalues	3.20	12.34
% of Variance	3.91%	15.04%

k=knowledge, C= component, refer to appendix A for knowledge items & components details, (Accepted loading factor>0.4)

Table 4.5: Factor loadings based on principal component analysis with varimax rotation for 82 knowledge items (continued)

Knowledge Items	Components	
	C10	C11

KN72	0.76	
KN70	0.76	
KN71	0.70	
KN73	0.38	
KN80		0.89
KN79		0.82
KN81		0.77
KN77		0.73
KN82		0.66
KN78		0.55
Eigenvalues	2.56	3.71
% of Variance	3.13%	4.52%
Total Variance Explained =59.79%		

k=knowledge, C= component, refer to appendix A for knowledge items & components details, (Accepted loading factor>0.4)

4.1.3.2 Exploratory factor analysis on attitude components

Principle component analysis (PCA) with Varimax rotation with Kaiser Normalization was applied as method of exploratory factor analysis to determine the structure and construct validity among 8 items related to attitude of nurses toward tuberculosis. Several well-known criteria for the factorability of a correlation were used. Firstly, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.77, above the suggested value of 0.6, and Bartlett's test of sphericity was significant ($\chi^2 = 713.73$), $p < 0.05$). The diagonals of the anti-image correlation matrix were all over 0.5, supporting the inclusion of each item in the factor analysis. Initial communalities are estimates of the variance in each variable accounted for by all components and small values (<0.3) indicate variables that do not fit well with the factor solution. In the current study, all initial communalities were above the threshold.

The results of factor analysis on two extracted components revealed that the eigenvalues were greater than 1. The eigenvalues and total variance explained by two components are shown in Table 4.6. The results after Varimax rotation showed that the first component which

included four items related to phobia of tuberculosis which explained 29.26 % of the variance and the second component which included four items to social stigma which explained 27.20% of the variance. All loading factors were above 0.4. However, the total variance explained by the two components was 56.46 %. The interpretation of the two components was consistent with previous attitude components in KAP questionnaire.

Table 4.6: Factor loadings based PCA with varimax rotation for 8 items related to attitude among nurses toward tuberculosis

Attitude items	Attitude Components	
	Phobia of TB	**Stigma of TB**
I wouldn't feel comfortable about being near to a tuberculosis patient	0.84	
I wouldn't want to be in prolonged contact with TB patient for safety	0.81	
If I had TB, it would be a problem to find a marriage partner	0.70	
I would leave my job if I got TB	0.60	
If I found out that I had TB, I would feel ashamed and embarrassed		0.75
If I had TB, others would think less of my family		0.73
I am worried that others might laugh at me if I got		0.68
I would hide my TB if I got it		0.64
Eigenvalues	2.34	2.17
% of Variance	29.26 %	27.20 %
Total variance explained = 56.46 %		

(Accepted loading factor>0.4)

4.1.3.3 Exploratory factor analysis on practice components

Principle component analysis with varimax rotation with Kaiser Normalization was applied as method of exploratory factor analysis (EFA) to determine the structure and construct validity among the items related to the practice of nurses in tuberculosis centres. Several well-known criteria for the factorability of a correlation were used. First, the KMO measure of sampling adequacy was 0.71, which was above the suggested value of 0.6, and Bartlett's test of sphericity was significant ($\chi^2 = 2673.32$, $p < 0.05$). Also, the diagonals of the anti-

image correlation matrix were all over 0.5, supporting the inclusion of each item in the factor analysis. Initial communalities are estimates of the variance in each variable accounted for by all the components and small values (< 0.3) indicate which of the variables do not fit well with the factor solution. In the current study, all the initial communalities were above the threshold.

The PCA revealed the presence of six components (Table 4.10). The eigenvalues for all the components exceeded 1, except for the sixth component whose eigenvalue was 1. The eigenvalues and total variance explained by the six components are shown in Table 4.7. The results after varimax rotation showed that the first component, which included four items regarding the admission protocol for TB patients in words, explained 12.77 % of the variance. The second component contained five items related to TB infection control measures and explained 12.69 % of the variance.

The third component included five items related to respiratory hygiene and collection of sputum and explained 12.10 % of the variance. Component four, which explained 8.956% of the total variance, contained four items related to TB treatment and drug delivery. In the fifth component, there were three items related to patient education about TB and this component explained 8.467% of the variance. The sixth and last component contained one item related to the collection of sputum samples and explained 2.93 % of the variance. Thus, together, the six components explained a 54.99 % of the variance. All the loading factors were above 0.4. However, item number 15, which had an eigenvalue of 1 (Table 4.7), was deleted because it became single in component 16 with a non-significant loading of 0.365.

Table 4.7: Factor loadings based on principal component analysis with varimax rotation for 22 items toward practice of nurses

Items	Practice Components					
	C1	C2	C3	C4	C5	C6
P 2	0.83					
P 1	0.78					
P 4	0.75					
P 3	0.65					
P 5		0.84				
P 9		0.83				
P 6		0.70				
P 8		0.65				
P 7		0.55				
P 10			0.87			
P 13			0.77			
P 12			0.68			
P 14			0.64			
P 16				0.71		
P 18				0.70		
P 17				0.58		
P 19				0.51		
P 20					0.82	
P 21					0.77	
P 22					0.55	
P15						0.36
Eigenvalues	2.81	2.79	2.63	1.97	1.86	1
% of Variance	12.77	12.69	11.10	8.95	8.46	2.93
Total Variance Explained =54.99 %						

P=practice, C = component, refer to appendix A for practice items & components details, (Accepted loading factor>0.4)

4.1.4 Conclusion

The results of exploratory factor analysis revealed that 109 (97.3%) out of the 112 items were acceptable. After Varimax rotation, the interpretation of the components was consistent with previous components in TB- KAP questionnaire except in knowledge, were two of the previous components merged together. However, there were only three items deleted: two items from knowledge components and one item from practice components. Table 4.8 shows the details of deleted items. The questionnaire on TB knowledge, attitude, and practice was

valid and reliable with good items that enable its use for assessing TB –KAP survey among the TB nurses.

Table 4.8: Deleted items based on exploratory factor analysis

Item	Its Number and Original Component in the Questionnaire	Reasons of Deletion
Patients do not need to continue medical treatment when the symptoms of tuberculosis subside or when they feel better.	(69) knowledge component 9 about drugs and treatment of TB	• Low loading <0.4 • Cross-loading into non relative and independent component
Renal function test.	(73) knowledge component 10 about tests used in monitoring of MDR-TB	• Low loading <0.4 • Cross-loading into non-relative and independent component
I help the patients to collect sputum when they cannot produce sputum.	(15) practice component 3 toward respiratory hygiene and collecting sputum sample	• Low loading <0.4 • Single item

4.2 Phase 2: Knowledge, attitude and practice towards tuberculosis

4.2.1 Demographic characteristics

Table 4.9 shows the demographic characteristics of the study population. In the sample 84 (21.9%) were male nurses and 300 (78.1%) were female nurses; 75 (19.5%) aged from18-25 years; 246 (64.1%) aged from 26-40 years and 63 (16.4%) aged more than 40 years. Amongst them, 136 (35.4%) had Bachelor's degree of nursing; 161 (41.9%) had Diploma of

nursing and 87 (22.7%) had training course certificate. Regarding residence, 176 (45.8 %) of total nurses were from urban areas while 206 (53.6%) were from rural areas. However, 48 (12.5%) had working period less than 1 year; 242 (63%) had working period ranged from 1year to 5 years and 84 (24.4%) of total respondents had working experience more than 5years years.

Table 4.9: Demographic characteristics of participants (n=384)

Demographic Variable	n (%)
Gender	
Male	84 (21.9%)
Female	300 (78.1%)
Age	
18 - 25 years	75 (19.5%)
26 - 40 years	246 (64.1%)
> 40 years	63 (16.4%)
Educational Level	
Training course certificate	87 (22.7%)
Diploma of nursing	161 (41.9%)
Bachelor of nursing	136 (35.4%)
Residence	
Urban	176 (45.8%)
Rural	206 (53.6%)
Work experience	
< 1 year	48 (12.5%)
1 -5 years	242 (63.0%)
> 5 years	94 (24.4%)

4.2.2 Participants' source on information about tuberculosis

Figure 4.1 shows the sources of information about TB among the participants. The results revealed that the most sources of information about TB were mostly from health professional (27%), hospitals (22 %), internet (17.7%), family (17.4%), journal (7.6%), and television (6.8%).

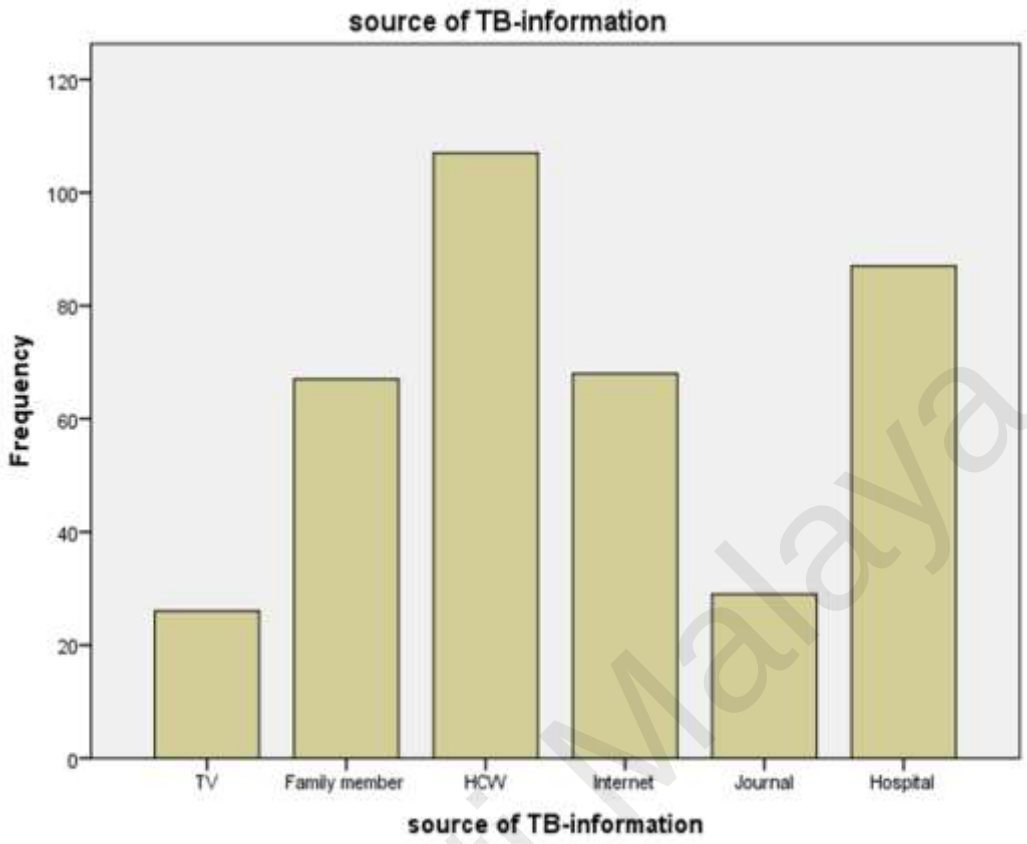


Figure 4.1: Source of information about tuberculosis among the participants

4.2.3 Normality test for data in knowledge, attitude and practice

The research variables in the KAP survey were assessed to determine the normality of their distribution. A number of methods can be used to check for any actual deviation from normality. One method involves the use of skewness and kurtosis. In this method, the values for skewness and kurtosis should not be significant if the observed distribution is exactly normal. Variable with statistically significant skewness and kurtosis often does not deviate enough from normality to make a difference in the analysis. Although this method is more applicable to small sample sizes, it was necessary to check the absolute values of skewness

and kurtosis. For normality assumption, the skewness and kurtosis statistics should be within in the range from -1.96 to +1.96 (Mallery & George, 2003). In this study, the skewness and kurtosis for the knowledge were ranged as (-.160 to 2.42) and (0.402 to3.66), respectively. However, the skewness and kurtosis for attitude were ranged as (0.43 to 0.95) and (-.35 to 0.41), respectively.

Moreover, the skewness and kurtosis for practice were ranged as (0.251 to 1.09) and (-.68 to 0.80), respectively. The Kolmogorov-Smirnov and Shapiro-Wilk tests are also very sensitive to sample size, particularly large data sets (Mallery & George, 2003). However, both the Kolmogorov-Smirnov and Shapiro-Wilk tests of normality were applied. The results revealed that there was violation of the assumption of normality as the significance values were 0.000. Therefore, a box plot was used to graphically represent and detect the extreme values and outliers in the data. The result revealed that non critical outliers or extreme values in the data were detected in the box plot.

4.2.4 Knowledge of nurses about tuberculosis

Out of 435 distributed questionnaires, 392 of them were returned, which represents a response rate of 90%. However, a further eight questionnaires were found to be incomplete and were therefore excluded. Therefore, 384 questionnaires were included in analysis.

According to previous studies (Barua, 2013; White, 2011), the 50% of the total score (40) was used as cut-off point to categorize the total knowledge levels as either low or high. Participants who gained a score equal or higher than the cut-off point of the total score were classified as having high knowledge, whereas those who were received a score less than the

cut-off point were classified as having low knowledge. However, the scores for each knowledge component were summed and the cut-off point for each component was used to categorize the knowledge levels as either low or high.

Based on the results, out of the 384 nurses who participated in the study, 327 (85%.2) of them had a low total knowledge level compared to 57(14.8%) of them had a high total knowledge on TB (Table 4.10). With the exception of knowledge on the causes and infectivity of TB (component 1) and preventive measures of TB (component 11), a clear knowledge gap was found among the nurses in regards to the remaining nine components (Table 4. 10). Table 4.11 shows the responses (incorrect, correct and do not know) of the nurses about their knowledge on TB.

With respect to knowledge on the causes and infectivity of TB (component 1), out of 384 nurses, 337 (87.8%) of them had a high level of knowledge, while, 47 (12.2%) only had a low knowledge level. A total of 356 (92.7%) participants correctly stated that bacteria is the cause of TB; 348 (90.6%) considered TB to be a serious disease; 202 (52.6%) demonstrated the knowledge that people may become infected with TB more than once their life; and 337 (87.8%) indicated that TB is a contagious and propagated disease.

The results also showed that, out of the 384 nurses, 301 (78.4%) of them had a low level of knowledge on the transmission of TB (component 2) compared to 83(21.6%) of them had a high knowledge level. Out of the total sample, 148 (38.5%) correctly stated that shaking of hands is not a method of TB transmission. However, 265 (69%) demonstrated that they thought TB could be transmitted through the air when a person with TB coughs. As regards

some of the other points of view on transmission, 99 (25.8%) of the participants said that drinking unpasteurized and non-sterile cow's milk is one of the possible methods of TB transmission. Only 94 (24.5%) of the participants stated that sharing the same plate as a TB-infected person during eating or the same cup during drinking was an unusual method of TB transmission, while 119 (31%) correctly stated that TB cannot be transmitted through touching items in public places. However, only 81 (21.1%) of the participants stated correctly that TB is a sexually transmitted disease.

As regards knowledge on the risk factors of TB (component 3), 273 (71.1%) of the 384 participants had a low level of knowledge while, 111(28.9%) of them showed high level of knowledge. Only 107 (27.9%) of the nurses correctly stated that people with HIV/AIDS are at high risk of TB. Also, just 130 (33.9%) of the participants demonstrated that they knew that people with poor nutritional state are more vulnerable to TB, while 250 (65.1%) indicated that people living in crowding areas are more susceptible to infection by TB. Among the other opinions expressed, 187 (48.7%) of the participants stated correctly that homeless persons are at high risk of acquiring TB. Also, 138 (35.9%) of the nurses knew that long-term hospital patients also have a chance of contracting TB. Furthermore, 244 (63.5%) of the 384 participants demonstrated that healthcare workers are vulnerable to TB and 144 (37.5%) stated correctly that prison inmates are at high risk of TB infection. Moreover, 144 (37.5%) of the total sample knew that children under five years of age are at risk of TB; 118 (30.7%) stated that farmers are susceptible to TB; and 255 (58.6%) demonstrated that family members are at high risk if one of the family becomes infected. In addition, persons with occupational lung disease are also susceptible to TB, and this was stated correctly by 174 (45.3%) of the participants.

The results also show that, out of 384 participants, 183 (47.7%) of them having low knowledge on clinical features of TB (component 4) while, 201 (52.3%) of the total participants had a high level of knowledge. However, 275 (71.6) of the total number of participants correctly indicated that coughing up blood is a clinical symptom of TB. Moreover, 318 (82.8%) correctly stated that coughing for over two weeks is a prominent feature of TB. As for the presence of fever, 238 (62%) of the nurses demonstrated that a fever of two weeks duration is one of the clinical signs of TB.

Regarding loss of appetite, 191 (49.7%) of the participants indicated this is one of the symptoms of TB, while 169 (44%) of the participants stated correctly stated that night sweats are also a feature of TB. Furthermore, the results revealed that 244 (63.5%) of the participants considered that chest pain and shortness of breath are complaints raised by TB patients. Also, 169 (44%) of the nurses indicated that TB patients may suffer from fatigability during the illness and 136 (35.4%) of the total sample stated that weight loss is a sign of TB.

In addition, it was found that, out of the 384 participants, 259 (67.4%) had a low level of knowledge and 125 (32.6.%) had a high knowledge level regarding the common sites of the body other than the lungs that could be affected by TB and the possible outcomes of an incomplete course of treatment (component 5). However, 86 (22.4%) of the total number of participants stated correctly that the lymph node is one the common sites affected by TB. Moreover, 108 (28.1%), 80 (20.8%) and 137 (35.7%) of the participants stated correctly that the kidney, brain and spinal cord are the target organs of TB, respectively.

Regarding the potential outcomes of an incomplete treatment course, 283 (73.7%) of the participants were of the opinion that a worsening of symptoms and prolonged treatment are two of the probable outcomes of an incomplete treatment course, while only 135 (35.2%) of the participants indicated that they knew that drug resistance could be one of the outcomes if treatment was not completed. However, 307 (79.7%) of the participants stated correctly that death is probable fade among patients who fail to complete a course of treatment for TB.

As regards the diagnosis of TB, based on the results, out of the 384 nurses who took part in the study, 260 (67.7%) of them had a high level of knowledge, while 124(32.3%) of them had a low level of knowledge on the diagnosis TB (component 6). Furthermore, 332 (86.51%) stated correctly that sputum smear microscopy and culture is the gold standard for TB diagnosis while 262 (68.2%) indicated that a chest x-ray is a helpful test for the diagnosis of pulmonary TB.

However, the results revealed that 339 (88.3%) of the participants had a low level of knowledge and compared to only 45 (11.7%) of them had a high knowledge level on the interpretation of a positive tuberculin skin test of >5-mm induration (component 7). Nevertheless, just 58 (15.1%) out of 384 participants stated correctly that this result could appear among patients with HIV.

Moreover, only 82 (21.4%) of the participants demonstrated that they knew that this reading is highly probable in people who have close contact with an infected person. Moreover, only 51 (13.3%) out of the total sample recognized that people with a chest x-ray finding for TB disease may also show this reading and only 53 (13.8%) of the participants mentioned that there is a high probability of this induration among people with organ transplants. However,

79 (20.6%) of the nurses stated correctly that immunosuppressed patients may also have a positive induration.

The results also showed that, out of the total number of participants, 302 (78.6%) had a low level of knowledge while, only 82 (21.4%) of them had a high knowledge level on the advantages of using the IGRA test (component 8) compared to tuberculin skin test. Only 80 (20.8%) of the participants stated that one of the advantages of the IGRA test is that the result can be available within 24 hours.

In addition, just 96 (25%) of the participants recognized that one of the preferred characteristics of this test is that it does not cause a booster phenomenon. Furthermore, out of all 384 participants, only 106 (27.6%) indicated that the IGRA test has a lower probability of an incorrect reading compared to the TST. However, 189 (49.2%) of the participants did recognize that the BCG vaccine does not affect the results.

With respect to knowledge about TB drugs and treatment approaches (component 9), the study outcome showed that, out of a total of 384 participants, 353 (91.9%) of them had a low level of knowledge regarding TB treatments and the delivering of TB drugs compared to only 31(8.1%) of the participant had a high level of knowledge. Regarding the DOTS programme, only 70 (18.2%) of the participants demonstrated that they knew that the DOTS regimen is the recommended treatment for newly active TB. However, 45 (11.7%) of the participants correctly stated that the standard length of treatment for a newly diagnosed case of TB is ≥ 6 months. In addition, 60 (15.6%) of the participants indicated that the DOTS strategy refers to the observation of the patient by an educated person during the course of treatment.

The results also revealed that 80 (20.8%) of the participants knew the isoniazid, rifampin, pyrazinamide and ethambutol are first-line drugs for the treatment of TB, while 92 (24%) stated that prednol, teofilin, ephedrine and isoniazid are a second-line drug combination that can be used to treat TB. Regarding knowledge on the use of ethambutol, 48 (12.2%) and 34 (8.9%) of the participants knew that ethambutol can cause hepatotoxicity and blindness, respectively. However, 32 (8.3%) of the nurses recognized the ethambutol can be taken after meals because it does not interact with foods and 52 (13.5%) of the participants indicated that ethambutol can be used for TB prophylaxis in patients who are at risk.

With respect to their knowledge on amikacin, only 38 (9.9%) of the participants indicated that hearing ototoxicity is a side effect of amikacin. As for the use of streptomycin, 53 (13.8%) of the nurses said that streptomycin should be administered through an intramuscular route and 70 (18.2%) of the participants recognized that dizziness, vertigo, tinnitus, disequilibrium and loss of hearing can be among the side effects of streptomycin.

Regarding knowledge on rifampin, only 92 (24%) out of the total of 384 nurses knew that women using contraceptive pills should be informed that rifampin might decrease the effects of oral hormone-based contraceptives. Moreover, just 44 (11.5%) of the participants indicated that patients using rifampin should be monitored for signs and symptoms of anaemia and thrombocytopenia.

In addition, just 62 (16.1%) of the participants correctly stated that, if a patient has nausea and vomiting during treatment, the oral form of rifampin cannot be given in divided doses at

different times in a day and only 83 (21.6%) of total participants indicated the blood sugar level should be monitored in diabetic patients during administration of rifampin.

With respect to knowledge on isoniazid, 78 (20.3%) of the 384 participants demonstrated that they knew that isoniazid is less effective when used with antacids containing aluminium hydroxide. Moreover, 54 (14.1%) of participants stated that they should explain to breast-feeding mothers that they should avoid breast-feeding during isoniazid administration.

The results also showed that only 51 (13.3%) of the participants recognized that multidrug-resistant tuberculosis (MDR-TB) is caused mainly by an organism that is resistant to both isoniazid and rifampicin. However, 78 (20.3%) of the participants said that the main reason for multidrug resistance during TB therapy is not the use of drug combinations and 114 (29.7%) of the participants indicated that the presence of acid-fast bacillus in the sputum samples of patients during the fifth month of medical treatment indicates multidrug resistance.

Furthermore, it was found that only 57 (14.8%) of the participants were correctly stated that anti-TB treatment should not be terminated in patients receiving haemodialysis. In addition, 96 (25%) of the participants stated correctly that, if the patient did not consume an anti-TB drug dose daily, the nurse should not double the dose the next day. Moreover, out of a total of 384 participants, only 59 (15.4%) of them answered correctly that patients with multidrug resistance should not continue therapy with the same treatment regimen drugs for an extra 1 month.

The results further revealed that, out of the 384 participants, 330 (85.9%) of them had a low level of knowledge compared to 54(14.1%) had a high knowledge level about the tests used in the monitoring of MDR-TB treatment (component 10). Out of the total sample, 58 (15.1%) indicated that the sputum smear and culture is one of the investigations used in monitoring MDR-TB treatment; 87 (22.7%) correctly stated that resistance to TB drugs can be monitored by the liver function test; and 57 (14.8%) said that the chest x-ray is one of the clinical methods that can be used to monitor MDR-TB.

Moreover, the results also showed that, out of total 384 participants, 359 (93.5%) of them had a high level of knowledge on the preventive measures for TB (component11) compared to only 25(6.5%) of them had a low knowledge level. Moreover, 368 (95.8%) of the participants indicated that one way of protecting against TB is minimizing direct contact with an infected person, while 243 (63.3%) said that a healthy diet and physical activities are measures that can decrease the chance of TB infection; 361 (94%) recognized that avoiding of substance abuse and wearing a protective face mask can minimize the rate of TB infection; 347 (90.4%) stated that living in well-ventilated residences lowers the chance of acquiring TB; and 339 (88.3%) knew that vaccination.

Table 4.10: Levels of knowledge on tuberculosis among the participants (n=384)

No	Knowledge Components	Levels of knowledge		
		Mean ± SD	**Low level** n (%)	**High level** n (%)
	Total knowledge score	30.95±13.84	327(85.2%)	57(14.8%)
1	TB-causes and infectivity	3.23 ± 1.02	47(12.2%)	337(87.8%)
2	Mode of transmission	2.09 ±1.94	301(78.4%)	83(21.6%)
3	Risk factors for TB	4.71 ±3.70	273(71.1%)	111(28.9%)
4	Clinical features of TB	4.53 ±2.52	183(47. %7%)	201(52.3%)
5	Common organs of the body affected by TB	2.95 ±1.99	259(67.4%)	125(32.6%)

6	Diagnostic tests of TB	1.54 ±.71	124(32.3%)	260(67.7%)
7	Interpretation of tuberculin skin test	.841 ±1.52	339(88.3%)	45(11.7%)
8	Advantages of Interferon-Gamma Release Assay	1.22 ±1.39	302(78.6%)	82(21.4%)
9	TB treatment and delivery of anti-TB drugs	4.01 ±5.80	353(91.9%)	31(8.1%)
10	Tests are used in monitoring of MDR treatment	0.52 ±.099	330(85.9%)	54(14.1%)
11	Prevention of TB infection	5.25 ± 1.24	25(6.5%)	359(93.5%)

Table 4.11: Frequency and proportion of responses for TB-knowledge of the nurses (n=384)

Knowledge variables	Incorrect n (%)	Correct n (%)	Don't know n (%)
Knowledge Component 1 (causes and infectivity of TB)			
1 The microbe that cause tuberculosis is a bacteria	10 (2.6%)	356 (92.7%)	18 (4.7%)
2 Tuberculosis is considered a serious disease	31 (8.1%)	348 (90.6%)	5 (1.3%)
3 Tuberculosis is a contagious can be spread from one to other	36 (9.4%)	337 (87.8%)	11 (2.9%)
4 The people may become infected with TB more than once in their lifetime	80 (20.8%)	202 (52.6%)	102 (26.6%)

Table 4.11: Frequency and proportion of responses for TB-knowledge (continued)

Knowledge variables	Incorrect n (%)	Correct n (%)	Don't know n (%)
Knowledge Component 2 (method of TB – transmission)			
1 Through handshakes	146 (38%)	148 (38.5)	90 (23.4)
2 Through the air when a person with TB coughs	76 (19.8%)	265 (69%.0)	43 (11.2%)
3 Drinking unpasteurized and non-sterile Cow's milk	145 (37.8%)	99 (25.8%)	140 (36.5%)
4 Through sharing the TB-infected person the same plate during eating or the same cup during drinking	204 (53.1%)	94 (24.5%)	86 (22.4%)
5 Through touching items in public places (doorknobs, handles in transportation)	169 (44%)	119 (31%)	96 (25%)
6 Through sexual intercourse	216 (56.3%)	81 (21.1%)	87 (22.7%)
Knowledge Component 3 (risk factors of TB)			
1 person with HIV/AIDS	183 (47.7%)	107 (27.9%)	94 (24.5%)
2 Person with poor nutritional state	133 (34.6%)	130 (33.9%)	121 (31.5%)
3 Person who living in Crowding	80 (20.8%)	250 (65.1%)	54 (14.1%)
4 Homeless person	78 (20.3%)	187 (48.7%)	119 (31.0%)
5 Patient with Long hospital admission	118 (30.7%)	138 (35.9%)	128 (33.3%)

6	Health care workers	92 (24%)	244 (63.5%)	48 (12.5%)
7	Prison inmates	145 (37.8%)	144 (37.5%)	95 (24.7%)
8	Children under five- years	112 (29.2%)	93 (24.2)	179 (46.6)
9	Farmer	108 (28.1%)	118 (30.7%)	158 (41.1%)
10	Family members of a confirmed case	126 (32.8%)	225 (58.6%)	33 (8.6%)
11	Person with occupational lung disease	90 (23.4%)	174 (45.3%)	120 (31.3%)
Knowledge Component 4 (clinical features of TB)				
1	Cough up blood	11 (2.9%)	275 (71.6%)	98 (25.5%)
2	Coughing for over two weeks	49 (12.8%)	318 (82.8%)	17 (4.4%)
3	Fever for over two weeks	87 (22.7%)	238 (62%)	59 (15.4%)
4	Loss of appetite	67 (17.4%)	191 (49.7%)	126 (32.8%)
5	Night sweating	82 (21.4%)	169 (44%)	133 (34.6%)
6	Chest pain and shortness of breath	64 (16.7%)	244 (63.5%)	76 (19.8%)
7	Total weakness	67 (17.4%)	169 (44%)	148 (38.5) %
8	Weight loss	97 (25.3%)	136 (35.4%)	151 (39.3%)
Knowledge Component 5 (common sites other than lungs of body affected by TB)				
1	Lymph node	114 (29.7%)	86 (22.4%)	184 (47.9%)
2	Kidney	68 (17.7%)	108 (28.1%)	208 (54.2%)
3	Brain	118 (30.7%)	80 (20.8%)	186 (48.4%)
4	Spinal cord	22 (5.7%)	137 (35.7%)	225 (58.6%)
5	Worsening of symptoms and prolonged treatment course	17 (4.4%)	283 (73.7%)	84 (21.9%)
6	Development of drug-resistance	80 (20.8%)	135 (35.2%)	169 (44.0%)
7	Death	57 (14.8%)	307 (79.9%)	20 (5.2%)

Table 4.11 Frequency and proportion of responses for TB-knowledge (continued)

	Knowledge variables	Incorrect n (%)	Correct n (%)	Don't know n (%)
Knowledge Component 6 (diagnosis of TB)				
1	Sputum Smear Microscopy and Culture is the gold test for TB-diagnosis	22 (5.7%)	332 (86.5%)	30 (7.8%)
2	Chest X-ray is helpful test for diagnosis of pulmonary Tuberculosis	113 (29.4%)	262 (68. %2)	9 (2.3%)
Knowledge Component 7 (interpretation of TST)				
1	People living with HIV	72 (18.8%)	58 (15.1%)	254 (66.1%)
2	Recent close contacts of people with infectious TB	53 (13.8%)	82 (21.4%)	249 (64.8%)
3	People with chest x-ray findings of TB disease	104 (27.1%)	51 (13.3%)	229 (59.6%)
4	People with organ transplants	153 (39.8) %	53 (13.8%)	178 (46.4%)
5	Other immunosuppressed patients	65 (16.9%)	79 (20.6%)	240 (62.5%)
Knowledge Component 8 (advantages of Interferon-Gamma Release Assays (IGRA) test				
1	Results can be available in 24 hours	101 (26.3%)	80 (20.8%)	203 (52.9%)

2	Does not cause booster phenomenon	84 (21.9%)	96 (25%)	204 (53.1%)
3	Less likely to have incorrect reading of results as compared to TST	61 (15.9%)	106 (27.6%)	217 (56.5%)
4	BCG vaccination does not affect the results	19 (4.9%)	189 (49.2%)	176 (45.8%)
Knowledge Component 9 (TB - treatment and delivery of drugs)				
1	DOTS regimen is the recommended treatment of newly active TB	175 (45.6%)	70 (18.2%)	139 (36.2%)
2	The standard length of treatment for a newly diagnosed case of TB is ≥6 months	172 (44.8%)	45 (11.7%)	167 (43.5%)
3	Regarding treatment of TB, Hearing loss and ototoxicity is considered side effect of Amikacin	79 (20.6%)	38 (9.9%)	267 (69.5%)
4	Hepatotoxicity is considered side effect of Ethambutol	58 (15.1%)	48 (12.5%)	278 (72.4%)
5	Ethambutol can be taken after meals because it does not interact with foods	87 (22.7%)	32 (8.3%)	265 (69.0%)
6	The nurse should monitor patients consuming ethambutol for vision changes, blurring and color blindness	32 (8.3%)	34 (8.9%)	318 (82.8%)

Table 4.11: Frequency and proportion of responses for TB-knowledge (continued)

	Knowledge variables	Incorrect n (%)	Correct n (%)	Don't know n (%)
7	Dizziness, vertigo, tinnitus, disequilibrium and loss of hearing are among the side-effects of streptomycin	14 (3.6%)	70 (18.2%)	300 (78.1%)
8	Isoniazid, rifampin, pyrazinamide and ethambutol are first-line drugs used in TB- treatment	67 (17.4%)	80 (20.8%)	237 (61.7%)
9	Second-line drug combination used to treat tuberculosis includes prednol, teofilin, ephedrine and isoniazid	71 (18.5%)	92 (24%)	221 (57.6%)
10	Direct Observation Therapy Strategy refers to observation of the patient by an educated person while properly consuming all the doses of the drugs	162 (42.2%)	60 (15.6%)	162 (42.2%)

11	Ethambutol can be used for tuberculosis prophylaxis in patients who are at risk	108 (28.1%)	52 (13.5%)	224 (58.3%)
12	Presence of acid-fast bacillus in the sputum samples of patients during the fifth month of medical treatment indicates multi-drug resistance.	41 (10.7%)	114 (29.7%)	229 (59.6%)
13	If the patient did not consume anti-tuberculosis drug daily, the nurse can double the dose the next day	136 (35.4%)	96 (25%)	152 (39.6%)
14	The nurse should administer streptomycin through an intramuscular	119 (31%)	53 (13.8%)	212 (55.2%)
15	Multidrug resistant tuberculosis (MDR TB) is caused by an organism resistant to both isoniazid and rifampicin	80 (20.8%)	51 (13.3%)	253 (65.9%)
16	The main reason of multi-drug resistance during tuberculosis therapy is use of drug combinations	20 (5.2%)	78 (20.3%)	286 (74.5%)
17	Anti-tuberculosis treatment should be terminated in patients receiving hemodialysis	115 (29.9%)	57 (14.8%)	212 (55.2%)
18	The nurse should explain to women that rifampin might decrease the effects of oral hormone-based contraceptives	3 (0.8%)	92 (24%)	289 (75.3%)
19	Patients using rifampin should be monitored for signs and symptoms of anaemia and thrombocytopenia	140 (36.5%)	44 (11.5%)	200 (52.1%)

Table 4.11: Frequency and proportion of responses for TB-knowledge **(**continued)

	Knowledge variables	**Incorrect n (%)**	**Correct Answer n (%)**	**Don't know n (%)**
20	Diabetic patients on rifampin should be monitored for blood-urine glucose level during treatment course	18 (4.7%)	83 (21.6%)	283 (73.7%)
21	Isoniazid might be less effective when used with antacids containing aluminum hydroxide	112 (29.2%)	78 (20.3%)	194 (50.5%)
22	The nurse should explain to mothers of newborns to avoid breast-feeding the baby while on isoniazid therapy	181 (47.1%)	54 (14.1%)	149 (38.8%)
23	If the patient has nausea and vomiting during treatment, the oral form of rifampin can be given in divided doses at different times in a day.	71 (18.5%)	62 (16.1%)	251 (65.4%)

24	Patients with multi-drug resistance should continue therapy with the same treatment regimen drugs for extra one (1) month	162 (42.2%)	59 (15.4%)	163 (42.4%)
Knowledge Component 10 (monitoring of MDR-TB treatment)				
1	Sputum smear and culture	274 (71.4%)	58 (15.1%)	52 (13.5%)
2	Liver Function Test	54 (14.1%)	87 (22.7%)	243 (63.3%)
3	Chest X-Ray	266 (69.3%)	57 (14.8%)	61 (15. %9)
Knowledge Component 11 (preventive measures of TB)				
1	Minimizing direct contact of TB patient	9 (2.3%)	368 (95.8%)	7 (1.8%)
2	By taking a healthy diet and doing a lot of physical activities	81 (21.1%)	243 (63.3%)	60 (15.6%)
3	By avoiding alcohol and other drug abuse	7 (1.8%)	361 (94%	16 (4.2%)
4	By wearing face mask as Personal protective Equipment (PPE)	14 (3.6%)	361 (94%)	9 (2.3%)
5	By living in ventilated residences	22 (5.7%)	347 (90.4%)	15 (3.9%)
6	By vaccination against the disea**se**	28 (7.3%)	339 (88.3%)	17 (4.4%)

4.2.5 Attitude among nurses towards tuberculosis

Table 4.12 shows the levels of attitude among the nurses about TB. The mean total attitude score was calculated to ascertain the overall attitude level of each of the participants. Based on the previous studies; (Barua, 2013) and (White, 2011), the cut-off point was 24 as the minimum score was 8 and the maximum was 40. Hence, total score equal to or higher than cut-off point (≥ 24) were considered high while if it was lower than the cut-off point, the total level of attitude was considered low. Based on the results, the overall attitude level among the nurses was low as only 80 (20.8%) out of the 384 participants had positive level of attitude towards TB. However, 304 (79.2%) of the participants had negative attitude about TB.

Out of all the participants, 302 (78.6%) had phobia of TB (component 1) while, 82(21.4%) of them did not show this phobia. Table 4.13 shows the responses of nurses regarding attitude items; out of total participants, 239 (62.2 %) of the participants said that they are more likely

to feel uncomfortable about being near to a TB patient. Also, nearly half of the total participants stated that it would not be safe to be in prolonged contact with a TB patient. Furthermore, 69.3% of the participants mentioned that it would be a problem to find a marriage partner if they became infected with TB. Moreover, 85% of the nurses said that they would leave their job if they contracted TB.

In addition, it was found that 269 (70.1%) of the 384 participants considered TB as a social stigma and 115 (29.9%) of them did not consider TB as a social stigma (component 2). 44% stated that if they found out they had TB; they would feel ashamed and embarrassed. Also, around 65% of the participants said that, if they had TB, others would have a low opinion about their families. Moreover, 56.6% of the nurses were worried that people would laugh at them if they got TB, while 56% said that they would hide their TB if they contracted the disease. Thus, in conclusion, the majority of the participants in this study showed negative attitude towards TB; many of the nurses had a phobia about the disease, while others considered TB as a social stigma.

Table 4.12: Levels of attitude on tuberculosis of the participants (n=384)

Component		Negative attitude	Positive attitude
	Mean ±SD	**n (%)**	**n (%)**
Total attitude	2.44±0.57	0.579	80(20.8%)
Attitude component 1 (TB phobia)	2.35±.72	302(78.6%)	82(21.4 %)
Attitude component 2 (TB stigma)	2.54±.70	269(70.1%)	115(29.9)

Table 4.13: Frequency and proportion of responses for attitude of the nurses (n=384)

N	Attitude components	Strongly agree n %	Agree n (%)	Somewhat agree n (%)	Disagree n (%)	Strongly disagree n (%)

Component 1 (phobia of TB)						
1	I wouldn't feel comfortable about being near to a tuberculosis patient	52 (13.5)	187 (48.7)	71 (18.5)	67 (17.4)	7 (1.8)
2	I wouldn't want to be in prolonged contact with a tuberculosis patient for safety reasons	47 (12.2)	144 (37.5)	112 (29.2)	68 (17.7)	13 (3.4)
3	If I had TB, it would be a problem to find a marriage partner	46 (12.0)	220(57.3)	84 (21.9)	25 (6.5)	9 (2.3)
4	I would leave my job if I got TB	120(31.3)	171 (44.5)	54 (14.1)	33 (8.6)	6 (1.6)
Component 2 (stigma of TB)						
1	If I found out that I had TB, I would feel ashamed and embarrassed	34 (8.9)	135 (35.2)	123 (32.0)	73 (19.0)	19 (4.9)
2	If I had TB, others would think less of my family	66 (17.2)	184 (47.9)	69 (18.0)	59 (15.4)	6 (1.6)
3	I am worried that others and hospital staff might laugh at me if I got TB	39 (10.2)	178 (46.4)	96 (25.0)	66 (17.2)	5 (1.3)
4	I would hide my TB if I got it	45 (11.7)	170 (44.3)	94 (24.5)	70 (18.2)	4 (1.3)

4.2.6 Practices of nurses in relation to tuberculosis

Table 4.14 shows the levels of practice among the participants. Table 4.15 show the nurses' responses about the practices they performed in relation to TB on a performance scale ranging from never performs to sometimes perform and always performs. Based on the previous studies; (Barua, 2013) and (White, 2011), the total score equal to or higher than cut-off point (≥ 42) were considered satisfactory while if it was lower than the cut-off point, the total level of practice was unsatisfactory. The results revealed that the overall level of practice among TB nurses in Libya was unsatisfactory because, out of the 384 participants, 326 (84.9%) of them had unsatisfactory level of practice and 58(15.1%) of them had satisfactory of practice. Moreover, unsatisfactory level of practice was found for all the components of practice.

The results showed that, out of all 384 participants, 297 (77.3%) had unsatisfactory level of practice, while 87(22.7%) of them had satisfactory practice level regarding the admission process and services for TB patients (component 1). Moreover, 224 (58.3%) of the participants stated that they had never asked patients during admission about their previous history of TB infection. In addition, 306 (79.7%) of the nurses said that they did not ask patients about whether or not they had any close contact with other household members or friends. However, 120 (31.3%) of the nurses indicated they never asked about the use of TB drugs during the admission of the patients and 46 (12%) of the participants said that they always filled out and sent the disease notification form to the relevant registration unit.

The study results also showed that 308 (80.2%) of the participants had unsatisfactory level of practice in regards to TB infection control measures (Component 2) compared to 76(19.8%) of them who satisfactory level. For example, 255 (66.4%) said that they had never asked the patients in the ward to always wear a protective mask. Furthermore, only 29 (7.6%) of the participants said that they always wear a protective face mask and gloves while handling TB patients; just 63 (16.4%) said that they always keep infectious and non-infectious TB patients in separate rooms; and a mere 57 (14.8%) stated that they use separate treatment and testing devices for every individual patient. Furthermore, the results revealed that only 29 (7.6%) out of a total of 384 participants said that they always ask the patients to cover their mouth and nose while they are coughing or talking.

Moreover, it was found that 259 (67.4%) of the participants had unsatisfactory level of practice regarding respiratory hygiene and the collecting of sputum samples (component 3)

compared to 125(32.6%) of them had satisfactory practice level. For instance, only 49 (12.8%) of the participants stated that they always collect sputum specimens from patients in a separate ventilated space. Moreover, just 82 (21.4%) of the participants mentioned that they always collect sputum in a pot with lid and then dispose of it properly. In addition, only 67 (17.4%) nurses said that they always collect three samples of sputum for acid fast bacilli with a fully completed form; 26 (6.8%) said that they always explain and follow the sputum collection procedures for the patients and 87 (22.7%) stated that they always explain to the patients how the test is to be done and the reason for doing it.

The results also indicated that 172 (44.8%) of the 384 participants had unsatisfactory level and 212(55.2%) had satisfactory level of practice regarding the treatment of patients and the delivering of drugs (component 4). However, a total of 166 (43.2%) participants indicated that they always ensure the correct dosage of drugs is administered during the distribution of medications, while 131 (34.1%) of the participants said they always ask and remind patients to take their drugs regularly on time. However, only 31 (8.1%) of the participants mentioned that they always take a note of any apparent side effects or allergic reactions to the drugs, while just 93 (24.2%) of the participants stated that they always monitor whether the patients have a response or resistance to treatment.

In addition, the results showed that 152 (39.6%) of the participants had unsatisfactory level of practice, while 232(60.4%) of the nurses had satisfactory regarding the education of TB patient (component 5). However, 73 (19.0%) of the participants said that they always teach the patients about the different aspects of TB. Moreover, 103 (26.8%) of the participants

stated that they always explain to the patients treatment at home and follow-up during discharge and 85 (22.1%) of the participants said that they are call and remind patients if they miss a follow-up appointment.

In conclusion, based on the findings, the majority of the study participants had unsatisfactory level of practice regarding TB regardless of the kind of task they perform. There was a low level of practice for all the practice components.

Table 4.14: Levels of practices in relation to TB of the participants (n=384)

	Practice Component		**Practice level**	
No		**Mean± SD**	**Unsatisfactory n (%)**	**Satisfactory n (%)**
	Total practice	1.75±0.24	326(84.9%)	58(15.5%)
1	Services on admission process	1.55±0.51	297(77.3%)	87(22.7%)
2	TB Infection control measures	1.56±0.47	308(80.2%)	76(19.8%)
3	Respiratory hygiene & sputum collection	1.77±0.45	259(67.4%)	125(32.6%)
4	Treatment of patient and delivery of drugs	1.95±0.46	172(44.8%)	212(55.2%)
5	Patient education and follow-up	1.93±.052	152(39.6%)	232(60.4%)

Table 4.15: Frequency and proportion of responses for practices in relation to TB of the Participants (n=384)

N0	**Practice items**	**Never perform**	**Sometimes perform**	**Always perform**
		n (%)	**n (%)**	**n (%)**
Component 1 (services on admission process of TB patients)				
1	I ask the patients during admission about previous history of TB infection	224 (58.3)	133 (34.6)	27 (7.0)
2	I ask patient about any close contact with household members or friends	306 (79.7)	61 (15.9)	17 (4.4)

3	I check the patients' drugs that they have during admission	120 (31.3)	152 (39.6)	112 (29.2)
4	I fill and send the disease notification form to the relevant registration unit	232 (60.4)	106 (27.6)	46 (12.0)
Component 2 (TB- Infection control measures)				
1	I ask the patients in the ward to always wear a protective mask	255 (66.4)	99 (25.8)	30 (7.8)
2	I wear the protective face mask and gloves while handling the patients	215 (56.0)	140 (36.5)	29 (7.6)
3	I keep the infectious and non- infectious TB -patients in the separate rooms	158 (41.1)	163 (42.4)	63 (16.4)
4	I use separate treating and testing devices for every individual patient	161 (41.9)	166 (43.2)	57 (14.8)
5	I ask the patients to cover their mouth and nose during coughing, or talking	283 (73.7)	72 (18.8)	29 (7.6)

Table 4.15: Frequency and proportion of responses for practices in relation to TB of the Participants (n=384) (Continued)

N0	Practice items	Never perform	Sometimes perform	Always perform
		n (%)	n (%)	n (%)
Component 3 (Regarding respiratory hygiene and collecting sputum samples)				
1	I collect sputum specimens from patients in a separate ventilated space	185 (48.2)	150 (39.1)	49 (12.8)
2	I collect the sputum in a pot with lid and then dispose properly	88 (22.9)	214 (55.7)	82 (21.4)
3	I collect the THREE (3) samples of sputum for AFB with fully completed form	164 (42.7)	153 (39.8)	67 (17.4)
4	I explain and follow the sputum collection procedures	292 (76.0)	66 (17.2)	26 (6.8)
5	I explain to the patients how the test to be done and the reason for doing it	110 (28.6)	187 (48.7)	87 (22.7)
Component 4 (During treatment of patient and delivering of drugs)				
1	I ensure the correct dosages of drugs during distribution of medications	48 (12.5)	170 (44.3)	166 (43.2)
2	I ask and remind the patients to take their drugs regularly on time	86 (22.4)	167 (43.5)	131 (34.1)

3	I take note of any appeared side effects or allergic reaction of drugs	268 (69.8)	85 (22.1)	31 (8.1)
4	I monitor whether the patients have response or resistance to treatment	85 (22.1)	206 (53.6)	93 (24.2)
Component 5 (Regarding patient education)				
1	I teach the patients about the different aspects of the TB disease	89 (23.2)	222 (57.8)	73 (19.0)
2	I explain to the patients treatment at home and follow up during discharge	105 (27.3)	176 (45.8)	103 (26.8)
3	I call and remind the patients if they missed the follow-up appointment	138 (35.9)	161 (41.9)	85 (22.1)

***AFB= acid fast* bacilli**

4.2.7 Association of demographic characteristics and work period with knowledge

This section presents results of the association demographic characteristics (age, gender, educational status, and residence) and work period of respondents with knowledge on TB. In target to exclude the multicollinearity, *correlation coefficient* should be <0.8 (UCLA, 2007). Based on our results, there was no multicollinearity detected as the correlations between the independent variables were not high ($r < 0.8$) and the variance inflation factors (VIF) were less than 10 (Table 4.16).

Table 4.16: Multicollinearity test for independent variables (n=384)

	Gender	Age	Educational level	Residence	Work period	VIF
Gender	1					1.25
Age	0.11*	1				1.04
Educational level	-0.04	0.11*	1			1.13
Residence	0.05	0.-0.01	-0.04	1		1.11
Work period	-0.04	0.05	0.11*	0.09	1	1.08

4.2.7.1 Age

Table 4.17 shows the association between age groups and knowledge levels on TB among the participants. The result indicated that, out of all knowledge components, there were statistically significant associations of knowledge score for seven of the knowledge components (C1, C4, C5, C8, C9, and C11) as well as total knowledge score with the age groups. Age group 3 (>40 years) (Adjusted OR =4.34, 95% CI=1.1-17.11, p =0 .03) had 4.34 times higher knowledge on causes and infectivity of TB (component 1) compared to age group 1(18-25 years).

With regards to knowledge on clinical features (component 4), the results showed that age group 3 (>40 years) (Adjusted OR =4.04, 95% CI=1.84-8.88, p = 0.01) had 4.04 times higher level of knowledge on clinical features of TB compared to age group 1(18-25 years).

Also, there was significant association between age group 3 (> 40 years) and knowledge on common sites of TB in body & outcomes of incomplete TB treatment course (component 5) (Adjusted OR =3.43, 95% CI=1.51-7.8, p = 0.03) which indicated that age group 3 (>40 years) had 3.43 times of higher knowledge compared to age group 1(18y-25 years).

Based on the results, there was a significant association between age group 3 (>40 years) and knowledge on advantages of Interferon-Gamma Release Assays (component 8) (Adjusted OR =3.20, 95% CI= 1.30-7.83, p = 0.01). This adjusted odd ratio indicated that age group3 (>40 years) had 3.20 times higher knowledge more than age group1 (18 -25 years).

In addition to that, nurses of age more than 40 years (Adjusted OR = 7.04, 95% CI = 1.57-31.5, p = 0 .03) had 7.04 times higher knowledge level on TB treatment and delivery of anti -TB drugs (component 9) compared with age group 1(18 -25 years).

Furthermore, there was a significant association of age group3 (>40 years) with the total knowledge score (Adjusted OR =3.90, 95% CI= 1.38-11, p = 0 .01). Age group 3 had 3.90 times higher level of knowledge on compared to age group1 (18y-25 years).

Moreover, there was a significant association between age group 2 (26-40 years) and knowledge on common sites of TB in body & outcomes of incomplete TB treatment course (component 5) (Adjusted OR =1.97, 95% CI=1.04-3.74, p = 0.03), which indicated that age group 2 (26-40 years) had 1.97 times higher knowledge level on this component compared to age group 1(18y-25 years).

Thereafter, a significant association was found between age group 2 (26-40 years) and knowledge on preventive measures of TB (component 11) (Adjusted OR =3.12, 95% CI=1.21-8.06, p = 0.01). This age group had 3.12 times higher knowledge level compared to age group 1(18-25 years).

In conclusion, there were statistically significant associations between age and knowledge level on TB among five knowledge components (C1, C4, C5, C8, and C9) as well as in the total knowledge score. The oldest age group (> 40 years) had a significant association with knowledge score on these five components and the total knowledge score. However, there was a significant association of age group 2 (26-40ys) with knowledge level for two components (component 5 and component 11) compared to the reference group (18-25ys).

4.2.7.2 Gender

Table 4.18 shows the association between gender and knowledge on TB among nurses. The result showed that the obtained *p*-values of all adjusted odd ratios were higher than 0.05 (Table 4.18), thus there was no associations of knowledge on TB with gender among the participants.

Table 4.17: Association between age and knowledge on TB (n=384)

C	Age	low n (%)	High n (%)	Crude OR (95%CI)	*P-value*	**Adjusted OR (95%CI)	*P-value*
	18-25ys	68(90.7)	7(9.3)	***Reference			
TK	26-40ys	210(85.4)	36(14.6)	1.66(0.70-3.91)	0.24	1.89(0.78-4.58)	0.15
		49(77.8)	14(22.2)			3.90(1.38-11)	*
	>40ys			2.77(1.04-7.38)	0.04		0.01
	18-25ys	12(16)	63(84)	***Reference			
C1	26-40ys	31(12.6)	215(87.4)	1.32(0.64-2.72)	0.45	1.08(0.47-2.51)	0.84
	>40 ys	4(6.3)	59(93.7)	2.81(0.85-9.19)	0.08	4.34(1.1-17.11)	*0.03
	18-25ys	60(80)	15(20)	***Reference			
C2	26-40ys	193(78.5)	53(21.5)	1.09(0.57-2.08)	0.77	1.12(0.57-2.18)	0.73
	>40ys	48(76.2)	15(23.8)	1.25(0.556-2.81)	0.58	1.40(0.61-3.33)	0.40
	18-25ys	57(76)	18(24)	***Reference			
C3	26-40ys	174(70.7)	72(29.3)	1.31(0.72-2.38)	0.37	1.39(0.74-2.62)	0.30
	>40ys	42(66.7)	21(33.3)	1.58(0.75-3.36)	0.22	2.09(0.94-4.67)	0.07
	18-25ys	39(52)	36(48)	***Reference			
C4	26-40ys	129(52.4)	117(47.6)	0.98(0.58-1.64)	0.94	0.97(0.57-1.6)	0.92
	>40ys	15(23.8)	48(76.2)	3.46(1.66-7.23)	0.01	4.04(1.84-8.88)	*0.01
	18-25ys	59(78.7)	16(21.3)	***Reference			
C5	26-40ys	160(65)	86(35)	1.98(1.075-3.65)	0.02	1.97(1.04-3.74)	*0.03
	>40ys	40(63.5)	23(36.5)	2.12(0.99-4.50)	0.05	3.43(1.51-7.8)	*0.03
	18-25ys	24(32)	51(68)	***Reference			
C6	26-40ys	81(32.9)	165(67.1)	0.95(0.551-1.66)	0.88	1.01(0.56-1.76)	0.99

	>40ys	19(30.2)	44(69.8)	1.09(0.52-2.24)	0.81	1.19(0.55-2.55)	0.65
	18-25ys	65(86.7)	10(13.3)	***Reference			
C7	26-40ys	217(88.2)	29(11.8)	0.86(0.40-1.87)	0.72	0.99(0.43-2.27)	0.98
	>40ys	57(90.5)	6(9.5)	0.68(0.23-2)	0.48	1.09(0.31-3.19)	0.98
	18-25ys	65(86.7)	10(13.3)	***Reference			
C8	26-40ys	193(78.5)	53(21.5)	1.78(0.85-3.71)	0.12	2.03(0.95-4.32)	0.06
	>40ys	44(69.8)	19(30.2)	2.80(1.19-6.60)	0.01	3.20(1.30-7.83)	*0.01
	18-25ys	72(96)	3(4)	***Reference			
C9	26-40ys	226(91.9)	20(8.1)	2.12(0.61-7.35)	0.23	2.45(0.67-8.91)	0.17
	>40ys	55(87.3)	8(12.7)	3.49(0.88-13.77)	0.07	7.04(1.57-31.5)	*0.01
	18-25ys	68(90.7)	7(9.3)	***Reference			
C10	26-40ys	206(83.7)	40(16.3)	1.88(0.80-4.40)	0.14	2.03(0.84-4.76)	0.11
	>40ys	56(88.9)	7(11.1)	1.21(0.40-3.66)	0.73	1.43(0.45-4.47)	0.53
	18-25ys	10(13.3)	65(86.7)	***Reference			
C11	26-40ys	11(4.5)	235(95.5)	3.28(1.33-8.07)	0.01	3.12(1.21-8.06)	*0.01
	>40ys	4(6.3)	59(93.7)	2.26(0.67-7.62)	0.18	1.82(0.52-6.40)	0.34

C (component), TK (total knowledge score), refer to Table 4.11for details of knowledge components
*Significant difference at p< 0.05.
**Adjusted for gender, educational level, work period and residence.
***Reference (18y-25ys).

Table 4.18: Association between gender and knowledge on TB (n=384)

C	Gender	low n (%)	High n (%)	Crude OR (95%CI)	*P-value*	**Adjusted OR (95%CI)	*P-value*
TK	Male	69(82.2)	15(17.8)	***Reference			
	Female	258(86)	42(14)	0.74(0.39-1.43)	0.38	0.78(0.39-1.56)	0.48
C1	Male	18(21.4)	66(78.6)	***Reference			
	Female	29(9.7)	271(90.3)	2.54(1.33-4.86)	0.05	4.45(2.05-9.67)	0.06
C2	Male	66(78.6)	18(21.4)	***Reference			
	Female	235(78.3)	65(21.7)	1.01(0.56-1.82)	0.96	1.15(0.61-2.16)	0.65
C3	Male	64(76.2)	20(23.8)	***Reference			
	Female	209(69.7)	91(30.3)	1.39(0.79-2.43)	0.24	1.53(0.83-2.82)	0.17
C4	Male	38(45.2)	46(54.8)	***Reference			
	Female	145(48.3)	155(51.7)	0.88(0.543-1.43)	0.61	1.05(0.60-1.81)	0.86
C5	Male	63(75)	21(25)	***Reference			
	Female	196(65.3)	104(34.7)	1.59(0.92-2.75)	0.09	1.68(0.92-3.04)	0.08
C6	Male	24(28.6)	60(71.4)	***Reference			
	Female	100(33.3)	200(66.7)	0.8(0.47-1.36)	0.41	0.74(0.42-1.31)	0.3
C7	Male	75(89.3)	9(10.7)	***Reference			
	Female	264(88)	36(12)	1.13(0.52-2.46)	0.74	1.39(0.59-3.27)	0.44
C8	Male	63(75)	21(25)	***Reference			
	Female	239(79.7)	61(20.3)	0.76(0.43-1.35)	0.35	0.87(0.47-1.62)	0.68
C9	Male	77(91.7)	7(8.3)	***Reference			

	Female	276(78.2)	24(77.4)	0.95(0.39-2.30)	0.92	0.81(0.31-2.16)	0.68
C10	Male	71(21.5)	13(24.1)	Reference			
	Female	259(78.5)	41(75.9)	0.86(0.43-1.70)	0.67	0.77(0.37-1.58)	0.47
C11	Male	7(28)	77(21.4)	***Reference			
	Female	18(72)	282(78.6)	1.42(0.57-3.53)	0.44	1.06(0.38-2.89)	0.9

C (component), TK (total knowledge score), refer to Table 4.11for details of knowledge components
*Significant difference at p< 0.05.

**Adjusted for age, educational level, work period and residence.

***Reference (male).

4.2.7.3 Education levels

Table 4.19 shows the association between education groups and knowledge among the participants. The result showed that, out of the total eleven knowledge components, there were statistically significant associations of knowledge score for eight of the knowledge components (C1, C2 C3, C5, C7 C8, C9 and C10) as well as the total knowledge score with the education groups.

It was found that diploma holders (Adjusted OR =3.74, 95% CI=1.57-8.90, p = 0 .03) had 3.74 times higher knowledge on causes and infectivity of TB (component 1) compared training certificate holders.

The results also showed that diploma holders (Adjusted OR =2.70, 95% CI=1.28-5.70, p-value =0.02) had 2.70 times higher knowledge level on the methods of TB transmission (component2) compared to training certificate holders.

Furthermore, the diploma holders (Adjusted OR =2.99, 95% CI=1.51-5.93, p = 0.02) had almost 3 times higher knowledge on TB risk factors (component 3) compared to training certificate holders.

In addition, the results revealed that diploma holders had 1.86 times higher knowledge on common sites of TB in body & outcomes of incomplete TB treatment course (component 5) (Adjusted OR =1.86, 95% CI=1.043-3.35, $p = 0.03$) compared to training certificate holders. Also, the results showed that diploma holders (Adjusted OR =22.1, 95% CI=2.9- 16.30, $p = 0.03$) had 22.1 times higher knowledge on interpretation of tuberculin skin test (component 7) compared to training certificate holders.

Based on the result, diploma holders had 2.27 times higher knowledge on advantages of Interferon-Gamma Release Assays (component 8) (Adjusted OR =2.27, 95% CI=1.09-4.69, $P = 0.02$) compared training certificate holders.

Moreover, with respect to knowledge TB treatment and delivery of anti -TB drugs (component 9), diploma holders (Adjusted OR =7.93, 95% CI=1.76-35.57, $p = 0.007$) had nearly 8 times higher knowledge on TB treatment compared to training certificate holders.

In addition, from the finding of our study, the knowledge level on tests used in monitoring of MDR-TB (component 10) of the diploma holders was found to be three times higher (Adjusted OR =2.92, 95% CI=1.20-7.11, $p = 0.01$) than that of training certificate holders.

As for the total knowledge score, the results showed that there was a significant association between educational levels and total knowledge score (component 12). The total knowledge score of the Diploma holders was (Adjusted OR =4.36, 95% CI=11.61-11.79, $p = 0.04$) was 4.36 times higher than the total knowledge score training certificate holders.

In conclusion, there were significant associations between education and knowledge on TB among the nurses. Diploma holders had higher knowledge compared to the training certificate. However, bachelor's holders didn't show any significant association with knowledge.

Table 4.19: Association between education and knowledge on TB (n=384)

C	Edu. level	low n (%)	High n (%)	Crude OR (95%CI)	*P-value*	**Adjusted OR (95% CI)	*P-value*
	TCC	82(94.3)	5(5.7)	***Reference			
TK		124(77)	37(23)			4.36(1.61-	
	Diploma			4.89(1.84-12.96)	0.01	11.79)	*0.04
	Bachelor	121(89)	15(11)	2.03(0.71-5.81)	0.18	1.57(0.53-4.64)	0.41
	TCC	20(23)	67(77)	Reference			
C1	Diploma	12(7.5)	149(92.5)	3.70(1.71-8.01)	0.01	3.74(1.57-8.90)	*0.03
	Bachelor	15(11)	121(89)	2.40(1.15-5.01)	0.01	1.83(0.80-4.16)	0.14
	TCC	76(87.4)	11(12.6)	***Reference			
C2	Diploma	115(71.4)	46(28.6)	2.76(1.34-5.67)	0.01	2.70(1.28-5.70)	*0.02
	Bachelor	110(80.9)	26(19.1)	1.63(0.76-3.50)	0.2	1.58(0.71-3.49)	0.25
	TCC	73(83.9)	14(16.1)	***Reference			
C3	Diploma	101(62.7)	60(37.3)	3.09(1.60-5.96)	0.01	2.99(1.51-5.93)	*0.02
	Bachelor	99(72.8)	37(27.2)	1.94(0.98-3.86)	0.05	1.65(0.81-3.38)	0.16
	TCC	48(55.2)	39(44.8)	***Reference			
C4	Diploma	77(47.8)	84(52.2)	1.34(0.79-2.26)	0.27	1.15(0.65-2.02)	0.62
	Bachelor	58(42.6)	78(57.4)	1.65(0.96-2.84)	0.06	1.16(0.64-2.08)	0.61
	TCC	61(70.1)	26(29.9)	***Reference			
C5		90(55.9)	71(44.1)			1.86(1.043-	
	Diploma			1.85(1.06-3.22)	0.03	3.35)	*0.03
	Bachelor	108(79.4)	28(20.6)	0.60(0.32-1.13)	0.11	0.53(0.27-1.02)	0.06
	TCC	29(33.3)	58(66.7)	***Reference			
C6	Diploma	51(31.7)	110(68.3)	1.07(0.61-1.88)	0.79	0.95(0.53-1.71)	0.87
	Bachelor	44(32.4)	92(67.6)	1.04(0.59-1.85)	0.87	0.88 (0.48-1.62)	0.69

	TCC	86(98.9)	1(1.1)	***Reference			
C7		124(77)	37(23)			22.1 (2.9-	
	Diploma			25.6(3.45-19.60)	0.02	16.30)	*0.03
		129(94.9)	7(5.1)			4.01(0.47-	
	Bachelor			4.66(0.56-38.60)	0.15	33.73)	0.2
	TCC	75(86.2)	12(13.8)	***Reference			
C8	Diploma	118(73.3)	43(26.7)	2.27(1.12-4.59)	0.02	2.27(1.09-4.69)	*0.02
	Bachelor	109(80.1)	27(19.9)	1.54(0.73-3.24)	0.24	1.28(0.59-2.77)	0.526
	TCC	85(97.7)	2(2.3)	***Reference			
C9		135(83.9)	26(16.1)			7.93(1.76-	
	Diploma			8.18(1.89-35.37)	0.05	35.57)	*.007
	Bachelor	133(97.8)	3(2.2)	0.95(0.15-5.85)	0.96	0.77(0.12-4.95)	0.786
	TCC	80(92)	7(8)	***Reference			
C10	Diploma	129(80.1)	32(19.9)	2.83(1.19-6.72)	0.01	2.92(1.20-7.11)	*0.01
	Bachelor	121(89)	15(11)	1.41(0.55-3.62)	0.46	1.54(0.58-4.08)	0.37
	TCC	8(9.2)	79(90.8)	***Reference			
C11	Diploma	12(7.5)	149(92.5)	1.25(0.49-3.20)	0.63	1.24(0.43-3.52)	0.68
	Bachelor	5(3.7)	131(96.3)	2.65(0.83-8.39)	0.09	2.68(0.77-9.24)	0.118

Edu (education), TCC (training course certificate), C (component), refer to Table 4.11for details of knowledge components
*Significant difference at p< 0.05.
**Adjusted for age, gender, work period and residence.
***Reference (TCC).

4.2.7.4 Work experience

Table 4.20 shows the association between work experience and level of knowledge on TB among the participants in this study. The result indicated that, out of the total eleven knowledge components and total knowledge score, there were statistically significant associations of knowledge score for three of the knowledge components (C1, C3 and C9) with the work experience.

The results revealed that nurses with one to five years of experience (Adjusted OR =3.48, 95% CI=1.51-8.0, p = 0 .03) had 3.48 times higher knowledge on causes and infectivity of TB (component 1) compared to nurses with less than one year of experience. However, nurses with more than five years of experience had 11.16 times higher knowledge on causes

and infectivity of TB (component 1) compared to those with less than one year of experience (Adjusted OR =11.16 , 95% CI=3.23-38.5, p = 0 .01).

Moreover, it was found that nurses with one to five years of work experience had 3.08 times higher level of knowledge on TB risk factors (component 3) compared to those with less than one year of experience (Adjusted OR =3.08 , 95% CI=1.20-7.87, p = 0 . 01). Also, based on the results, nurses with more than five years of experience had 4.67 times higher level of knowledge on TB treatment and delivery of anti -TB drugs (component 9) (Adjusted OR =4.67, 95% CI=1.32-16.49, p = 0.01) compared to nurses with less than one year working experience. In conclusion, there were significant associations between the length of work experience among the participants and level of knowledge for three knowledge components (C1, C3 and C9).

Table 4.20: Association between work period and knowledge on TB (n=384)

C	Work Period	Low n (%)	High n (%)	Crude OR (95%CI)	*P-value*	**Adjusted OR (95% CI)	*P-value*
	< 1 y	46(95.8)	2(4.2)	***Reference			
TK	1-5ys	201(83.1)	41(16.9)	4.69 (1.09-20.1)	0.03	4.0(0.89-17.97)	0.07
	>5 ys	80(85.1)	14(14.9)	4.02 (0.87-18.5)	0.07	3.10(0.65-14.85)	0.15
	< 1 y	16(33.3)	32(66.7)	***Reference			
C1	1-5ys	27(11.2)	215(88.8)	3.98(1.93-8.19)	0.01	3.48(1.51-8.0)	*0.03
	>5 ys	4(4.3)	90(95.7)	11.2(3.5-36.159)	0.01	11.16(3.23-38.5)	*0.01
	< 1 y	40(83.3)	8(16.7)	***Reference			
C2	1-5ys	193(79.8)	49(20.2)	1.26(0.55-2.88)	0.56	0.85(0.35-2.03)	0.71
	>5 ys	68(72.3)	26(27.7)	1.9(0.79-4.62)	0.15	1.29(0.51-3.28)	0.58
	< 1 y	42(87.5)	6(12.5)	***Reference	0.02		0.051
C3	1-5ys	163(67.4)	79(32.6)	3.39(1.38-8.31)	.008	3.08(1.20-7.87)	*0.01
	>5 ys	68(72.3)	26(27.7)	2.67(1.01-7.04)	0.04	2.5(0.91-6.82)	0.07
	< 1 y	28(58.3)	20(41.7)	***Reference			
C4	1-5ys	111(45.9)	131(54.1)	1.65(0.88-3.09)	0.11	2.02(1.0-4.11)	0.051
	>5 ys	44(46.8)	50(53.2)	1.59(0.78-3.21)	0.19	1.75(0.80-3.82)	0.15
	< 1 y	38(79.2)	10(20.8)	***Reference	0.16		0.48
C5	1-5ys	157(64.9)	85(35.1)	2.05(0.97-4.33)	0.05	1.62(0.73-3.59)	0.23
	>5 ys	64(68.1)	30(31.9)	1.78(0.78-4.04)	0.16	1.45(0.61-3.48)	0.39

	< 1 y	17(35.4)	31(64.6)	***Reference			
C6	1-5ys	75(31)	167(69)	1.22(0.63-2.34)	0.54	1.29(0.63-2.63)	0.47
	>5 ys	32(34)	62(66)	1.06(0.51-2.20)	0.87	1.06(0.48-2.3)	0.87
	< 1 y	48(100)	0(0)	***Reference	0.88		0.79
C7	1-5ys	211(87.2)	31(12.8)	1.17 (0.77-2.85)	0.99	1.13 (0.67-2.14)	0.89
	>5 ys	80(85.1)	14(14.9)	0.84(0.42-1.660)	0.99	0.77(0.36-1.62)	0.51
	< 1 y	40(83.3)	8(16.7)	***Reference			
C8	1-5ys	192(79.3)	50(20.7)	1.30 (0.57-2.95)	0.52	1.21(0.50-2.89)	0.66
	>5 ys	70(74.5)	24(25.5)	1.71 (0.70-4.17)	0.23	1.53(0.60-3.9)	0.36
	< 1 y	48(100)	0(0)	***Reference	0.08		0.05
C9	1-5ys	214(88.4)	28(11.6)	1.16(0.73-2.68)	0.99	1.09 (0.83-2.23)	0.89
	>5 ys	91(96.8)	3(3.2)	3.96 (1.17-13.3)	0.99	4.67(1.32-16.49)	*0.01
	< 1 y	43(89.6)	5(10.4)	***Reference			
C10	1-5ys	202(83.5)	40(16.5)	1.70 (0.63-4.56)	0.29	1.16(0.41-3.30)	0.76
	>5 ys	85(90.4)	9(9.6)	0.91 (0.27-2.88)	0.87	0.59(0.18-1.98)	0.4
	< 1 y	6(12.5)	42(87.5)	***Reference			
C11	1-5ys	11(4.5)	231(95.5)	3(1.052-8.553)	0.04	2.48(0.76-8.02)	0.12
	>5 ys	8(8.5)	86(91.5)	1.53 (0.50-4.71)	0.45	1.2(0.37-4.39)	0.69

C= component, TK (total knowledge score), refer to Table 4.11for details of knowledge components
*Significant difference at p< 0.05
**Adjusted for age, gender, educational levels and residence.
***Reference (<1year)

4.2.7.5 Residence

Table 4.21 shows the association between residence and level of knowledge among the participants. The result showed that out of the total eleven knowledge components and total knowledge score, there were statistically significant associations of knowledge score for three of the knowledge components (C2, C4 and C6) with the residence.

The results revealed that rural resident nurses (Adjusted OR =2.02, 95% CI=1.19-3.42, p = 0 .009) had 2.02 times higher level of knowledge on TB transmission (component 2) compared to urban resident nurses. However, rural resident nurses had 0.50 times lower level of knowledge on TB clinical features (component 4) (Adjusted OR =0.50, 95% CI=0.327-0.77, p = 0.002) compared to urban resident nurses. Moreover, it was found that rural resident

nurses (Adjusted OR =0.60, 95% CI=0.38-0.94, p = 0. 026) had 0.40 times lower level of knowledge on TB diagnostic tests (component 6) compared to urban resident nurses.

In conclusion, there were significant associations between the residence of participant in this study and knowledge for three components (C2, C4 and C6). Nurses from rural areas had higher level of knowledge on TB transmission than nurses from urban areas. However, Nurses from rural areas had lower level of knowledge on TB clinical features and TB diagnosis compared to nurses from urban areas.

Table 4.21: Association between residence and knowledge on TB (n=384)

C	Reside -nce	low n (%)	High n (%)	Crude OR (95%CI)	*P-value*	**Adjusted OR (95% CI)	*P-value*
TK	Urban	153(86.9)	23(13.1)	Reference			
	Rural	172(83.5)	34(16.5)	1.31(0.74-2.33)	0.34	1.18(0.65-2.15)	0.57
C1	Urban	22(12.5)	154(87.5)	Reference			
	Rural	25(12.1)	181(87.9)	1.03(0.56-1.90)	0.91	0.87(0.43-1.74)	0.71
C2	Urban	149(84.7)	27(15.3)	Reference			
	Rural	150(72.8)	56(27.2)	2.06(1.23-3.43)	.006	2.02(1.19-3.42)	*.009
C3	Urban	114(64.8)	62(35.2)	Reference			
	Rural	157(76.2)	49(23.8)	0.57(0.36-0.89)	0.01	0.49(0.307-0.78)	0.3
C4	Urban	68(38.6)	108(61.4)	Reference			
	Rural	113(54.9)	93(45.1)	0.51(0.34-0.78)	.002	0.50(0.327-0.77)	*.002
C5	Urban	126(71.6)	50(28.4)	Reference			
	Rural	131(63.6)	75(36.4)	1.44(0.93-2.22)	0.09	1.30(0.826-2.05)	0.25
C6	Urban	46(26.1)	130(73.9)	Reference			
	Rural	76(36.9)	130(63.1)	0.60(0.39-0.93)	0.02	0.60(0.38-0.94)	*.026
C7	Urban	160(90.9)	16(9.1)	Reference			
	Rural	177(85.9)	29(14.1)	1.63(0.85-3.18)	0.13	1.43(0.72-2.85)	0.3
C8	Urban	131(74.4)	45(25.6)	Reference			
	Rural	169(82)	37(18)	0.63(0.39-1.04)	0.07	0.59(0.35-0.98)	*0.04
C9	Urban	168(95.5)	8(4.5)	Reference			
	Rural	183(88.8)	23(11.2)	2.63(1.14-6.06)	0.02	2.28(0.94-5.51)	0.06

	Urban	158(89.8)	18(10.2)	Reference			
C10	Rural	170(82.5)	36(17.5)	1.85(1.014-3.40)	0.04	1.77(0.95-3.31)	0.07
	Urban	11(6.3)	165(93.8)	Reference			
C11	Rural	14(6.8)	192(93.2)	0.91(0.404-2.06)	0.83	0.77(0.32-1.82)	0.55

C (component), TK (total knowledge score), refer to Table 4.11for details of knowledge components

*Significant difference at p< 0.05.

**Adjusted for age, gender, educational levels and work period.

***Reference (Urban)

4.2.8 Association of demographic characteristics and work period with attitude

This section presents the results for the association of demographic characteristics (age, gender, educational level, and residence) and work period of respondents with attitude towards tuberculosis.

4.2.8.1 Age

Table 4.22 shows the association between age and attitude towards TB among the participants. Based on the result there was no significant association between age and attitude wards TB among the nurses ($P > 0.05$).

Table 4.22: Association between age and attitude towards TB (n=384)

C	Age	Negative n (%)	Positive n (%)	Crude OR (95%CI)	*P-value*	**Adjusted OR (95% CI)	*P-value*
	18-25ys	58(77.3)	17(22.7)	***Reference			
TA	26-40ys	203(82.5)	43(17.5)	0.72(0.38-1.36)	0.31	0.62(0.31-1.20)	0.15
	>40ys	43(68.3)	20(31.7)	1.58(0.74-3.38)	0.23	1.53(0.67-3.48)	0.3
	18-25ys	58(77.3)	17(22.7)	***Reference			
C1	26-40ys	19(28.8)	47(71.2)	0.80(0.43-1.50)	0.5	0.68(0.35-1.31)	0.25
	>40 ys	45(71.4)	18(28.6)	1.36(0.63-2.94)	0.42	1.36(0.59-3.16)	0.46
	18-25ys	52(69.3)	23(30.7)	***Reference			
C2	26-40ys	17(19.3)	71(80.7)	0.91(0.52-1.61)	0.76	0.83(0.46-1.49)	0.54
	>40ys	42(66.7)	21(33.3)	1.13(0.55-2.31)	0.73	1.1(0.51-2.34)	0.8

C= component, TA (total attitude score), refer to table 4.13 for details of attitude components

*Significant difference at p< 0.05

**Adjusted for gender, educational level, work period and residence.

***Reference (18y-25ys).

4.2.8.2 Gender

Table 4.23 shows the association between gender and attitude scores among the participants. The result showed that there was significant association between and gender and attitude towards TB. Female participants (Adjusted OR =2.99, 95% CI=1.37- 6.53, p = 0 .006) (1.371-6.53) had almost 3 times more phobia from TB compared to male participants. However, there were no significant associations of TB- stigma and total attitude scores with gender.

Table 4.23: Association between gender and attitude towards TB (n=384)

C	Gender	Negative n (%)	Positive n (%)	Crude OR (95%CI)	*P-value*	**Adjusted OR (95% CI)	*P-value*
TA	Male	68(81)	16(19)	***Reference			
	Female	236(78.7)	64(21.3)	1.15(0.62-2.12)	0.64	1.61(0.81-3.21)	0.173
C1	Male	73(86.9)	11(13.1)	***Reference			
	Female	229(76.3)	71(23.7)	2.0(1.03-4.09)	0.04	2.99(1.37-6.53)	*.006
C2	Male	60(71.4)	24(28.6)	***Reference			
	Female	209(69.7)	91(30.3)	1.08(0.63-1.85)	0.75	1.10(0.62-1.95)	0.732

TA (Total attitude score). C= component, refer to table 4.13 for details of attitude components

*Significant difference at p< 0.05.

**Adjusted for age, educational level, work period and residence.

***Reference (male).

4.2.8.3 Education levels

The result revealed that there was no association between attitude and education among the nurses, since the obtained p-values of all adjusted odd ratios were higher than 0.05 (Table 4.24).

Table 4.24: Association between education and attitude towards TB (n=384)

C	Edu. Level	Negative n (%)	Positive n (%)	Crude OR(95%CI)	*P-value*	**Adjusted OR(95% CI)	*P-value*
	TCC	72(82.8)	15(17.2)	***Reference			0.63
TA	Diploma	124(77)	37(23)	1.43(0.73-2.78)	0.29	1.39(0.66-2.89)	0.37
	Bachelor	108(79.4)	28(20.6)	1.24(0.62-2.49)	0.53	1.14(0.53-2.46)	0.73
	TCC	71(81.6)	16(18.4)	***Reference			
C1	Diploma	124(77)	37(23)	1.32(0.68-2.54)	0.4	1.48(0.72-3.04)	0.27
	Bachelor	107(78.7)	29(21.3)	1.20(0.60-2.37)	0.59	1.27(0.60-2.69)	0.52
	TCC	67(77)	20(23)	***Reference			0.38
C2	Diploma	113(70.2)	48(29.8)	1.42(0.77-2.6)	0.25	1.19(0.63-2.24)	0.58
	Bachelor	89(65.4)	47(34.6)	1.76(0.96-3.26)	0.06	1.53(0.80-2.91)	0.19

Edu= education, TA (total attitude score), refer to table 4.13 for details of attitude components
*Significant difference at p< 0.05.
**Adjusted for age, gender, work period and residence,
***Reference (TCC).

4.2.8.4 Work experience

Table 4.25 shows the association between work experience and attitude among the participants. The result indicated that, there were statistically significant associations between work experiences among the nurses and their attitude towards TB.

The results revealed that nurses with more than five years of experience (Adjusted OR =2.86, 95% CI=1.13-7.28, p = 0 .02) had 2.86 times more stigma of TB compared to nurses with less than one year of experience. Also, it was found that nurses with more than five years of experience (Adjusted OR =3.49, 95% CI=1.09-11.16, p = 0 .03) had 3.49 times positive attitude generally towards TB compared to those with less than one year of experience. In conclusion, nurses with more than five years of experience showed less stigma and more positive attitude towards TB compared to participants with less than one year work of experience.

Table 4.25: Association between work period and attitude towards TB (n=384)

C	Work period	Negative n (%)	positive n (%)	Crude OR (95%CI)	*P-value*	**Adjusted OR (95% CI)	*P-value*
TA	< 1 y	42(87.5)	6(12.5)	Reference			
	1-5ys	194(80.2)	48(19.8)	1.73(0.69 - 4.31)	0.23	2.19(0.71-6.70)	0.16
	>5 ys	68(72.3)	26(27.7)	2.67(1.01-7.04)	0.04	3.49(1.09-11.16)	*0.03
C1	< 1 y	40(83.3)	8(16.7)	Reference			
	1-5ys	191(78.9)	51(21.1)	1.33(0.58-3.03)	0.48	1.32(0.50-3.47)	0.56
	>5 ys	71(75.5)	23(24.5)	1.62(0.66-3.95)	0.29	1.79(0.63-5.04)	0.27
C2	< 1 y	41(85.4)	7(14.6)	Reference			
	1-5ys	169(69.8)	73(30.2)	2.53(1.08-5.90)	0.03	2.11(0.87-5.08)	0.09
	>5 ys	59(62.8)	35(37.2)	3.47(1.40-8.58)	.007	2.86(1.13-7.28)	*0.02

C (component), TA (total attitude score), refer to table 4.13 for details of attitude components
*Significant difference at p< 0.05

**Adjusted for age, gender, educational levels and residence)

***Reference (<1year)

4.2.8.5 Residence

Table 4.26 shows the association between residence and attitude among the participants. Based on the result there were statistically significant associations between residences of nurses and their attitude towards TB.

The results revealed that rural resident nurses (Adjusted OR =2.46, 95% CI=1.42-4.25, p = 0 .001) had 2.46 times higher phobia of TB (component 1) compared to urban resident nurses. However, rural resident nurses (Adjusted OR =1.71, 95% CI=1.08-2.71, p = 0.022) had 0.71 times higher negative attitude (more stigma) towards TB (component 2) compared to urban resident nurses.

Moreover, generally, the rural resident nurses (Adjusted OR =2.37, 95% CI=1.36-4.12, p = 0.002) had 2.37 times higher positive attitude towards of TB compared to urban resident

nurses. In conclusion, nurses from rural areas had more positive attitude towards TB compared to nurses from urban areas.

Table 4.26: Association between residence and attitude towards TB (n=384)

C	Residen -ce	Negative n (%)	Positive n (%)	Crude OR (95% CI)	*P-value*	**Adjusted OR (95% CI)	*P-value*
TA	Urban	153(86.9)	23(13.1)	***Reference			
	Rural	151(73.3)	55(26.7)	2.42(1.41-4.14)	.001	2.37(1.36-4.12)	*.002
C1	Urban	153(86.9)	23(13.1)	***Reference			
	Rural	149(72.3)	57(27.7)	2.54(1.49-4.34)	.001	2.46(1.42-4.25)	*.001
C2	Urban	134(76.1)	42(23.9)	***Reference			
	Rural	133(64.6)	73(35.4)	1.75(1.11-2.74)	.014	1.71(1.08-2.71)	*.022

C (component), TA (total attitude score), refer to table 4.13 for details of attitude components

*Significant difference at p< 0.05.

**Adjusted for age, gender, educational levels and work period.

***Reference (Urban)

4.2.9 Association of demographic characteristics and work period with practice

This section presents the results for the association of demographic characteristics (age, gender, educational level, and residence) and work period of participants with practice towards TB.

4.2.9.1 Age

Table 4.27 shows the association between age of participants and practice towards TB. The result revealed that there was no association between age and practice levels among the participants (p>0.05).

Table 4.27: Association between age and practice towards TB (n=384)

C	Age	Unsatisfa - ctory	Satisfa- ctory n (%)	Crude OR (95%CI)	*P-value*	**Adjusted OR (95%CI)	*P-value*

		n (%)					
	18-25ys	65(86.7)	10(13.3)	***Reference			
TP	26-40ys	205(83.3)	41(16.7)	1.3(0.617-2.74)	0.49	1.40(0.65-3.03)	0.38
	>40ys	56(88.9)	7(11.1)	0.81(0.29-2.27)	0.69	1.04(0.36-3.01)	0.94
	18-25ys	57(76)	18(24)	***Reference			
C1	26-40ys	190(77.2)	56(22.8)	0.93(0.50-1.71)	0.82	0.93(0.49-1.78)	0.84
	>40 ys	50(79.4)	13(20.6)	0.82(0.36-1.84)	0.63	1.03(0.44-2.44)	0.93
	18-25ys	59(78.7)	16(21.3)	***Reference			
C2	26-40ys	206(83.7)	40(16.3)	0.71(0.37-1.36)	0.31	0.66(0.34-1.30)	0.23
	>40ys	43(68.3)	20(31.7)	1.71(0.79-3.68)	0.16	2.07(0.92-4.65)	0.07
	18-25ys	56(74.7)	19(25.3)	***Reference			
C3	26-40ys	157(63.8)	89(36.2)	1.67(0.93-2.98)	0.08	1.62(0.89-2.94)	0.11
	>40ys	46(73)	17(27)	1.089(0.50-2.33)	0.82	0.98(0.44-2.20)	0.97
	18-25ys	31(41.3)	44(58.7)	***Reference			
C4	26-40ys	114(46.3)	132(53.7)	0.81(0.48-1.37)	0.44	0.82(0.47-1.43)	0.49
	>40ys	27(42.9)	36(57.1)	0.93(0.477-1.85)	0.85	1.06(0.51-2.21)	0.86
	18-25ys	29(38.7)	46(61.3)	***Reference			
C5	26-40ys	102(41.5)	144(58.5)	0.89(0.52-1.51)	0.66	0.97(0.55-1.69)	0.92
	>40ys	21(33.3)	42(66.7)	1.26(0.62-2.54)	0.51	1.2(0.56-2.55)	0.63

C (component), TP (total practice), refer to Table 4.15 for details of practice components
*Significant difference at p< 0.05. * Significant difference at p< 0.05
**Adjusted for gender, educational level, work period and residence.
***Reference (18 -25ys).

4.2.9.2 Gender

Table 4.28 shows the association between gender and practice. The result revealed that, there was significant association between gender and practice level among the participants for only one practice component.

Female participants (Adjusted OR =2.26, 95% CI=1.08-4.76, p = 0 .03) (1.371-6.53) had 2.26 times more satisfactory practice level on infection control measures of TB (component 2) compared to male participants. In conclusion, there was significant association between the gender of participants and only practice on infection control measures of TB.

Table 4.28: Association between gender and practice towards TB (n=384)

C	Gender	Unsatisfa-ctory n (%)	Satisfa-ctory n (%)	Crude OR (95%CI)	*P-value*	**Adjusted OR (95%CI)	*P-value*
TP	Male	69(82.1)	15(17.9)	***Reference			
	Female	257(85.7)	43(14.3)	0.77(0.40-1.46)	0.42	0.7(0.35-1.38)	0.3
C1	Male	68(81)	16(19)	Reference			
	Female	229(76.3)	71(23.7)	1.31(0.71-2.41)	0.37	1.18(0.61-2.26)	0.61
C2	Male	72(85.7)	12(14.3)	***Reference			
	Female	236(78.7)	64(21.3)	1.62(0.83-3.18)	0.15	2.26(1.08-4.76)	*0.03
	Male	54(64.3)	30(35.7)	***Reference			
C3	Female	205(68.3)	95(31.7)	0.83(0.50-1.38)	0.48	0.72(0.41-1.25)	0.24
	Male	37(44)	47(56)	***Reference			
C4	Female	135(45)	165(55)	0.96(0.59-1.56)	0.87	0.93(0.54-1.60)	0.81
	Male	20(23.8)	64(76.2)	***Reference			
C5	Female	132(44)	168(56)	0.39(0.29-0.69)	0.01	0.40(0.22-0.74)	0.03

C (component), TP (total practice), refer to Table 4.15 for details of practice components
* Significant difference at p< 0.05
**Adjusted for age, educational level, work period and residence.
***Reference (male)

4.2.9.3 Education levels

Table 4.29 shows the association between education level and practice. The result indicated that, out of the total five practice components, there was a statistically significant association of practice level for only one practice component (component 1) with the education. Diploma holders and bachelor's holders had equal chance (0.51) of unsatisfactory practice on admission services of TB patients (Adjusted OR =0.49, 95% CI=0.25-0.93, p = 0 .03) compared to training certificate holders. In conclusion, nurses with diploma and bachelor's degree had equal chance of low practice on services of patient admission.

Table 4.29: Association between education level and practice towards TB (n=384)

C	Edu. level	Unsatisfa-ctory n (%)	Satisfa-ctory n (%)	Crude OR(95%CI)	*P-value*	**Adjusted OR(95%CI)	*P-value*
	TCC	74(85.1)	13(14.9)	***Reference			
TP	**Diploma**	127(78.9)	34(21.1)	1.52(0.75-3.07)	0.23	1.44(0.70-2.98)	0.31

	Bachelor	125(91.9)	11(8.1)	0.50(0.21-1.17)	0.11	0.49(0.20-1.18)	0.11
	TCC	57(65.5)	30(34.5)	***Reference			
C1	**Diploma**	130(80.7)	31(19.3)	0.45(0.25-0.81)	.009	0.49(0.26-0.92)	*0.02
	Bachelor	110(80.9)	26(19.1)	0.44(0.24-0.83)	.011	0.49(0.25-0.93)	*0.03
	TCC	75(86.2)	12(13.8)	***Reference	0.28		
C2	**Diploma**	127(78.9)	34(21.1)	1.67(0.81-3.42)	0.16	1.51(0.71-3.21)	0.27
	Bachelor	106(77.9)	30(22.1)	1.76 (0.85-3.67)	0.12	1.38(0.64-2.98)	0.4
	TCC	54(62.1)	33(37.9)	Reference			
C3	**Diploma**	107(66.5)	54(33.5)	0.82 (0.48-1.42)	0.49	0.83(0.47-1.48)	0.54
	Bachelor	98(72.1)	38(27.9)	0.63(0.35-1.12)	0.11	0.68(0.37-1.25)	0.21
	TCC	47(54)	40(46)	***Reference			
C4	**Diploma**	62(38.5)	99(61.5)	1.87(1.10-3.18)	.019	1.65(0.94-2.92)	0.08
	Bachelor	63(46.3)	73(53.7)	1.36(0.79-2.33)	0.26	1.09(0.61-1.95)	0.76
	TCC	39(44.8)	48(55.2)	***Reference			
C5	**Diploma**	56(34.8)	105(65.2)	1.52(0.89-2.59)	0.12	1.3(0.73-2.28)	0.36
	Bachelor	57(41.9)	79(58.1)	1.12(0.65-1.93)	0.66	0.91(0.51-1.63)	0.76

C (component), TP (total practice), refer to Table 4.15 for details of practice components
* Significant difference at p< 0.0
**Adjusted for age, gender, work period and residence.
***Reference (TCC).

4.2.9.4 Work experience

Table 4.30 shows the association between work experience and practice levels among the participants. The result revealed that, there were statistically significant associations of work experience among the nurses with practice towards TB.

Nurses with more than five years of experience (Adjusted OR=0.25, 95% CI=0.10-0.61, *p* = 0 .002) had almost 0.75 times of unsatisfactory practice towards admission services of TB patient (component 1) compared to nurses with less than one year of experience.

The results also showed that nurses who had one to five 5 years of work experiences (Adjusted OR =2.77, 95% CI=1.38-5.56, *p* = 0 .004) had 2.77 times more satisfactory practice on TB treatment and delivery of TB drugs (component 4) compared to those with less than one year of experience.

In conclusion, there were statistically significant associations between work period experience of the nurses and practice towards TB. Nurses with one to five service years had higher satisfactory practice on TB treatment and drug delivery compared to nurses with less than one year work experience. On other hand, nurses with more than five service years had more unsatisfactory practice on admission services of TB patient compared to nurses with less than one year of work experience.

Table 4.30: Association between work period and practice towards TB (n=384)

C	Work period	Unsatisfa-ctory n (%)	Satisfa-ctory n (%)	Crude OR(95%CI)	*P-value*	**Adjusted OR(95%CI)	*P-value*
	< 1 y	42(87.5)	6(12.5)	***Reference			
TP	1-5ys	204(84.3)	38(15.7)	1.30(0.51-3.28)	0.57	1.17(0.44-3.08)	0.75
	>5 ys	80(85.1)	14(14.9)	1.22(0.43-3.42)	0.69	1.082(0.37-3.14)	0.88
	< 1 y	30(62.5)	18(37.5)	***Reference			
C1	1-5ys	185(76.4)	57(23.6)	0.51(0.26-0.98)	.046	0.52(0.25-1.06)	0.07
	>5 ys	82(87.2)	12(12.8)	0.24(0.105-0.56)	.001	0.25(0.10-0.61)	*.002
	< 1 y	42(87.5)	6(12.5)	***Reference			
C2	1-5ys	192(79.3)	50(20.7)	1.82(0.73-4.53)	0.19	1.82(0.7-4.77)	0.21
	>5 ys	74(78.7)	20(21.3)	1.89(0.70-5.08)	0.20	1.95(0.69-5.47)	0.2
	< 1 y	35(72.9)	13(27.1)	***Reference			0.27
C3	1-5ys	157(64.9)	85(35.1)	1.45(0.73-2.90)	0.28	1.71(0.8-3.66)	0.16
	>5 ys	67(71.3)	27(28.7)	1.08(0.49-2.36)	0.83	1.27(0.55-2.94)	0.56
	< 1 y	29(60.4)	19(39.6)	***Reference			
C4	1-5ys	95(39.3)	147(60.7)	2.36(1.25-4.45)	.008	2.77(1.38-5.56)	*.004
	>5 ys	48(51.1)	46(48.9)	1.46(0.72-2.96)	0.29	1.60(0.75-3.43)	0.21
	< 1 y	21(43.8)	27(56.3)	***Reference			
C5	1-5ys	106(43.8)	136(56.2)	0.99(0.53-1.86)	0.99	1.06(0.53-2.12)	0.85
	>5 ys	25(26.6)	69(73.4)	2.14(1.03-4.45)	0.04	2.09(0.95-4.62)	0.06

C (component), TP (total practice), refer to Table 4.15 for details of practice components
* Significant difference at p< 0.05.
**Adjusted for age, gender, education and residence.
***Reference (<1year).

4.2.9.5 Residence

Table 4.31 shows the association between residence and practice among the participants. The result showed that there were no statistically significant associations between residences of nurses and their practice towards TB as the obtained *p*-values of all adjusted odd ratios were higher than 0.05.

Table 4.31: Association between residence and practice towards TB (n=384)

C	Residence	Unsatisfa-ctory n (%)	Satisfa-ctory n (%)	Crude OR (95%CI)	*P-value*	**Adjusted OR (95%CI)	*P-value*
TP	Urban	151(85.8)	25(14.2)	***Reference			
	Rural	173(84)	33(16)	1.15(0.65-2.02)	0.62	1.03(0.58-1.85)	0.89
C1	Urban	139(79)	37(21)	***Reference			
	Rural	156(75.7)	50(24.3)	1.20(0.74-1.95)	0.45	1.3(0.79-2.19)	0.24
C2	Urban	136(77.3)	40(22.7)	***Reference			
	Rural	170(82.5)	36(17.5)	0.72(0.43-1.19)	0.2	0.67(0.39-1.13)	0.13
C3	Urban	122(69.3)	54(30.7)	***Reference			
	Rural	137(66.5)	69(33.5)	1.13(0.73-1.75)	0.55	1.04(0.67-1.62)	0.84
C4	Urban	59(33.5)	117(66.5)	***Reference			
	Rural	111(53.9)	95(46.1)	0.43(0.28-0.65)	0.51	0.38(0.24-0.58)	0.61
C5	Urban	62(35.2)	114(64.8)	***Reference			
	Rural	88(42.7)	118(57.3)	0.72(0.48-1.10)	0.13	0.71(0.46-1.10)	0.13

C (component), TP (total practice), refer to Table 4.15 for details of practice components
* Significant difference at p< 0.0
**Adjusted for age, gender, education and work period.
***Reference (Urban).

4.2.10 Association of knowledge and attitude with practice

Regression analysis with three models was applied to explore the association of knowledge and attitude with practice. In model 1, only the knowledge was included as independent variable. However, in model 2 age, gender, education levels, work experience and residence

were included in addition to the knowledge. Moreover, in model 3, knowledge, attitude, age, gender, education levels, work experience and residence were included.

The results revealed that at model 1 (R square =0.047, F 19.71, *P* <0.001 and beta= 0.222), had explained almost 4.7% of the practice and the knowledge had 0.22 of contribution to explain the practice. However, in model 2 (R square = 0.48, F=3.98, P <0.001) which indicated also the knowledge had unique contribution in explaining the practice. Moreover, in model 3 the beta values were low and not statistically significant (Table 4.32). In conclusion, the knowledge was significantly associated with practice.

Table 4.32: Association of knowledge and attitude with practice towards TB (n =384)

	Model 1			**Model 2**			**Model 3**		
	Beta	**t-value**	**p-value**	**Beta**	**t-value**	**p-value**	**Beta**	**t-value**	**p-value**
(Constant)		53.842	<0.001		17.034	<0.001		16.749	<0.001
TK	0.222	4.41	<0.001	.212	4.182	<0.001	0.232	4.273	<0.001
TA				-	-	-	-0.06	-1.077	0.28
Gender				-.029	-.579	.563	-0.023	-0.452	0.652
Age				-.047	-.887	.376	-0.049	-0.923	0.357
Education				-.104	-1.973	.049	-0.101	-1.921	0.056
Residence				-.076	-1.491	.137	-0.064	-1.239	0.216
Work. E				-.021	-.403	.687	-0.001	-0.023	0.981
F		19.719			3.989			3.133	
p value		<0.001			<0.001			<0.001	
R2		0.047			0.48			0.048	

TK= total knowledge, TA = total attitude, Edu = education. Work. p= work experience, R2 = R square

4.2.11 Conclusions regarding the KAP survey (Phase 2)

Out of 435 distributed questionnaires, 392 were returned, which represented a response rate of 90%. However, a further eight questionnaires were incomplete and were excluded. Therefore, 384 questionnaires were analysed. The results showed that, out of the 384 nurses who participated in the study, 327 (85.2%) had a low level of TB knowledge. Moreover, a clear knowledge gap was found among the nurses in regards to the 11 components, except for two components: knowledge on the causes and infectivity of TB (component 1) and preventive measures for TB (component 11).

With respect to association of knowledge level with demographic characteristics, there were statistically significant associations between age and knowledge level on TB among the participant. The oldest age group (> 40 years) had a significant association with knowledge score on five knowledge components and the total knowledge score. However, there was a significant association of age group 2 (26 years - 40 years) with knowledge for two components (component 5 and component 11) compared to nurses of age 18 years -25 years.

There was no significant association between the gender and level of knowledge among the participants. A significant association was found between the educational and knowledge level. With except of knowledge on clinical features, diagnosis and total score of knowledge, diploma holders had a higher knowledge level on TB regarding the entire remained knowledge components compared to the training certificate holders. However, bachelor's holders didn't show any significant association with knowledge level.

Moreover, there were significant associations between the work experience among the participant and knowledge level for three components (C1, C3 and C9). Nurses with more than five years work experiences had a higher knowledge level than nurses with less than five years work experience. Furthermore, there were significant associations between the residence of participant and knowledge for three components (C2, C4 and C6). Nurses from rural areas had a higher knowledge on TB transmission than nurses from urban areas. However, nurses from rural areas had low knowledge on TB clinical features and diagnosis compared to nurses from urban areas.

As for attitude, the overall attitude level among the nurses was negative as only 80 (20.8%) out of the 384 participants had positive attitude towards TB. A total of 302 (78.6%) on the nurses showed a phobia of TB and 269 (70.1%) of them considered TB as a social stigma. With respect to association of demographic characteristics and work experience with attitude towards TB among the participants, age and education were not significantly associated with attitude towards TB.

Moreover, there were statistically significant association between residences of the nurses and attitude towards TB; nurses from rural areas had more positive attitude towards TB compared to nurses from urban areas. Phobia of TB was higher among female participants compared to male participants. Nurses with more than five years of experience had more positive attitude compared to nurses with less than five years work experience. In respect of practice, out of the 384 participants, 326 (84.9%) of them had unsatisfactory level of practice. However, unsatisfactory level of practice was fond for all the practice components.

The level of practice was not significantly affected by age and residence of the participants. Female nurses had more satisfactory practice level on infection control measures than male nurses. Diploma holders and bachelor's holders had equal chance of unsatisfactory practice level on admission services of TB patients compared to training certificate holders. Nurses with one to five years of work experiences had more satisfactory practice level on TB treatment and delivery of TB drugs compared to nurses with less than one year work experience. On other hand, nurses with more than five years work experience had unsatisfactory practice level on admission services of TB patient compared to nurses with less than one year of work experience.

Finally, most of TB nurses in Libya showed low levels of knowledge, poor attitude and unsatisfactory practice towards TB. Their knowledge was affected by age, educational level, work experience and kind of residence but it was not affected by gender. However, their attitude was not affected by age and educational level but it was affected by gender, work experience and residence. Moreover, their practice was affected by gender, educational level and work experience but it was not affected by age and residence. Regressing analysis revealed that the knowledge was significantly associated with practice among the participants.

4.3 Phase 3: Effectiveness of TB - educational intervention

4.3.1 Demographic characteristics of the study population

4.3.1.1 Intervention group

Table 4.33 shows the demographic characteristics of the intervention group. Initially, at pre-test, there were a total of 50 nurses, but due to dropping out of three nurses in the follow-up rounds the total number of nurses involved in this test was 47. Out of these 47 participants, 13 (27.7%) were male and 34 (72.3%) were female nurses; 16 (34.0%) were 18–25 years old, 24 (51.1%) were 26–40 years old and 7 (14.9%) were more than 40 years old. Among them, 13 (27.7%) had a bachelor's degree in nursing; 20 (42.6%) had a diploma of nursing and 14 (29.8%) had a training course certificate. As for work experience, 11 (23.4%) had worked for less than 1 year; 30(63.8%) had been in the nursing profession for a period of 1–5 years and 6 (12.7%) had a work experience period of more than 5 years. 29 (61.7%) of them are urbans, while 18 (38.3%) are rural residents.

4.3.1.2 Control group

Table 4.33 shows the demographic variables of the control group. Initially, at pre-test, there were 50 nurses, but due to the dropping out of two nurses in the follow-up rounds there were a total of 48 in the control group. Out of these 48 participants 12 (25.0%) were male and 36 (75.0%) were female. A total of 13 (27.1%) were 18–25 years old, 26 (54.2%) were 26–40 years old and nine (18.8%) were more than 40 years old. Among them, 15 (31.3%) had a bachelor's degree in nursing; 19 (39.6%) had a diploma of nursing and 14 (29.2%) had a training course certificate. As regards period of work experience, 12 (25.0 %) had less than

1 year; 28 (58.3%) had 1–5 years and 8 (16.7%) had more than 5 years of work experience. 32 (66.7%) are residing in urban cities while, 12 (25%) are from rural areas.

Table 4.33: Demographic variables of the of intervention (n=47) and control group (n=48)

Variable	Level	Intervention n (%)	Control n (%)	$\chi 2$	p value
Gender	Male	13(52)	12(48)	.457	0.499
	Female	34(48.6)	36(51.4)		
Age	18-25ys	16(55.2)	13(44.8)	.480	0.787
	26-40ys	24(48)	26(52)		
	>40	7(43.8)	9(56.2)		
Education	Training certificate	14(50)	14(50)	.067	0.967
	Diploma	20(51)	19(49)		
	Bachelor	13(46.4)	15(53.6)		
Residence	Urban	29(47.5)	32(52.5)	.698	0.705
	Rural	18(53)	16(47)		
work experience	< 1 year	11(47.8)	12(52.2)	0.06	0.971
	1year - 5years	30(51.8)	28(49.2)		
	>5years	6(42.8)	8(57.2)		

4.3.2 Comparison of the knowledge, attitude and practice of the intervention and control groups at pre-test

Table 4.34 shows the scores of knowledge, attitude and practice of the two groups at bassline. The results indicated that there was no significant difference in the mean scores for knowledge at pre-test between the intervention group (M ± SD = 31.09 ± 3.33) and control group (M ± SD = 32.80 ± 3.68), p = 0.102. The results also revealed that there was no significant difference in the mean scores for attitude at pre-test between the intervention (M ± SD = 2.16 ± 0.167) and control group (M ± SD = 2.15 ± 1.64), p = 0.940. Moreover, there was no significant difference in the mean scores for practice at pre-test between the

intervention (M ± SD = 39.9 ± 4.33) and control group (M ± SD = 39.54 ± 3.93), $p = 0.556$. In conclusion, there were no significant differences in the mean scores between the two groups for knowledge, attitude, and practice at pre -test.

Table 4.34: Mean comparison between intervention (n=47) and control (n=48) Groups for knowledge, attitude and practice at pre-test

Research Variables	Group	n	Mean ±SD	T	*P-value*
Pre -Knowledge	Intervention	47	31. 09 ± 3.337	-1.650	0.102
	Control	48	32.85 ± 3.687		
Pre- Attitude	Intervention	47	2.16 ± 0.167	0.076	0.940
	Control	48	2.15 ± 0.164		
Pre- Practice	Intervention	47	39.9 ± 4.33	-0.591	0.556
	Control	48	39.54 ± 3.93		

4.3.3 Preliminary tests of assumptions for repeated measure ANOVA

The assumption for repeated measure ANOVA such as normality, homogeneity and sphericity were tested.

4.3.3.1 Normality test

According to Stevens (2012), it is necessary to evaluate the normality of all research variables before using statistical methods, especially for inferential statistics. For normally distributed data, the skewness and kurtosis should be within range of -2 to +2 (George & Mallery, 2003). In this study, the skewness was within the range of -0.51 to 0.64 and the kurtosis was in the range of -0.80 to 0.66 for all research variables, which indicated that all the variables were normally distributed (Table 4.35).

Table 4.35: Normality test for all research variables

Group	Skewness	SE	Ratio	Kurtosis	SE	Ratio
Intervention group						
Pre-test Knowledge	-0.46	0.34	-1.35	-0.26	0.66	-0.39
Post -test Knowledge	-0.25	0.34	-0.74	0.27	0.66	0.41
At 3 months Knowledge	-0.10	0.34	-0.28	0.20	0.66	0.31
At 6months Knowledge	-0.12	0.35	-0.33	-0.30	0.68	-0.43
Pre-test Attitude	0.51	0.34	1.50	-0.18	0.66	-0.27
Post-test Attitude	-0.42	0.34	-1.23	0.58	0.66	0.87
At 3 months attitude	0.33	0.34	0.99	-0.05	0.66	-0.08
At 6 months Attitude	0.35	0.35	1.02	0.66	0.68	0.98
Pre-test Practice	-0.41	0.34	-1.20	0.61	0.66	0.91
At 3 months Practice	-0.47	0.34	-1.39	-0.54	0.66	-0.82
At 6mo Practice	-0.16	0.35	-0.46	-0.41	0.68	-0.60
Control group						
Pre-test Knowledge	0.38	0.34	1.13	-0.80	0.66	-1.21
Post -test Knowledge	-0.03	0.34	-0.10	0.08	0.66	0.12
At 3 months Knowledge	-0.22	0.34	-0.66	0.04	0.66	0.06
At 6months Knowledge	-0.29	0.34	-0.84	0.17	0.67	0.24
Pre-test Attitude	0.64	0.34	1.91	0.07	0.66	0.11
*Post-test Attitude	0.33	0.34	0.96	-0.20	0.66	-0.30
At 3 months attitude	0.38	0.34	1.13	0.54	0.66	0.81
At 6 months Attitude	0.39	0.34	1.13	0.63	0.67	0.93
Pre-test Practice	0.05	0.34	0.16	0.10	0.66	0.15
At 3 months Practice	-0.48	0.34	-1.42	0.03	0.66	0.05
At 6mo Practice	-0.51	0.34	-1.48	0.30	0.67	0.44

*Post-test = (immediate post-test)

4.3.3.2 Homogeneity of variance test

The assumption of homogeneity of variance is where the variance within each of the populations is equal. This is an assumption that is required for analysis of variance ANOVA. Hence, for ANOVA there needs to be homogeneity of variance for each combination of groups. Levene's test for homogeneity of variance is more valuable when seeking to evaluate this kind of assumption. The result (Table 4.36) revealed that the variance was homogenous at pre-test, as the significant values were more than 0.05.

Table 4.36: Levene's test of equality of error variances

	Levene Statistic	df1	df2	*p-value*
Pre- Knowledge	0.74	1.00	98.00	0.39
Pre- Attitude	0.18	1.00	98.00	0.67
Pre -Practice	0.19	1.00	98.00	0.67

4.3.3.3 Sphericity test

Repeated measures ANOVA must meet the assumption of sphericity. The sphericity assumption requires that the variance of population difference score for any two conditions are the same as variance of population difference scores for any other two conditions (as assumption is commonly violated).

Mauchly's test was used to evaluate the sphericity assumption and the result showed violation of sphericity assumption for knowledge ($\chi 2$ =233.51, P=0.001), therefor the F-values were adjusted by a Greenhouse-Geisser correction (Table 4. 37).

Table 4.37: Mauchly's test of sphericity

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	p value	Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Knowledge	0.078	233.519	<0.001	0.471*	0.482	0.333
Attitude	0.845	15.406	0.009	0.916*	0.956	0.333
Practice	0.285	115.563	<0.001	0.583*	0.592	0.5

**Greenhouse-Geisser correction*

4.3.4 Effect of TB Educational intervention on knowledge

Table 4.38 shows the descriptive statistics of knowledge over time for intervention and control group. At pre-test the mean of total knowledge score for intervention group was 31.09 ± 3.33 while for control group was 32.85 ± 3.68. Moreover, immediately post-test, the mean of total knowledge score for intervention group was improved as it became 71.68 ± 3.79, while for control group was 33.60 ± 4.22. Three months later, the mean for intervention group was 69.62 ± 3.25 and for control group was 34.38 ± 4.27. At 6-month follow-up, the mean for intervention group became 70.06 ± 3.06 while for the control group was 34.79 ± 4.32.

Table 4.38: Mean ± SD of total knowledge score for intervention and control group across the time

Times	Group	n	Mean ±SD
Pre-test knowledge	Intervention	47	31.09 ± 3.337
	Control	48	32.85 ± 3.687
Immediate post-test knowledge	Intervention	47	71.68 ± 3.79
	Control	48	33.60 ± 4.22
At 3-month follow-up knowledge	Intervention	47	69.62 ± 3.25
	Control	48	34.38 ± 4.27
At 6-month follow-up knowledge	Intervention	47	70.06 ± 3.06
	Control	48	34.79 ± 4.32

Table 4.39 shows the overall effect of time, group and time* group interaction on knowledge. The result indicated that was statistically significant ($F = 1772.6$, $p < 0.001$, $\eta 2 = 0.950$). The main effect of group was also statistically significant ($F = 1680.9$, $p < 0.001$, $\eta 2 = 0.948$). The result also revealed that the interaction between group and time was statistically significant ($F = 1524.4$, $p < 0.001$, $\eta 2 = 0.943$), which means that the groups had a different pattern for knowledge over time.

Table 4.39: Summary of within and between subjects ANOVA for knowledge

Source	MS	F	*P* -value	η^2
Time	20544.3	1772.6*	<0.001	0.950
Group	68553.9	1680.9*	<0.001	0.948
Time * Group	17667.7	1524.4*	<0.001	0.943

* Significant at 0.05 level, MS=Mean square,

Table 4.40: Mean comparison of knowledge between groups across the time

Test	Groups		MD	*P* value	95% CI		η^2
	Intervention n=47 M±SD	Control n=48 M±SD			Lower Bound	Upper Bound	
Pre-test	31.09 ± 3.33	32.85 ± 3.68	-1.154	0.117	-2.60	0.29	0.026
Post-test	71.68 ± 3.79	33.60 ± 4.22	38.077*	<0.001	36.44	39.71	0.958
Follow-up 3 -month	69.62 ± 3.25	34.38 ± 4.27	35.263*	<0.001	33.71	36.81	0.957
Follow-up 6 -month	70.06 ± 3.06	34.79 ± 4.32	35.272*	<0.001	33.74	36.8	0.958

** The mean difference is significant at the .05 level. MD: mean difference*

Table 4.40 shows the comparison of the means of total of knowledge score between the two groups and over time. The results revealed that the difference in the knowledge scores between the intervention and control groups at pre-test was not statistically significant ($p > 0.05$), while there were significant differences in the knowledge scores between the intervention and control groups at immediate post-test, at 3-month follow-up and at 6-month follow-up ($p < 0.05$).

Separate comparisons for each group were performed to determine the effect of the TB educational intervention on the knowledge scores at pre-test, immediate post-test, at 3-month follow-up and at 6-month follow-up in the intervention and control groups (Table 4.41).

The results showed that the mean of total knowledge score for the intervention group at pre-test was significantly different from the knowledge score at immediate post-test and at 3-month and 6-month follow-up ($p = <0.001$, $\eta 2 = 0.979$). However, the post-test knowledge score was not significantly different from the knowledge scores at 3-month and 6-month follow-up. Moreover, there was no significant difference in the knowledge score between the 3-month and 6-month follow-up tests.

For the control group, the result indicated that knowledge score at pre-test was not significantly ($p > 0.05$) different from the knowledge score at immediate post-test, 3-month follow-up and 6-month follow-up. Furthermore, the immediate post-test knowledge score was also not significantly different from the knowledge score at 3-month and 6-month follow-up. Moreover, there was no significant difference between the 3-month and 6-month follow-up knowledge scores ($p > 0.05$). Thus there were no significant differences in the mean of total knowledge score among control group across the time.

Table 4.41: Mean comparison of knowledge across the time for each group

Group	(I) Time	(J) Time	MD	P value	95% CI Difference		η^2
					Lower Bound	Upper Bound	
Intervention n=47	1	2	-40.085*	<0.001	-41.773	-38.397	0.979
	1	3	-38.043*	<0.001	-39.795	-36.29	
	1	4	-38.468*	<0.001	-40.165	-36.771	
	2	3	2.043	0.891	1.279	2.806	
	2	4	1.617	0.101	0.824	2.41	
	3	4	-.426	0.21	-0.779	-0.072	
Control n=48	1	2	-0.854	1	-2.524	0.816	0.232
	1	3	-1.625	0.079	-3.359	0.109	
	1	4	-2.042	0.119	-3.721	-0.363	
	2	3	-.771	0.103	-1.526	-0.016	
	2	4	-1.188	0.121	-1.972	-0.403	
	3	4	-.417	0.081	-0.766	-0.067	

* MD= mean difference is significant at p <0.001, (1= pre-test, 2= immediately post-test, 3= at3 months follow-up, 4= at 6 months follow-up)

Figure 4.2 shows the plot of the mean scores for total knowledge of the intervention and control groups over time. It is very clear that in the intervention group the knowledge mean score increased at immediate post-test, then slightly decreased at 3-month follow-up and became stationary at 6-month follow-up, whereas it was constant in the control group over time.

Table 4.42 shows the means and standard deviations of the knowledge components for the intervention group at 4 different points of time (pre-test, immediate post-test, 3-month follow-up and 6-month follow-up). The results revealed that with the exception of the knowledge component regarding the causes and infectivity of TB (component 1, p=0.016) and the knowledge component regarding preventive measures of TB (component 11, p=0.217), there were significant changes in mean score (p <0.001) among the remaining nine knowledge components across time, since the mean scores increased from pre-test to immediate post-test, and this increased mean scores remained stable and significant at 3-month follow-up and 6-month follow-up.

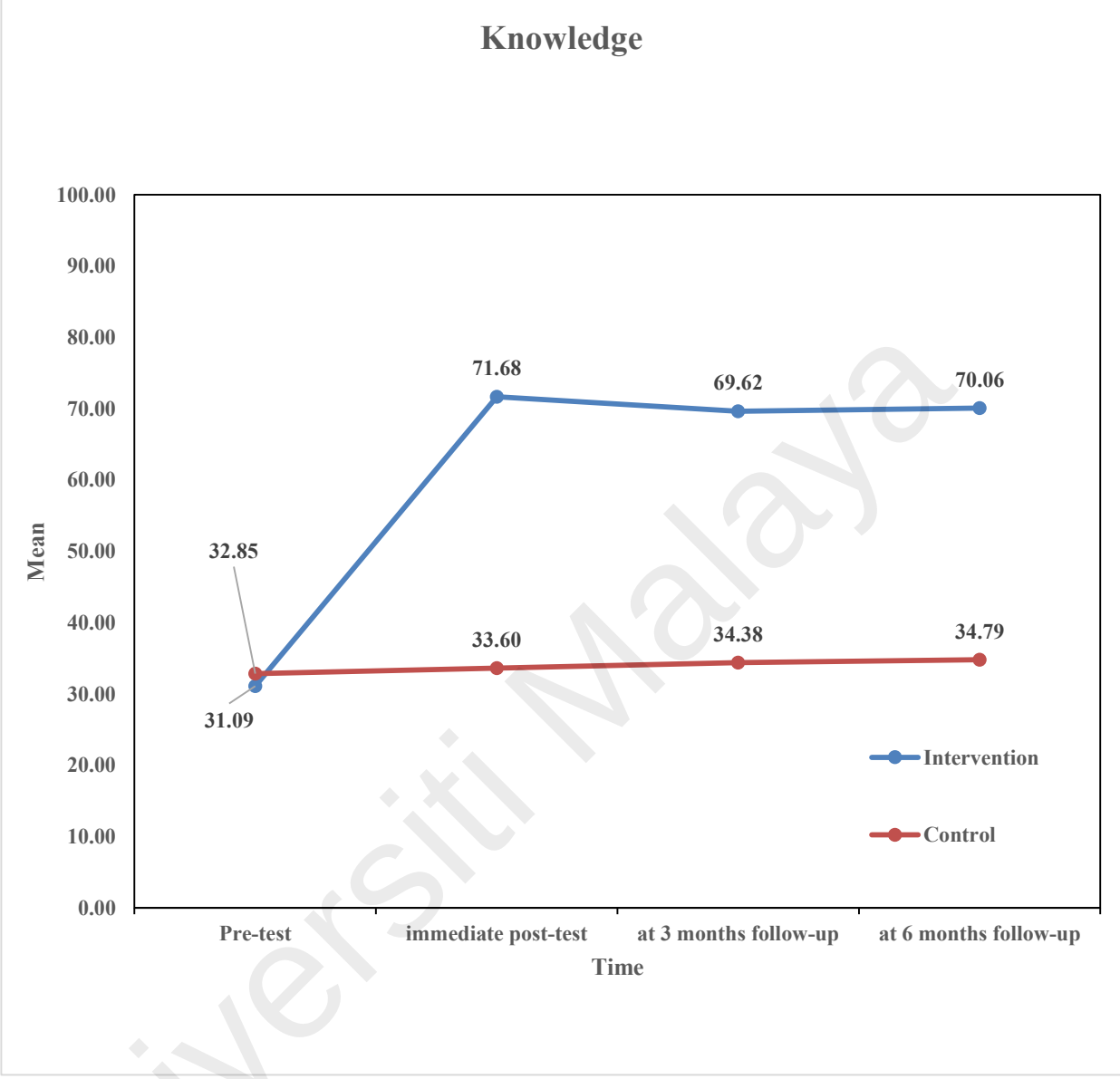


Figure 4.2: Mean plot of knowledge mean score in groups across the time

Table 4.43 shows the mean and standard deviation of the knowledge components for the control group at 4 different points of time (pre-test, immediate post-test, at 3-month follow-up and at 6-month follow-up. The results revealed that there were no significant changes in mean score among all the knowledge components across the time.

Table 4.42: Mean score of knowledge components for intervention group over the time (n=47)

KC	Pre-test M±SD	immediate Post-test M±SD	3months follow-up M±SD	6months follow-up M±SD	p-value
C1	3.26 ± 0.64	3.3 ± 0.66	3.28 ± 0.68	3.15 ± 0.72	0.016
C2	1.81 ± 1.14	4.06 ± 1.49	4.23 ± 1.4	3.94 ± 1.47	<0.001
C3	4.81 ± 1.66	10.81± 0.97	10.72 ± 1.02	10.55 ± 0.9	<0.001
C4	4.36 ± 1.42	7.7 ± 0.93	7.49 ± 0.95	7.32 ± 0.91	<0.001
C5	1.13 ± 1.17	5.26 ± 1.42	4.94 ± 1.47	5.15 ± 1.23	<0.001
C6	1.83 ± 0.43	1.98 ± 0.15	1.94 ± 0.25	1.81 ± 0.45	<0.001
C7	0.79 ± 0.91	4.96 ± 0.2	4.77 ± 0.43	4.72 ± 0.45	<0.001
C8	0.96 ± 1.02	4 ± 0.01	3.79 ± 0.41	3.7 ± 0.51	<0.001
C9	5.98 ± 2.42	22.23 ± 1.88	21.23 ± 1.89	21.11±1.95	<0.001
C10	1.36 ± 0.76	2.38 ±0.8	2.32 ± 0.78	2.28 ± 0.77	<0.001
C11	4.81 ± 0.88	5 ± 0.86	4.83 ± 0.82	4.89 ± 0.81	0.217

KC (knowledge component), C (component), refer to table 4.44 for details of knowledge components

Table 4.43: Mean scores of knowledge components for control group over time (n=48)

KC (knowledge component), C (component), refer to table 4.44 for details of knowledge components

KC	Pre-test M±SD	immediate Post-test M±SD	3months follow-up M±SD	6months follow-up M±SD	p-value
C1	3.25 ± 0.53	3.25 ± 0.53	3.21 ± 0.54	3.23 ± 0.52	0.293
C2	3.1 ± 1.17	2.9 ± 1.06	2.73 ± 1.11	3 ± 1.07	0.06
C3	5.98 ± 2.25	5.85 ± 2.08	5.85 ± 2.08	5.85 ± 2.08	0.36
C4	3.31 ± 2.28	3.48 ± 2.13	3.52 ± 2.06	3.56 ± 2.06	0.112
C5	1.19 ± 0.98	1.29 ± 1.03	1.33 ± 1.02	1.4 ± 1.05	0.068
C6	1.31 ± 0.9	1.29 ± 0.9	1.21 ± 0.85	1.35 ± 0.84	0.129
C7	1.06 ± 0.89	1.38 ± 1.04	1.42 ± 1.03	1.5 ± 1.09	0.107
C8	0.98 ± 1	1.15 ± 1.03	1.31 ± 1.09	1.35 ± 1.1	0.104
C9	6.31 ± 2.95	6.71 ± 3.37	7.25 ± 3.35	7.38 ± 3.33	0.114
C10	1.5 ± 0.8	1.56 ± 0.9	1.63 ± 0.96	1.54 ± 0.9	0.334
C11	4.85 ± 0.74	4.81 ± 0.73	4.75 ± 0.79	4.63 ± 0.89	0.101

Table 4.44 shows the detail of knowledge items. Table 4.45 shows the proportion of nurses with correct responses for the knowledge items over time in intervention group.

It was found that with the exception of knowledge items (1, 2, 3, & 4) regarding causes and infectivity, two knowledge items regarding TB transmission (5, 6), one item regarding cough for two weeks (23), two items regarding diagnosis of TB (34 & 35) and 6 items regarding TB prevention (75,76,77,78,79 & 80), the nurses in the intervention group showed significantly greater number of correct responses ($p < 0.001$) for the all the remaining knowledge items at immediate post-test compared to that at pre-test. The increase in the number of correct response remained stable and significant at 3-months and 6-months follow-up.

Table 4.46 shows the portions of correct response for the knowledge items at four different points of time (pre-test, immediately post-test, at 3-months and 6-months follow-up) among the nurses in the control group. The results revealed that there were no significant changes in the proportions of the correct responses for all knowledge items among the nurses in the control group over time.

In conclusion, there was significant improvement of correct responses was observed on majority of knowledge items among the nurses in intervention group, while the nurses control group didn't show any significant improvement on knowledge items.

Table 4.44: Details of knowledge items

No	Knowledge items:
Based on your knowledge about TB -causes and infectivity (component1) ,please check all	
1	The microbe that cause tuberculosis is a bacteria

2	Tuberculosis is considered a serious disease
3	Tuberculosis is a contagious can be spread from one to other
4	The people may become infected with TB more than once in their lifetime
In your opinion, how the person became infected with TB? (component 2) please check all	
5	Through handshakes
6	Through the air when a person with TB coughs
7	Drinking unpasteurized and non-sterile Cow's milk
8	Through sharing the TB-infected person the same plate during eating or the same cup during drinking
9	Through touching items in public places (doorknobs, handles in transportation)
10	Through sexual intercourse
In your opinion, who are the persons most likely to become infected with TB? (component 3), please check all	
11	person with HIV/AIDS
12	Person with poor nutritional state
13	Person who living in Crowding
14	Homeless person
15	Patient with Long hospital admission
16	Health care workers
17	Prison inmates
18	Children under five- years
19	Farmer
20	Family members of a confirmed case
21	Person with occupational lung disease
About TB- symptoms , signs and affected organ, what is/are the main symptom(s) and sign(s) that could be appeared on infected person (component 4), please check all	
22	Cough up blood
23	Coughing for over two weeks
24	Fever for over two weeks
25	Loss of appetite
26	Night sweating
27	Chest pain and shortness of breath
28	Total weakness
29	Weight loss
Other than lungs ,common sites in the body may also affected by TB (component 5) is /are, please check all	
30	Lymph node
31	Kidney
32	Brain
33	Spinal cord
Regarding the diagnosis of TB infection (component 6) ,please check all	
34	Sputum Smear Microscopy and Culture is the gold test for TB-diagnosis
35	Chest X-ray is helpful test for diagnosis of pulmonary tuberculosis

Table 4.44: Details of knowledge items (continued)

No	Knowledge items:
Regarding interpretation of tuberculin skin test (TST), Induration of >5 mm is considered positive for some cases (component 7). Based on your knowledge, please check all	
36	People living with HIV
37	Recent close contacts of people with infectious TB

38	People with chest x-ray findings of TB disease
39	People with organ transplants
40	Other immunosuppressed patients
In your opinion, what is/are the advantages of Interferon-Gamma Release Assays (IGRA) test (component 8) please check all	
41	Results can be available in 24 hours
42	Does not cause booster phenomenon
43	Less likely to have incorrect reading of results as compared to TST
44	BCG vaccination does not affect the results
Regarding TB treatment and delivering of anti -TB drugs (component 9), please check all	
45	DOTS regimen is the recommended treatment of newly active TB
46	The standard length of treatment for a newly diagnosed case of TB is ≥6 months
47	Regarding treatment of TB, Hearing loss and ototoxicity is considered side effect of Amikacin
48	Hepatotoxicity is considered side effect of Ethambutol
49	Ethambutol can be taken after meals because it does not interact with foods
50	The nurse should monitor patients consuming ethambutol for vision changes, blurring and colour blindness
51	Dizziness, vertigo, tinnitus, disequilibrium and loss of hearing are among the side-effects of streptomycin
52	Isoniazid, rifampin, pyrazinamide and ethambutol are first-line drugs used in TB- treatment
53	Second-line drug combination used to treat tuberculosis includes prednol, teofilin, ephedrine and isoniazid
54	Direct Observation Therapy Strategy refers to observation of the patient by an educated person while properly consuming all the doses of the drugs
55	Ethambutol can be used for tuberculosis prophylaxis in patients who are at risk
56	Presence of acid-fast bacillus in the sputum samples of patients during the fifth month of medical treatment indicates multi-drug resistance.
57	If the patient did not consume anti-tuberculosis drug daily, the nurse can double the dose the next day
58	The nurse should administer streptomycin through an intramuscular
59	Multidrug resistant tuberculosis (MDR TB) is caused by an organism resistant to both isoniazid and rifampicin
60	The main reason of multi-drug resistance during tuberculosis therapy is use of drug combinations
61	Anti-tuberculosis treatment should be terminated in patients receiving haemodialysis
62	The nurse should explain to women that rifampin might decrease the effects of oral hormone-based contraceptives
63	Patients using rifampin should be monitored for signs and symptoms of anaemia and thrombocytopenia
64	Diabetic patients on rifampin should be monitored for blood-urine glucose level during treatment course
65	Isoniazid might be less effective when used with antacids containing aluminium hydroxide

Table 4.44: Details of knowledge items (continued)

No	**Knowledge items:**
66	The nurse should explain to mothers of newborns to avoid breast-feeding the baby while on isoniazid therapy

67 If the patient has nausea and vomiting during treatment, the oral form of rifampin can be given in divided doses at different times in a day.
68 Patients with multi-drug resistance should continue therapy with the same treatment regimen drugs for extra one (1) month

In your opinion , which of the following test/tests is/are used in monitoring of MDR-TB treatment (component 10) please check all

69 Sputum smear and culture
70 Liver Function Test
71 Chest X-Ray

What do you consider to be the main risk to the patient associated with incomplete or interrupted treatment course for TB

72 Worsening of symptoms and prolonged treatment course
73 Development of drug-resistance
74 Death

Regarding prevention of TB infection, what do you think are the best ways a person can prevent getting aTB (component 11)?

75 Avoidance of direct contact of TB patient
76 By taking a healthy diet and doing a lot of physical activities
77 By avoiding alcohol and other drug abuse
78 By wearing face mask as Personal protective Equipment (PPE)
79 By living in ventilated residences
80 By vaccination against the disea**se**

Table 4.45: Correct responses of knowledge items over the time of intervention group (n=47)

*Knowledge items	Pre-test Correct (%)	Immediate Post- test Correct (%)	At 3 month Correct (%)	At 6 month Correct (%)	p-value

Knowledge 1	41(87.2)	41(87.2)	40(85.1)	39(83)	0.3
Knowledge 2	44(93.6)	44(93.6)	44(93.6)	43(91.5)	0.245
Knowledge 3	46(97.9)	46(97.9)	46(97.9)	44(93.6)	0.112
Knowledge 4	22(46.8)	24(51.1)	24(51.1)	22(46.8)	0.261
Knowledge 5	15(31.9)	20(42.6)	20(42.6)	19(40.4)	0.102
Knowledge 6	32(68.1)	32(68.1)	32(68.1)	31(66)	0.392
Knowledge 7	7(14.9)	24(51.1)	25(53.2)	24(51.1)	<0.001
Knowledge 8	5(10.6)	28(59.6)	33(70.2)	28(59.6)	<0.001
Knowledge 9	12(25.5)	42(89.4)	44(93.6)	38(80.9)	<0.001
Knowledge 10	14(29.8)	45(95.7)	45(95.7)	44(93.6)	<0.001
Knowledge 11	15(31.9)	46(97.9)	46(97.9)	44(93.6)	<0.001
Knowledge 12	17(36.2)	46(97.9)	46(97.9)	46(97.9)	<0.001
Knowledge 13	37(78.7)	46(97.9)	45(95.7)	45(95.7)	<0.001
Knowledge 14	22(46.8)	46(97.9)	46(97.9)	45(95.7)	<0.001
Knowledge 15	14(29.8)	46(97.9)	46(97.9)	44(93.6)	<0.001
Knowledge 16	36(76.6)	47(100)	47(100)	46(97.9)	<0.001
Knowledge 17	18(38.3)	47(100)	47(100)	45(95.7)	<0.001
Knowledge 18	10(21.3)	46(97.9)	44(93.6)	43(91.5)	<0.001
Knowledge 19	11(23.4)	46(97.9)	46(97.9)	47(100)	<0.001
Knowledge 20	29(61.7)	46(97.9)	45(95.7)	46(97.9)	<0.001
Knowledge 21	17(36.2)	46(97.9)	46(97.9)	45(95.7)	<0.001
Knowledge 22	24(51.1)	47(100)	46(97.9)	43(91.5)	<0.001
Knowledge 23	45(95.7)	47(100)	46(97.9)	45(95.7)	0.468
Knowledge 24	40(85.1)	46(97.9)	45(95.7)	43(91.5)	0.06
Knowledge 25	28(59.6)	46(97.9)	46(97.9)	46(97.9)	<0.001
Knowledge 26	15(31.9)	46(97.9)	43(91.5)	42(89.4)	<0.001
Knowledge 27	28(59.6)	43(91.5)	42(89.4)	42(89.4)	<0.001
Knowledge 28	17(36.2)	45(95.7)	43(91.5)	43(91.5)	<0.001
Knowledge 29	5(10.6)	42(89.4)	41(87.2)	40(85.1)	<0.001
Knowledge 30	9(19.1)	40(85.1)	39(83)	41(87.2)	<0.001
Knowledge 31	9(19.1)	44(93.6)	42(89.4)	41(87.2)	<0.001
Knowledge 32	4(8.5)	43(91.5)	40(85.1)	43(91.5)	<0.001
Knowledge 33	8(17)	44(93.6)	40(85.1)	41(87.2)	<0.001
Knowledge 34	41(87.2)	46(97.9)	44(93.6)	42(89.4)	0.127
Knowledge 35	45(95.7)	47(100)	47(100)	43(91.5)	0.041
Knowledge 36	10(21.3)	45(95.7)	43(91.5)	43(91.5)	<0.001

Table 4.45: Correct responses of knowledge items over the time of intervention group (n=47) (continued)

*Knowledge items	Pre-test Correct (%)	Immediate Post- test Correct (%)	At 3 month Correct (%)	At 6 month Correct (%)	p-value

Knowledge 37	9(19.1)	47(100)	47(100)	46(97.9)	<0.001
Knowledge 38	6(12.8)	47(100)	44(93.6)	44(93.6)	<0.001
Knowledge 39	6(12.8)	47(100)	44(93.6)	43(91.5)	<0.001
Knowledge 40	6(12.8)	47(100)	46(97.9)	46(97.9)	<0.001
Knowledge 41	9(19.1)	47(100)	46(97.9)	44(93.6)	<0.001
Knowledge 42	4(8.5)	47(100)	43(91.5)	43(91.5)	<0.001
Knowledge 43	16(34)	47(100)	45(95.7)	44(93.6)	<0.001
Knowledge 44	16(34)	47(100)	44(93.6)	43(91.5)	<0.001
Knowledge 45	29(61.7)	47(100)	47(100)	47(100)	<0.001
Knowledge 46	21(44.7)	47(100)	47(100)	47(100)	<0.001
Knowledge 47	11(23.4)	47(100)	41(87.2)	43(91.5)	<0.001
Knowledge 48	6(12.8)	47(100)	42(89.4)	43(91.5)	<0.001
Knowledge 49	12(25.5)	47(100)	42(89.4)	43(91.5)	<0.001
Knowledge 50	9(19.1)	47(100)	45(95.7)	45(95.7)	<0.001
Knowledge 51	6(12.8)	46(97.9)	44(93.6)	43(91.5)	<0.001
Knowledge 52	16(34)	47(100)	43(91.5)	44(93.6)	<0.001
Knowledge 53	17(36.2)	46(97.9)	45(95.7)	44(93.6)	<0.001
Knowledge 54	14(29.8)	47(100)	44(93.6)	43(91.5)	<0.001
Knowledge 55	9(19.1)	45(95.7)	44(93.6)	43(91.5)	<0.001
Knowledge 56	8(17)	45(95.7)	44(93.6)	43(91.5)	<0.001
Knowledge 57	28(59.6)	45(95.7)	43(91.5)	42(89.4)	<0.001
Knowledge 58	13(27.7)	44(93.6)	40(85.1)	40(85.1)	<0.001
Knowledge 59	6(12.8)	38(80.9)	36(76.6)	37(78.7)	<0.001
Knowledge 60	7(14.9)	40(85.1)	40(85.1)	39(83)	<0.001
Knowledge 61	16(34)	43(91.5)	42(89.4)	42(89.4)	<0.001
Knowledge 62	4(8.5)	41(87.2)	39(83)	37(78.7)	<0.001
Knowledge 63	17(36.2)	45(95.7)	43(91.5)	43(91.5)	<0.001
Knowledge 64	5(10.6)	40(85.1)	40(85.1)	40(85.1)	<0.001
Knowledge 65	11(23.4)	44(93.6)	43(91.5)	42(89.4)	<0.001
Knowledge 66	6(12.8)	39(83)	38(80.9)	37(78.7)	<0.001
Knowledge 67	0(0)	35(74.5)	33(70.2)	33(70.2)	<0.001
Knowledge 68	10(21.3)	33(70.2)	33(70.2)	32(68.1)	<0.001
Knowledge 69	27(57.4)	41(87.2)	40(85.1)	38(80.9)	<0.001
Knowledge 70	7(14.9)	31(66)	30(63.8)	30(63.8)	<0.001
Knowledge 71	30(63.8)	40(85.1)	39(83)	39(83)	<0.001

Table 4.45: Correct responses of knowledge items over the time of intervention group (n=47) (continued)

*Knowledge items	Pre-test Correct (%)	Immediate Post- test Correct (%)	At 3 month Correct (%)	At 6 month Correct (%)	p-value

Knowledge 72	8(17)	28(59.6)	24(51.1)	24(51.1)	<0.001
Knowledge 73	8(17)	28(59.6)	27(57.4)	30(63.8)	<0.001
Knowledge 74	7(14.9)	20(42.6)	20(42.6)	22(46.8)	<0.001
Knowledge 75	31(66)	35(74.5)	35(74.5)	36(76.6)	0.209
Knowledge 76	46(97.9)	46(97.9)	46(97.9)	46(97.9)	1
Knowledge 77	29(61.7)	34(72.3)	32(68.1)	33(70.2)	0.112
Knowledge 78	44(93.6)	45(95.7)	42(89.4)	44(93.6)	0.284
Knowledge 79	44(93.6)	43(91.5)	40(85.1)	41(87.2)	0.058
Knowledge 80	32(68.1)	32(68.1)	32(68.1)	30(63.8)	0.112

* Referred to table 4.44for item details

Table 4.46: Correct responses of knowledge items across the time of control group (n=48)

*Knowledge items	Pre-test Correct (%)	Immediate Post- test Correct (%)	At 3 month Correct (%)	At 6 month Correct (%)	p-value
Knowledge 1	43(89.6)	43(89.6)	43(89.6)	42(87.5)	1
Knowledge 2	45(93.8)	45(93.8)	45(93.8)	45(93.8)	0.682
Knowledge 3	47(97.9)	44(91.7)	46(95.8)	47(97.9)	1
Knowledge 4	21(43.8)	21(43.8)	21(43.8)	21(43.8)	1
Knowledge 5	17(35.4)	16(33.3)	16(33.3)	16(33.3)	0.392
Knowledge 6	44(91.7)	44(91.7)	44(91.7)	44(91.7)	1
Knowledge 7	18(37.5)	17(35.4)	17(35.4)	17(35.4)	0.392
Knowledge 8	24(50)	23(47.9)	23(47.9)	23(47.9)	0.342
Knowledge 9	23(47.9)	20(41.7)	20(41.7)	20(41.7)	0.03
Knowledge 10	23(47.9)	19(39.6)	19(39.6)	19(39.6)	0.07
Knowledge 11	34(70.8)	33(68.8)	33(68.8)	33(68.8)	0.392
Knowledge 12	30(62.5)	28(58.3)	28(58.3)	28(58.3)	0.112
Knowledge 13	43(89.6)	42(87.5)	42(87.5)	42(87.5)	0.392
Knowledge 14	35(72.9)	33(68.8)	33(68.8)	33(68.8)	0.112
Knowledge 15	22(45.8)	19(39.6)	19(39.6)	19(39.6)	0.3
Knowledge 16	37(77.1)	37(77.1)	37(77.1)	37(77.1)	1

Table 4.46: Correct responses of knowledge items across the time of control group (n=48) (Continued)

*Knowledge items	Pre-test Correct (%)	Immediate Post- test Correct (%)	At 3 month Correct (%)	At 6 month Correct (%)	p-value

Knowledge 17	26(54.2)	26(54.2)	26(54.2)	26(54.2)	1
Knowledge 18	14(29.2)	14(29.2)	14(29.2)	14(29.2)	1
Knowledge 19	13(27.1)	12(25)	12(25)	12(25)	0.261
Knowledge 21	13(27.1)	15(31.3)	15(31.3)	15(31.3)	0.112
Knowledge 22	23(47.9)	23(47.9)	23(47.9)	23(47.9)	1
Knowledge 23	33(68.8)	34(70.8)	32(66.7)	33(68.8)	0.733
Knowledge 24	32(66.7)	32(66.7)	32(66.7)	32(66.7)	1
Knowledge 25	14(29.2)	14(29.2)	15(31.3)	15(31.3)	0.392
Knowledge 26	11(22.9)	13(27.1)	14(29.2)	14(29.2)	0.066
Knowledge 27	16(33.3)	17(35.4)	17(35.4)	17(35.4)	0.412
Knowledge 28	14(29.2)	15(31.3)	15(31.3)	16(33.3)	0.261
Knowledge 29	16(33.3)	19(39.6)	20(41.7)	21(43.8)	0.15
Knowledge 30	10(20.8)	11(22.9)	11(22.9)	12(25)	0.261
Knowledge 31	10(20.8)	11(22.9)	10(20.8)	10(20.8)	0.733
Knowledge 32	8(16.7)	8(16.7)	8(16.7)	9(18.8)	0.301
Knowledge 33	7(14.6)	9(18.8)	9(18.8)	10(20.8)	0.096
Knowledge 34	29(60.4)	30(62.5)	30(62.5)	31(64.6)	0.572
Knowledge 35	34(70.8)	32(66.7)	32(66.7)	34(70.8)	0.572
Knowledge36	11(22.9)	13(27.1)	13(27.1)	13(27.1)	0.112
Knowledge37	11(22.9)	14(29.2)	14(29.2)	14(29.2)	0.234
Knowledge 38	11(22.9)	13(27.1)	14(29.2)	15(31.3)	0.241
Knowledge 39	9(18.8)	13(27.1)	14(29.2)	17(35.4)	0.22
Knowledge 40	9(18.8)	13(27.1)	13(27.1)	13(27.1)	0.46
Knowledge 41	12(25)	16(33.3)	18(37.5)	18(37.5)	0.12
Knowledge 42	12(25)	13(27.1)	15(31.3)	15(31.3)	0.318
Knowledge 43	9(18.8)	14(29.2)	16(33.3)	16(33.3)	0.01
Knowledge 44	14(29.2)	12(25)	14(29.2)	16(33.3)	0.47
Knowledge 45	22(45.8)	17(35.4)	19(39.6)	19(39.6)	0.084
Knowledge 46	22(45.8)	18(37.5)	22(45.8)	22(45.8)	0.308
Knowledge 47	12(25)	9(18.8)	10(20.8)	10(20.8)	0.392
Knowledge 48	11(22.9)	10(20.8)	11(22.9)	13(27.1)	0.655
Knowledge 49	20(41.7)	19(39.6)	19(39.6)	19(39.6)	0.934
Knowledge 50	9(18.8)	10(20.8)	10(20.8)	10(20.8)	0.956
Knowledge 51	4(8.3)	6(12.5)	6(12.5)	7(14.6)	0.096
Knowledge 52	16(33.3)	18(37.5)	19(39.6)	20(41.7)	0.172

Table 4.46: Correct responses of knowledge items across the time of control group (n=48) (Continued)

*Knowledge items	Pre-test Correct (%)	Immediate Post- test Correct (%)	At 3 month Correct (%)	At 6 month Correct (%)	p-value
Knowledge 53	16(33.3)	15(31.3)	16(33.3)	16(33.3)	0.857

Knowledge 54	13(27.1)	16(33.3)	17(35.4)	17(35.4)	0.16
Knowledge 55	13(27.1)	14(29.2)	15(31.3)	15(31.3)	0.629
Knowledge 56	3(6.3)	7(14.6)	9(18.8)	9(18.8)	0.007
Knowledge 57	25(52.1)	26(54.2)	26(54.2)	27(56.3)	0.261
Knowledge 58	14(29.2)	17(35.4)	18(37.5)	18(37.5)	0.019
Knowledge 59	7(14.6)	12(25)	14(29.2)	14(29.2)	0.01
Knowledge 60	6(12.5)	9(18.8)	9(18.8)	9(18.8)	0.29
Knowledge 61	14(29.2)	15(31.3)	15(31.3)	16(33.3)	0.194
Knowledge 62	11(22.9)	15 (31.3)	16(33.3)	16(33.3)	0.037
Knowledge 63	14(29.2)	14(29.2)	16(33.3)	17(35.4)	0.19
Knowledge 64	12(25)	13(27.1)	14(29.2)	13(27.1)	0.194
Knowledge 65	7(14.6)	9(18.8)	12(25)	12(25)	0.07
Knowledge 66	15(31.3)	17(35.4)	18(37.5)	18(37.5)	0.261
Knowledge 67	9(18.8)	8(16.7)	9(18.8)	9(18.8)	0.733
Knowledge 68	8(16.7)	8(16.7)	7(14.6)	7(14.6)	0.392
Knowledge 69	30(62.5)	30(62.5)	29(60.4)	29(60.4)	0.392
Knowledge 70	8(16.7)	9(18.8)	10(20.8)	10(20.8)	0.46
Knowledge 71	34(70.8)	33(68.8)	33(68.8)	33(68.8)	0.925
Knowledge 72	7(14.6)	8(16.7)	8(16.7)	8(16.7)	0.392
Knowledge 73	6(12.5)	7(14.6)	10(20.8)	10(20.8)	0.017
Knowledge 74	9(18.8)	8(16.7)	8(16.7)	8(16.7)	0.39
Knowledge 75	33(68.8)	32(66.7)	30(62.5)	30(62.5)	0.61
Knowledge 76	47(97.9)	47(97.9)	47(97.9)	47(97.9)	1
Knowledge 77	27(56.3)	26(54.2)	24(50)	25(52.1)	0.196
Knowledge 78	46(95.8)	46(95.8)	46(95.8)	46(95.8)	1
Knowledge 79	47(97.9)	48(100)	46(95.8)	47(97.9)	0.94
Knowledge 80	32(66.7)	33(68.75)	31(64.58)	34(70)	0.89

* Referred to table 4.44 for item details

4.3.5 Effect of TB educational intervention on attitude

Table 4.47 shows the descriptive statistics for the attitude of the groups over time. At pre-test the mean of total attitude score for intervention group was 2.16 ± 0.17 while for control

group was 2.15 ± 0.17, moreover, at immediate post-test, the mean of total attitude score for intervention group was 3.93 ± 0.31, while for control group was 2.21 ± 0.28.

Three months later, the mean of total attitude score for intervention group was 4.01 ± 0.29 and for control group was 2.22 ± 0.21. At 6 month follow-up, the mean of total attitude for intervention group became 3.91 ± 0.26 while for the control group was 2.20 ± 0.23. Thus, among the intervention group there were significant improvements of attitude (reduction of stigma and phobia of TB) at immediately post-test and these improvements remained stable over the time. On other hand, there were no significant changes in the mean of total attitude score across the time among the control group.

Table 4.47: Mean of total attitude score over the time for the two groups

Times	Group	n	Mean ±SD
Pre-test attitude	Intervention	47	2.16 ± 0.17
	Control	48	2.15 ± 0.17
Immediate post –test attitude	Intervention	47	3.93 ± 0.31
	Control	48	2.21 ± 0.28
At 3-month follow-up attitude	Intervention	47	4.01 ± 0.29
	Control	48	2.22 ± 0.21
At 6-month follow-up attitude	Intervention	47	3.91 ± 0.26
	Control	48	2.20 ± 0.23

Table 4.48 shows the overall effect of time, group and time* group interaction on attitude. The results showed that the overall effect of time on attitude was statistically significant ($F = 548.563$, $p < 0.001$, $\eta 2 = 0.855$) and that the main effect of group was also statistically significant ($F = 1267.27$, $p < 0.001$, $\eta 2 = 0.932$). The results also showed that the interaction

between group and time was statistically significant (F = 477.43, p < 0.001, η2 = 0.837), which means groups had a different pattern for attitude over time.

Table 4.48: Summary of within – between subjects ANOVA for attitude

source	MS	F	P value	η^2
Time	22.288	548.563*	<0.001	0.855
Group	162.36	1267.27*	<0.001	0.932
Time * Group	19.398	477.43*	<0.001	0.837

* Significant at 0.05 level, MS=Mean square

Table 4.49 shows the comparison of the mean scores for attitude between the groups and over time. The results of the Bonferroni test revealed that the difference in the mean of total attitude score between the intervention and control group at pre-test was not statistically significant (P > 0.05). However, there were significant differences in the mean of total attitude scores between the intervention and control groups at post-test, at the 3-month and 6-month follow-up (p < 0.001).

Table 4.49: Mean comparison of attitude between groups across the time

Test	**Groups**		**MD**	***P* value**	**95% CI**		η^2
	Intervention n=47 M±SD	**Control n=48 M±SD**			**Lower Bound**	**Upper Bound**	
Pre-test	2.16 ± 0.17	2.15 ± 0.17	0.01	0.745	-0.05	0.07	0.001
Immediate post-test	3.93 ± 0.31	2.21 ± 0.28	1.717*	<0.001	1.59	1.83	0.895
At 3-month	4.01 ± 0.29	2.22 ± 0.21	1.789*	<0.001	1.68	1.89	0.928
At 6-month	3.91 ± 0.26	2.20 ± 0.23	1.712*	<0.001	1.61	1.81	0.926

*MD=mean difference is significant at p <0.001 level.

Table 4.50 shows the separate comparisons for each group to determine the effect of the TB educational intervention on the mean of total attitude scores at pre-test, immediate post-test, 3-month follow-up and 6-month follow-up in both the intervention and the control group.

The results showed that the mean of total attitude score for the intervention group at pre-test was significantly different from the attitude score at post-test and at 3-month and 6-month follow-up (p =< 0.001, η2 = 0.965). However, the post-test attitude score was not significantly different from attitude scores at the 3-month and 6-month follow-up ($p > 0.05$). On the other hand, there was no significant difference in the attitude score between the 3-month and 6-month follow-up (p =0.134).

The results also revealed that, for the control group, the mean of total attitude score at pre-test was not significantly different from that at post-test, 3-month follow-up and 6-month follow-up ($p > 0.05$). Also, immediately post-test the mean of total attitude score was not different from the mean of total attitude scores at 3-month and 6-month follow-up ($p > 0.05$). Moreover, there was no significant difference in attitude score between the 3-month and 6-month follow-up (p = >0.5). Thus, there were no significant changes in the mean of total attitude score across the time among the control group.

Figure 4.3 shows the plot of the mean for total attitude score of the control and intervention groups over time. It is very obvious that in the case of the intervention group the attitude mean score increased at post-test, then became stationary at 3-month follow-up and at 6-month follow-up, whereas it was constant in the control group over time.

Table 4.50: Mean comparisons of total attitude across the time for each group

Group	(I) Time	(J) Time	MD	P-value	95% CI Difference Lower Bound	95% CI Difference Upper Bound	η^2
intervention n=47	1	2	-1.769*	<0.001	-1.886	-1.651	0.965
	1	3	-1.848*	<0.001	-1.96	-1.737	
	1	4	-1.753*	<0.001	-1.86	-1.645	
	2	3	-0.08	0.441	-0.199	0.039	
	2	4	0.02	1	-0.078	0.11	
	3	4	.096	0.134	0.005	0.187	
Control n=48	1	2	-0.06	0.91	-0.179	0.054	0.036
	1	3	-0.07	0.533	-0.181	0.04	
	1	4	-0.05	1	-0.158	0.054	
	2	3	-0.01	1	-0.125	0.11	
	2	4	0.01	1	-0.082	0.103	
	3	4	0.02	1	-0.072	0.109	

* MD= mean difference is significant at p <0.001, 1= pre-test, 2= immediately post-test, 3= at 3 months follow-up, 4= at 6 months follow-up.

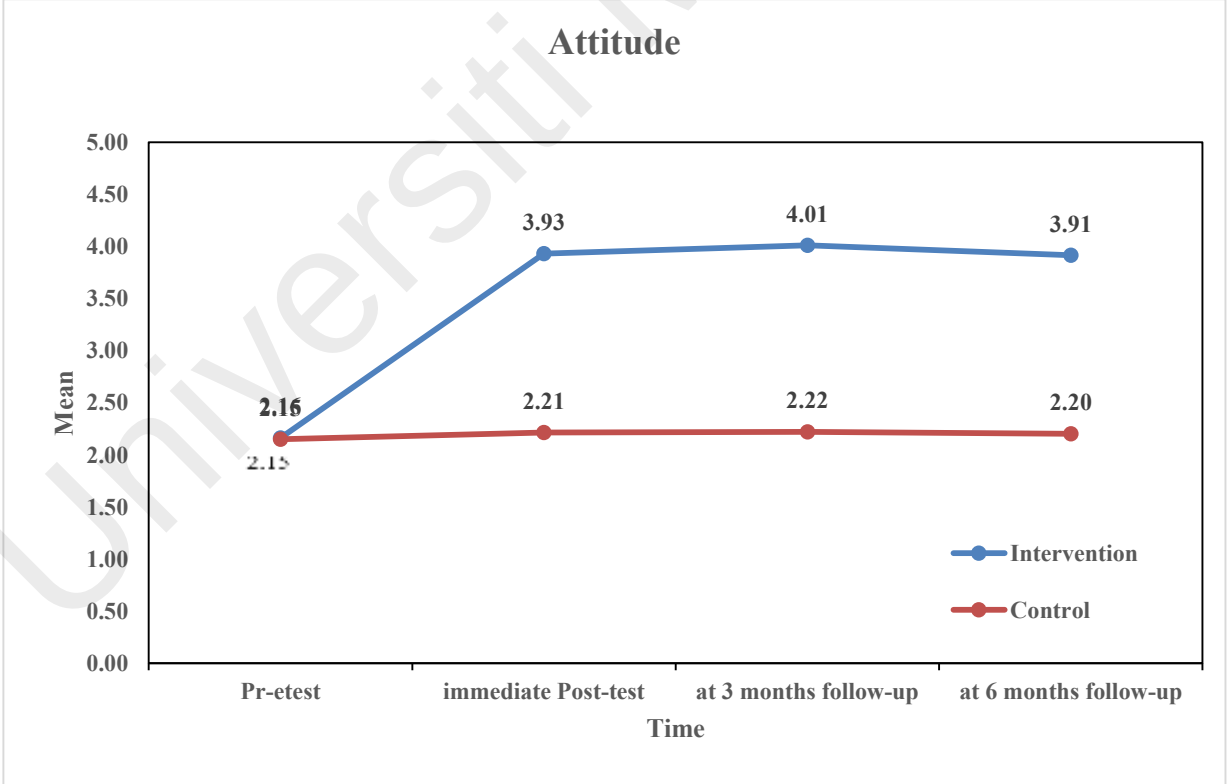


Figure 4.3: Mean plot of attitude mean score in groups across the time

Table 4.51 shows the mean and standard deviation of attitude components for intervention group at pre-test, immediate post-test, 3-month follow-up and 6-month follow-up. The result revealed that phobia of TB (component 1) was significantly reduced ($p < 0.001$) as the mean of the positive attitude increased from 2.05 ± 0.3 at pre-test to 3.88 ± 0.33 immediate post-test and these improvements remained stable over time as it were 3.95 ± 0.32 and 3.91 ± 0.36 at 3-month follow-up and 6-month follow-up respectively.

There was a statistically significant reduction in stigma of TB (component 2) in intervention group (p <0.001) as the mean of the positive attitude increased from 2.27 ± 0.37 at pre-test to 3.98 ± 0.4 at immediate post-test. However, this reduction of stigma about TB remained stable across the time as the mean of positive attitude was 4.07 ± 0.45 and 3.95 ± 0.35 at 3-month and 6–month follow-up respectively.

Table 4.51: Mean scores of attitude components for control group over the time (n=47)

AC	Pre-test M±SD	immediate Post-test M±SD	3months follow-up M±SD	6months follow-up M±SD	p-value
C1	2.05 ± 0.3	3.88 ± 0.33	3.95 ± 0.32	3.91 ± 0.36	<0.001
C2	2.27 ± 0.37	3.98 ± 0.41	4.07 ± 0.45	3.95 ± 0.35	<0.001

AC (attitude component), C= component, C1= (phobia- related items of TB), C2= (stigma –related items of TB)

Table 4.52 shows the mean and standard deviation of attitude components for control group at pre-test, immediate post-test, at 3-month follow-up and 6-month follow-up. The result revealed that there were no significant changes in the mean of attitude for the both component over time.

Table 4.53 shows the detail of attitude items. Table 4.54 shows the proportion of nurses who showed positive attitude per item over the time among intervention group. The result showed that there were significant ($p < 0.001$) improvements in attitude regarding TB-phobia and TB-stigma among the nurses in intervention group as the proportions of nurses with positive attitude were more higher at immediate post-test compared to the proportion before the education intervention. However, these improvements of attitude towards TB among the nurses remained nearly constant over the time.

Table 4.52: The Mean ± SD of attitude components for control group (n=48) over the time

AC	Pre-test M±SD	immediate Post-test M±SD	3months follow-up M±SD	6months follow-up M±SD	p-value
C1	2.01 ± 0.3	2.04 ± 0.31	2.04 ± 0.3	2.02 ± 0.27	0.449
C2	2.3 ± 0.31	2.39 ± 0.47	2.41 ± 0.39	2.39 ± 0.44	0.131

AC (attitude component), C= component, C1= (phobia- related items of TB), C2= (stigma –related items of TB)

Table 4.53: Details of attitude items

No	1(Strongly agree), 2 (agree) , 3 (Somewhat agree) , 4 (dis agree) , 5 (strongly disagree)
Items regarding phobia of tuberculosis	
1	I wouldn't feel comfortable about being near to a tuberculosis patient
2	I wouldn't want to be in prolonged contact with a tuberculosis patient for safety reasons
3	If I had TB, it would be a problem to find a marriage partner
4	I would leave my job if I got TB
Items regarding social stigma of tuberculosis	
5	If I found out that I had TB, I would feel ashamed and embarrassed
6	If I had TB, others would think less of my family
7	I am worried that others and hospital staff might laugh at me if I got TB
8	I would hide my TB if I got it

Table 4.54: Proprtion of nurses with positive attitude over the time in intervention group (n=47)

*Attitude	Pre- test positive attitude (%)	Immediate post-test positive attitude (%)	At 3month follow-up positive attitude (%)	At 6 month follow-up positive attitude (%)	p-value
Attitude1	2 (4.26)	33 (70.21)	33 (70.21)	32 (68.09)	<0.001
Attitude2	1 (2.13)	40 (85.11)	43 (91.49)	40 (85.11)	<0.001
Attitude3	4 (8.51)	36 (76.6)	39 (82.98)	37 (78.72)	<0.001
Attitude4	3 (6.38)	43 (91.49)	44 (93.62)	42 (89.36)	<0.001
Attitude5	2 (4.26)	43 (91.49)	44 (93.62)	41 (87.23)	<0.001
Attitude6	3 (6.38)	43 (91.49)	43 (91.49)	39 (82.98)	<0.001
Attitude7	1 (2.13)	40 (85.11)	39 (82.98)	36 (76.6)	<0.001
Attitude8	2 (4.26)	31 (65.96)	35 (74.47)	35 (74.47)	<0.001

* Referred to table 4.53 for item details

Table 4.55 shows the proportion of nurses who had positive attitude per item over the time among control group. The result showed that there were no significant changes in attitude regarding stigma and phobia of TB among the group overtime.

Table 4.55: Proportion of nurses in control group with positive attitude over the time (n=48)

*Attitude	Pre- test positive attitude (%)	Immediate post- test Positive attitude (%)	At 3month follow-up positive attitude (%)	At 6month follow-up positive attitude (%)	p-value
Attitude1	4 (8.33)	2 (4.17)	2 (4.17)	2 (4.17)	0.875
Attitude2	1 (2.08)	1 (2.08)	1 (2.08)	1 (2.08)	0.3
Attitude3	3 (6.25)	2 (4.17)	2 (4.17)	2 (4.17)	0.78
Attitude4	1 (2.08)	2 (4.17)	3 (6.25)	2 (4.17)	0.394
Attitude5	4 (8.33)	2 (4.17)	1 (2.08)	1 (2.08)	0.388
Attitude6	9 (18.75)	6 (12.5)	4 (8.33)	3 (6.25)	0.854
Attitude7	1 (2.08)	2 (4.17)	1 (2.08)	1 (2.08)	0.112
Attitude8	2 (4.17)	2 (4.17)	2 (4.17)	2 (4.17)	1

* Referred to table 4.53 for item details

4.3.6 Effect of TB- Educational intervention on practice

As it was unreliable to assess practice immediately after the education intervention, a post-test analysis of practice was omitted. Therefore the assessment of the differences in the mean scores was conducted three times (i.e., at pre-test, 3-month follow-up and 6-month follow-up) rather than four.

Table 4.56: Mean of total practice score over the time for intervention and control groups

Times	Group	n	Mean ±SD
Pre-test Practice	Intervention	47	39.09 ± 4.33
	Control	48	39.54 ± 3.93
3-months follow-up Practice	Intervention	47	57.32 ± 2.70
	Control	48	40.65 ± 3.27
6-months follow-up Practice	Intervention	47	54.36 ± 3.41
	Control	48	40.42 ± 3.23

Table 4.56 shows the descriptive statistics for the total practice of the groups over time. At pre-test the mean of total practice score for intervention group was 39.09 ± 4.33 while for control group was 39.54 ±3.93. Three months later, the mean of total practice score for intervention group was improved as it reached 57.32 ± 2.70 and for control group was 40.65 ± 3.27. At 6-month follow-up, the mean of total practice for intervention group became 54.36 ±3.41 while for the control group remained constant as it was in 3-months follow-up 40.42 ±3.23. Thus, among the intervention group there were significant improvement of practice at 3- month follow-up and these improvements remained stable at 6-month follow-up. On other hand, there were no significant changes in the mean of total practice score across the time among the control group.

Table 4.57 shows the overall effect of time, group and time* group interaction on practice. The overall effect of time on practice was statistically significant ($F = 442.115$, $p < 0.001$, $\eta 2 = 0.826$). The main effect of group was statistically significant ($F = 281.24$, $p < 0.001$, $\eta 2 = 0.751$). The results also indicated that the interaction between group and time was statistically significant ($F = 348.405$, $p < 0.001$, $\eta 2 = 0.789$), which means that the two groups had a different pattern for practice over time.

Table 4.57: Summary of within – between Subjects ANOVA for practice

Source	MS	F	P value	η^2
Time	9.929	442.115	<0.001	0.826
Group	16.33	281.24	<0.001	0.751
Time * Group	7.824	348.405	<0.001	0.789

* Significant at 0.05 level, MS=Mean scores,

Table 4.58 shows the comparison of the mean scores for practice between the two groups and over time. The results of the Bonferroni test revealed that the difference in the practice score between the intervention and control group at pre-test was not statistically significant ($p > 0.05$). However, there were significant differences in the practice scores between the intervention and control groups at 3-month follow-up and 6-month follow-up ($p < 0.001$).

Table 4.58: Mean comparison of practice between groups across the time

Test	Groups		MD	*P*-value	95% CI		η^2
	Intervention n=47 M±SD	Control n=48 M±SD			Lower Bound	Upper Bound	
Pre-test	39.09 ± 4.33	39.54 ± 3.93	-0.45	0.392	-0.261	0.452	0.123
Follow-up 3 month	57.32 ± 2.70	40.65 ± 3.27	16.67	<0.001	14.431	18.526	0.958
Follow-up 6 month	54.36 ± 3.41	40.42 ± 3.23	13.94	<0.001	11.752	14.822	0.937

* The mean difference is significant at the p<0.001 level. MD: mean difference

Table 4.59 shows the separate comparisons for each group were performed to determine the effect of the TB educational intervention on the mean of total practice scores at pre-test, 3-month follow-up and 6-month follow-up in both the intervention and control groups. The results showed that the mean of total practice score of the intervention group at pre-test was significantly different from the mean of total practice score at 3-month (MD= -18.23, $p < 0.001$) and 6-month follow-up (MD= -15.27 $p < 0.001$). However, there was no significant difference in the mean of total practice score between the 3-month and 6-month follow-up tests (MD=2.96, p= 0.101) and η^2 =0.923.

The results also revealed that, for the control group, the mean of total practice score at pre-test was not significantly different from that at 3-month follow-up (MD= -1.11, P =0.179) and 6-month follow-up (MD= -0.88, p > 0.426). Also, there was no significant difference in the mean of total practice score between the 3-month and 6-month follow-up (MD=0.23, p = 0.715).

Figure 4.4 shows the plot of the mean of total practice score for both the control and intervention groups over time. It is clear that in the case of the intervention group the mean of total practice score increased at 3-month from the time of the TB intervention and then slightly declined at 6-month follow-up. However, the score was constant in the control group over time.

Table 4.60 shows the means and standard deviations of practice components for intervention group at pre-test, 3-month and 6-months follow-up. The result revealed that there were significant improvements in the means of all practice components (p < 0.001) towards TB

among intervention group across the time. However, these improvements in practice scores remained stable and significant at 6-month follow-up.

Table 4.59: Mean comparison of practice across the time for each group

Group	(I) Time	(J) Time	MD	P value	95% CI Difference		η^2
					Lower Bound	Upper Bound	
Intervention n=47	1	2	-18.23	<0.001	-16.12	-0.17.43	
	1	3	-15.27	<0.001	-13.322	-14.458	0.923
	2	3	2.96	0.101	0.198	3.163	
Control n=48	1	2	-1.11	0.179	-0.12	2.015	
	1	3	-0.88	0.426	-0.66	0. 87	0.147
	2	3	0.23	0.715	-0.012	0.033	

*The mean difference is significant at the 0.001 level. 1= pre-test, 2 = 3-month follow-up and 3= 6- month follow-up

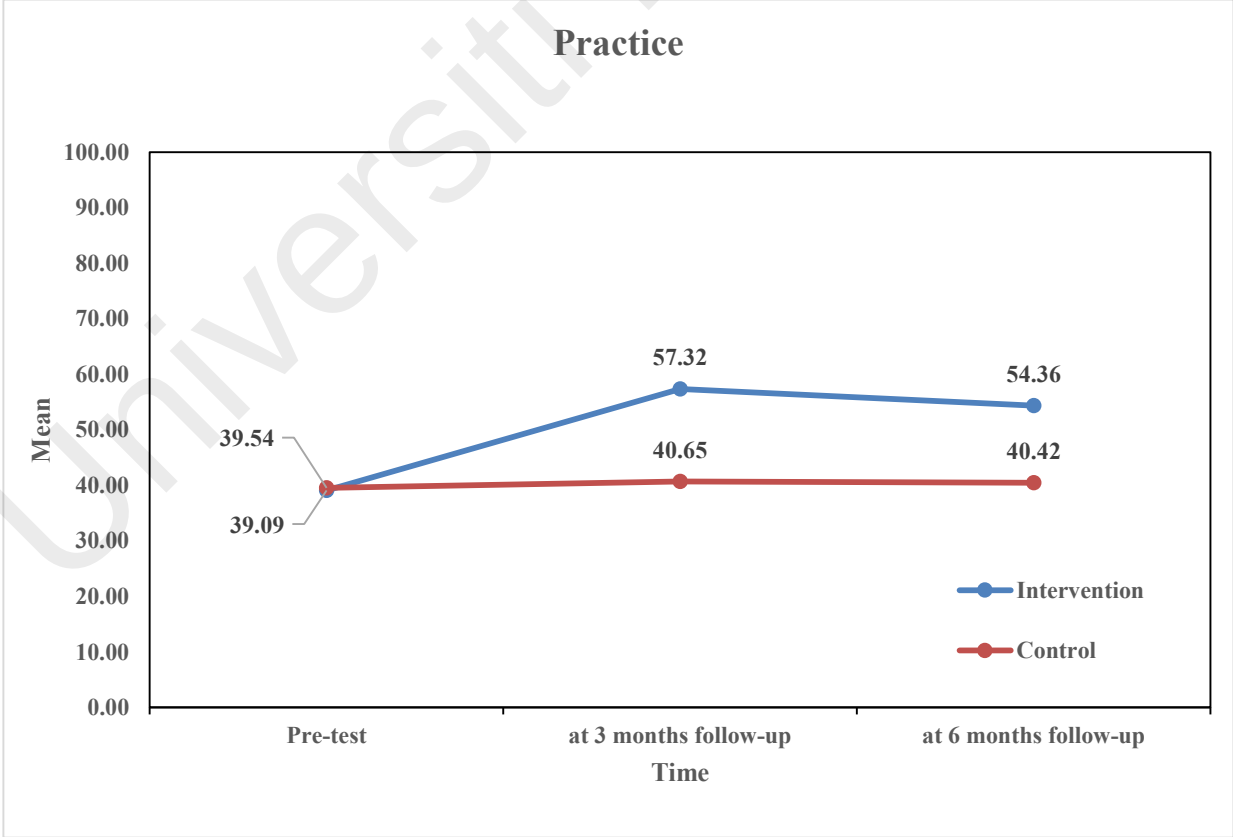


Figure 4.4: Mean plot of practice mean score in groups across the time

Table 4.60: Mean score of practice components of intervention group over time (n=47)

PC	Pre-test M±SD	3months follow-up M±SD	6months follow-up M±SD	p-value
C1	7.02 ± 1.51	9.68 ± 1.36	9.72 ± 1.31	<0.001
C2	11.40 ± 1.61	13.57 ± 1.22	12.89 ± 1.23	<0.001
C3	9.31 ± 1.68	14 ± 1.04	13.14 ± 1.51	<0.001
C4	7.25 ± 1.42	11.57 ± 0.74	10.53 ± 1.23	<0.001
C5	4.08 ± 0.83	8.48 ± 0.85	8.10 ± 1.026	<0.001

PC (practice component), C (component), refer to table 4. 62 for details of practice components

Table 4.61 shows the mean and standard deviation of practice components for control group at pre-test, 3-month follow-up and 6-month follow-up. The result revealed that there were no significant changes in the means of all practice components over the time among the control group.

Table 4.61: The Mean score of practice components of control group over time (n=48)

PC	Pre-test M±SD	3months follow-up M±SD	6months follow-up M±SD	p-value
C1	7.18 ± 1.39	7.33 ± 1.53	7.41 ± 1.44	0.068
C2	11.45 ± 1.557	11.39 ± 1.41	11.14 ± 1.50	0.016
C3	9.33 ± 1.616	9.75 ± 1.73	9.68 ± 1.69	0.35
C4	7.45 ± 1.501	7.75 ± 1.45	7.70 ± 1.41	0.224
C5	4.10 ± 0.778	4.41 ± 1.06	4.52 ± 1.07	0.042

PC (practice component), C (component), refer to table 4. 62 for details of practice components

Table 4.62 shows the detail of practice items. Table 4.63 shows the proportion of nurses in intervention group who revealed satisfactory practice per item across the time. The result showed that with exception of practice on items 6 and 7 regarding TB infection control measures, there were significant (p<0.001) improvements in practice on TB among the nurses in intervention group, since the proportion of nurses with satisfactory practice increased from pre-test to 3-month follow-up.

However, these improvements in practice remained significant and stable at 6-month follow-up. Table 4.64 shows the proportion of nurses in control group who showed satisfactory practice per item across the time. The result revealed there were no significant changes in proportion of nurses in control group with satisfactory practice regarding all practice items.

Tabl 4.62: The Detail of Practice Items

	Items regarding practice
At the admission of TB patients (component1)	
1	I ask the patients during admission about previous history of TB infection
2	I ask patient about any close contact with household members or friends
3	I check the patients' drugs that they have during admission
4	I fill and send the disease notification form to the relevant registration unit
Regarding TB- Infection control measures (component2)	
5	I ask the patients in the ward to always wear the protective mask
6	I wear the protective face mask and gloves while handling the patients
7	I keep the infectious and non- infectious TB -patients in the separate rooms
8	I use separate treating and testing devices for every individual patient
9	I ask the patients to cover their mouth and nose during coughing, or talking
	Regarding respiratory hygiene and collecting sputum samples (component3)
10	I collect sputum specimens from patients in a separate ventilated space
11	I collect the sputum in a pot with lid and then dispose properly
12	I collect the THREE (3) samples of sputum for AFB with fully completed form
13	I explain and follow the sputum collection procedures
14	I explain to the patients how the test to be done and the reason for doing it
	During treatment of patient and delivery of anti- TB drugs (component4)
15	I ensure the correct dosages of drugs during distribution of medications
16	I ask and remind the patients to take their drugs regularly on time
17	I take note of any appeared side effects or allergic reaction of drugs
18	I monitor whether the patients have response or resistance to treatment
	Regarding patient education (component5)
19	I teach the patients about the different aspects of the TB disease
20	I explain to the patients treatment at home and follow up during discharge
21	I call and remind the patients if they missed the follow-up appointment

Table 4.63: Proprtion of nurses in intervention with satisfactory practice per item over the time (n=47)

*Practice	Pre- test satisfactory practice	At 3months satisfactory practice	At 6months satisfactory practice	p -value
Practice 1	17(36.17)	24(51.06)	23(48.94)	<0.001
Practice 2	0(0)	17(36.17)	17(36.17)	<0.001
Practice 3	2(4.26)	22(46.81)	22(46.81)	<0.001
Practice 4	13(27.66)	30(63.83)	30(63.83)	<0.001
Practice 5	29(61.7)	37(78.72)	35(74.47)	0.011
Practice 6	28(59.57)	29(61.7)	25(53.19)	0.307
Practice 7	34(72.34)	40(85.11)	34(72.34)	0.057
Practice 8	12(25.53)	33(70.21)	25(53.19)	<0.001
Practice 9	6(12.77)	31(65.96)	20(42.55)	<0.001
Practice 10	4(8.51)	31(65.96)	23(48.94)	<0.001
Practice 11	30(63.83)	41(87.23)	30(63.83)	0.01
Practice 12	16(34.04)	34(72.34)	30(63.83)	<0.001
Practice 13	4(8.51)	43(91.49)	34(72.34)	<0.001
Practice 14	2(4.26)	42(89.36)	36(76.6)	<0.001
Practice 15	1(2.13)	42(89.36)	28(59.57)	<0.001
Practice 16	2(4.26)	44(93.62)	31(65.96)	<0.001
Practice 17	32(68.09)	42(89.36)	34(72.34)	0.028
Practice 18	1(2.13)	42(89.36)	29(61.7)	<0.001
Practice 19	0(0)	43(91.49)	35(74.47)	<0.001
Practice 20	10(21.28)	39(82.98)	34(72.34)	<0.001
Practice 21	0(0)	36(76.6)	31(65.96)	<0.001

Referred to table 4.62for item details

Table 4.64: Proportion of nurses in control with satisfactory practice per item across the time (n=48)

*Practice items	Pre- test satisfactory practice	At 3months satisfactory practice	At 6months satisfactory practice	p -value
Practice 1	16(33.33)	17(35.42)	17(35.42)	0.368
Practice 2	1(2.08)	2(4.17)	2(4.17)	0.368
Practice 3	2(4.17)	4(8.33)	3(6.25)	0.156
Practice 4	14(29.17)	14(29.17)	14(29.17)	1
Practice 5	30(62.5)	30(62.5)	29(60.42)	0.368
Practice 6	28(58.33)	27(56.25)	25(52.08)	0.097
Practice 7	33(68.75)	32(66.67)	30(62.5)	0.097
Practice 8	12(25)	10(20.83)	10(20.83)	0.135
Practice 9	7(14.58)	7(14.58)	7(14.58)	1
Practice 10	4(8.33)	8(16.67)	8(16.67)	0.07

Table 4.64: Proportion of nurses in control with satisfactory practice per item across the time (n=48) (continued)

*Practice items	Pre- test satisfactory practice	At 3Months satisfactory practice	At 6Months satisfactory practice	p -value
Practice 11	31(64.58)	26(54.17)	24(50)	0.301
Practice 12	14(29.17)	13(27.08)	13(27.08)	0.717
Practice 13	5(10.42)	6(12.5)	5(10.42)	0.115
Practice 14	2(4.17)	3(6.25)	3(6.25)	0.011
Practice 15	39(81.25)	30(62.5)	29(60.42)	0.01
Practice 16	6(12.5)	8(16.67)	7(14.58)	0.141
Practice 17	2(4.17)	5(10.42)	5(10.42)	0.005
Practice 18	3(6.25)	3(6.25)	3(6.25)	0.103
Practice 19	1(2.08)	2(4.17)	2(4.17)	0.368
Practice 20	11(22.92)	9(18.75)	9(18.75)	0.368
Practice 21	0(0)	1(2.08)	1(2.08)	0.018

* Referred to table 4.62 for item details

4.3.10 Conclusion regarding the TB educational intervention

The differences in the mean scores for knowledge, attitude and practice between the intervention and control groups at baseline were comparable. On the other hand, there was a clear difference in the mean of total knowledge scores between the intervention and control group at post-test, 3-month follow-up and 6- month follow-up. For the intervention group, there was significant difference in the mean of total knowledge score at pre-test and immediate after the intervention, since the mean scores increased from pre-test to immediate post-test. However, the improvement of the scores remained stable at 3-month and 6-month follow-up. At component level, with exception of knowledge about causes and infectivity of TB (component 1) and knowledge regarding preventive measures of TB (component 11) the nurses showed improvement of knowledge among the remained 9 components.

With regard the knowledge per item, the nurses in intervention group showed significant improvement of correct response for almost entire knowledge items at immediate post-test

except the knowledge on 4 items regarding causes and infectivity, 2 knowledge items about TB transmission, one knowledge item about clinical features of TB, two items regarding diagnosis of TB and 6 items regarding TB prevention. However, these improvements of scores remained significant at 3-month- follow-up and 6-month follow-up.

On the other hand and with regard the knowledge for the control group, there were no significant differences in the mean of total knowledge score across the time. However there were no significant changes in scores in the components or items of knowledge detected over time.

About the attitude, the mean of total attitude scores of intervention at pre-test was significantly different from that at post-test, since the scores of positive attitude increased at immediate post-test. However, these improvements of positive attitude scores remained stable at 3-months and 6-months follow-up. For the control group, there were no differences in the mean total attitude scores over time.

About practice, the mean total practice score was increased at month follow-up compared to pretest score and then slightly declined at 6 month follow-up. There was also a small difference in the practice score between the 3-month and 6-month follow-ups, but not significant. However, the mean of total practice score was constant in the control group over time.

Overall, the scores of knowledge, attitude and practice at baseline between the intervention and control groups were comparable. There were significant changes in knowledge, attitude

and practice among the nurses in intervention group over the time. However, there were no significant changes in knowledge, attitude and practice among the nurses in control over the time. Moreover, there were significant differences in knowledge, attitude and practice scores between intervention and control groups after the intervention. Furthermore, the interaction (group * time); the time; and the groups each were found to have a statistically significant effect on knowledge, attitude and practice. Therefore, the health education intervention program was effective in improving knowledge, attitude and practice regarding tuberculosis among TB nurses in Libya.

CHAPTER 5: DISCUSSION

About this chapter

This chapter discusses the findings pertaining to validation of TB KAP questionnaire (phase 1), knowledge of, attitude and practice towards tuberculosis among TB nurses (phase 2) and the effectiveness of TB educational intervention program in improving KAP among the TB nurses (phase 3) and compares the above findings with from similar studies done previously by other researchers. The strengths and limitations of this study are also discussed in this chapter.

5.1 Phase 1: Validity and reliability of TB- KAP questionnaire

The knowledge, attitude and practice towards tuberculosis (TB-KAP) are crucial for fruitful performance by nurses and for effective prevention of TB infection among susceptible groups. Hence, it is necessary to have a valid tool for the assessment of knowledge of and attitude and practice towards TB. Validity is the ability of an instrument to measure what it is intended to measure. There are three types of validity analysis, namely: content or face validity, concurrent validity and construct validity; while reliability indicates the consistent performance of the questionnaire (Kimberlin & Winterstein, 2008).

Most of the published studies regarding validity and reliability of TB-KAP questionnaire were conducted among TB patients (Elmi et al., 2014; Fan et al., 2018), students (Jiang et al., 2017) and general populations (de Almeida Crispim et al., 2017). However, items and questions in these studies were not suitable to be used in our questionnaire since we were conducting the study among the nurses. Moreover, one study conducted in Malaysia

(Abdullah et al., 2014) to assess the validity and reliability of TB- KAP questionnaire among healthcare worker in general hospital.

In this study, a new structured questionnaire was developed to assess the knowledge, attitude and practice towards TB among nurses employed in TB centers. The validity and reliability were assessed among nurses working in TB centers in Libya.

5.1.1 Content validity

The content validity was ascertained through assessment of the items in the questionnaire by a panel of six experts in their fields from different specialities; public health, respiratory medicine, health education and microbiology, in aim of obtaining high assessment scores of all items. Based on the guideline for an acceptable I-ICV in relation to the number of experts, an I-CVI score of ≥ 0.83 is acceptable when the number of experts is more than five (Polit et al., 2007). In this study all the items had I-ICV scores of ≥ 0.83; therefore, all the items for all the components in the questionnaire were considered eligible and therefore, retained.

5.1.2 Exploratory factor analysis

Regarding knowledge components, the sample used in the analysis was adequate, as reflected by the obtained Kaiser-Meyer-Olkin (KMO) value of (0.895), which is above the suggested value of 0.6. This finding is consistent with the value of (0.827) obtained in another study (Elmi et al., 2014). The exploratory factor analysis (EFA) revealed that 109 (97.3%) out of the 112 items were acceptable. After Varimax rotation, the interpretation of the components was consistent with the original components in TB- KAP questionnaire, except in knowledge,

where two of the previous components were merged together. However, there were only three items deleted to low loading (<0.4) and cross loading: two items from knowledge components, item 69 (patients do not need to continue medical treatment when the symptoms of tuberculosis subside or when they feel better), item 73 (use of renal function test in MDRTB), and item (15) from practice components (I helped the patients to collect sputum when they could not produce sputum).

5.1.3 Reliability

In our study, the overall Cronbach's alpha values for knowledge, attitude and practice components in the questionnaire, this indicated that these components in the questionnaire were reliable. These Cronbach's alpha values were similar to values obtained from a study conducted in Malaysia which assessed TB-KAP validity and reliability among healthcare workers (Abdullah et al 2014). However, Cronbach's alpha score of our study would have dropped if any attitude item was deleted, indicating that all the items should be retained.

The intraclass correlation coefficient (ICC) was computed and a high degree of reliability was found between the items of the questionnaire. For the knowledge component items, the ICC was in the range of 0.63–0.961, while for the attitude component items it was in the range of 0.682–8.99 and for the practice component items it ranged from 0.659–0.981. These ICC values matched the finding (ICC=0.606) of a study conducted in China (Fan et al., 2018). The valid and reliable created questionnaire was used as a tool in phase 2 of the study to assess the knowledge, attitude and practice (KAP) towards TB among nurses employed in

TB centers, and in phase 3, to assess the effectiveness of TB educational program in improving KAP of TB.

5.2 Phase 2: Knowledge, attitude and practice towards tuberculosis

5.2.1 Response rate and sample

The response rate from the all selected TB centers in Libya was satisfactory and met the target number of required sample size. Out of 435 distributed questionnaires, 392 were returned, which represented a response rate of 90%; which was more slightly higher than the response rate (86.6%) of a study conducted in Lesotho (Adebanjo, 2011); and much higher than another rate (64%) of study conducted in south Africa (Singh, 2014). However, in this study around 13% (n= 58) of the distributed questionnaires were not returned due to some reasons and this was expected in any research using a questionnaire as a tool of data collection. Moreover, a further eight questionnaires were incomplete and were excluded. Therefore, 384 questionnaires were analysed. Unfortunately, some female non-respondents for various reasons refrained from giving their phone numbers.

Among the reasons for non-responses include: the participants were on medical and non-medical leaves despite their having agreed to participate in the study; the questionnaire was too lengthy, the participants were too busy with work or they had misplaced or forgotten to answer the questionnaire; and reluctance to disclose personal details. These reasons were also quoted in (Korkeila et al., 2001) .

5.2.2 Sociodemographic and working characteristics

With regard to the age, in this study, 75 (19.5%) aged from 18-25 years; 246 (64.1%) were aged from 26-40 years and 63 (16.4%) aged more than 40 years. Most of the nurses were in the middle ages (25-40 years). This was not surprise because most of the participants joined the workforce after completion of a bachelor's degree in nursing, at nursing faculties at twenty-four years of age. These findings were comparable to those of the findings of Ukwaja et al (2013), Shrestha et al. (2017) and Yükseltürk & Dinç. (2013).

With regards to the gender of respondents in this study, 21.9% of our participating nurses were males and 78.1% were females. The fact that over 70% of healthcare worker being females was expected, not only in Libya, but globally (WHO, 2019). This fact is possibly due to the fact that females like nursing more than males. A higher proportions of females than males were also found in other studies conducted among healthcare workers in TB care facilities (Adebanjo, 2011; Bhebhe, et al., 2014; Singh, 2014). In contrast, in a study conducted in Iraq, which assessed knowledge, attitude and practice towards TB among healthcare workers (Hashim et al., 2003), the proportion of females was 30% of the total number of participants.

With regards to the level of education, the nursing educational programs in Libya have been established for nationals to meet their increasing demand for the programs. However, this demand was markedly increased after the revolution in 2011, when most of the expatriate nurses left the country. To compensate for the loss, the national ministry of health offered a short course (six months) to aspiring nurses. At present, the three major sources of nurses in Libya are the nursing faculties, nursing institutions, and graduates of a six months course

(WHO, 2010). In this study, 87 (22.7%) of the nurses had training course certificates. Amongst the participants, 136 (35.4%) had each a Bachelor's Degree of Nursing. This is consistent with the findings of another study conducted in Turkey, where the proportion of nurses holding a Bachelor's Degree of Nursing' each was only 28% (Yükseltürk & Dinç. (2013).

In contrast, the proportion of 'Bachelor's Degree of Nursing' holders was higher, that is, 87%, compared to that of diploma holders, in a study conducted in Iraq (Hashim et al., 2003). However, in our study, the proportion of 'Diploma of Nursing' holders was 161 (41.9%) which corresponded with the proportion in the finding of Yükseltürk & Dinç (2013).

With regards to work experience and duration of employment, 242 (63%) of our participants had working periods ranging from 1 year to 5 years in the tuberculosis centres in Libya. However, we predicted correctly that most of the employed nurses had less than 5 years of working duration, despite the permanent employment scheme offered, and the old age of TB centres.

The reason for the above fact that most of the employed nurses had less than 5 years of working duration should be investigated. One of the possible reasons was the fast turnover of the nursing staff due to the fear of being infected with TB. This proportion of (63%) was higher than that in the studies by Yükseltürk & Dinç (2013) and Adebanjo (2011), in which the proportions were 50% and 54%, respectively. Moreover, in our study, 84 (24.4%) of total respondents had a working experience of more than 5 years. In contrast, in the study by Ukwaja et al. (2013) the proportion of nurses with more than five years working experience

was 63% while 48 (12.5%) of the more junior of our participants had working periods of less than 1 year. This corresponds to the finding of another study conducted in South Africa (Singh, 2014).

Regarding residence, in this study, 176 (45.8 %) of the total number of nurses had come from urban areas, where most of the TB Centres are located, while 206 (53.6%) had come from rural areas. In contrast, in another study, 61% of the participants were urban residences (Hashim et al; 2003).

5.2.3 Knowledge on tuberculosis

5.2.3.1 Description of knowledge

Out of the 384 nurses who participated in the study, only 57 (14.8%) of nurses showed a high level of knowledge on tuberculosis. This finding is consistent with the results obtained from previous studies (al, 2013; Alotaibi et al., 2019; Lertkanokkun et al., 2013; Sima et al., 2019; Ukwaja et al., 2013; Vassilopoulos et al., 2010). In contrast, higher level of knowledge was reported by other studies (Hashim et al., 2003; Yükseltürk & Dinç, 2013; Hng et al., 2018). Moreover, in our study a clear knowledge gap was found among the nurses in regards to the 11 components, except for two components: knowledge on the causes and infectivity of TB and preventive measures for TB. This finding is consistent with finding of other study conducted in Pakistan where the nurses had high level of knowledge regarding infectivity of TB, while they had low knowledge level regarding the other aspects of TB (Shah et al ., 2018).

Not surprisingly, higher proportion of correct answers (92%) about bacteria is the cause of TB was observed among our participants. However, this was expected from nurses who performing daily investigation process of TB patient as name of the bacteria usually labelled. This finding consistent with the findings of studies (Singla, 1998; Hashim et al., 2003; Bhebhe, et al., 2014) as the good knowledge among the respondents of these studies was in range from 78% to 97%.

Lacking of knowledge about the ways of TB transmission can increase the risk of nurses to this nosocomial infection (Mussi, 2012). In our study, only 83(21.6%) of the participants had a high level of knowledge of TB transmission, it was relatively low comparing to findings of other studies were conducted in two different countries; South Africa (Bhebhe, et al., 2014) and Greece (Vassilopoulos, 2010) as levels of knowledge regarding transmission of TB were 89.2% and 59.1%, respectively. However, 204 (53.1%) of our participant wrongly stated that there is possibility of TB transmission through sharing the TB-infected person the same plate during eating or the same cup during drinking.

Moreover, inappropriate way of transmission as waterborne was also reported (Bhebhe, et al., 2014). With agreement of finding reported by (Weiss et al., 2008), 56% of our respondents stated incorrectly that TB is associated with sexual contact. Furthermore, sharing needle and overcrowding are another ways of TB transmission were reported in two studies; (Woith et al., 2010) and (Renuka & Dhar, 2012), respectively.

Nurses are considered the frontline care-givers, and are at a higher risk of nosocomial TB infection, since they usually have prolonged and often close contact with patients (Jesudas &

Thangakunam, 2013). The findings of the current study showed that only 28.9% of participants had high levels of knowledge on TB risk factors. However, 63% of our participants stated correctly that healthcare workers were at high risk of TB infection. Hashim et al. (2003) stated that the correct responses about TB risk factors among the participants in his study were 83%, which was relatively higher than our finding. Sixty-five percent of our participants knew that crowded place increased the risk of contracting TB. This corresponded to the finding of (63%) in a study conducted in India (Singla et al., 1998).

Highly specific clinical signs/symptoms such as coughing with sputum of more than two weeks, haemoptysis (coughing up blood), and chest pain usually are predictors of TB (Starke & Kulkarni, 2017). About half of the participants in this study (52.3%) had a high level of knowledge regarding clinical manifestations of TB. A higher proportion (67.4%) had good knowledge on symptoms of TB. This was also found in a study conducted in Nepal (Shrestha et al., 2017).

However, our finding was satisfactory compared to those of other studies (Ukwaja et al, 2013; Woith, et al., 2010), where the participants incorrectly stated that diarrhoea, vomiting, joint pain, eye pain and neck swelling were symptoms of TB. Moreover, a satisfactory proportion of correct response (71.6%) was found among our respondents regarding coughing up blood as a clinical symptom of TB. This finding exactly corresponded to that obtained from a study conducted in Iraq (71%) (Hashim et al., 2003).

The proportion of correct response was high (82.8%) among our participants about coughing for over two weeks as a prominent feature of TB, which corresponded to the finding of two

studies (Hashim et al., 2003; Renuka & Dhar, 2012). In the case of the presence of fever, 238 (62%) of the nurses stated that a fever of two weeks duration was one of the clinical signs of TB. This proportion was slightly higher than the proportions of (53.5%) among nurses which stated the same statement in Lesotho (Bhebhe, et al., 2014) and (Hashim et al., 2003).

Regarding loss of appetite, 191 (49.7%) of the participants indicated this as one of the symptoms of TB. However, loss of appetite is commonly found in various infections and diseases, that is, it is not a specific symptom of TB, and therefore, it was not very bad that almost half of the nurses in this study had a low level of knowledge regarding it.

Moreover, a TB patient usually produces a high amount of sweat, particularly at night. Regarding this matter, 169 (44%) of the participants stated correctly that night sweats were also a feature of TB. This proportion was less than the finding of (70%) in another study (Hashim et al., 2003). 244 (63.5%) of the participants in our study was found to consider chest pain and shortness of breath as complaints raised by TB patients. This proportion was however, higher than that in the finding in the study (51.4%) by Hashim et al. (2003).

Sputum examination is very sensitive, specific and has golden role in diagnosis of TB. In agreement with other study studies (Renuka & Dhar, 2012; Singla et al., 1998), a high proportion (86.5%) of nurses in our study stated correctly that sputum smear microscopy and culture is the gold test for TB-diagnosis. This result was however, less than expected, since the nurses should be very familiar to this test, which is routinely requested for any TB investigation on a suspected patient at TB clinics. However, the exact proportion (86.6%) of Indian nurses who took care of TB patients stated that sputum smear microscopy and culture

was the gold test for TB-diagnosis (Singla et al., 1998). In contrast, in another study (Hashim et al., 2003), the proportion was (77.6%), which was slightly lower than the proportion (86.5%) in our finding.

Furthermore, chest X-ray is an essential tool in the diagnosis of pulmonary tuberculosis, and in our study 68.2% of the nurses recognized chest X-ray as being mandatory in the detection of pulmonary TB. This proportion is considered as still being low among nurses dealing with TB patients. A low proportion of correct response regarding the fact that chest X-ray is an essential tool in the diagnosis of pulmonary tuberculosis was also found in a study conducted among TB nurses in India (34%) (Singla et al., 1998).

Tuberculosis mainly affects the lungs and it is called pulmonary tuberculosis; but the causative bacteria can be transmitted through the blood and reach various organs in the body such as the brain, the kidneys, the lymph nodes and the spinal cord (Starke & Kulkarni, 2017). In our study, 22% of the nurses stated correctly that the lymph nodes and the brain are occasionally extra-pulmonary places of *Mycobacterium* tuberculosis. However, 28% of participants mentioned the kidneys as being involved in TB pathogenesis. In contrast, 55.6% of correct responses regarding TB infection of the kidneys were found in the study by Hashim et al. (2003).

Nurses play an important role in the treatments of TB, and the delivering of TB drugs in clinical wards. Lacking knowledge in the above may result in treatment errors and an ineffective TB control. However, a high proportion of our participants (91.9%) had low level of knowledge regarding TB treatments and the delivering of TB drugs. In contrast, high proportions (91%) and (95%) of nurses with a good level of knowledge in the above were

found in these two studies (Yükseltürk & Dinç 2013) and (Hashim et al., 2003), respectively. Surprisingly in our study only 18.2% of the participants who performed fulltime duties in TB centers knew that the DOTS regimen was the recommended treatment for newly active TB.

Moreover, only 11.7% of the nurses in this study correctly stated that the standard length of treatment for a newly diagnosed case of TB was ≥ 6 months. This finding is consistent with the findings of other studies (23%) (Singla et al., 1998) and (31%) (White, 2011) but inconsistent with the finding of (87%) by (Hashim et al., 2003). In contrast, Renuka & Dhar.(2012), reported high proprtion (72%) of correct answer regarding standard length of TB treatment.

About the sequence of anti-TB drug delivery, 20.8% of our participants correctly stated that isoniazid, rifampin, pyrazinamide and ethambutol were first-line drugs for the treatment of TB. Regarding drugs used as second–line treatments of TB, 24% of our participants stated that prednol; teofilin, ephedrine and isoniazid were a second-line drug combination that could be used to treat tuberculosis. These proportions were very low compared to the finding of two previous studies (Yükseltürk & Dinç 2013; Ukwaja et al., 2013).

Regarding side effects and complications of drugs, about 12.2% of the nurses in our study knew that ethambutol could cause hepatotoxicity and 8.9% knew that ethambutol could cause blindness. However, a higher percentage (77.9%) of Turkish nurses had good knowledge regarding loss of vision as an adverse effect of ethambutol (Yükseltürk & Dinç 2013). Moreover, in another study, about 87% of TB nurses recognised that drugs for TB could cause side effects such as jaundice (Singla et al., 1998).

A drug such as ethambutol is not affected by food; hence, it can be taken orally after a meal. However, only 8.3% of our participants stated the above fact correctly. About 13.5% of the participants in our study indicated that ethambutol could not be used for TB prophylaxis in patients who were at risk of TB infection. These proportions were very low compared to finding of other study conducted in Turkey (Yükseltürk & Dinç 2013).

With respect to knowledge on amikacin, only 38 (9.9%) of our participants indicated that ototoxicity was a side effect of amikacin (aminoglycoside antibiotic). Regarding the use of streptomycin, 53 (13.8%) of our nurses said that streptomycin should be administered through an intramuscular route, and 18.2% of the participants recognised that dizziness, vertigo, tinnitus, disequilibrium and loss of hearing were some of the side effects of streptomycin. In contrast, Yükseltürk & Dinç (2013) reported that 81% of their participants knew of this adverse effect of amikacin.

Our participants also showed a low level of knowledge regarding the interaction of rifampin with contraceptive pills (24%) and with anti-diabetic drugs (21%). In contrast, a much higher proportion of correct response (86%) was reported among Turkish nurses regarding these interactions (Yükseltürk & Dinç 2013).

Twenty percent of our participants correctly stated that isoniazid became less effective when used with antacids containing aluminium hydroxide. Also, in our study 14% of the participants which stated that they should advise breast-feeding mothers to continue breast

feeding during isoniazid administration. These proportions of both statements were found to be lower than that reported by Yükseltürk & Dinç (2013).

Our study found low proportions of correct statements about the definition (13.3%) and the cause of multidrug-resistant tuberculosis (MDR- TB) (20.3 %). In contrast, in two other studies, the proportions of correct answers were high, (75%) (Yükseltürk & Dinç 2013), and (84%) (Singh, 2014). About discontinuation of treatments when there is no response during drug resistance, 15.4% of our respondent recognised that during drug resistance, a patient should not continue with the same drug regimens for an additional one month.

Regarding the potential outcomes of an incomplete or inadequate treatment course, 73.7% of the participants recognised that worsening of symptoms and the necessity of prolonged treatments were two of the probable outcomes of an incomplete treatment course; while only 35.2% of them stated that drug resistance could be one of the consequences if treatments were not completed. Our finding was much better than the finding of a study conducted in Jamaica in which equal proportions (26%) of correct answers for both questions were reported (White, 2011).

However, comparable proportions of participants giving correct answers to these questions of probable outcomes of incomplete treatment were also observed in another study (Minnery et al., 2013). Moreover, 79.7% of our participants stated correctly that death was a probable fate among patients who fail to complete a course of treatments for TB.

Knowledge about tuberculosis infection control and prevention is crucial, particularly among healthcare workers. The highest and most satisfactory knowledge level observed in our study was regarding preventive measures of TB. However, such level of knowledge could possibly be attributed to the educational activities carried out by educational programme through mass media, or the nurses obtaining knowledge form the healthcare environment.

However, 95%, 94% and 90% of our respondents were having higher knowledge about the importance of minimising direct contact with patients, wearing protective masks and vaccination against TB, respectively. A high level of knowledge regarding preventive measures of TB was also reported by Singh. (2014). In contrast, low level of knowledge on TB preventive measures was found in other studies (Sodhi et al., 2013; Ukwaja et al., 2013; Woith et al., 2010).

5.2.3.2 Association of knowledge with socio-demographic characteristics and work experience

(a) **Age**

The proportion of nurses in our study with a high level of knowledge increased significantly with age; as the oldest age group in our participants (>40 years) had significantly higher knowledge ($p<0.05$) regarding the cause, clinical features, common sites of TB in the body, and treatment of TB, compared to middle age (26-40 years) and younger (18-25 years) participants. However, knowledge on TB prevention was very significantly higher among nurses of age (26-40 years) compared to that of older nurses. However, other studies (Adebanjo, 2011; Yükseltürk & Dinç, 2013) reported that the level of knowledge was

affected by age, as older nurses had a higher level of knowledge compared to younger nurses. Studies by Ukwaja et al, (2013); and Hng et al, (2018) however, reported that the level of knowledge was not affected by age.

(b) Gender

There was no significant difference in the level of knowledge between male and female nurses in our study. This might be reflecting the absence of gender discrepancy in Libyan healthcare facilities and education. However, Ukwaja et al, (2013) reported that the level of knowledge was significantly different between male and female nurses. Moreover, female nurses were more knowledgeable about TB than male nurses(Luba et al., 2019).

(c) Education level

Surprisingly, in our study nurses who each hold a diploma degree in nursing were having more knowledge than those with other degrees. However, there was no significant association between knowledge on TB and the bachelor's degree of participants. This result should prompt us to revise the nursing curricula in the faculty of nursing in Libya. In contrast, a study by White (2011), reported that a bachelor's degree holders showed higher levels of knowledge of TB compared to diploma holders. However, our finding is consistent with the finding of a study conducted in Malaysia (Hng et al., 2018). Moreover, (Minnery et al., 2013) and Ukwaja et al, (2013) also found no association between the education level and the level of knowledge on TB. It was found that students in the medical faculty had a higher level of knowledge on tuberculosis compared to the nursing staff (Bhandari & Bande, 2016). This

finding could be attributed to differences between the medical and nursing curricula in the respective faculties.

(d) Work experience

It is normally expected that many years of work experience would increase the knowledge level of a practising nurse. This was the case in our study, since the most senior nurses (>5 years) were found to have a higher level of knowledge on the cause, risk factors and treatment of TB, compared to junior nurses (<5 years). It was possible that long duration of service years subjects the nurses to more knowledge or nurses with longer years of experience in TB centres were continually updating themselves about TB. A similar finding was reported in other studies (Noé et al., 2017; Ukwaja et al., 2013). Also it was found that knowledge level was higher among nurses with experience of more than eight years than nurses with experience of less than that (Sodhi et al., 2013).

In contrast, an inverse relationship between the duration of work and the level of knowledge on TB was reported in a study conducted in Malaysia (Hng et al., 2018). Additionally, the level of knowledge on TB was found to be not significantly different between that of nurses with experience of six to ten years, and those with experience of more than ten years (Wang, 1995). However, the knowledge was not influenced by the length of work duration (Singla et al., 1998).

5.2.4 Attitude towards tuberculosis

5.2.4.1 Description of attitude towards tuberculosis

Tuberculosis is feared since it is contagious, and has long been associated with negative attitudes in people because it predominantly affects the poor, homeless, HIV positive and incarcerated people (Coreil et al., 2012). Our study found that 79.2 % of respondents had negative attitude towards tuberculosis. A negative of attitude was also reported among healthcare workers in other studies, (Wang, 1995; Adebanjo, 2011; Ibrahim et al., 2014; Sima et al., 2019). These findings are inconsistent with the findings of other studies where high proportion of positive attitude was detected (Shrestha et al., 2017; Bhebhe et al., 2014, Luba et al., 2019; Alotaibi et al., 2019). A study conducted to assess the causes of stigma and discrimination against TB infected people revealed that the causes were fear of contracting TB (58%), poverty (40%) and lack of knowledge (34%) (Auer, 2003).

TB-associated stigma and phobia continue to be global problems since many years ago, and remain as important social issues of the disease. Stigma has a negative impact on TB patients, as well as healthcare providers, since it forms physical as well as mental barriers between them. Findings of another study indicated that many factors were involved in causing the drop in the quality of HCWs service towards TB patients. These include fear of contracting TB, negative attitudes towards TB patients and losing their jobs as consequences to the factors stated earlier (Moloi, 2003).

Despite continuously working in the field, most of our participants had a phobia of TB; (62.2 %) of them said that they felt uncomfortable being very close to a TB patient. Almost half of the participants stated that it would not be safe for them to be in prolonged contact with a TB

patient, and 85% of the nurses said that they would leave their job if they contracted TB. Fear of the resulting prolonged hospital admission and complicated treatment course and isolation were also reported in other study (Tudor et al., 2013).

With agreement of findings reported in previous studies (Jurčev-Savičević, 2011; Khan et al., 2006), about 70% of our nurses mentioned that TB could minimize the chance of marriage. In addition, it was found that 70.1% of our participants considered TB as a social stigma. A similar finding was also reported in another study (Bodur et al., 2018). 44% in our study stated that if they ever found out they had contracted TB; they would feel ashamed and embarrassed.

Around 65% of the participants said that, if they had TB, other people would have a low opinion of their families, while 56.6% of the nurses were worried that people would laugh at them if they contracted TB. 56% of the nurses said that they would hide the fact that they had contracted TB if that was the case. Loss of self-esteem, feeling ashamed, and having less respect from others were the findings of other studies which assessed the stigma of TB among healthcare workers (Coreil et al., 2012; Tudor et al., 2013). Hence, prompt educational intervention should be introduced to minimise the phobia and stigma of TB among TB nurses in Libya. This would ensure optimal care and appropriate management for TB patients.

5.2.4.2 Association of attitude with socio-demographic characteristics and work experience

(a) **Age**

Despite there being a wide spectrum of age (18-50 years), there was no a phobia of TB found to be associated with any age group. This finding is consistent with the finding of another study (Adebanjo, 2011). In contrast, Tudor et al., 2013 reported that, phobia of the TB treatment course and cost was higher among aged nurses (>40 years) compared to that of the younger nurses. This finding could possibly be attributed to the higher level of knowledge regarding the course, cost and complications of TB treatment among the older nurses compared to that of the younger nurses. However, in another study, stigma towards TB was not different by the age of participants (Coreil et al., 2012). Moreover, participants of younger displayed a positive attitude towards TB than other older ages (Alotaibi et al., 2019; Lertkanokkun et al., 2013).

(b) **Gender**

The female participants in our study had higher TB phobia compared to male participants. Similar findings were reported in other studies (Adebanjo, 2011; Onifade et al., 2010). Sensitivity to contact with co-workers of TB and stigma towards TB in the society were believed to be more among women than men (Johansson et al., 1999). However, in our study, there was no significant difference between male and female nurses in their attitudes towards perceived TB stigma. This finding corresponded with other studies (Alotaibi et al., 2019; Coreil et al., 2012; Tudor et al., 2013)

(c) **Education level**

The finding in our study that both phobia and stigma of TB were not interfered by the various educational levels among our nurses, was similar to that of (Musasa, 2011). Another study also found that the stigma of TB was not expressed by the participants despite the various education levels (Coreil et al., 2012). In some previous studies, items related to knowledge and practice on TB were considered to be attitude items in the questionnaires; however, in the fact, such items were not expressed the actual concept of attitude. Hence, to avoid any misconception and confusion, we didn't include such kind of studies in our discussion part.

(d) **Work experience**

In our study, the length of work experience among the nurses was found to be statistically significantly associated with their attitudes towards TB. Senior nurses with more than five years of experience had positive attitude compared to those of nurses with less than five years of work duration. It could be that the nurses with longer years of experience in TB centres were continually updating and gaining in knowledge, which then subsequently reduces their perceived stigma and phobia of TB. This finding is consistent with the finding of of another study (Adebanjo, 2011). However, among the participants in other studies, the attitude towards TB was not affected by the work duration (Tudor et al., 2013, Coreil, et al., 2012).

5.2.5 Practice towards tuberculosis

5.2.5.1 Description of practice towards tuberculosis

With respect to practice, it was unexpected that only 15 % of our participants had satisfactory level of practice on TB. This finding is consistent with the findings in two other studies (Bhebhe et al., 2014; Hashim et al 2003). The application of infection control measures is essential for any high risk setting, particularly for nosocomial infections such as TB.

However, 20% of our respondents had satisfactory practice levels for infection control measures. In contrast, much higher level of satisfactory practice on application of TB infection control measures was reported in other studies (Hng et al, 2018; Alotaibi et al., 2019; Bhebhe et al., 2014).

In our study, 56%, 36.5% and 7.6% respectively of our participants stated that they never used, they sometimes used or always used the gloves during the handling of TB patients. 66.4% of our participants said that they had never told the patients in the ward to always wear protective masks. This was not acceptable, since all nurses must use protective masks when dealing with TB patients. This situation should therefore be rectified, since by taking protective measures for their health, the nurses involved in the TB wards would also be protecting their family members and everyone they interact with. In contrast, other studies reported acceptable levels of practice of using protective masks, but it should be much recommended that a high proportion of nurses used protective masks when dealing with TB patients; (82%) (Adebanjo, 2011) and (71%) (Bhebhe et al., 2014).

As part of their jobs, professional nurses in TB healthcare facilities are required to know how to collect sputum from patients by hygienic methods. Regarding this task, 67.4% of our participants had low levels of practice. For instance, only 6.8% said that they always followed the correct procedures to collect sputum from the patients. This could possibly be due to lacking of proper training or unavailability of practical guidelines in the TB centres. This finding is consistent to the finding in another study (Bhebhe et al., 2014). Lertkanokkun et al. (2013) however, found satisfactory level of practice regarding the collection of sputum from TB patients.

Being more readily available to TB patients than other healthcare workers, nurses in TB healthcare facilities are usually responsible for delivery of TB drugs to the admitted patients. Hence, they play a major role in successful treatment of TB patients. In our study, 55.2% of participants had satisfactory level of practice regarding the treatment of patients and delivering of drugs. 43.2% of participants indicated that they always ensured that the correct dosage of drugs was administered during the distribution of medications, while 34.1% of the participants said they always reminded patients to take their drugs regularly on time. However, only 8.1% of the participants mentioned that they always note of any apparent side effects or allergic reactions of the patients to the drugs.

Only 24.2 % of the participants stated that they always monitored whether the patients showed a response or resistance to treatment. This finding could probably be due to low levels of knowledge of TB treatment among our respondents. In contrast, 90% of nurses emphasised the importance of the patients taking medication regularly, 70% indicated that they always ensured the correct dosage of drugs was taken, while 30% always monitored the side effects or allergic reactions of the patients to the drugs (Ibrahim et al., 2014; Yükseltürk & Dinç, 2013). In another study 60% of the respondents recognised the four drugs used in first -line treatment, but failed to relate jaundice to the possible side effects of drugs (Noé et al., 2017) .

Nurses in TB centres are also responsible for providing health education to patients about the disease. However, 19.0% of our participants said that they always taught the patients about the different aspects of TB. Nurses who lack knowledge on TB would naturally find it

difficult to satisfactorily educate patients on TB, and therefore nurses with insufficient knowledge were less likely to be involved in educating patients.

In contrast, in a study by Adebanjo (2011), 66.4% of participants stated that they were independently involved in educating patients about TB. 22.1% of the participants said that they would call and remind patients if the patients miss any of their follow-up appointments. Lertkanokkun et al. (2013) reported that 98% of the respondents used various methods to call or remind patients if the patients miss any of their follow-up appointments, most commonly, by telephoning. Other barriers to educate the patient such as lack of communication skills by nurses and negative attitude towards the patient were reported in other study conducted in Nigeria (Ibrahim et al., 2014).

5.2.5.2 Association of practice with socio-demographic characteristics and work experience

(a) **Age**

The level of practice shown towards tuberculosis among our participants was not affected by their ages. This corresponded to the finding in another study (Hng et al., 2018). Both findings contribute towards stressing the fact that age was not a potent factor in enhancing the level of practice, compared to the number of years of service, and level of education. However, Adebanjo (2011) reported that, younger participants (< 30 years) were found to be using protective mask more frequently than older participants.

(b) **Gender**

Taking into consideration of all the components of 'practice' in our study, a significant association was found between gender and the level of practice in only one practice component; female nurses were found to have satisfactory level of practice in infection control measures than male nurses. Similarly, Adebanjo (2011) reported that females nurses were more involved in patients' education than males. He reported however, that male participants used the personal masks as protective measures during contact with TB patients more frequently than females.

(c) Education level

Both diploma and bachelor's holders from our participants had equally unsatisfactory level of practice on admission of TB patients compared to training certificate holders. However, the levels of education did not affect the remaining components of practice. Possible reasons for this finding include the lack of proper practical sessions and teaching materials regarding tuberculosis in the educational curricula of both the faculties and institutes of nursing care. It was also found that there was no significant association between the level of education and practice in a study conducted in Malaysia (Hng et al., 2018). However, a study (Rosseter, 2014) found that increasing the proportion of bachelor's holders in nursing care in among the hospitals, was associated with increasing levels of better practice and patients' outcomes.

(d) Work experience

Interestingly, it was found that nurses with more than 5 years of work experience had unsatisfactory levels of practice in administrative services of patients compared to the more junior nurses. The reasons for this anomaly studied further through face to face interviews. However, it was found that nurses with 1 year to 5 years of work experience had satisfactory

practice levels in TB treatment and drug delivery compared to those with less than 1year of work experience. This finding is to be expected, since satisfactory practice levels in TB treatment and drug delivery go along with experience in handling and treating TB patients.

Moreover, nurses with more than 5 years of work experience were more involved in educating patients about TB and in using personal protective equipment, compared to those with less than 5 years of work experience in the field (Adebanjo, 2011; Lertkanokkun et al. 2013). In another study, it was found that nurses with more than 5 years of work experience referred more to the TB treatment guidelines compared to junior nurses with less than 5 years of work experience (Malangu & Adebanjo, 2015). Finally, a study by Hng et al., (2018) found that a good level of practice in TB was found to be associated with more than 10 years of work experience.

5.2.6 Association of knowledge and attitude with practice

Shrestha et al. (2017) reported that a good level of knowledge in tuberculosis, associated with the positive attitude, ultimately resulted in a good level of practice. In our study, there was a significant association between knowledge and practice ($P < 0.001$). similar finding was reported in previous study (Sutiono et al., 2016). However, finding of prevoius study (Sarani et al., 2016), revealed that satisfactory level of knowledge about infection control, and positive attitude were significantly associated with the nurses' levels of practice.

5.3 Phase 3: Effectiveness of TB educational intervention

An intervention program utilising structured modules on tuberculosis was delivered as a strategy to improve knowledge, attitude and practice regarding TB, among nurses working in TB centres in Libya. The results of this study provide evidence that significant improvement in knowledge, attitude, and practice regarding TB among such nurses can be achieved through a designed health education intervention.

We believe that the observed changes in the study the results of the intervention delivered. However, studies that evaluated the effects of health education intervention on the levels of knowledge in TB, the attitude, and practice towards TB among healthcare workers, are scarce. Hence, we find limited number of investigations on nurses or healthcare workers with which to compare the results of our study.

5.3.1 Response rate

Initially, at pre-test, there were a total of 50 nurses in the intervention group of our study, but due to three nurses dropping out in the follow-up rounds; the total number of nurses involved was 47. However, two nurses in the control group in the follow-up rounds dropped out, leaving 48 in the control group. The criteria used for the retention of participants were effective communication through calls, text messages on the days for intervention, and subsequent follow-ups.

Such incidence of dropping out was anticipated, due to various reasons and circumstances of any employee. Similar incidence of dropping out was reported in previous studies (Bisallah et al., 2018; Kaushal et al., 2015). The sample size in this phase of our study was small, since only one hundred nurses were recruited. This was due to the limited number of TB nurses in

Libya; where most of TB nurses were involved in the baseline KAP survey (phase 2). In contrast, other studies reported a large sample size (Naidoo et al., 2011; Wu et al., 2009; Bisallah et al., 2018).

5.3.2 Effectiveness of intervention on knowledge

In our study, at baseline, there was no significant difference in mean knowledge scores between the intervention and the control groups (mean = 31.09 ± 3.337 vs. 32.85 ± 3.687, p = 0.17). However, significantly higher mean knowledge scores were found in the intervention group compared to the control group, indicating that there were improvement in knowledge among participants that received the intervention; at immediate post-test, 3-month and the 6-month follow-up, (71.68 ± 3.79 vs. 33.60 ± 4.22, p< 0.001, 69.62 ± 3.25 vs. 34.38 ± 4.27, p < 0.001 and 70.06 ± 3.06 ± vs. 34.79 ± 4.32, p <0.001), respectively,. This finding is consistent with the findings of other studies (Kaushal et al., 2015; Wu et al., 2009; Bisallah et al., 2018; Hagag et al., 2012).

In contrast, in one study, nurses were the least group of healthcare worker which showed improvements in the levels of knowledge from TB post education intervention (Naidoo et al., 2011). The knowledge scores were not affected by the sociodemographic variables and work experiences among the nurses in our study. In our study, the group * time interaction was significant (p<0.001), which was similar to the finding of Bisallah et al. (2018).

However, in our study, significant improvement was observed in the entire knowledge components across time, except of knowledge on TB causation and prevention. This finding could be contributed to the good basic knowledge of nurses regarding the causes and

prevention of TB. The result of our KAP survey also revealed that the nurses had good levels of knowledge regarding the causes and prevention of TB. Moreover, in our study, the improvements of knowledge, attitude and practice were stable at three month and six month follow-up. In comparison, finding of other study revealed that the impaction of health education intervention on knowledge, attitude and practice was declined over the time (Suchitra & Devi, 2007).

5.3.3 Effectiveness of intervention on attitude

We were able to investigate whether tuberculosis education intervention was effective in working against TB stigmatisation and phobia, and whether there were statistically significant differences in the scores between pre-test, immediate post-test, 3-month and 6-month follow-up. Before education intervention, there was no difference in the mean attitude scores between intervention and control groups (2.16 ± 0.17 vs 2.15 ± 0.17, $P = 0.725$).

In general, the result of our study revealed that there was a reduction in phobia and stigmatisation of TB among nurses in the intervention group compared to the control group, at immediate post-test, 3-month and the 6-month follow-up, (3.93 ± 0.31vs. 2.21 ± 0.28, $p< 0.001$, 4.01 ± 0.29 vs. 2.22 ± 0.21, $p < 0.001$ and $3.91 \pm 0.26 \pm$ vs. 2.20 ± 0.23, $p <0.001$), respectively. Our finding indicated that education intervention had improved the attitude score toward TB, similar to the findings reported in other studies (Wu et al., 2009; Hagag et al., 2012; Bisallah et al., 2018).

In our study, sociodemographic variables and work experiences were found to have no effects on the attitude of nurses across the time. The results of our study revealed that the

group across time interaction was significant (p<0.001), which corresponded to the findings of Bisallah et al. (2018). Attempts at improving the levels of attitude among frontline healthcare providers, such as nurses, toward tuberculosis; will ultimately have a positive impact on their performance, and ensure optimal care of patients as well as adherence to appropriate TB infection control measures.

5.3.4 Effectiveness of intervention on practice

Initially at baseline evaluation there was no difference in the mean practical scores between intervention and control groups (39.09 ± 4.33vs 39.54 ± 3.93, *P* = 0.392). This finding was similar to that at baseline assessment cores of knowledge and attitude. It was unreliable to assess the practice score immediately post-test. Hence a period of six months was given to give them an adequate opportunity to increase their practice scores from the knowledge gained in the TB educational programme.

Our educational intervention showed significant improvements in the mean practice scores among the intervention group compared to control group at 3- month and at 6-month follow-up (57.32 ± 2.70 vs. 40.65 ±3.27, p< 0.001, 54.36 ±3.41vs. 40.42 ±3.23, p< 0.001), respectively. In agreement with our findings, other studies (Kaushal et al., 2015; Bisallah et al., 2018) also reported the effectiveness of health education intervention in improving practices regarding tuberculosis. There was another study has showed the effectiveness of education program in improving prevention practices regarding TB (Mohammadi et al., 2012).

However, the level of practice was not affected by sociodemographic variables and work experiences of nurses across time. Our effect on the level of practice was higher than the large effect of Cohen ($\eta 2 = 0.14$) (Lakens, 2013). Moreover, in our study, the group across time interaction was significant ($p<0.001$), which corresponded to the finding of Bisallah et al. (2018).

In our study, no contamination of KAP' results was detected across time, as there was no significant changes observed among the control group. This finding could be due to the fact that the intervention and control groups were from different cities. In comparison, such contamination has been reported in other studies where the control groups showed some improvement in knowledge and practical scores, despite separation (Bisallah et al., 2018; Maduka & Tobin-West, 2013). This kind of contamination might decrease the internal validity of the study. With respect to the importance of effective practice in tuberculosis prevention and control, the need for information, training, and positive attitudinal change towards the disease are vital.

5.4 Limitations and strengths of the study

5.4.1 Phase 1: Validity and reliability of TB-KAP questionnaire

5.4.1.1 Limitations

Regarding validity and reliability of the TB-KAP questionnaire, at present, we could not find a gold standard KAP questionnaire regarding tuberculosis, since most of the published questionnaires were insufficient to cover the entire aspects of knowledge, attitude and practice towards TB. Hence, we did not test our developed questionnaire against any other

standard measurement. Due to limited number of TB-nurses in Libya and a large sample would be needed to carry out the next two phases of the study; test-retest reliability was carried out among small sample of nurses (n=30). Moreover, because of this reason also, we couldn't perform confirmatory factor analysis (CFA) that could give more constructive validity. However, some participants stated that our questionnaires were rather long as they had to spend more than 30 minutes to complete it. Besides, this instrument was validated to be used among TB nurses and may not be suitable for the assessment of knowledge, attitude and practice among nurses in non-TB healthcare facilities.

5.4.1.2 Strengths

The content and face validity were determined through assessment of the questionnaire by an expert panel of six members from various specialties; public health, microbiology, respiratory medicine, TB control team, and medical education. All the items for all the components in the questionnaire were considered eligible and therefore retained. To avoid contamination of the result by previous to the questionnaires, during reliability testing the questionnaires were distributed among participants different from those who were involved in the other part of validation. However, the structure and meaning of sentences in the remaining items of the components remained the same, as only three items were removed from the original questionnaire after exploratory factor analysis (EFA). Moreover, no specific item regarding KAP on TB for Libyan culture and society was used; therefore, this instrument can be applied in future in any similar research in Libya or other countries.

5.4.2 Phase 2: Knowledge, attitude and practice towards tuberculosis

5.4.2.1 Limitations

Regarding the KAP survey, the finding was not supported by a qualitative study as the assessment was only based on self-administered questionnaires. However, the outcome of the research would have been more precise and reliable if the attitude and practice were evaluated by qualitative methods such as focus group discussions and direct observations of nurses at the working places. Moreover, we did not enquire from the respondents the training that could be received before the study. Thereafter, because of limited number of TB nurses in Libya, the same sample size was used for both, exploratory analysis in validation and KAP survey. In addition to that, the results could not be generalised to all nurses working in general (non-TB) hospitals in Libya, as the study was carried out only among TB nurses.

It was clearly stated that lacking of knowledge and poor practice on TB infection control measures are likely to contribute in increasing the risk of nosocomial transmission of TB among the staff and patients (Viney et al., 2014; Farley et al., 2012; He et al., 2010; Kanjee et al., 2011; Park, 2018; Sissolak et al., 2011). Our study findings also showed low level of knowledge, high level of negative attitude and unsatisfactory practice among the nurses. However, low levels of KAP are not wholly to be blamed for that the nurses are still being infected. Other factors maybe the reason for this occurrence, and should be investigated.

5.4.2.2 Strengths

The study is unique as it is the first nationwide survey in Libya with a large sample and high response rate among TB nurses. The probability sampling technique and large sample size

both give a high degree of generalisability of our findings. This study also offers novel outcomes that may be applied to similar settings. Despite the study being conducted among nurses scattered in wide geographical areas of Libya, there was no financial or time constrains in the study.

5.4.3 Phase 3: Effectiveness of TB educational intervention

5.4.3.1 Limitations

The constraints in this study were: the educational program was more theoretical than practical; a small sample size was used in the study due to the limited number of TB nurses in Libya.

5.4.3.2 Strengths

Formative assessment was part of the instructional process throughout the whole programme, because evaluation of any progress made during the course of an intervention, helps to improve the effectiveness of the intervention. This study found strong evidence of the significance of the effect of health education intervention in improving knowledge, attitude, and preventive practice regarding tuberculosis, among nurses from different cities, with respect to their sociodemographic variables.

However, no contamination of the control group findings was observed, since the study was conducted among the intervention and control groups at the same time. Moreover, the study is the first of its kind in Libya, and the finding may be used as baseline information for future education intervention.

CHAPTER 6: CONCLUSION, RECOMMENDATION AND PUBLIC HEALTH IMPLICATION

About this chapter

This chapter synthesises the conclusion from the findings in this thesis and makes a few recommendations for public health practice.

6.1 Conclusion

6.1.1 Phase 1: Validation of TB KAP questionnaire

The TB KAP questionnaire demonstrated reliability and adequate content as well as construct validity. It is a valid instrument with good items that can be reliably used to assess the

knowledge, attitude and practice among nurses dealing with TB patients in Libya or even in other countries. The finding of the validation process indicated that 109 (97.3%) out of the 112 items were acceptable, and only three items were deleted from the questionnaire. However, the structure and meaning of sentences in the remaining items of the components were still the same as the original questionnaire after exploratory factor analysis.

6.1.2 Phase 2: Knowledge, attitude and practice towards tuberculosis

Based on our finding, the TB nurses in Libya showed low levels of knowledge, attitude and practice towards tuberculosis. Their knowledge was affected by age, educational level, work experience and location of living, but was not affected by gender. However, their attitude was not affected by age and educational level but was affected by gender, work period experience and residence. Moreover, their practice was affected by gender, educational level and work experience was not affected by age and residence. Regressing analysis revealed that the level of knowledge was a significant predictor of level of practice among the participants.

6.1.3 Phase 3: Effectiveness of TB education intervention

The health education intervention was effective in improving the levels of knowledge, attitude and practice of nurses towards TB. The intervention group showed significant improvements in the mean scores for knowledge, attitude at immediate post-test. The mean scores remained stable at 3-month and 6-months follow-up. Practice scores were increased at 3-month follow-up and remained stable at 6-months follow-up.

There were no improvements of the results over the time observed in the mean scores of knowledge, attitude and practice among the control group. However, there were significant differences in knowledge, attitude and practice scores between the intervention and control groups over time. The interaction (group * time); the time; and the groups each were found to have a statistically significant effect on knowledge, attitude and practice.

6.2 Recommendations

6.2.1 Phase 1: Validation of TB KAP questionnaire

The findings from our study lead us to strongly recommend that future study on validity and reliability of TB-KAP questionnaire should include confirmatory factor analysis, which could help to improve the construct validity of the questionnaires. In addition, the questionnaire should be tested against standard measure.

6.2.2 Phase 2: Knowledge, attitude and practice towards tuberculosis

Tuberculosis is a common communicable disease, and being healthcare professionals, nurses should have enough knowledge about each aspect of the disease. Nurses in hospitals are not only involved in the management of patients and administration of the wards, but they are also responsible for providing health education to the patients about the disease. Moreover, nurses are usually responsible for carrying out routine investigations, treatments and discharge of patients from the wards. Thus the results of this study suggest that there is a need to increase and maintain the knowledge of nurses in Libya about the disease through continuous health education programs.

Moreover, more research is required to examine the reasons behind inadequate knowledge regarding TB, among the nurses. Ideally, with the aim to obtain the maximum value of KAP surveys, and to increase the validity of the information gained, they should be repeated over time, and triangulated with qualitative methods, such as focus group discussion, and direct observation of the nurses' work at their working places. These studies can provide more in-depth understanding of their attitude and practice, respectively.

TB health education program should also become a part of the regular activities undertaken by all nurses in colleges, institutes and hospitals in Libya. Additionally, future surveys should be carried out on other healthcare workers as well, and not restricted only to the nurses. Revision of nursing curricula and teaching methodologies in teaching faculties is also suggested. Thereafter, as the electronic media was one of the most frequent sources of information. Hence, all measures should be taken to remove barriers to educational messages transmitted by this media.

6.2.3 Phase 3: Effectiveness of TB education intervention

Health education is a fundamental driver of change in knowledge, attitude and practice of nurses. The nurses' development programme can be linked to both theory and practice and the result benefits the nurses in clinical areas. Therefore, this tuberculosis education programme could be included in continuous performance development (CPD) of nurses in Libya to improve, update and maintain knowledge on TB as well as enhance the clinical performance of nurses in the work place.

The developed module is recommended to be included as a strategy in the national tuberculosis control guidelines in the training of nurses on tuberculosis prevention at

healthcare facilities. The study also indicated the need for implementing frequent health educational programs among the nurses to maintain the knowledge and practice for infection control. For future research, cluster randomized control trial should be conducted as the current study was not randomized. Additionally, the intervention was done only among nursing staff; hence future studies should include other categories of healthcare workers.

6.3 Public health implication

Based on the collaboration between World Health Organization (WHO) and Libyan ministry of health regarding tuberculosis; the national strategy to fight tuberculosis has determined three main goals; the implementation of the DOTS strategy according to the guidelines of WHO, revision and updating of the medical faculties' curricula and improvement of tuberculosis laboratories by the establishment of a multiple drug resistance laboratory, and use of advanced techniques in diagnosis (WHO, 2006). The national centre of disease control and prevention is in Zleiten. It has established a surveillance network and performs several training activities on detection and reporting of TB cases.

In addition, national guidelines for disease surveillance have been adapted and the reporting system is operational in all districts. However, despite this, the rate of tuberculosis detected in Libya is gradually rising, as the number of cases is increasing each year due to the increase in the number of immigrants and workers from highly prevalent countries where TB is prevalent, such as Sub-Sahara Africa, India, and Bangladesh. In Libya, there were 100-1500 new cases each year, and 60% of cases occur in the productive age group of 15 –56 years (WHO, 2018). Moreover, the infectious diseases section of the health information department belonging to Libyan ministry of health has indicated that nurses working in

tuberculosis centres in Libya are still at risk of acquiring tuberculosis infections, since new cases of infected nurses are being reported each year.

To remain successful in the fight against tuberculosis, keeping knowledge at a high level is essential. Health education plays a major role in changing the knowledge, attitude and behaviour of nurses towards public health issues such as tuberculosis. However, no workplace–based health education programs regarding tuberculosis have been implemented in the health or other public settings in Libya. Therefore, heath education intervention programs should be applied in workplace settings, particularly healthcare facilities.

Nurses are the frontline healthcare workers who provide comprehensive care to the patients, including health education. Hence it is recommended that nurses should also be afforded the opportunity to provide further inputs in the development of the training education programs.

As a change in behaviour is a difficult process that rarely occurs within a short time, it is recommended that these training and educational material be made widely available and offered regularly through various media, to continually promote the desired changes among the nursing staff. Research findings of our study showed that prioritised interventions are needed to improve communication and information dissemination on tuberculosis to the healthcare workers to aid TB control and all prevention efforts.

The standard of nursing care of Libya is still inadequate, due to poor quality nursing education. Nursing is not taught up to the degree level, and the teaching curricula are out of date (WHO, 2007). Therefore, at the completion of this study, a full copy of this report will

be made available to the human resource development department in Ministry of Health and curricula development and updating department in Ministry of education in Libya to facilitate access to the findings. The module developed is recommended to be included as a strategy in the National tuberculosis control guidelines in the training and prevention at TB healthcare facility level. It is hoped that these results will be used to revise the curricula of faculties of nursing and to plan better educational and training provision in the hope of strengthening nurses' capabilities, hence providing higher quality services and improved patient care in TB healthcare facilities. Hopefully, the results of this study will be considered as baseline data on nurses' knowledge, attitude and practices for tuberculosis.

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