An-Najah National University

Faculty of Graduate Studies

AWARENESS AND COMPLIANCE TO FOLIC ACID SUPPLEMENTATION AMONG PREGNANT WOMEN AND GUIDING PHARMACISTS IN WEST BANK (QALQILYA)

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Dedication

“I dedicated this thesis to the sake of GOD, and my great teacher and messenger, Mohammed (May Allah bless and grant him), who taught us the purpose of life.

To my homeland Palestine, the intimate womb”

“My great parents, who have always loved me unconditionally and whose have taught me to work hard for the things that I aspire to achieve, To My teachers, to all my family, and my friends who encourage and support me, all the people in my life who touch my heart, I dedicate this research”.

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“First, I give all the glory to God, the source of my strength, for granting me both the mental and physical endurance to complete this monumental task”.

“I would like to extend a very special thanks to my advisors Dr. Nihal Natour and Dr. Maryam Al-Tell for believing in me and for their diligent supervision, clear guidance, continued support and encouragement throughout this process”.

“My teachers, I extend special thanks and gratitude to you for your assistance, encouragement, and support”.

“Then, I would like to thank my entire family, especially my loving parents, for their love, understanding, and support “

“To everyone who gave me the moral support for the completion of this task, Thank you”.

Declaration

I, the undersigned, declare that I submitted the thesis entitled:

AWARENESS AND COMPLIANCE TO FOLIC ACID SUPPLEMENTATION AMONG PREGNANT WOMEN AND GUIDING PHARMACISTS IN WEST BANK (QALQILYA)

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

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Date: 29/12/2024

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AWARENESS AND COMPLIANCE TO FOLIC ACID SUPPLEMENTATION AMONG PREGNANT WOMEN AND GUIDING PHARMACISTS IN WEST BANK (QALQILYA)

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Abstract

Introduction: In pregnant women, susceptibility to folate deficiency could happen from factors such as increased requirements during pregnancy, Undernutrition caused by poverty, food insecurity, and gender inequalities. Furthermore, insufficient knowledge of appropriate dietary practices increases the risk, leading to increased deficiencies in folic acid. Folic acid deficiency correlates with adverse outcomes like preeclampsia, premature birth, neural tube abnormalities, congenital defects, type 2 diabetes, and infant obesity.

Method: A quantitative study conducted in Qalqilia from October 1, 2021, to January 7 2023, evaluated the awareness and adherence to folic acid supplementation among 160 pharmacists and 350 pregnant women. The survey investigated pharmacists' awareness, knowledge, and attitudes, as well as the compliance and obstacles faced by pregnant women regarding supplementation. Comprehensive quantitative analysis of the data provided insights into the current levels of awareness and adherence among both pregnant women and pharmacists.

Results: The finding indicated that 62.0% of the sample size of participants are city residents, 59.7% of them were between 25-35 years old. And 67.4% has never suffered from anemia, 44.9% of the participants has hemoglobin level between 10-12. The participants had a moderate level of awareness and knowledge regarding the intake of folic acid and iron ,with a mean score (1.97 ± 0.32)**.** The level of compliance among participants towards taking supplementation was medium**,** the level of the barriers that prevent pregnant women using supplements was medium, with mean score (1.99±

0.41)**.** The role of pharmacists in instructing and educating women to intake folic acid was medium, with mean score (2.25±0.50)**.**

Conclusion: Pregnant women demonstrated moderate compliance with iron and folic acid supplementation. Factors affecting adherence included the timing of initiating antenatal care, awareness of anemia, guidance on the importance of supplementation, the number of supplements given per visit, the number of children, and the distance to healthcare facilities from the participants' living locations and the supplements side effects had minimal impact on the intake of folic acid supplementation. Strengthening health education for providers is crucial. While pregnant women had good knowledge, supplement attitudes were limited. Focus on behavioral studies is recommended for conclusive insights. Recommendations include enhancing awareness through education programs, implementing reminder systems, and promoting supplement use in university women, with an active role for pharmacists in public health.

Keywords: pregnant women; attitude, pharmacists; Awareness; folic acid; knowledge; Compliance.

Chapter One

Introduction

Iron and folic acid supplements are prescribed substances, and their adherence is the degree to how closely one follows the prescription. (1) According to Hilda Duplessy, a woman qualifies as being adherent to her dosage when she takes in 65% of the total iron and folic acid supplement. In this way, an adherent woman will have taken the supplements at least four days a week. (2)

Adherence to iron and folic acid supplements is essential for addressing anemia and supporting pregnancy health. For optimal outcomes, adherence involves consistently taking these supplements in line with prescribed dosages, which can vary based on individual health needs and medical guidelines. As defined by Duplessy, a minimum adherence threshold of 65% allows for some flexibility but ensures adequate nutrient levels for those most at risk of deficiencies, especially pregnant women. Adherence not only involves taking the supplements regularly but also understanding the impact of missing doses, which may reduce the effectiveness of the treatment and delay the health benefits intended by supplementation.

The degree of adherence directly impacts the efficacy of these supplements in reducing anemia rates and associated health risks in both pregnant women and the general population. Research highlights that consistent supplementation can mitigate severe anemia cases, which are particularly harmful in resource-limited settings where women might lack access to nutrient-dense diets. For pregnant women, consistent adherence ensures that iron levels are maintained to meet increased physiological demands, significantly lowering risks for maternal anemia, adverse pregnancy outcomes, and neural tube defects in the fetus.

To encourage adherence, healthcare providers often recommend simplifying supplement regimens, using combined iron-folic acid tablets, or tailoring recommendations to each patient’s lifestyle. Studies suggest that regular reminders and support from healthcare professionals can boost adherence rates, as can improving patient understanding of the critical role of these nutrients. (1)(2)

Iron deficiency anemia occurs when the body cannot produce a sufficient number of red blood cells because of a lack of iron, which is needed to produce hemoglobin (1). This form of anemia is caused by a low amount of hemoglobin in the bloodstream, typically due to an insufficient consumption of nutrients (3). Anemia is a global health issue that severely increases the chances of falling ill or dying, mainly in children and pregnant women . According to World's Health Organization, more than 2 billion people, which are more than 30% of the world's population, are affected by iron deficiency. I consider this number to be more than shocking (4).

Pregnant women are one of the populations that are especially susceptible to iron deficiency because of their elevated nutritional requirements. Iron deficiency anemia is extremely disadvantageous to maternal and fetal health. Moreover, folic acid deficiency in pregnancy and in early pregnancy increases danger of neural tube defects, as well as a number of additional adverse pregnancy outcomes, including facial cleft lip.(5)

Iron deficiency anemia is an illness where the body loses the ability to create red blood cells because it does not have enough iron to create hemoglobin (1). This anemia results from reduced hemoglobin levels below normal because of inadequate nutrients (3). It is an emerging infectious health threat that poses high risks to human health increment of illness and death rates, particularly among children and pregnant women. In this regard, it has been established that over 2 billion people of the global population, or over one-third, definitely experience moderate to severe forms of shortage of iron within their diets today; more commonplace in developing nations (4).

Each of these groups is at a higher risk than the general population since they need special nutrition. The effects of iron deficiency anemia are on maternal and fetal health burden. Further, high risk pregnancy, low birth weight, neural tube defects, and early pregnancy folate intake are other factors which have shown deleterious effects on pregnancy period which includes orofacial clefts (5).

According to the World Health Organization (WHO), it is critical for all pregnant women to receive a daily supplement of 400 micrograms (mcg) of folic acid along with 30-60 milligrams (mg) of elemental iron throughout the first six months of pregnancy. This recommendation is based on robust evidence indicating that sufficient folic acid intake significantly reduces the risk of neural tube defects (NTDs) in developing

fetuses, while adequate iron levels support maternal health and reduce the likelihood of iron deficiency anemia. Iron, a vital component of hemoglobin, aids in transporting oxygen to both maternal and fetal cells, which is crucial for healthy fetal development and maternal well-being during pregnancy (6).

In addition to addressing common nutrient deficiencies, combining iron and folic acid supplementation with broader public health actions, such as malaria prevention, early detection, and treatment, offers comprehensive maternal health protection, especially in regions where malaria poses a substantial risk to pregnant women and infants. Malaria infection during pregnancy can exacerbate maternal anemia and lead to adverse birth outcomes, including preterm delivery and low birth weight. Consequently, integrating malaria prevention measures, such as insecticide-treated nets, with daily supplementation of iron and folic acid not only enhances maternal health but also improves pregnancy outcomes.

The 2012 WHO guidelines emphasize that these nutritional interventions should be part of a holistic antenatal care (ANC) strategy that prioritizes accessible healthcare, timely screenings, and preventative actions for diseases like malaria that can compromise maternal and fetal health. The folic acid dosage of 400 mcg per day during pregnancy ensures a protective effect against neural tube malformations, particularly during the first trimester when the neural tube forms and closes. Iron supplementation of 30-60 mg daily is equally essential, as pregnancy increases maternal blood volume, necessitating additional iron to prevent anemia, which can cause fatigue, weakness, and other health issues that affect both mother and child (6).

These recommendations underscore the importance of comprehensive prenatal care to support a safe and healthy pregnancy. As studies have demonstrated, a daily intake of iron and folic acid significantly contributes to reducing maternal and neonatal mortality rates, making these supplements fundamental components of maternal health protocols worldwide (6).

Iron deficiency anemia at any given time affects approximately 50% of all anemias (7) (1). Folic acid is a micronutrient that is involved in metabolism; fetal growth as well as the development of the neural tube (8). It is well understood that pregnant women are at a higher risk of anemia, in part due to the biological demands of the pregnancy for the

anemic woman and for the unborn child. Other conditions include poverty leading to malnutrition, food insecurity, gender disparity and poor nutrition knowledge may also worsen the levels of iron/folic acid (9).

Lack of pregnancy folic acid can result in preeclampsia, premature labor, neural tube disorders, congenital abnormalities, diabetes Mellitus type 2 and neonatal adiposity. Maternal consequences of ADA include haemorrhage, preterm delivery, premature rupture of membranes, reduced working capacity, and increased maternal mortality. It also impacts newborns, and results in low birth weight, cognitive impairment, preterm birth, and cardiovascular complications (10) (11) (12).

Folic acid is an essential nutrient for maternal and fetal health during pregnancy, as its importance extends beyond preventing neural tube defects to include various health aspects. Low levels of folic acid can lead to serious complications for the mother, such as preeclampsia, a condition characterized by high blood pressure and is considered a life-threatening condition for the mother and fetus. Folic acid deficiency is also associated with an increased risk of premature birth and premature rupture of membranes, which may contribute to high rates of morbidity and mortality among mothers. In addition, a deficiency in this element may lead to an increased risk of bleeding in the mother and decreased physical ability during pregnancy, which confirms the essential role of folic acid in maintaining the mother's health during pregnancy. As for the fetus, the effect of folic acid deficiency is no less serious, as children born to mothers with low levels of folic acid are more likely to have low birth weight, delayed cognitive development, and heart problems. Some research also indicates a link between a lack of folic acid in the mother and an increased risk of obesity in children, a condition that may lead to diseases such as type 2 diabetes and heart disease later in life. Folic acid deficiency is also associated with some birth defects, such as heart defects and cleft lip, highlighting its important protective role in healthy fetal development.

Early awareness and education of women about the importance of folic acid by healthcare providers, especially pharmacists, can help women of childbearing age maintain adequate levels of this element before and during pregnancy. This proactive approach may contribute significantly to reducing the rates of preeclampsia, gestational

diabetes and other health complications associated with folic acid deficiency, thus enhancing pregnancy safety and healthy birth outcomes.

The repercussions of anemia are even considered accountable for 50,000 of maternal mortality associated with childbirth each year globally (12). According WHO guidelines for nutrition in pregnancy, pregnant women should take iron and folic acid supplements beginning at least at six months (6). Iron is vital for the growth of the fetus, newborn, and infant, contributing to red blood cell production and the development of the brain and muscles, especially during early life stages (13). For preterm infants, iron supplementation helps to boost iron levels, address anemia, and improve birth weight. For pregnant women, periodic iron supplementation is preferred over daily intake (14). Folic acid, found in dark green leafy vegetables and supplements, is essential during pregnancy, as women require 5-10 times more folate than non-pregnant individuals (15). Folate supports neurotransmitter production, cell division, gene regulation, cell growth, and tissue development in the uterus and placenta during pregnancy. A folate deficiency can lead to various health issues, including neural tube defects (NTD) (16) (17).

Scientific research has confirmed the protective effect of folic acid supplementation taken by women before and during early pregnancy in reducing the risk of NTDs and other negative pregnancy outcomes.

Epidemiological research suggests that women who do not receive adequate folic acid supplementation before and during pregnancy face higher risks of complications. Studies reveal that insufficient folic acid intake among pregnant women is linked to an increased likelihood of maternal and fetal health issues. This study evaluates the Knowledge, Attitudes, and Practices (KAP) of community pharmacists and pharmacy technicians regarding their advice on folate intake for women of reproductive age. The goal is to assess how effectively women are exposed to this important health information. Pharmacists are crucial in promoting adherence to folic acid supplementation through their counseling efforts, thus contributing to improved pregnancy outcomes.

Folic acid is essential in the early stages of pregnancy as it significantly reduces the risks of neural tube defects (NTDs), which are serious birth defects affecting the brain and spine (109). The World Health Organization (WHO) recommends that all women of reproductive age take 400 micrograms (mcg) of folic acid daily, especially before conception and during the first trimester, to maximize protective effects (112). Inadequate folic acid intake is linked to higher risks of pregnancy complications, including preterm birth, low birth weight, and maternal anemia, underscoring the vital role of health professionals in raising awareness (111).

In this context, pharmacists play an influential role in guiding women to start folic acid supplementation early, ideally before conception. This is because neural tube defects typically form within the first 28 days after conception, often before a woman is aware that she is pregnant (107). Therefore, community pharmacists and pharmacy technicians are pivotal in educating women on the benefits of daily folic acid intake, particularly for those planning pregnancy or of childbearing age (110). This study aims to evaluate the extent to which pharmacists provide accurate and timely folic acid information, ensuring that women receive the right guidance to improve maternal and fetal health outcomes.

Pharmacists' counseling and engagement with pregnant women not only promote adherence to folic acid supplements but also extend to discussions on overall nutrition and preventive health measures. They contribute directly to public health efforts by actively supporting women's health initiatives that seek to reduce preventable birth defects. Thus, strengthening pharmacists' knowledge and communication strategies on folic acid supplementation can greatly impact pregnancy outcomes on a broader scale (108).

1.1 Significance of the study

The importance of this study is underscored by the lack of research focusing on knowledge and changes in folate supplementation among pregnant women. A major challenge related to folic acid deficiency is adherence, as women frequently miss prescribed doses due to various factors. This research holds global significance, as it explores the diverse causes contributing to anemia during pregnancy. Although the WHO recommends 60 mg of iron and 400 μg of folic acid supplementation in regions

with more than 40% prevalence of iron deficiency anemia (IDA), existing literature shows significantly lower compliance, particularly in low- and middle-income countries. This ongoing low rate of supplementation undermines efforts to effectively prevent anemia.

1.2 Problem statement

Folic acid supplementation is essential for protection from neural tube defect and low birth weight. Folic acid is usually prescribed to women during prenatal care and during periconceptional periods, but whether pharmacists are knowledgeable, enough about supplementation or whether pregnant women are compliant is important aspect for complete protection. Another supplement, which is important prenatally, is iron supplementation which protects from premature delivery, low birth weight and having infants with low iron status.

Through my training in health institutions and hospitals, and my professional experience, I noticed that pregnant women often have limited awareness of the importance of folic acid supplements. This issue might be due to inadequate counseling from pharmacists about the significance and proper usage of folic acid supplementation.

1.3 Purpose of the research

The study objectives are the following:

- To measure the knowledge of using folic acid supplementation among pregnant women in Qalqilya district using likerted score questionnaire.
- To measure the compliance of pregnant women to using folic acid supplementation in Qalqilya district taking supplementation of iron and folate using likerted score questionnaire.
- To assess the barriers that prevents pregnant women in Qalqilya district from using iron and folate supplementation.
- To assess the knowledge of community pharmacists regarding counseling women of reproductive age on adequate folate and iron intake using a Likert scale questionnaire.

- To evaluate the attitudes of community pharmacists towards counseling women of reproductive age on appropriate folate and iron intake using a Likert scale questionnaire.
- To outline the role of pharmacists in guiding and educating women on the intake of folic acid.

1.3 Research questions

Q1: What were the Likert scale ratings for knowledge, awareness, and adherence (KAP) among pregnant women in the Qalqilya district?

Q2: What were the Likert scale ratings for obstacles to folic acid supplementation among pregnant women in the Qalqilya district?

Q3: What were the socioeconomic factors that are related to KAP scores among pregnant women Qalqilya district.

Q4: What were the likerted scores of KAP among community pharmacists with regards to recommending folic acid supplementation to pregnant women.

1.4 Research Hypothesis

H0: There is no significant variation in awareness and knowledge regarding folic acid adherence among pregnant women in the Qalqilya district when categorized by age, at a significance level of 0.05.

H0: There is no significant variation in awareness and knowledge regarding folic acid adherence among pregnant women in the Qalqilya district when categorized by educational level, at a significance level of 0.05.

H0: There is no significant variation in awareness and knowledge regarding folic acid adherence among pregnant women in the Qalqilya district when categorized by employment status, at a significance level of 0.05.

H0: There is no significant variation in awareness and knowledge regarding folic acid adherence among pregnant women in the Qalqilya district when categorized by place of residence, at a significance level of 0.05.

H0: There is no significant variation in awareness and knowledge regarding folic acid adherence among pregnant women in the Qalqilya district when categorized by income level, at a significance level of 0.05.

H0: There is no significant variation in awareness and knowledge regarding folic acid adherence among pregnant women in the Qalqilya district when categorized by health issues, at a significance level of 0.05.

1.5 Literature Review

Folic acid, one of the eight water-soluble B vitamins, is commonly found in foods such as green leafy vegetables, liver, wheat, broccoli, certain fruits, fortified cereals, and collard greens (18). Also known as vitamin B9, folate acts as a coenzyme that assists in single-carbon transfers necessary for the metabolism of nucleic acids, amino acids, and vitamin synthesis (19). This vitamin is essential for generating genetic materials like DNA and RNA, particularly during rapid periods of cell and tissue growth such as infancy, adolescence, and pregnancy (20). Folate is also crucial for the formation of red and white blood cells in the bone marrow (21) and is vital for normal cell division, making it important for embryonic development. Supplementing with folate around conception can significantly lower the risk of serious health conditions like cleft palate and neural tube defects (22).

Extensive research has highlighted the importance of folate and folic acid in preventing various health issues, including neural tube defects, megaloblastic anemia, and cardiovascular diseases (22). Due to its significant role in health, the World Health Organization (23) has provided guidelines on folate consumption. In 1992, the US Public Health Service recommended that all women of childbearing age (13 to 45 years) take 0.4 mg of folic acid daily (24).

Folic acid is a B-complex vitamin that plays a special role in the development of vital tissues and organs, making it an essential component of reproductive and fetal health. In recent years, there has been increasing focus on the importance of this vitamin in the preconception period and during the first weeks of pregnancy; recent research is expanding our understanding of the indirect benefits of folic acid that go beyond the prevention of neural tube defects, to include important effects on the quality of the placenta and the development of its associated blood vessels. Placental health is of

paramount importance because a healthy placenta means a better environment for the fetus to grow, while reducing the risk of premature birth or low birth weight.

In addition, studies have shown that taking adequate doses of folic acid can have a protective effect against a range of chronic diseases that can affect expectant mothers, such as type 2 diabetes and some types of cancer. These benefits are linked to folic acid's ability to regulate levels of homocysteine, an amino acid whose elevation is associated with multiple health risks.

Some studies also recommend specific doses that may vary slightly depending on individual and health conditions, such as a person's medical history and diet. Women with a family history of neural tube defects may be advised to take higher doses, reflecting the interest of health authorities in developing flexible guidelines to meet the needs of diverse groups of women. (112)

Despite existing guidelines and mandatory fortification programs, awareness of folic acid remains inadequate in some regions. For example, in the United States, even though recommendations for folic acid are extensively promoted, only 83.3% of women aged 18 to 24 from a study of 1,921 participants reported taking vitamin supplements, and merely 47.6% of these supplements included folic acid (25). In Malaysia, a study showed that while 88.3% of 400 women were aware of folic acid, only 8% had a deep understanding of its benefits (26). Proper knowledge of folate is vital for preventing conditions related to its deficiency, whether or not pregnancies are planned. Although folic acid awareness is present in countries such as Iran, Germany, and the United States, it remains limited in Malaysia (26). Despite a relatively low incidence of spina bifida (0.43 per 1,000 individuals at Hospital Kuala Lumpur), it is important to continue educating young mothers, particularly those aged 20 to 30, about folate (27).

Globally, approximately 500 million women of childbearing age are affected by anemia. In 2011, anemia impacted 29% of non-pregnant women and 38% of pregnant women aged 15–49 worldwide, with the highest prevalence found in South Asia and Central and West Africa. Effective strategies to address this include iron and folic acid (IFA) supplementation and improving dietary practices through diversification and fortification.

These interventions are essential to achieving the Sustainable Development Goals (SDG) target of lowering the global Maternal Mortality Ratio (MMR) to fewer than 70 maternal deaths per 100,000 live births by 2030 (28).

To effectively achieve the SDG, it is essential to implement a multi-faceted approach that addresses the various factors that influence maternal health. This includes improving access to quality prenatal care, improving nutrition, and ensuring that women receive essential nutritional supplements, such as folic acid and iron, to support healthy pregnancies. Education and awareness programmes targeting women of reproductive age can help empower them to make informed decisions about their health and nutrition.

Furthermore, strengthening health care systems is vital to providing comprehensive care. This can include training health care professionals to recognize the signs of complications during pregnancy and equipping facilities with the resources to respond effectively. Community engagement is also important; engaging local leaders and health care workers can build trust and improve health-seeking behaviours among women.

Finally, regular monitoring and evaluation of maternal health programmes is essential to assess their effectiveness and adapt them based on emerging needs. By addressing these aspects, countries can create an environment that not only reduces maternal mortality but also promotes overall maternal and child health, contributing to the achievement of the SDGs.

Pregnant women are at higher risk for Iron Deficiency Anemia (IDA) because their bodies require more iron than usual, a need that often exceeds what they can absorb from their diet. This increased demand, combined with the expansion of plasma volume in the second trimester, often results in insufficient dietary intake, leading to IDA (29) (6). According to data from the Ethiopian health and demographic survey, approximately 29 percent of women of reproductive age are anemic and folate deficient, and 47 percent suffer from iron deficient anemia, which means that these are micronutrient disorders of great importance in Ethiopia (30).

These two nutrients, folic acid and iron are part of the pregnancy complementary feeding where supplementation is viewed as the initial line of intervention to IDA in pregnancy. These nutrients are a requirement for the health of both the mother and the fetus in the development of the baby's spinal cord, brain, and skull. Also, folic acid contributes to an increase of the maternal blood volume and the growth of new tissues in the woman and her child (30).

Iron deficiency is a major public health issue due to its widespread impact and potential for serious consequences. It can lead to complications such as low birth weight, premature delivery, stillbirth, and increased mortality rates for both mothers and newborns. Given that infants are particularly susceptible to iron deficiency, it is essential to address iron status in pregnant women as well, as focusing only on infants is not enough. Oral iron and folic acid supplements offer a practical and cost-effective solution for preventing and managing iron deficiency anemia. Research shows that during pregnancy, such supplementation can lower the incidence of maternal anemia by 70% and reduce iron deficiency anemia specifically by 57% (6).

Effective supplementation can decrease anemia-related mortality by 24%. For every 1 g/dl increase in hemoglobin levels, an estimated 1.8 million deaths among children aged 28 days to 10 years can be avoided. Simple supplementation methods have proven effective in improving hemoglobin levels. For example, in Nepal and Pakistan, neonatal death rates fell by 57% and 45%, respectively, when women took over 90 tablets and began supplementation at or before the fifth month of pregnancy. Consistent adherence to these supplementation practices during pregnancy significantly lowers the risk of negative outcomes (31).

Effective nutritional supplements are not only important for improving hemoglobin levels; they also play a critical role in the overall health and well-being of mothers and their children. Anemia during pregnancy can lead to serious complications, including preterm birth, low birth weight, and increased maternal morbidity. By proactively addressing anemia through nutritional supplements, health care systems can reduce the incidence of these complications and improve maternal and child health outcomes (116).

Furthermore, community education is essential to encourage adherence to nutritional supplement regimens. Women need to understand the importance of starting nutritional supplements early in pregnancy and maintaining them throughout pregnancy. This education can be provided through various channels, including health care facilities, community health workers, and local organizations focused on maternal and child health (113).

Collaboration between government health programs and nongovernmental organizations can also enhance the reach and effectiveness of nutritional supplementation initiatives. By providing resources, such as iron and folic acid tablets, along with educational materials, these organizations can help ensure that all pregnant women get the support they need to improve their health and that of their babies (114).

Finally, ongoing research and monitoring of nutritional supplementation programmes is essential to assess their effectiveness and make adjustments as needed. By analysing data on maternal and child health outcomes, programmes can be tailored to address specific regional challenges, ensuring that the most vulnerable groups receive the support they need. In doing so, we can make a significant contribution to reducing anaemia-related deaths and improving health outcomes more broadly (115).

Although many developing countries have introduced iron and folic acid supplementation programs, only a few have made notable progress in controlling and preventing anemia. Studies conducted in various regions, including Asia, Latin America, and Africa, reveal low adherence rates to daily iron and folic acid supplements. This low adherence is a major factor contributing to the reduced effectiveness of Iron Folic-Acid Supplementation (IFAS) programs. The factors influencing adherence are not extensively studied, which presents a gap in understanding how to improve program effectiveness (32).

1.6 History of Folic Acid food fortification

Folic acid supplementation during the perinatal period and prior to conception in reducing the incidence of neural tube birth defects and other health issues in newborns. Global endeavors, including the compulsory fortification of food with folic acid, have resulted in a decline in NTD rates. However, there are ongoing concerns about potential unintended consequences of increased folic acid intake and fortification programs.

It is essential that these initiatives are continually monitored to accurately assess their effectiveness and address any issues that may arise quickly (33).

1.7 Folic Acid and the Prevention of Neural Tube Defects

Folate which primarily exists in natural foods and in supplemented synthetic form as folic acid, is highly involved in numerous biochemical activities. It is involved in cell division, synthesis of DNA and RNA, protein methylation and many other functions. This is an important point because genetic differences between individuals can determine how the vitamin is metabolized and affects its ability to protect against birth defects including NTDs. However, more extensive study must be conducted to explicate how exactly folate helps in the prevention of NTD's because, as seen in several studies, its efficiency still holds some mystery (34). Folate requirement is higher during pregnancy as the maternal body metabolism and that of the growing fetus also requires higher metabolism. This requirement is important to enhance synthesis of DNA and prompt proliferation of cells as well as healthy development of the fetus. Folate intake also requires to be balanced before conception given that lack of adequate folic acid during pregnancy has been found to cause neural tube defects including spina bifida and anencephaly (35). Reference guidelines for assessing folate level among pregnant women have been set internationally; from collaborative ten projects. These comprise of seven prospective studies of serum folate levels as well as 3 prospective studies of red blood cell folate levels hence offering baseline principles in the examination of laboratory data. Using these ranges, pregnant women can be taken through a thorough healthcare regime with their folate levels kept in optimum level for a healthy pregnancy (36).

1.8 Unmetabolized Folic Acid

Folic acid is generally transformed into tetrahydrofolate in the liver after ingestion (37). When the body's ability to metabolize folic acid is exceeded, unmetabolized folic acid may enter the bloodstream. Research suggests that this happens when folic acid intake exceeds 200 μg in a single dose (38), a quantity often reached through supplements or fortified foods like breakfast cereals (39). In the U.S., standard fortification levels are unlikely to reach this threshold on their own (40)(41)(42). While unmetabolized folic acid can be found in over-the-counter supplements and prenatal vitamins, recent

technological advancements have only recently enabled its measurement in the bloodstream. This form has been detected in various groups, including older adults in the U.S. and newborns' umbilical cord blood (43) (44). The link between unmetabolized folic acid and cognitive decline in older adults remains unsubstantiated by strong evidence, with other factors like pernicious anemia possibly influencing outcomes (45). Currently, no definitive research confirms the health effects associated with unmetabolized folic acid. The study of folic acid began in the 1930s when Wills and his team investigated yeast and marmite for treating tropical megaloblastic anemia, discovering an unknown bioactive substance that laid the groundwork for future research (46).

In the 1960s, Richard Smithells and Elizabeth Hibbard made significant advancements by observing that women who had children with severe birth defects, particularly neural tube defects, had abnormal levels of formiminoglutamic acid (FIGLU), suggesting poor folate status. This finding led Smithells to conduct a large-scale intervention study that provided vitamin supplements, including folic acid (0.36 mg/day), to women with a history of neural tube defect pregnancies around conception. Women who were already pregnant or chose not to participate served as control subjects.

The same study in 1980 had observed a decrease of neural tube defects by a factor of 7 in people who took the supplement. This discovery underlines the significance of the folic acid and related vitamin supplements in the prevention of neural tube defects, which has lead to further progress in the conceptual approaches towards these diseases prevention (34).

Building on Smithells and Hibberd's groundbreaking research, subsequent studies have reinforced the critical importance of folic acid in prenatal health. Researchers have determined that folic acid not only helps prevent neural tube defects, but also supports overall fetal development. It plays a vital role in DNA synthesis and repair, which is critical during the rapid cell division and growth that occurs early in pregnancy. This has led health organizations around the world to recommend folic acid supplementation for all women of childbearing age, emphasizing the need to begin supplementation before conception.

Furthermore, the effects of folic acid deficiency extend beyond neural tube defects. Adequate folic acid levels are associated with a reduced risk of various complications during pregnancy, including placental abruption and preeclampsia. These findings highlight the need for public health initiatives aimed at raising awareness of the importance of folic acid and encouraging routine supplementation.

The success of the initial studies has led to the creation of various public health campaigns aimed at promoting folic acid intake. These initiatives often include educating health care providers to ensure they are able to effectively counsel women about the importance of folic acid before and during pregnancy. In addition, fortification of staple foods with folic acid has been a key strategy in many countries to reduce the incidence of neural tube defects at the population level, ensuring that women who may not otherwise be aware of the need for supplementation receive adequate folic acid. Furthermore, ongoing research continues to explore the potential benefits of folic acid in reducing other pregnancy-related issues, including the potential association between low folic acid levels and postpartum depression. As our understanding of the role of folic acid in maternal and child health evolves, it is clear that its importance in prenatal care cannot be overstated. Ensuring adequate folic acid intake remains a vital public health goal to promote healthy pregnancies and improve outcomes for mothers and their babies.

1.8.1 Deficiency of Folic Acid Worldwide

Folic acid refers to a water-soluble vitamin from the B group and has been widely incorporated in supplements and fortified to foods. Folate is present in foods of plant and animal origin, but primarily from the foods of plant origin. Raw or lightly cooked green leafy vegetables and other foods containing folic acid include fruits and vegetables containing vitamin C and beta carotene, whole grain products, beans, and nuts. Food rich in this vitamin include liver, dairy products and egg yolk (47).

Sources of folate, a form of vitamin B9, include green leafy vegetables, cereals fortified with folic acid, oranges and strawberries. Folate intake during pregnancy should be sufficient in order to avoid maternal anemia and peripheral neuropathy and possibly help prevent pre-term delivery. Folate is involved in syntheses of DNA, RNA, breakdown of amino acid chains, formation of new red blood cells, and other cell

formation and repair. It is a fact that folate requirements for the body is higher during cell growth and division during the whole life cycle (48). Preconception folate deficiency is regarded as a significant causal factor in the development of neural tube and other congenital anomalies (49). Neural tube defects affect above 300,000 babies every year and are therefore world wide public health concerns (RCT, 50). Neural tube defects are prevalent at a rate of 9 per 10,000 births in Europe and the same as in Poland (51). Observational research as well as randomized controlled trials have shown that folate before conception is effective in preventing neural tube defects (52). This is especially so because a large number of pregnancies are unwanted or accidental. The current European unintended pregnancy rate per 1,000 women of child bearing age (15–49) years in the period 2015–2019 was 36. The rate in Poland was 29 for 1,000 women, while overall 46 % of pregnancies were of unplanned nature. The World Health Organization (WHO) recommends that folic acid supplementation begin before conception or as early as possible during pregnancy, with a daily dose of 0.4 mg (400 mcg) throughout pregnancy (54).

Iron deficiency anemia occurs when the body produces fewer red blood cells due to a lack of iron, an essential nutrient required to produce hemoglobin (3). Anemia occurs when hemoglobin levels fall below normal, often due to a lack of essential nutrients (2). This is a widespread public health concern, and is associated with increased risks of illness and death, particularly affecting young children and pregnant women. More than 2 billion people, more than 30% of the world's population, are iron deficient, making it the most common nutritional deficiency worldwide, especially in developing countries (3). Pregnant women are particularly at risk due to their increased nutritional needs. Iron deficiency anemia negatively impacts the health of both mother and child. In addition, not getting enough folic acid during pregnancy and in the early stages of pregnancy increases the risk of neural tube defects and other negative pregnancy outcomes, such as facial cleft lip (4).

1.9 Time Trends in Folic Acid Supplementation Practices

In a crucial turn of events in 1991, the Medical Research Council Vitamin study reported an overwhelming 72% reduction in the risk of NTDs through pre-conceptional folic acid (FA) (55). Despite collaborative efforts to encourage women to adopt healthier dietary habits or join daily vitamin supplements for increased folate intake,

progress in reducing NTD rates remains slow. The natural challenges lie in the necessity for behavioral changes, improved accessibility, affordability, and sustainability (56) . Diets high in naturally occurring folate are generally less effective compared to intakes from folic acid-fortified foods or supplements, primarily due to the lower bioavailability of naturally occurring folates (57). While over 70 countries, including the USA, Canada, and Australia, have successfully implemented mandatory food fortification, over 120 countries, including all European Union (EU) member states, have yet to adopt this measure (58)(59)(60)(61). As a result, a substantial number of women of childbearing age are advised to take folic acid supplements before conception to reduce the risk of pregnancies affected by neural tube defects (NTDs). A recent national audit in Ireland spanning 2009–2011 highlighted 236 NTD cases among 226,000 births, indicating an obvious increase from 0.92 to 1.04 per thousand births between 2005–2006 and 2009–2011 compared to Among the cases studied, 106 individuals, comprising 45%, were diagnosed with anencephaly, while 115, representing 49%, were identified with spina bifida. Additionally, 15 cases, or 6%, were found to have an encephalocoele. Out of these cases, 184, which makes up 78%, resulted in live births or stillbirths, whereas 52 cases, totaling 22%, ended in terminations abroad. Regarding folic acid supplement intake around the time of conception, only 13.7% of the 124 cases for whom supplement intake information was available reported taking folic acid supplements.. This highlights the critical need for general awareness campaigns and educational initiatives to empower women with knowledge on the advantages of pre-conceptional FA, providing to comprehensive maternal and fetal health (14,16,17,35–46,55–69).

Folic acid supplementation rates have shown variations in recent decades. While public health education has proven effective in enhancing folic acid usage during planned pregnancies (66), research highlights gaps. Rates of folic acid supplementation tend to be higher among individuals with a higher socioeconomic status (SES). However, primary prevention strategies, even with strong public health promotion, often fail in reaching socially disadvantaged groups, potentially setting them at the greatest risk (67) (68)

1.10 Factors associated with the compliance of pregnant women to take folic acid

A study conducted in Zinder, Niger, aimed to evaluate the prevalence of antenatal care (ANC) coverage and adherence to iron and folic acid (IFA) supplementation recommendations among pregnant women (70). The study assessed 923 pregnant women from 64 randomly selected villages across 12 health centers. The findings indicated that ANC coverage was 60.1%, while IFA coverage was 43.6%. Among those who attended ANC, 71.7% received IFA supplements. Of the 401 women who reported taking IFA supplements, 99.3% had attended ANC during their current pregnancy, and 68.6% followed the recommended IFA regimen, consuming it daily over the previous week. Women in their third trimester (≥27 weeks) were significantly more likely to attend ANC compared to those in their second trimester (<27 weeks), with an odds ratio (OR) of 21.81 (95% confidence interval [CI]: 13.81, 34.45). Additionally, women who received advice from their husbands about ANC attendance were more likely to attend ANC (OR: 1.48, 95% CI [1.03, 2.11]) and adhere to IFA recommendations (OR: 1.80, 95% CI [1.04, 3.13]) compared to those who did not receive such advice. The study underscores the key factors influencing ANC attendance and IFA adherence among pregnant women in the region.

A study conducted in Ethiopia explored the critical role of adherence to iron and folic acid supplementation in preventing anemia during pregnancy (71). The study, which included 418 women, found that more than half (55.3%), or 231 women, adhered to the recommended folic acid supplementation regimen. Factors associated with higher adherence included starting antenatal care (ANC) early [Adjusted Odds Ratio (AOR) = 2.43], having more frequent ANC visits [AOR = 2.73], consuming fewer tablets per visit [AOR = 3.0], having a history of anemia [AOR = 1.9], and living in urban areas [AOR = 2.2].

The results of this study present the factors peculiar to the consumption of iron and folic acid supplements and inform the strategy for preventing anemia among pregnant women in Ethiopia.

A cross-sectional assay study carried out in the West Bank/Palestine investigated the determinants of nonacceptance of iron and folic acid supplements among pregnant Palestinian women (72). The current study recruited 286 pregnant women attending

private and governmental ANC clinics in Hebron city in the period from January to April 2018. Participants were grouped based on the duration of their iron intake: ≤3 months or >3 months. Regarding the number of antenatal care visits, there was a statistically significant difference between two groups, those who had been visiting within less than or equal to 3 months and those who visited after 3 months, mean ±SD 2.06 ± 0.864 as compared to 2.58 ± 0.745 respectively and p-value = 0.033.

Another study that was done in north western Ethiopia was done to determine the prevalence of factors that affect the use of iron/folic acid by pregnant women (73). The overall level of adherence was at 47.6 percent with pregnant women at the receiving end of the study. Those who reported previously had miscarriage, informed about anemia and had received health education had higher adherence. Furthermore, awareness of the impact of supplementation and no issues revolved around collection of iron and folic acid tablets from health facilities was other positive influences to compliance. It raises useful information on understanding factors affecting compliance with iron and folic acid supplements and the need to adopt more focused and intensive health-promoting efforts and behavior-changing communications in the area.

1.10.1 Perception about Folic Acid

If taken during pregnancy, folic acid deficiency causes complications like congenital heart diseases, preeclampsia, miscarriages,-placental abruption, preterm birth and multiple births (74). To minimize the development of neural tube defects you should take 400 mcg of folic acid daily in the form of supplements and food products. For those who had relatively risky pregnancies in the past this dose should begin about 1-3 months before conception and during the first trimester of pregnancy. According to WHO, pregnant and postpartum moms should take a DAI containing 30 – 60 mg of iron and 0.4 mg of folic acid. It is hoped that this supplement will help avoid such situations as maternal anemia, toksicosis after childbirth, low birth rate and preterm delivery (75).

Several factors can impact folic acid supplementation during pregnancy, including the mother's age, educational background, marital status, employment situation, number of previous pregnancies, income level, whether the pregnancy was planned or not, and the degree of awareness and understanding regarding the importance of folic acid supplementation both before and during pregnancy (76).

Perception involves selecting, organizing, and interpreting sensory information. Selection refers to focusing attention on specific sights, sounds, tastes, touches, or smells from the environment. Organization involves arranging the selected information into a coherent pattern in the mind. Interpretation is the process of assigning meaning to the information by recalling relevant and familiar details to make sense of what is being perceived (77).

Nurses play a pivotal role in educating women about the benefits of folic acid. Their role extends beyond merely providing information; they have a unique opportunity to influence women's behaviors concerning folic acid intake and dietary choices. This includes dispelling misconceptions about vitamin use, offering solutions to overcome obstacles to daily folic acid consumption, and helping women make healthier food decisions (78).

Teaching about folate consumption is vital for preventing nutritional deficiencies, and nurses are ideally situated to offer this education. With their ongoing interactions with women and their accessibility, nurses act as a primary resource for guidance. They can assist women in managing their diet, weight, and avoiding harmful nutritional practices (79).

A deficiency in maternal folic acid is associated with birth defects, marking it as a major global health concern. Enhancing awareness and promoting positive attitudes towards folic acid intake among pregnant women can help avert complications. Neural tube defects (NTDs), including spina bifida and anencephaly, are seen in approximately 1-5 per 1,000 live births worldwide (80).

In the U.S., the occurrence of NTDs is about one per 1,000 pregnancies, with approximately one third of these pregnancies ending in spontaneous or elective abortion. This results in roughly 2,500 live births with NTDs each year in the U.S. (81).

Globally, between 300,000 and 400,000 infants are born annually with conditions such as spina bifida and anencephaly. In Egypt, the prevalence of congenital malformations (CMs) among children aged 0–18 years is around 2%. Specifically, central nervous system (CNS) anomalies occur at an estimated rate of 26.92%. CNS anomalies are

among the most frequent congenital disorders in both live-born and stillborn infants, a trend that is evident in Egypt and worldwide (82).

1.11 Role of pharmacists counselling in folate compliance

Recent study showed the need for care practitioners to be educated and trained regarding nutritional supplements, especially folic acid, during pregnancy, and the fact that pharmacists are at a selling point puts them in a better position to advise women on the use of nutritional supplement(63) , There is a significant correlation between participants' level of awareness and positive pregnancy outcomes. Pharmacists have been identified as a crucial source of information regarding folic acid, with their counseling significantly influencing the regularity of folate intake. In a cross-sectional study conducted in Serbia with 730 pharmacists, 96.6% correctly identified deformities preventable by folic acid, and 77.0% were aware of the recommended dosage for women of childbearing age (63).

Additionally, a health promotion program titled "Knowledge and Use of Folic Acid Among College Women," organized by pharmacy students and faculty in 2010, emphasized the role of pharmacists in public health.

The program intended to assess the changes in college women’s knowledge regarding folic acid, prevention of neural tube defects, and use of multivitamin. They comprised of an oral session where more information about folic acid supplementation was given and other friendly jingling buzzers. This practice program was a big success as 32 college women came to the presentation on their own free will and 78.2 % (25 women) complied to do the four week post test which is 83. Mean test scores and responses to a set of questions regarding folic acid and neural tube defects were also compared pre and posttest for increased correctness with an overall $P < 0.0001$ for test scores and $P < 0.05$ for each question. Participants also indicated a highly significant improvement in multivitamin use frequency ≥ 4 times per week ($P = 0.023$). Recipients of the targeted health promotion efforts by pharmacy professionals and students should increase their knowledge and engage in better health habits according to these results among college women.

1.12 Knowledge, Attitudes, and Practices for Counseling Among Pharmacists

Sample of pregnant and lactating women attending antenatal clinics in Dar Es' Salaam were used to assess the knowledge, attitude and practice: utilising iron and folic acid (IFA) supplementation among HIV positive women (84). Further, knowledge, perception and counseling practices of Serbian pharmacists and pharmacy technicians about folic acid have been explored by Milica Zeković and Dušanka Krajnović in 2019 (64). Their survey of 730 participants revealed that 96.6% accurately identified deformities that folic acid can prevent, and 77.0% knew the recommended dosage for women planning to become pregnant. However, only 61.1% were aware of the optimal timing for folic acid intake, and 42.9% knew the correct dose to prevent neural tube defects (NTDs). Interestingly, 43.2% of pharmacy technicians did not see it as their role to offer counseling on preventing congenital anomalies, in contrast to only 4.7% of licensed pharmacists and none of the interns holding this view ($\chi 2 = 198.287$; df = 4; p-value < 0.001). The study highlighted the need for targeted education to improve knowledge and ensure consistent counseling practices among pharmacy professionals in Serbia.

Bethany L. Murphy and Natalie A. DiPietro (2012) investigated the long-term impact of a pharmacist-led educational program on college women's understanding and use of folic acid (85). The study involved 32 participants, with 84% (27 women) completing the 12-month follow-up. Results at the 12-month mark showed significant improvements in knowledge, particularly regarding folic acid-rich foods (p-value = 0.023), spinal development (p-value = 0.011), and NTD prevention (p-value = 0.044). Nonetheless, no significant knowledge improvements were noted concerning the recommended daily intake of folic acid (p-value = 0.817) and the challenge of obtaining sufficient folic acid through diet alone (p-value = 0.617). Furthermore, there was no significant increase in regular multivitamin use (≥ 4 times per week) from the baseline (p-value = 0.592). These findings suggest that while the program successfully enhanced specific aspects of folic acid knowledge, further intervention is needed to address other areas.

Claire R. Rodrigues and Natalie A. DiPietro (2012) researched community pharmacists' knowledge and counseling practices about folic acid in Ohio (86). Out of 122 pharmacists surveyed, 95.1% knew folic acid prevents some birth defects. However, only 22.9% "always" or "usually" discussed multivitamins with women of childbearing age, and just 15.6% did so for folic acid supplements. There were notable knowledge gaps, with 63.1% correctly identifying the recommended dose for most women of childbearing age, but only 13.1% knew the dose for women with a history of NTD-affected pregnancies. Pharmacists preferred getting more information through continuing education programs, pharmacy journals, and the Internet. The study underscores the need for targeted education to improve counseling practices among community pharmacists in Ohio.

Studies about Folic Acid in the World Taking folic acid supplements early in pregnancy can greatly lower the risk of neural tube defects (NTDs). Despite the well-documented advantages of folic acid, there is a lack of comprehensive data on public awareness, attitudes, and consumption patterns. A study conducted in China assessed the understanding, attitudes, and practices of healthcare professionals regarding folic acid and its role in preventing NTDs. The research found that while there was general awareness of folic acid's preventive benefits, significant gaps in knowledge persisted, which could result in suboptimal preventive practices. The study suggested that additional training for healthcare providers is necessary to improve their knowledge and practices related to folic acid (87).

Another investigation evaluated community pharmacists' awareness of folic acid's role in NTD prevention. Out of 122 pharmacists surveyed, 116 (95.1%) recognized that folic acid helps prevent certain birth defects. Nevertheless, only 28 (22.9%) frequently discussed multivitamins with women of reproductive age, and just 19 (15.6%) regularly talked about folic acid supplements. The pharmacists indicated that they preferred continuing education programs, professional journals, and online resources for gaining more information about folic acid and its preventive role. The study highlighted that community pharmacists have a significant opportunity to contribute to public health by advising women about folic acid intake. Offering educational resources could enhance pharmacists' knowledge and support their role in patient education (87).

In Japan, a decade-long study examined if changes in women's lifestyles were leading to a decrease in spina bifida cases. Participants recorded their dietary intake over three days, and lifestyle surveys revealed a notable rise in folic acid awareness and supplement use, with the proportion of women knowledgeable about folic acid increasing from 15.3% to 43.7% and those taking supplements rising from 9.1% to 61.5% between 2002 and 2011. The dietary records showed average folate intake between 260 and 360 micrograms daily, which is below the government-recommended daily allowance. However, there was a significant increase in the percentage of pregnant women in their first trimester who took folic acid supplements from 4 weeks before conception to 12 weeks afterward, jumping from 7.4% in 2003 to 69.6% in 2011.

The findings indicated that lifestyle changes among pregnant women in Japan have increasingly supported the reduction of spina bifida risk over the past decade. The study highlighted the importance of ongoing education by healthcare professionals, including doctors, nurses, midwives, dietitians, and pharmacists, in promoting daily folic acid intake of 400 micrograms for women planning to conceive or of childbearing age (86).

It is well established that, to minimize the risk of NTDs, adequate amounts of folic acid must be consumed before and during early pregnancy. Subsequently, international health organizations advise pregnant women or intending to be pregnant should take at least 400 μg of folic acid daily to reduce the risk of NTDs. This recommendation is backed by current talks showing that increased folic acid intake may reduce most kinds of folate related NTD (88).

1.12.1 Knowledge of Folic Acid

Folic acid together with folate is an important vitamin B9 that plays diverse functions in our body. This molecule is needed for DNA synthesis, fix and methylation and is also a derivative in various biochemical series. Ideally, folate is important in fast growing body tissues amongst pre-certain critical developmental stages like infancy and pregnancy. The failure to take folic acid before conception results in neural tube defects (NTDs) (89).

It underlines the importance of folic acid in maternal and fetal health and the necessity of the enhanced promo- tion of folic acid and women’s awareness of its importance during the childbearing period.

According to the data, worldwide, the hidden hunger is widespread, and about 2 billion people lacked the amounts of micro micronutrients necessary for the human body. This condition affects the health status and Economic growth and proper intervention is vital in addressing most of the MDGs. Southern Africa, India and Afghan are countries where hidden hunger is predominant; factors like stunting, iron deficiency anemia and vitamin A deficiency are prevalent in these regions. malnutrition and hence, micronutrient deficiencies are responsible for 1.5 – 12% DALYs in thirty six countries (90).

1.12.2 Impact of Folate on Health

From the outlined findings in the study, there is a clear significance of folate concentration in determining birth weight. UP 4 There is a positive dose response relationship between folate intake and birth weight, where each increase in the folate intake by a fold increases birth weight control by 2 fold (17). Maternal low folate intake was also established as contributing to higher odds of infancy autism spectrum disorders (91). Early systematic studies do indicate potential relationship between folic acid consumption and lack of Down syndrome (92) and that supplementary consumption of folic acid before and during pregnancy may reduce risk of congenital heart diseases in babies (93).

1.12.3 Neural Tube Defects (NTDs) Incidence

Globally, the incidence of neural tube defects (NTDs) varies between 1.0 and 10.0 per 1,000 live births, with anencephaly and spina bifida (SB) being the predominant types, occurring with nearly equal frequency (94). In the United States, a comparison between a 24-month period before and after mandatory fortification (1995-1996 vs. 1999-2000) showed a reduction in NTDs. Prior to fortification, there were approximately 2,490 cases of spina bifida and 1,640 cases of anencephaly annually. Post-fortification, these figures decreased to about 1,640 cases of spina bifida and 1,380 cases of anencephaly, leading to an overall reduction of 27% in NTDs (95).

In Swat, Pakistan it ranges from anencephaly 11.33 per thousand birth and spina bifida is 0.72 per thousand birth respectively (96). Further, in one of the preliminary cross sectional study conducted on pregnant women attending any ANC clinic in a tertiary care hospital in Rawalpindi 57% anemia was found due to iron deficiency, 20% folate,

19% with both iron and folate and 4% with cobalamin deficiency during the first ANC visit.

These findings therefore call for increase awareness and fortification of essential micronutrients especially folic acid to enhance reproductive health of women of child bearing age as well as their newborns across the world.

1.12.4 Knowledge Regarding Folic Acid Deficiency Among Women of Childbearing Age (WOCBA)

Knowledge of folic acid deficiency is weak among WOCBA, with many WOCBA demonstrating poor perception and behaviour towards the importance of folic acid and supplementation. Unfortunately, folic acid is taken by few women either prior to pregnancy or during pregnancy. The best way to minimize the occurrence of micronutrient deficiencies, therefore, has to do with enhancing education. To this effect therefore, there is need to educate the WOCBA about the need to fight this hidden hunger. This can be done involving the health facility staffs, community health worker, pharmacists, using media facilities, symposiums and workshops. Lack of knowledge is a causal factor in the deficiency of folic acid a preventable public health problem more education is therefore required.

1.12.5 Knowledge of Pregnant Women About Folic Acid

Assessing pregnant women's knowledge and attitudes regarding folic acid supplementation is essential for understanding their level of awareness. This assessment should cover their knowledge of natural folic acid sources, its role in preventing neural tube defects, and the guidelines for preconception intake. Additionally, it is important to evaluate their attitudes toward adhering to folic acid supplementation (98).

Maternity nurses are pivotal in advancing and preserving the health of pregnant women and their babies. They play a key role in educating expectant parents about the significance of early and continuous prenatal care. Evidence shows that infants whose mothers receive folic acid supplementation during pregnancy experience better health outcomes. Providing comprehensive prenatal care is essential for ensuring the well-being of newborns. Prenatal nurses support expecting mothers by helping them avoid,

identify, and manage potential health issues that could arise before, during, or after childbirth (99).

Chapter Two

Methodology

2.1 Introduction

In this section, the researcher shows the most common aspects the methodological approach that was applied to conducted the current study, including its design, site, setting, sampling, data collection tool and process, and statistical analysis, for two part The first part was pregnant women, the second part was pharmacists .

2.2 Part 1: Pregnant women

2.2.1 Study design

A quantitative, cross-sectional study was used to achieve the purpose of the study, The study was conducted between (October 1, 2021 and January 7 ,2023).

2.2.2 Setting

The study was carried out on pregnant women : the prenatal care clinics / PHC centers (MOH) in where the pregnant women were selected and fulfilled the questionnaire, in Qalqilia .

2.2.3 Population and sample size

The accessible population of pregnant women was 390 as mentioned by ministry of health- . The sample size was computed by Raosoft (2008) software in wich the size of the population was preserved at 350 ,the response rate was set at 50% whereas the confidence interval and margin of error were set at 98 % and 2% .

2.2.4 Inclusion criteria

include all pregnant women who live in qalqilia district and attending to Prenatal clinic .

2.2.5 Exclusion criteria

Pregnant women who didnt attend to prenatal clinic.

2.2.6 Study instrument

Data collection was conducted in one point of time for every participant that agrees to enter the study, by a structured questionnaire that we developed to cover all the aspects regarding this topic. A pre-tested assisted -administered questionnaire included both closed and open ended questions relating to-pregnant woman's knowledge of folic acid, awareness and compliance

The data collection tool composed of The first section about pregnant women that composed of five parts, the first part is demographic data, which is reflected by question number from 1-18, the second part is scale of awareness and knowledge, which is reflected by question number from 19-32, the third part is scale of Nutritional habits, which is reflected by question number from 33-34, the fourth part is scale of Compliance, which is reflected by question number from 35-43, the fifth part is scale of barriers, which reflected by question number from 44-52 questions.

2.2.7 Variables

Independent variables: 1 -Demographic variables: including, age, place of residence, income, education, housing condition, marital status, social variables, number of pregnancies, number of births , 2 - Dietary data, 3- Pregnancy health indicators such as weight gain, anemia, risks . Dependent variables: Knowledge attitudes, compliance

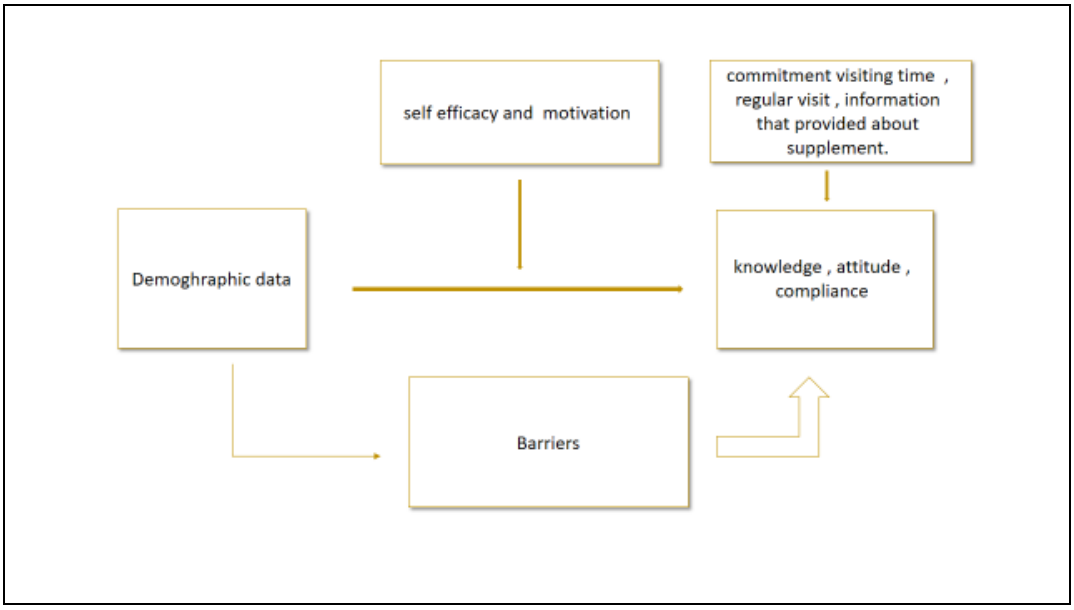
Mediatieng variables: self efficacy and motivation .

Moderating variables: barriers

Control variables: commitment visiting time , regular visit, information that provided about supplement.

Figure 1

Conceptual framework



Validity and Reliability of the Questionnaire

Validity: Experts in public health reviewed the questionnaire to determine its content validity. This review confirmed that the questions effectively addressed the key aspects of folic acid knowledge and practices intended for measurement.

Reliability: To ensure reliability, a pilot study was conducted before the main research. This preliminary study involved 15 randomly selected pregnant women to test the clarity and practicality of the questionnaire. It took between 15 and 30 minutes for participants to complete the questionnaire. The reliability was further validated by a Cronbach's alpha value of 0.90, demonstrating strong internal consistency and supporting the questionnaire's suitability for the main study.

2.2.8 The scoring system

We have one scale statement for 3 choices of likert scale was scored as following:

2 Scale depends on the interval length=range/number of intervals, interval length= (3-1)/3=0.67. The following table represents the result:

Low level	1-less than 1.67
Medium level	1.67- less than 2.34
High level	2.34-3

Likert, Rensis (1932). "A Technique for the Measurement of Attitudes". Archives of Psychology 140: 1–55

2.2.9 Ethical considerations

This study was conducted following approval from the institutional review board (IRB) at An-Najah University (Annex A). Prior to the study, every participant was presented with a consent form, ensuring that voluntary participation was clearly explained. Personal information, including names, were not revealed, and strict confidentiality measures were applied, using the collected data exclusively for study purposes. Participants were assured of no adverse consequences for refusing participation, ensuring the quality of care. Each participant received an explanation of the study's objectives and tools, with sufficient time provided for any questions or concerns.

2.2.10 Data collection

After obtaining approval from the An-Najah University, the researcher contacted to the Ministry Of Health present the purpose of the study , the researcher went to prenatal clinic and selected pregnant women who attended to it randomly, while the researcher was available in setting , distributed the questionnaire to the pregnant women in the waiting room and answer or explain them, questions if needed , they were encouraged to read and answer the questionnaire , Arabic version of the instrument was used .

2.2.11 Data Analysis

The data was systematically categorized, organized, and tabulated for analysis using SPSS statistical software. Descriptive statistics, including frequency, percentage, mean, and standard deviation, were employed to summarize the data. Statistical significance was determined with a threshold set at $p<0.05$.

2.3 The Second Part: Pharmacists

2.3.1 Study Design

A quantitative cross-sectional study design was implemented to meet the study objectives. Data collection occurred between October 1, 2021, and January 2, 2022.

2.3.2 Setting

The study was carried out on pharmacists: the community pharmacies in where the pharmacist fulfilled the questionnaire in Qalqilia district.

2.3.3 Population and sample size

The accessible population of pharmacists was 208 as mentioned by the Palestinian pharmacists syndicate (Qalailia branch) distributed in Qalqilia district. They were the same sample size but 48 of them could not be reached or complete the questionnaire, for various reasons (13 participants did take a vacation , 23 They were not present at their workplace at the time of my visit ,12 It was not possible to reach them due to poor or unavailability of roads and transportation in their areas),160 participants completed the questionnaire .Using convenient method .

2.3.4 Inclusion criteria

all pharmacists who had worked in pharmacies in Qalaqilia.

2.3.5 Exclusion criteria

The pharmacists were excluded if they hadn't work in pharmacies .

2.3.6 Study instrument

Data collection was conducted in one point of time for every participant that agrees to enter the study, by a structured questionnaire that we developed to cover all the aspects regarding this topic. A pre-tested self-administered paper based English questionnaire included both closed and open ended questions relating the role of pharmacists in guiding pregnant women. The data collection tool composed four parts ,the first part is demographic data ,which is reflected by the question numbers from 53-60 , the second part is scale of the role of pharmacists ,which is reflected by question number from 61-63, the third part is scale of attitude m which is reflected by question number from 64-

67 , the fourth part is scale of knowledge ,which is reflected by question number from 68- 72 questions .

2.3.6.1 Independent variables (pharmacist)

Pharmacists demographic variables (your major, graduation year, place of study, age, sex, relationship to workplace, place of residence,)

2.3.6.2 Dependent variables (pharmacist)

-Pharmacist knowledge and attitudes, role of pharmacists.

2.3.7 Validity

The content validity of the questionnaire was evaluated by experts in public health .

2.3.8 Reliability

Before conducting the study, a quantitative pilot study was performed to assess the reliability of the questionnaire. This pilot study aimed to evaluate the clarity and usefulness of the study tools and to estimate the time required to complete them. It involved a random sample of 15 pharmacists. The questionnaire took between 10 and 15 minutes to complete. The reliability of the questionnaire was confirmed with a Cronbach's alpha value of 0.90, indicating high internal consistency and suitability for use in the main study.

2.3.9 The scoring system

We have one scale statement for 3 choices of likert scale was scored as following

2 Scale depends on the interval length=range/number of intervals, interval length= (3-1)/3=0.67. The following table represents the result:

Low level	1-less than 1.67
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Likert, Rensis (1932). "A Technique for the Measurement of Attitudes". Archives of Psychology 140: 1–55

2.3.10 Ethical considerations

This study was conducted following approval from the institutional review board (IRB) at An-Najah University (Annex A). Prior to the study, every participant was presented with a consent form, ensuring that voluntary participation was clearly explained. Personal information, including names, were not revealed, and strict confidentiality measures were applied, using the collected data exclusively for study purposes. Participants were assured of no adverse consequences for refusing participation, ensuring the quality of care. Each participant received an explanation of the study's objectives and tools, with sufficient time provided for any questions or concerns.

2.3.11 Data collection

After obtaining approval from the An-Najah University, the researcher contacted to the Palestinian Pharmacists Syndicate – Jerusalem (Qalqilia branch) present the purpose of the study , the researcher took the list of pharmacists from the Palestinian pharmacist syndicate – Jerusalem (Qalqilya branch) , consisting of the names and locations of all pharmacies in Qalqilya city , the researcher went to all pharmacies in the city and selected all pharmacists working in them .

The researcher went to all shifts to collect data from all of them until the required proportion number of the sample was achieved without any assist or read a questions. English version of the instrument was used as all eligible participants are fluent in English.

2.3.12 Data analysis

Data were categorized, organized, and tabulated for statistical analysis using SPSS software. The analysis included:

Frequency: Counting occurrences of specific responses.

Percentage: Calculating the proportion of each response relative to the total.

Mean: Computing the average value of the responses.

Standard Deviation: Measuring the dispersion or variability of the responses.

The significance level for interpreting the results was set at $p<0.05$, indicating that differences or associations were considered statistically significant if the probability of their occurrence by chance was less than 5%.

Chapter Three

Results

The first group of the study participants consisted of 350 pregnant women who were mainly residents of Qalqilya city (62%), whereas fewer number were residents in villages. More than half of the study women were from age 25-35 years. Also, more than 50% of the study participants were with Bsc degree. This group of women household income was from 2000-5000 shekel and majorty of women were housewives and not working as is shown in table 1.

Table 1

Distribution of percentage of participants among pregnant women according to their demographic data (n=350)

Variable	levels	NO.	(%)
Residence	City	217	62.0
	Village	133	38.0
Age	Between 17-24.9 years	118	33.7
	Between 25-34.9 years	209	59.7
	Between 35-45 years	23	6.6
Education level	Preparatory school	48	13.7
	High school	79	22.6
	Vocational training	24	6.9
	Bachelor	182	52.0
	More than bachelor	17	4.9
Family income	Less than 2000 NIS	40	11.4
	Between 2000-5000 NIS	162	46.3
	More than 5000 NIS	148	42.3
Work nature	House wife	269	76.9
	Employee	81	23.1

With regards to disease history. The study group had less than 5% prevalence of health conditions such as diabetes mellitus, high cholesterol and asthma and no neurological diseases. Constipation was present in 30% of study group, anemia was present in 30% in the study group, normal hemoglobin was present in 44%. Most of the women had more than one pregnancy, 27.7% of women had one miscarriages, 6.3% had more than once miscarriages (Table 2).

Table 2

Distribution of pregnant women according to their medical history (n=350)

Variable	levels	NO.	(%)
Health problem	Diabetic	16	4.6
	Blood pressure	11	3.1
	High cholesterol	17	4.9
	Asthma	6	1.7
	Neurological disease	0	0.0
	Other than that,	300	85.7
You had Constipation	Never	243	69.4
	Sometimes	75	
	Always	32	9.1
You had Anemia	Never	236	67.4
	Sometimes	81	23.1
	Always	33	9.4
Hemoglobin level	Less than 10	38	10.9
	Between 10-12	157	44.9
	More than 12	155	44.3
Ferritin level	Low	28	8.0
	Normal	72	20.6
	I don't know	250	71.4
Number of previous pregnancies	One time	68	19.4
	More than one	230	65.7
	I've never been pregnant	52	14.9
Number Miscarriages	One time	97	27.7
	More than one	22	6.3
	I've never been abortion	231	66.0
Twins	One time	36	10.3
	More than one	2	0.6
	I've never been birth	312	89.1

Table 3 represents participants' answers on questions that test the knowledge on folate. With regards to folate sources, the most food items the participants thought could be good sources for folate included: fruits, vegetables, fish and meat. Participants showed medium to high knowledge on aspects such as taking folate from supplementation, relationship between folate and successful pregnancy, prevention of anemia, protection from malformation, DNA synthesis, regulation of menstruation and prevention of menstruation. The participants did not think that folate supplementation is related to child gender or infant weight.

Table 3

Distribution of means and standard deviations of the level of knowledge of pregnant women regard taking folic acid and iron

Statement	Mean	St.D	Level
Knowledge about food Sources			
1. Is Fruits good source of folate	2.25	0.83	Medium
2. Is Green vegetables a good source of folate	2.37	0.82	High
3. Is Milk a good source of folate	1.94	0.81	Medium
4. Is Sea food /fish good source of folate	2.32	0.85	Medium
5. Is Meat a good source of folate	2.25	0.83	Medium
6. Is Breakfast cereal a good source of folate	1.76	0.87	Medium
7. Is Bread a good source of folate	1.67	0.75	Medium
Other Knowledge			
1. As a part of food and drink, there are other ways that women who are pregnant or planning to become pregnant can get folic acid	2.16	0.93	Medium
2. Eating food that contains iron and folic acid is better than taking supplements	1.47	0.83	Low
3. Taking iron and folic acid supplements increase the chance of pregnancy	1.99	0.71	Medium
4. Taking iron and folic acid supplements increase the chance of get a boy	1.47	0.83	Low
5. Adherence to folic acid supplements helps prevent anemia	2.42	0.67	High
6. Folic acid enhances the protection of the fetus from malformations (neural tube malformation)	2.56	0.64	High
7. Folic acid is essential for building DNA	2.19	0.70	Medium
8. Taking folic acid helps regulate the menstrual cycle	1.77	0.69	Medium
9. Does folic acid reduce the chances of abortion	1.80	0.68	Medium
10. Folic acid deficiency reduces the weight of the fetus from the normal	1.61	0.63	Low
Total average of knowledge	1.97	0.32	Medium

In table 4, the compliance to using the mineral and vitamins supplementation was high to medium with regards to many aspects such as taking supplementation on time, regular visits to health care centers, and whether information was provided to participants by healthcare worker and whether the participants were referred to nutritionists.

Table 4

Distribution of Means and standard deviations of the level of compliance of pregnant women regard taking supplementation

Statement	Mean	Standard Deviation	Level
Iron supplement has been taken in the previous 6 months	2.04	0.86	Medium
Are you taking any kind of supplement or vitamins at the present time	2.61	0.65	High
Supplements and vitamins are taken regularly	2.48	0.66	High
Do you have regular visitation to prenatal care clinic	2.76	0.52	High
Commitment to the visiting times	1.98	0.56	Medium
Iron and folic acid supplementation received at each visit	2.58	0.66	High
Information about these supplements has been provided	2.56	0.65	High
The participants was referred to a nutritionist	1.15	0.52	Low
Total average of compliance	2.27	0.30	Medium

In table 5, participants indicated that they received clear and adequate information with regards to many supplements and that there is low level of barriers in terms of reach to places where supplementations are distributed and the presence of conditions that prevents the use of those supplements.

Table 5

Distribution of Means and standard deviations of the level of the barriers that prevent pregnant women using supplements

Statement	Mean	Standard Deviation	Level
Clarity and adequacy of instructions			
Instruction to take iron and folic acid supplementation	2.62	0.65	High
Iron intake during pregnancy	2.69	0.58	High
Iodine intake during pregnancy	1.50	0.77	Low
Calcium intake during pregnancy	2.09	0.82	Medium
Distance between the place of residence and the center	1.53	0.75	Low
Presence of a health conditions that could interfere with the use of supplements	1.25	0.61	Low
Total average of barriers	1.99	0.41	Medium

Table 6

The differences in Knowledge and compliance regarding folic acid and other supplementation according sociodemographic variables

Variable	Category	N	Mean	SD	F	p-value
Knowledge						
Age	17-25 y	118	1.94	0.28	1.14	0.32
	26-35 y	209	1.98	0.36		
	36-45 y	23	2.04	0.17		
School	Preparatory	48	1.63	0.24	21.6	0.00
	High school	79	2.01	0.33		
	Vocational	24	1.9	0.22		
	Bachelor	182	2.06	0.28		
	Graduate	17	1.96	0.4		
Work	Wife	269	1.98	0.33	T=0.42	0.67
	Employee	81	1.96	0.32		
Place	City	217	1.93	0.31	T=-3.1	0.00
	Village	133	2.04	0.33		
Income	Less than 2000 NIS	40	1.71	0.21	30.2	0.00
	2000-5000 NIS	162	1.92	0.29		
	5000 NIS	148	2.1	0.32		
Number of pregnancies	One time	68	2.05	0.31	6.3	0.00
	More than one time	230	1.98	0.33		
	Never	52	1.85	0.27		
Compliance						
Variable	Category	N	Mean	SD	F	p-value
Age	17-25 y	118	2.24	0.28	1.17	0.31
	26-35 y	209	2.29	0.32		
	36-45 y	23	2.25	0.34		
School	Preparatory	48	2.23	0.32	0.95	0.43
	High school	79	2.26	0.33		
	Vocational	24	2.31	0.17		
	Bachelor	182	2.28	0.29		
	Graduate	17	2.38	0.42		
Work	House wife	269	2.26	0.31	-1.34	0.18
	Employee	81	2.31	0.28		
Place	City	217	2.27	0.33	-0.32	0.75
	Village	133	2.28	0.27		
Income	Less than 2000 NIS	40	2.24	0.32	0.35	0.71
	2000-5000 NIS	162	2.27	0.28		
	5000 NIS	148	2.29	0.33	0.49	0.61
Number of pregnancies	One time	68	2.28	0.31		
	More than one	230	2.28	0.31		
	Never	52	2.24	0.26		

Table 6 shows the differences in knowledge and compliance according to sociodemographic variables. There was no significant differences in knowledge about supplementation between categories of work and age. The knowledge score was higher for more educated, higher income, and one pregnancy relative to other categories, whereas there was no significant difference in compliance according to sociodemographic variables.

Section 2: Pharmacist Survey

The second survey consisted of 160 pharmacists who mainly with Bsc in pharmacy, fewer were pharmacy technicians, another segment were pharm D. 53.8% were males, 31% were employers and the rest were employee. Many were residents of cities.

Table 7

Sociodemographic Description of study pharmacists (n=160)

Variable	levels	Frequency	(%)
Major	Pharmacist	106	66.2
	Assistant pharmacist	21	13.1
	Doctor of pharmacy	33	20.6
Sex	Male	86	53.8
	Female	74	46.2
Relationship to the workplace	Owner	50	31.2
	Employee	98	61.3
	Owner the license and work with it	12	7.5
Place of residence	City	125	78.1
	Village	35	21.9

Table 8 describes the perception of pharmacists in their role in instructing and guiding pregnant women on using folate supplementation. The pharmacists, had medium confidence in their ability to help pregnant women to deliver a healthy baby, they said they had a medium effect on womens' decision on take supplementation and they have medium role in supporting the health of pregnant women and her infant. The pharmacists highly supported that women who are planning to become pregnant should take supplementation of folic acid and they had medium support to give women discount or promotional items to support healthy pregnancy. The pharmacists highly supported that folic acid supplementation had high degree of effect on women and infant health and low support that the supplementation is only suitable for protection from anemia.

Table 8

Distribution of Means and standard deviations of the perception of pharmacists in instructing and educating women to intake folic acid

Statement	Mean	Standard Deviation	Level
Perception of pharmacists in instructing and educating women			
Confidence that you can help pregnant women give birth to a healthy baby.	2.32	0.71	Medium
The pharmacist doesn't have much influence on a pregnant women's decision to take the supplement.	2.20	0.63	Medium
The pharmacist plays an important role in encouraging and supporting the health of the pregnant woman and the health of her child, its necessary to take supplement.	2.29	0.55	Medium
Role of pharmacist	2.25	0.50	Medium
Attitudes			
Girls about to get married advised to use iron and folic acid supplements	2.67	0.63	High
Give pregnant women discount or promotional items when they purchase supplements	1.79	0.57	Medium
Attitude	2.23	0.38	Medium
Knowledge			
To which degree is the effect of iron and folic acid supplements during pregnancy on women's health	2.85	0.56	High
To which degree is the effect of iron and folic acid supplements during pregnancy on the health of fetus	2.76	0.81	High
Iron and folic acid supplementation is only for pregnant women who suffer from anemia	1.79	0.86	Medium
Knowledge	2.47	0.74	High

Chapter Four

Discussions and Conclusions

4.1 Introduction

This discussion examines the study's findings in the context of existing research and provides an evaluative perspective from the researcher. Evidence indicates that taking folic acid supplements before conception is linked to a reduced risk of neural tube defects (NTDs), and maintaining supplementation throughout pregnancy is effective in preventing megaloblastic anemia. It is generally recommended that women intake at least 400 mcg of folic acid daily. Despite mandatory fortification of flour with folic acid, providing women with guidance on folate supplementation remains crucial. Public awareness campaigns are also important to encourage its use, as these strategies have successfully diminished NTD rates in several countries (62).

Neural tube defects are serious birth anomalies affecting the early development of the brain, spinal cord, and associated structures. They rank as the second most common type of congenital defect, with an incidence of 2-3% among live births. Conditions like anencephaly are invariably fatal, while spina bifida can lead to a spectrum of physical and cognitive disabilities (65).

Reports from various countries reveal a significant discrepancy in awareness and use of folic acid supplements among pregnant women. For example, awareness is notably low in Spain (6.9%) and Ireland (2.7%), where folic acid intake is similarly low. In contrast, countries like the USA and Canada exhibit better adherence rates, ranging from 25% to 45%. This lower intake in some regions may be linked to high rates of unplanned pregnancies and late initiation of antenatal care. Additionally, many women struggle with identifying good dietary sources of folate (65). Health workers and media are primary sources of information on folic acid, but increasing education on this topic could improve awareness and compliance (65).

In the United States, about 85% of women are aware of the benefits of folic acid supplementation. In Qatar, however, only 53.7% of women have heard of folic acid, and merely 15% understand its role in preventing neural tube defects. A study in Taipei found that just 15.6% of women took folic acid before conception [55] (100).

Awareness levels vary across other regions, with 60% in Lebanon, 37% in Nigeria, 93% in Jordan, and 88% in Saudi Arabia (101).

The World Health Organization recommends that women who are planning to conceive should take 400 mcg of folic acid daily and continue this regimen for the first 12 weeks of pregnancy. Despite a high level of awareness about the benefits of folic acid, adherence to supplementation remains notably low in many Middle Eastern countries. For instance, rates of folic acid supplementation are 6.2% in Lebanon, 8.8% in Egypt, 16.9% in Jordan, and 17.6% in Israel (101). Folic acid can be obtained from dietary sources such as green leafy vegetables, including broccoli, spinach, and romaine lettuce, as well as fruits like oranges and bananas.

4.2 What is the level of knowledge of pregnant women in Qalqilya district/ towards taking folic acid?

It was noticed that the level of knowledge of pregnant women in Qalqilya district/ towards taking folic acid an is medium, the mean score equals (1.97) which is moderate score , the highest mean score equals (2.56) related to item " folic acid enhances the protection of the fetus from malformations (neural tube malformation)" with shows high level of estimation, The lowest mean is (1.47) related to the item (Taking iron and folic acid supplements increase the chance of get a boy) which shows low level of estimation.

The study sample knows that “Green vegetables a good source of folate, Adherence to folic acid supplements helps prevent anemia and Folic acid enhances the protection of the fetus from malformations (neural tube malformation) in high degree . The study knows that (Fruits good source of folate, Milk a good source of folate, Sea food /fish good source of folate, Meat a good source of folate, Breakfast cereal a good source of folate, Bread a good source of folate, As a part of food and drink, there are other ways that women who are pregnant or planning to become pregnant can get folic acid. Taking iron and folic acid supplements increase the chance of pregnancy. Adherence to folic acid supplements helps prevent anemia. Folic acid is essential for building DNA, Taking folic acid helps regulate the menstrual cycle and folic acid reduce the chances of abortion) in moderate degree. Finally, eating food that contains iron and folic acid is better than taking supplements, taking iron and folic acid supplements increase the

chance of get a boy and folic acid deficiency reduces the weight of the fetus from the normal.

It is obvious that Fruits, Green vegetables, Milk, Sea food /fish, Meat, Bread are very essential food for healthy body , particularly, pregnant women and the moderate knowledge is unacceptable. Pregnant women in their conditions must have high knowledge about nutrition in order for the health of both women and baby. Also, other knowledge such as eating food that contains iron and folic acid is better than supplements. Taking folic acid helps regulate the menstrual cycle and Folic acid deficiency reduces the weight of the fetus from the normal with moderate levels are unacceptable. Women in pregnancy should increase their knowledge to high or very high.

These results are compared to Hassan, A. S., & Al-Kharusi, B. M. (2008) survey assessing the knowledge and use of folic acid among pregnant Arabian women in Qatar and Oman. . Results of the survey indicated that 94% of the women knew about folic acid, 41.3% knew it should be taken periconceptionally, 58.5% knew that it prevents birth defects and 34.4% were able to identify five or more food sources of folic acid. (102)10.8% respondents of Koirala, S., , & Pokharel, S., (2018) Study result revealed that they had good knowledge whereas, 65.6% had poor knowledge about preconception folic acid supplementation. 87.2% had taken folic acid at some point of pregnancy and 17.6 % of pregnant women had taken preconceptional folic acid. 21.2% had heard about folic acid supplement and 20% had known about benefits of preconceptional folic acid. 17.6% knew that it should be taken one month before conception and 16% answered that it could prevent neural tube defects (103)**.**

The level of compliance of pregnant women in Qalqilya district/ regarding taking supplementation ranged between medium to high . The mean score equals (2.27) which is moderate degree of estimation. The highest mean score equals (2.76) was reflected in items like "regular visitation to prenatal care clinic " which had a high score level, The lowest score was for " Iron supplement has been taken in the previous 6 months" with a moderate score.

The high levels of compliance were for the items: taking any kind of supplement or vitamins at the present time. Supplements and vitamins are taken regularly, regular visitation to prenatal care clinic, Iron and folic acid supplementation received at each visit and Information about these supplements has been provided. These indicators (vitamins are taken regularly, king any kind of supplement or vitamins at the present time, regular visitation to prenatal care clinic, Iron and folic acid supplementation received at each visit and Information about these supplements has been provided) are positive and in the benefit of the pregnant woman.

Compliance of Iron supplement has been taken in the previous 6 months and commitment to the visiting times are in a moderate degree and the participants was referred to a nutritionist in low degree. These should be enhanced to reach high degree in order for the pregnant to have good period of pregnancy and safety delivery.

In a similar study by Getachew, M., Abay, M., Zelalem, H., Gebremedhin, T., Grum, T., & Bayray, A. (2018) showed that the adherence rate was found to be 64.7% [95% CI (59.7%, 70.0%)]. Women who had lower knowledge about anemia [AOR; 0.23 95% CI (0.14, 0.38)] and not receiving information about importance of iron-folic acid supplementation [AOR; 0.43 95% CI (0.25, 0.74)] were negatively associated with adherence to iron and folic acid., Having four or more antenatal care visits [AOR; 2.83 95% CI (1.46, 5.48)] were positively significantly associated with adherence to iron-folic acid supplementation (104)**.**

In comparison with similar study, Solomon, Y., Sema, A., & Menberu, T. (2021) et al revealed that 71.8% of pregnant women have adhered to iron/folic acid supplements. Pregnant women who had ≥4 antenatal care visits (AOR=3.15; 95% CI: 1.16-9.05), got advice about iron/folic acid supplementation (AOR=3.12; 95% CI: 1.15-5.29), good knowledge about iron/folic acid supplementation (AOR=3.56; 95% CI: 1.42-8.54), good knowledge about anemia (AOR=5.22; 95% CI: 2.06-8.33), and currently anemic (AOR=2.58; 95% CI: 2.38-9.61) were significantly associated with adherence of iron/folic acid supplementation (105)**.**

The level of the barriers that prevent pregnant women in Qalqilya district using supplements is medium, the mean score equals (1.99), the highest mean score equals (2.69) related to the item "Iron intake during pregnancy" with a high level. The lowest

mean score related to the statement “presence of health conditions that could interfere with the use of supplements” with (1.25) which is a low level.

One of the barriers is that instructions to take iron and folic acid supplementation during pregnancy was not available which means that pregnant should be clearly instructed well in order to overcome these difficulties .

In a similar study , Lyoba, W. B., Mwakatoga, J. D., Festo, C., Mrema, J., & Elisaria, E. (2020) study et al. indicated that out of the 320 respondents of the survey, 20.3% (n = 65) adhered to IFAS. Factors associated with adherence to IFAS among pregnant women included time to start ANC (AOR = 3.72, 95% CI: 1.42, 9.79), knowledge of anemia (AOR = 3.84, 95% CI: 1.335, 10.66), counseling on the importance of the iron-folic acid (AOR = 3.86, 95% CI: 1.42, 10.50), IFAS given during clinical visit (AOR = 15.72, 95% CI: 5.34, 46.31), number of meals consumed (AOR = 3.44, 95% CI: 1.28, 9.21), number of children (AOR = 3.462, 95% CI: 1.035, 11.58), and distance to health facility (AOR = 0.34, 95% CI: 0.131, 0.886) (106)**.**

Qualitative findings revealed that delayed first ANC visit, lack of remainder for pregnant women to take IFAS, low awareness about the negative effects of anemia, low of knowledge of IFAS and management of side effects, negative beliefs about the use of IFAS, and follow-up mechanism were major reasons for poor adherence.

4.3 The differences in knowledge and compliance according to

There were no significant differences in knowledge about supplementation between categories of work and age. The knowledge score was higher for more educated, higher income, and one pregnancy relative to other categories, whereas there was no significant difference in compliance according to sociodemographic variables.

High levels of education ,high levels of monthly income and one pregnancy were associated with better knowledge scores about supplementation because study sample individuals with these levels have more abilities to get knowledge due to their positions in the society.

In contrast to the findings presented by Mary Wanjira Kamau, Waithira Mirie, and Samuel Kimani in their study on compliance with Iron and Folic Acid Supplementation (IFAS) among pregnant women in Kiambu County, Kenya, our research produced different results. Their study reported a prevalence of 32.7% for IFAS compliance among 364 respondents, with 40.9% scoring high on IFAS knowledge. However, our study did not agree with their observed association between high knowledge levels and compliance, our results indicated a disagreement in this finding .

4.4 The Perception of Pharmacists in their Role in Instructing and guiding Pregnant Women on using Folate Supplementation

Pharmacists Perceptions and Attitudes were moderate towards educating pregnant women on folic acid supplementation and having influence on a pregnant women's decision to take the supplement. Probably and up to author knowledge because nutrition education in pharmacy school and continuous education for practicing pharmacist is not sufficient. Despite that, giving pregnant women discount or promotional items when they purchase supplements was modest this was probably done to improve sales from pharmacies rather than as a part of health education .Hence there should be initiatives to improve pharmacists involvement in spreading health education in aspects related to nutrition of society by holding community course to show pharmacists the practical importance of improving their participation especially in aspects related to prenatal care.

Pharmacist counseling on using folic acid supplementation is very important to improve the compliance with folic acid supplements. Lack to compliance with folic acid supplementation could be due to forgetfulness, lack of sufficient knowledge, and fear of side effects although a rare cause (117). Particularly, using pharmacists to disseminate knowledge is practical because most people can reach to pharmacies easily by simply walking. Reports indicate that interventions delivered by community-pharmacists are feasible and lead to improve in women health behavior (118). Pharmacists are most accessible, cost effective health care professional. Pharmacists are recommended to participate public health activities and participate in improving societal wellbeing (119). Pharmacists should have valuable role in reducing maternal mortality. Robust implementation of pharmacist-provided maternal health requires partnership between providers, payers and pharmacists.

4.5 Recommendations

In light of the study results, the researcher suggests the following recommendations:

1. Pregnant knowledge about food Sources and other knowledge concerning them should be enhanced.

2. It is necessary to increase compliance of pregnant women regard taking supplementation such as commitment to the visiting times and time of taking supplements should be increased.

3. It is important to decrease Barriers that prevent pregnant women using supplements about clarity and adequacy of instructions should be decreased to a minimum levels.

4. Perceptions of pharmacists in instructing and educating women to intake folic acid should be increased in order to benefit pregnant women when asking instructions.

5. Profound studies about the same subject should be conducted.

4.6 Strength and Limitation

4.6.1 Strength of study

1. To the best of our knowledge, the researcher believes that the study is the first in this field in Palestine.

2. Small sample size, the study was in Qalqilia city only and this may not be presentative to other places in palestine.

4.6.2 limitation of study

1. This study did not cover all health facilities since it was conducted only in one clinic in Qalqilia , another clinic has a lot of pregnant women and they excluded .

2. long time to gathering the information.

List of Abbreviations

Abbreviation	Full term
ANC	Antenatal Clinic
IFAS	Iron and Folic Acid Supplementation
NTDs	Neural Tube Defects
KAP	Knowledge, Attitude and Practice

References

(1) 2011 W. The global prevalence of anaemia in 2011. Who [Internet]. 2011;1–48. Available from: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://iris.who.int/bitstream/handle/10665/177094/9789241564960_eng.pdf?sequence=1#:~:text=For the year 2011%2C it,and 32 million pregnant women.

(2) Lauren H Marcewicz, Britta L Anderson, Vanessa R Byams AMG and JS. Screening and Treatment for Iron Deficiency Anemia in Women: Results of a Survey of Obstetrician-Gynecologists. 2017; Available from: https://pubmed.ncbi.nlm.nih.gov/28251440/

(3) WHO. WHO The Global Prevalence of Anaemia in 2011. Geneva: World Health Organization. 2015.

(4) B. de Benoist, E. McLean IE and MC. Prevention Ca, Atlanta. Worldwide prevalence of anaemia 1993–2005". In: WHO Global Database on Anaemia. 2008.

(5) Gebre A. Assessment of Factors Associated with Adherence to Iron-Folic Acid Supplementation Among Urban and Rural Pregnant Women in North Western Zone of Tigray, Ethiopia: Comparative Study. Int J Nutr Food Sci. 2015;4(2):161.

(6) World Health Organization, Williams a L, van Drongelen W, Lasky RE, Sanderson M, Lai D, et al. Guideline : Daily iron and folic acid supplementation in pregnant women. World Heal Organ. 2012;46:323–9.

(7) Stevens GA, Finucane MM, De-Regil LM, Paciorek CJ, Flaxman SR, Branca F, et al. Global, regional, and national trends in haemoglobin concentration and prevalence of total and severe anaemia in children and pregnant and non-pregnant women for 1995-2011: A systematic analysis of population-representative data. Lancet Glob Heal [Internet]. 2013;1(1):16–25. Available from: https://www.thelancet.com/journals/langlo/article/PIIS2214-109X(13)70001-9/fulltext

(8) Naithani M, Saxena V, Mirza AA, Kumari R, Sharma K, Bharadwaj J. Assessment of Folic Acid Supplementation in Pregnant Women by Estimation of Serum Levels of Tetrahydrofolic Acid, Dihydrofolate Reductase, and

Homocysteine. Scientifica (Cairo) [Internet]. 2016;2016. Available from: https://www.hindawi.com/journals/scientifica/2016/1520685/

(9) Yakoob MY, Khan YP, Bhutta ZA. Maternal mineral and vitamin supplementation in pregnancy. Expert Rev Obstet Gynecol [Internet]. 2010;5(2):241–56. Available from: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.tandfonline.com/doi/pdf/10.1586/eog.10.8

(10) Alemu T, Umeta M. Reproductive and obstetric factors are key predictors of maternal anemia during pregnancy in Ethiopia: Evidence from demographic and health survey (2011). Anemia. 2015;2015.

(11) Rae Galloway JM. Determinants of compliance with iron supplementation: Supplies, side effects, or psychology? 2002; Available from: https://www.sciencedirect.com/science/article/abs/pii/027795369490135X?via%3Dihub

(12) Kurniawati Dwi, Aprilian Pratama JIKG. Retracted: Folic acid supplementation, dietary folate intake during pregnancy and risk for spontaneous preterm delivery: a prospective observational cohort study. Power [Internet]. 2014;1(3):2012. Available from: http://dx.doi.org/10.1016/S0149-2918(08)00405-0

(13) Cerami C. Iron Nutriture of the Fetus, Neonate, Infant, and Child. Ann Nutr Metab. 2017;71(3):8–14.

(14) McCarthy EK, Dempsey EM, Kiely ME. Iron supplementation in preterm and low-birth-weight infants: A systematic review of intervention studies. Nutr Rev. 2019;77(12):865–77.

(15) L B Bailey. New standard for dietary folate intake in pregnant women. 2000; Available from: https://pubmed.ncbi.nlm.nih.gov/10799406/

(16) Liew SC. Folic acid and diseases - Supplement it or not? Rev Assoc Med Bras. 2016;62(1):90–100.

(17) Fekete K, Berti C, Trovato M, Lohner S, Dullemeijer C, Souverein OW, et al. Effect of folate intake on health outcomes in pregnancy: A systematic review and meta-analysis on birth weight, placental weight and length of gestation. Nutr J. 2012;11(1):1–8.

(18) Lindsay H Allen. Causes of vitamin B 12 and folate deficiency. Food Nutr Bull. 2008;29(2):S20-34; discussion S35-7.

(19) Gao Y, Sheng C, Xie RH, Sun W, Asztalos E, Moddemann D, et al. New perspective on impact of folic acid supplementation during pregnancy on neurodevelopment/autism in the offspring children - A systematic review. PLoS One. 2016;11(11):1–16.

(20) Hisam A, Ur Rahman M, Mashhadi SF. Knowledge, attitude and practice regarding folic acid deficiency; a hidden hunger. Pakistan J Med Sci. 2014;30(3):583–8.

(21) Erlandsen A. Folate and vitamin B 12. Proc Nutr Soc. 1998;58(2):441–8.

(22) Kondo A, Kamihira O, Ozawa H. Neural tube defects: Prevalence, etiology and prevention. Int J Urol. 2009;16(1):49–57.

(23) Supplementation FA, Supplementa- FA. WEEKLY IRON-FOLIC ACID SUPPLEMENTATION (WIFS) IN WOMEN OF REPRODUCTIVE AGE : ITS ROLE IN PROMOTING OPTIMAL MATERNAL AND CHILD HEALTH ThE WhO glOBal ExPERT cOnSUlTaTiOn WEEkly iROn and FOlic acid SUPPlEmEnTaTiOn cOnSUlTaTiOn REcOmmEndaTiOnS. Organization. 2009;

(24) Chivu CM, Tulchinsky TH, Soares-Weiser K, Braunstein R, Brezis M. A systematic review of interventions to increase awareness, knowledge, and folic acid consumption before and during pregnancy. Am J Heal Promot. 2008;22(4):237–45.

(25) S. Lane, Annette Hines HK. Predicting folic acid intake among college students. Mother Child Nutrition. MCN, Am J Matern Child Nurs. 2015;51–7.

(26) A. Klusmann, B. Heinrich, Heike Stöpler, J. Gärtner EM and RK. A decreasing rate of neural tube defects following the recommendations for periconceptional folic acid supplementation. Acta Paediatr. 2005;1538–42.

(27) E. Ismail, Nurhaziqah Supari, Mohammad Osman, Nurina Musta'ani Hamedon, Rosni, A. Ibrahim SR and AR. INCIDENCE OF SPINA BIFIDA: AN EIGHT-YEAR ANALYSIS AT KUALA LUMPUR HOSPITAL. 2009.

(28) the United Nations (UN). Our Work on the Sustainable Development Goals in Ethiopia [Internet]. 2017. Available from: https://ethiopia.un.org/en/sdgs

(29) Burke RM, Leon JS, Suchdev PS. Identification, prevention and treatment of iron deficiency during the first 1000 days. Nutrients. 2014;6(10):4093–114.

(30) Haidar JA, Pobocik RS. Iron deficiency anemia is not a rare problem among women of reproductive ages in Ethiopia: A community based cross sectional study. BMC Blood Disord. 2009;9:7.

(31) Scott SP, Chen-Edinboro LP, Caulfield LE, Murray-Kolb LE. The impact of anemia on child mortality: An updated review. Nutrients. 2014;6(12):5915–32.

(32) Taye B, Abeje G, Mekonen A. Factors associated with compliance of prenatal iron folate supplementation among women in Mecha district, Western Amhara: A cross-sectional study. Pan Afr Med J. 2015;20:1–7.

(33) Crider KS, Bailey LB, Berry RJ. Folic acid food fortification-its history, effect, concerns, and future directions. Nutrients. 2011;3(3):370–84.

(34) Temple, C., & Montgomery J. CHEMICAL AND PHYSICAL PROPERTIES OF FOLIC ACID AND REDUCED DERIVATIVES. 1985;

(35) Leslie E. Daly, Peadar N. Kirke, Anne Molloy DGW and JMS. Folate Levels and Neural Tube Defects Implications for Prevention. 1995; Available from: https://jamanetwork.com/journals/jama/article-abstract/392244

(36) Abbassi-Ghanavati, Mina MD; Greer, Laura G. MD; Cunningham FGM. Pregnancy and Laboratory Studies A Reference Table for Clinicians. 2009; Available from: https://journals.lww.com/greenjournal/abstract/2009/12000/pregnancy_and_laboratory_studies__a_reference.25.aspx

(37) Wang S, Ge X, Zhu B, Xuan Y, Huang K, Rutayisire E, et al. Maternal continuing folic acid supplementation after the first trimester of pregnancy increased the risk of large-for-gestational-age birth: A population-based birth cohort study. Nutrients. 2016;8(8):1–11.

(38) Sweeney M, McPartlin J, Scott J. Folic acid fortification and public health: Report on threshold doses above which unmetabolised folic acid appear in serum. BMC Public Health. 2007;7(January 1998):1–7.

(39) Rock CL. Multivitamin-multimineral supplements: Who uses them? Am J Clin Nutr [Internet]. 2007;85(1):277S-279S. Available from: https://doi.org/10.1093/ajcn/85.1.277S

(40) Kelly P, McPartlin J, Goggins M, Weir DG, Scott JM. Unmetabolized folic acid in serum: Acute studies in subjects consuming fortified food and supplements. Am J Clin Nutr [Internet]. 1997;65(6):1790–5. Available from: https://doi.org/10.1093/ajcn/65.6.1790

(41) Sweeney MR, McPartlin J, Weir DG, Daly L, Scott JM. Postprandial serum folic acid response to multiple doses of folic acid in fortified bread. Br J Nutr. 2006;95(1):145–51.

(42) Kalmbach RD, Choumenkovitch SF, Troen AM, D'Agostino R, Jacques PF, Selhub J. Circulating folic acid in plasma: Relation to folic acid fortification. Am J Clin Nutr. 2008;88(3):763–8.

(43) Bailey RL, Mills JL, Yetley EA, Gahche JJ, Pfeiffer CM, Dwyer JT, et al. Serum unmetabolized folic acid in a nationally representative sample of adults ≥60 years in the United States, 2001-2002. Food Nutr Res. 2012;56:10–2.

(44) Obeid R, Kasoha M, Kirsch SH, Munz W, Herrmann W. Concentrations of unmetabolized folic acid and primary folate forms in pregnant women at delivery and in umbilical cord blood. Am J Clin Nutr [Internet]. 2010;92(6):1416–22. Available from: https://doi.org/10.3945/ajcn.2010.29361

(45) Morris MS, Jacques PF, Rosenberg IH, Selhub J. Circulating unmetabolized folic acid and 5-methyltetrahydrofolate in relation to anemia, macrocytosis, and cognitive test performance in American seniors. Am J Clin Nutr [Internet]. 2010;91(6):1733–44. Available from: https://doi.org/10.3945/ajcn.2009.28671

(46) A. V. Hoffbrand. Pernicious Anaemia. 1983; Available from: https://journals.sagepub.com/doi/10.1177/003693308302800304?icid=int.sj-abstract.similar-articles.3

(47) Myszczyszyn A, Krajewski R, Ostapów M, Hirnle L. Folic acid-role in the body, recommendations and clinical significance. Pielegniarstwo XXI Wieku. 2019;18(1):50–9.

(48) Ficms BAA hashimi, Family C. Knowledge, attitude & practice of pregnant women about the role of periconceptional use of folic acid in three primary health care centers in Baghdad / AL-Russafa. 2016;103–8.

(49) Gillner K PM. The importance of folic acid metabolism in the development of neural tube defects. 2019;281–300.

(50) Cdc.gov. Centers for Disease Control and Prevention [Internet]. 2022. Available from: https://www.cdc.gov/

(51) Khoshnood B, Loane M, De Walle H, Arriola L, Addor MC, Barisic I, et al. Long term trends in prevalence of neural tube defects in Europe: Population based study. BMJ. 2015;351:1–6.

(52) Wilson RD, O'Connor DL. Maternal folic acid and multivitamin supplementation: International clinical evidence with considerations for the prevention of folate-sensitive birth defects. Prev Med Reports [Internet]. 2021;24:101617. Available from: https://doi.org/10.1016/j.pmedr.2021.101617

(53) Guttmacher.org. Guttmacher Institute 2022 [Internet]. 2022. Available from: https://www.guttmacher.org/

(54) Guttmacher.org. Guttmacher Institute Releases Sexual and Reproductive Health Profiles for More Than 130 Countries [Internet]. 2022. Available from: https://www.guttmacher.org/news-release/2021/guttmacher-institute-releases-sexual-and-reproductive-health-profiles-more-130

(55) Prevention of neural tube defects: results of the Medical Research Council Vitamin Study. MRC Vitamin Study Research Group. 1991; Available from: https://pubmed.ncbi.nlm.nih.gov/1677062/

(56) G J Cuskelly HM and JMS. Effect of increasing dietary folate on red-cell folate: implications for prevention of neural tube defects. 1996; Available from: https://pubmed.ncbi.nlm.nih.gov/8596381/

(57) Reynolds E, Sillender M. Fortification of flour with folic acid. Bmj. 2002;324(7342):918.

(58) Food Fortification Initiative (FFI). Flour Fortification Initiative [Internet]. 2014. Available from: https://www.ffinetwork.org/global_progress/ (accessed 28 October 2014)

(59) Honein MA, Paulozzi LJ, Mathews TJ, Erickson JD, Wong LYC. Impact of folic acid fortification of the US food supply on the occurrence of neural tube defects. Jama. 2001;285(23):2981–6.

(60) Jorge S. López-Camelo, Iêda M. Orioli, Maria da Graça Dutra, Julio Nazer-Herrera, Nelson Rivera, María Elena Ojeda, Aurora Canessa, Elisabeth Wettig, Ana María Fontannaz CM and EEC. Reduction of birth prevalence rates of neural tube defects after folic acid fortification in Chile. 2005; Available from: https://onlinelibrary.wiley.com/doi/10.1002/ajmg.a.30651

(61) De Wals P, Tairou F, Van Allen MI, Uh SH, Lowry RB, Sibbald B, et al. Reduction in Neural-Tube Defects After Folic Acid Fortification in Canada. Obstet Anesth Dig. 2008;28(1):13–4.

(62) Le Zhang, Zhiwen Li, Ling Hao YT and ZL. Awareness and use of folic acid, and blood folate concentrations among pregnant women in northern China—An area with a high prevalence of neural tube defects. 2006; Available from: https://www.sciencedirect.com/science/article/abs/pii/S089062380600058X

(63) Sciences AH. Role of pharmacist's counseling on folate compliance. 2014;3(1):221–6.

(64) Zeković M, Krajnović D, Nikolić M, Stojković T, Gurinović M, Glibetić M. Periconceptional folic acid supplementation: Knowledge, attitudes and counselling practice of Serbian pharmacists and pharmacy technicians. Vojnosanit Pregl. 2019;76 (11):1127–38.

(65) Anzaku A. Assessing folic acid awareness and its usage for the prevention of neural tube defects among pregnant women in Jos, Nigeria. J Basic Clin Reprod Sci. 2013;2(1):13.

(66) Bower C, Blum L, O'Daly K, Higgins C, Loutsky F, Kosky C. Promotion of folate for the prevention of neural tube defects: Knowledge and use of periconceptional folic acid supplements in Western Australia, 1992 to 1995. Aust N Z J Public Health [Internet]. 1997;21(7):716–21. Available from: http://dx.doi.org/10.1111/j.1467-842X.1997.tb01786.x

(67) Margaret Miller JP and PS. Promotion of folate for the prevention of neural tube defects: who benefits? 2005; Available from: https://onlinelibrary.wiley.com/doi/10.1111/j.1365-3016.2005.00675.x

(68) Watson LF, Brown SJ, Davey MA. Use of periconceptional folic acid supplements in Victoria and New South Wales, Australia. Aust N Z J Public Health. 2006;30(1):42–9.

(69) McDonnell R, Delany V, O'Mahony MT, Mullaney C, Lee B, Turner MJ. Neural tube defects in the Republic of Ireland in 2009-11. J Public Heal (United Kingdom). 2015;37(1):57–63.

(70) Begum K, Ouédraogo CT, Wessells KR, Young RR, Faye MT, Wuehler SE, et al. Prevalence of and factors associated with antenatal care seeking and adherence to recommended iron-folic acid supplementation among pregnant women in Zinder, Niger. Matern Child Nutr. 2018;14(March 2017):1–11.

(71) Birhanu TM, Birarra MK, Mekonnen FA. Compliance to iron and folic acid supplementation in pregnancy, Northwest Ethiopia. BMC Res Notes [Internet]. 2018;11(1):3–7. Available from: https://doi.org/10.1186/s13104-018-3433-3

(72) Shaheen MMA, Hejaz H. European Journal of Determinants of Iron Supplement Non-Adherence Among Young Pregnant Women in Southern West-Bank : Awareness of Anemia and Iron – Folic Acid Supplements. 2019;6(10):74–83.

(73) Assefa H, Abebe SM, Sisay M. Magnitude and factors associated with adherence to Iron and folic acid supplementation among pregnant women in Aykel town, Northwest Ethiopia. BMC Pregnancy Childbirth. 2019;19(1):1–8.

(74) Argyridis S. Folic acid in pregnancy, Obstetrics, Gynaecology & Reproductive Medicine. 2019.

(75) King SE, Yeh PT, Rhee DK, Tuncalp Ö, Rogers LM, Narasimhan M. Self-management of iron and folic acid supplementation during pre-pregnancy, pregnancy and postnatal periods: A systematic review. BMJ Glob Heal. 2021;6(5):1–6.

(76) Nicholas J Wald, Joan K Morris CB. Urgent need for folic acid fortification of flour and grains: response to the 2019 UK Government's public consultation, Archives of Disease in Childhood. 2020;6–9.

(77) S. Sarwar MIA. The willingness and perception of people regarding green roofs installation. Environmental Science and Pollution Research. 2022;25703–14.

(78) Hong Lu , Yang Zhao AW. Job satisfaction among hospital nurses: a literature review, International journal of nursing studies. 2020;21–31.

(79) Zelalem, A., Endeshaw, M., Ayenew, M., Shiferaw, S., and Yirgu R. Effect of nutrition education on pregnancy specific nutrition knowledge and healthy dietary practice among pregnant women in Addis Ababa, Clinics in Mother and Child Health. 2019;265–74.

(80) Kumar, M., Hasija, A., Garg, N., Mishra, R., and Chaudhary SR. Relative Prevalence and Outcome of Fetal Neural Tube Defect in a Developing Country. The Journal of Obstetrics and Gynecology of India. 2020;195–201.

(81) Shamsuddin, H., Raudenbush, C. L., Sciba, B. L., Zhou, Y. P., Mast, T. C., Greaves, W. L. and Straus W. Evaluation of neural tube defects (NTDs) after exposure to raltegravir during pregnancy. Journal of acquired immune deficiency syndromes (1999). 2019;247.

(82) Alshahwani, S. M., and Abdullah SA. Neural tube defects: Incidence andtypes. The Medical Journal of Tikrit University. 2019;104–14.

(83) Murphy BL, Dipietro NA, Kier KL. Knowledge and use of folic acid among college women: A pilot health promotion program led by pharmacy students and faculty. Pharm Pract (Granada). 2010;8(4):220–5.

(84) Mshanga CN, Maseta EJ. Knowledge, Attitudes and Practices towards the Use of Iron and Folic Acid Supplements among Pregnant and Lactating Women in Dar es Salaam. Tanzania J Sci. 2022;48(3):640–8.

(85) Murphy BL, Dipietro NA. Impact of a pharmacist-directed educational program on the long-term knowledge and use of folic acid among college women: a 12-month follow-up study. Pharm Pract. 2012;10(2):105–9.

(86) Rodrigues CR, Dipietro NA. Knowledge of folic acid and counseling practices among Ohio community pharmacists. Pharm Pract. 2012;10(3):168–72.

(87) Li T, Zhu J, Zeng Z, Wang Y, Liang J YP. Study of KAP with regard to taking folic acid supplements and factors affecting the recommendation and prescription of those supplements among obstetricians and specialists in women's health in six provinces of Northern China. 2011;104–10.

(88) Kondo A, Iwagaki S, Kihira M, Nakanishi Y, Shimosuka Y, Okai I SK. Changes in life styles of pregnant women and risks for having a pregnancy afflicted with spina bifida. Nihon Hinyokika Gakkai Zasshi. 2013;598–604.

(89) Weinstein SJ, Hartman TJ, Stolzenberg-Solomon R, Pietinen P, Barrett MJ TP. Null association between prostate cancer and serum folate, vitamin B(6), vitamin B(12), and homocysteine. 2003;1271–1272.

(90) Muthayya S, Rah JH, Sugimoto JD, Roos FF, Kraemer K, Black RE. The Global Hidden Hunger Indices and Maps: An Advocacy Tool for Action. PLoS One. 2013;8(6):1–12.

(91) Schmidt RJ, Tancredi DJ, Ozonoff S, Hansen RL, Hartiala J, Allayee H, et al. Maternal periconceptional folic acid intake and risk of autism spectrum disorders and developmental delay in the CHARGE (CHildhood Autism Risks from Genetics and Environment) case-control study. Am J Clin Nutr. 2012;96(1):80–9.

(92) James SJ, Pogribna M, Pogribny IP, Melnyk S, Hine RJ, Gibson JB, et al. Abnormal folate metabolism and mutation in the methylenetetrahydrofolate reductase gene may be maternal risk factors for Down syndrome. Am J Clin Nutr [Internet]. 1999;70(4):495–501. Available from: https://doi.org/10.1093/ajcn/70.4.495

(93) Bazzano LA. Folic acid supplementation and cardiovascular disease: the state of art. 2009;48–49.

(94) Kit Sing Au, Allison Ashley-Koch and HN. Epidemiologic and genetic aspects of spina bifida and other neural tube defects. Rickham's neonatal Surg. 2010;16(1):6–15.

(95) Mersereau MNP, Kilker K, Carter H, Fassett E, Williams GJ et al. Spina Bifida and Anencephaly Before and After Folic Acid Mandate --- United States, 1995-1996 and 1999-2000. 2012;

(96) Khattak ST, Khan M, Naheed T, Khattak Iu IM. Prevalence and management of anencephaly at Saidu Teaching Hospital, Swat. J Ayub Med Coll Abbottabad. 2010;61–63.

(97) Khan DA, Fatima S, Imran R KF. Iron, folate and cobalamin deficiency in anaemic pregnant females in tertiary care centre at Rawalpindi. 2010;17–21.

(98) Sabi EM, Mujamammi AH, Alturki N, Alzaid T, Almutairi A, Algarni R, et al. Level of Knowledge and Awareness of Female Undergraduate Students and Determinants of Knowledge of Folic Acid and Supplementation. Med. 2022;58(8):1–8.

(99) Linnell A, Murphy N, Godwin J, Cremona A. An evaluation of adherence to folic acid supplementation in pregnant women during early gestation for the prevention of neural tube defects. Public Health Nutr. 2022;25(11):3025–35.

(100) W Al-Darzi , F Al-Mudares , A Farah AA and DM. Knowledge of periconceptional folic acid use among pregnant women at Ain Shams University Hospital, Cairo, Egypt. 2014; Available from: https://pubmed.ncbi.nlm.nih.gov/25343469/

(101) Alsammani MA, Kunna A, Adam EM. Factors associated with folic acid knowledge and intake among pregnant women in Sudan. East Mediterr Heal J. 2017;23(10):662–9.

(102) Abdelmonem S. Hassan , PhD M and BMAK. Knowledge and use of folic acid among pregnant Arabian women residing in Qatar and Oman. 2009; Available from: https://www.tandfonline.com/doi/full/10.1080/09637480701668770

(103) Koirala S, Pokharel S. Assessing the level of knowledge in the preconceptional use of folic acid supplement among primigravida women. Kathmandu Univ Med J. 2018;16(64):306–10.

(104) Getachew M, Abay M, Zelalem H, Gebremedhin T, Grum T, Bayray A. Magnitude and factors associated with adherence to Iron-folic acid supplementation among pregnant women in Eritrean refugee camps, northern Ethiopia. BMC Pregnancy Childbirth. 2018;18(1):1–8.

(105) Solomon Y, Sema A, Menberu T. Adherence and associated factors to iron and folic acid supplementation among pregnant women attending antenatal care in public hospitals of Dire Dawa, Eastern Ethiopia. Eur J Midwifery. 2021;5:1–7.

(106) Hassen Ali S, Ahmed Abdo Z. Adherence to Iron-folic Acid Supplementation and Associated Factors Among Pregnant Women in Borena Woreda, South Wollo, Ethiopia. Am J Heal Res. 2022;10(2):24.

(107) Centers for Disease Control and Prevention. (2020). Recommendations for use of folic acid to reduce the number of cases of spina bifida and other neural tube defects. Morbidity and Mortality Weekly Report, 41(RR-14), 1-7.

(108) Goh, Y. I., & Koren, G. (2008). Folic acid in pregnancy and fetal outcomes. Journal of Obstetrics and Gynaecology Canada, 30(6), 518–531.

(109) Greenberg, J. A., Bell, S. J., Guan, Y., & Yu, Y. H. (2011). Folic acid supplementation and pregnancy: more than just neural tube defect prevention. Reviews in Obstetrics and Gynecology, 4(2), 52–59.

(110) Moyer, V. A. (2014). Folic acid for the prevention of neural tube defects: U.S. Preventive Services Task Force recommendation statement. Annals of Internal Medicine, 160(9), 634–641.

(111) Williams, A. L., van Drongelen, W., Lasky, R. E., Sanderson, M., Lai, D., et al. (2012). Guideline: Daily iron and folic acid supplementation in pregnant women. World Health Organization.

(112) World Health Organization. (2012). Guideline: Daily iron and folic acid supplementation in pregnant women. World Health Organization.

(113) McLean, E., Cogswell, M., Egli, I., Wojdyla, D., & de Benoist, B. (2011). Worldwide prevalence of anemia 1993–2005. World Health Organization. https://www.who.int/publications/i/item/9789241596657

(114) United Nations. (2020). Sustainable Development Goals. United Nations. https://sdgs.un.org/goals

(115) Public Health Service. (1992). Folic acid and the prevention of neural tube defects: The U.S. Public Health Service recommendations. Morbidity and Mortality Weekly Report, 41(RR-14), 1-7.

(116) World Health Organization. (2012). Guideline: Daily iron and folic acid supplementation in pregnant women. World Health Organization. https://www.who.int/publications/i/item/9789241501039

(117) Kousalya, K. (2020). Pharmacists' role in enhancing compliance with folic acid supplementation: Addressing barriers and disseminating knowledge. Journal of Community Health, 45(4), 765–772. https://doi.org/10.1007/s10900-020-00839-0

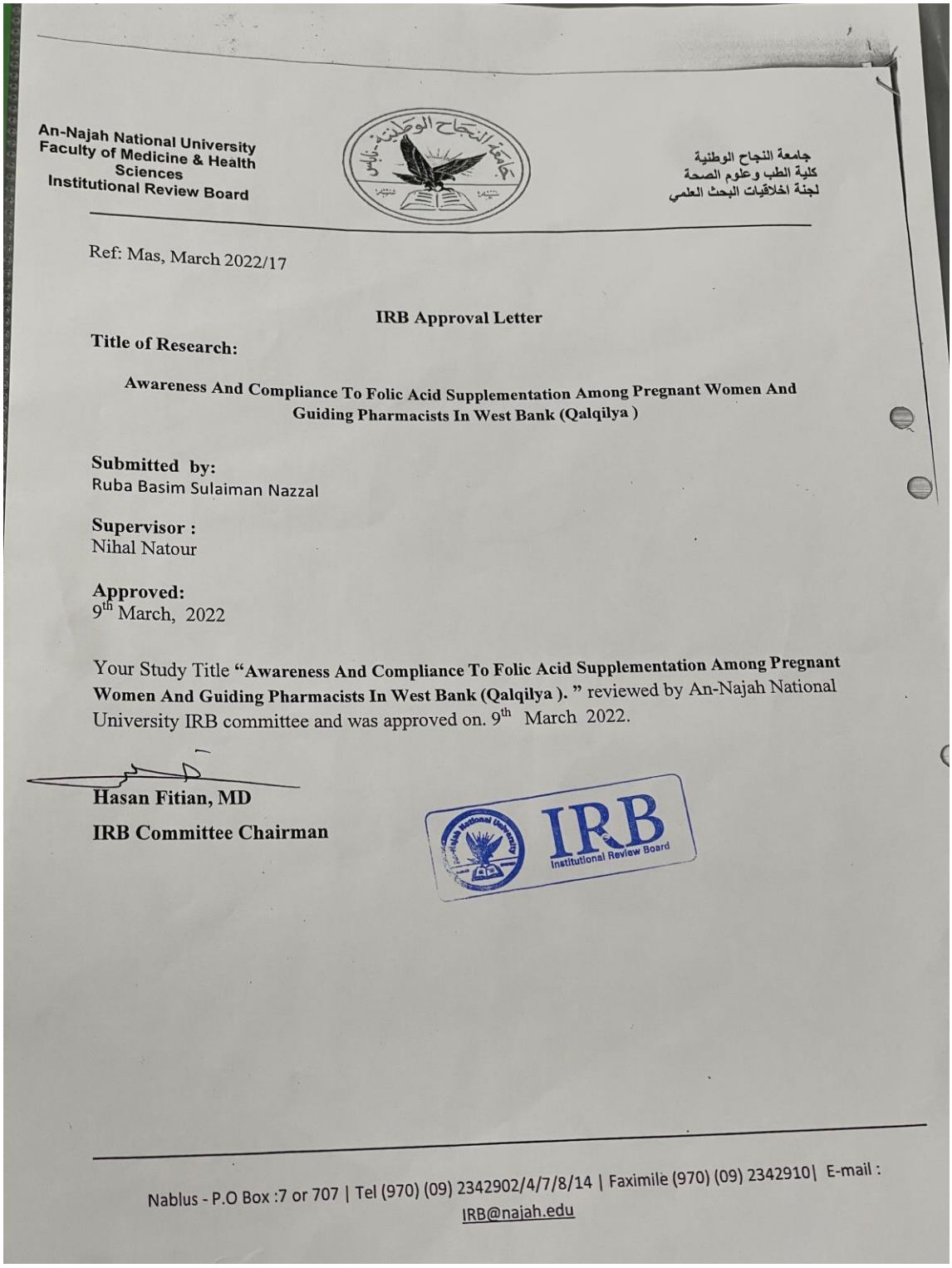
(118) Scott, D. M., Desselle, S. P., & Abraham, O. (2021). The role of community pharmacists in public health: A systematic review. PLOS ONE, 16(12), e0260466. https://doi.org/10.1371/journal.pone.0260466

(119) Samuel, S., Abraham, J., & Mathew, E. (2020). Beyond contraception: Pharmacists' roles to support maternal health. Pharmacy, 10(6), 163. https://doi.org/10.3390/pharmacy10060163

Appendices

Appendix A

IRB



An-Najah National University
Faculty of Medicine & Health Sciences
Institutional Review Board

جامعة النجاح الوطنية
كلية الطب وعلوم الصحة
لجنة اخلاقيات البحث العلمي

Ref: Mas, March 2022/17

IRB Approval Letter

Title of Research:

Awareness And Compliance To Folic Acid Supplementation Among Pregnant Women And Guiding Pharmacists In West Bank (Qalqilya)

Submitted by:
Ruba Basim Sulaiman Nazzal

Supervisor :
Nihal Natour

Approved:
9th March, 2022

Your Study Title **"Awareness And Compliance To Folic Acid Supplementation Among Pregnant Women And Guiding Pharmacists In West Bank (Qalqilya). "** reviewed by An-Najah National University IRB committee and was approved on. 9th March 2022.

Hasan Fitian, MD

IRB Committee Chairman

IRB Institutional Review Board

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

Appendix B

Informed constant

جامعة
النجـــاح الوطنية
كلية الدراسات العليا

An-Najah
National University
Faculty of Graduate Studies

التاريخ : 2022/3/21م

حضرة الدكتور رائد ولويل المحترم
عضو مجلس نقابي / نقابة الصيدلة المركزية

الموضوع: تسهيل مهمة الطالبة/ ربا نزال رقم تسجيل (11952842)
تخصص ماجستير الصحة العامة

تحية طيبة وبعد ،،،

الطالبة/ ربا نزال، رقم تسجيل 11952842، تخصص ماجستير الصحة العامة في كلية الدراسات العليا، وهي بصدد اعداد الاطروحة الخاصة بها والتي عنوانها:

Awareness and compliance to folic acid supplementation among pregnant women and guiding pharmacist in West Bank (Qalqilya)

يرجى من حضرتكم تسهيل مهمتها في جمع البيانات والمعلومات في الفترة الزمنية الواقعة بين 2022/3/28 – 2022/6/30 ، من النساء الحوامل اللواتي يزرن الرعايات الصحية الاولية – رعاية الحوامل، كما سيتم تعبئة استبانة متعلقة بالصيادلة الكترونياً.

علماً بأن البيانات والمعلومات سوف تستخدم لأغراض البحث العلمي واستكمال مشروع البحث فقط.

شاكرين لكم حسن تعاونكم.

مع وافر الاحترام ،،،

أ.د. وليد صويلح
عميد كلية الدراسات العليا

جامعة النجاح الوطنية
كلية الدراسات العليا

فلسطين، نابلس، ص.ب 7،707 هاتف:/2345115، 2345114، 2345113 (09)(972)* فاكسميل:2342907(09)(972)
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جامعة النجاح الوطنية

كلية الدراسات العليا

الوعي والامتثال لتكميل حمض الفوليك بين النساء الحوامل وتوجيه الصيادلة في الضفة الغربية (قلقيلية)

إعداد

ربا باسم سليمان نزال

إشراف

د نهال الناطور

د مريم الطل

قدمت هذه الرسالة استكمالا لمتطلبات الحصول على درجة الماجستير في الصحة العامة، من كلية الدراسات العليا، في جامعة النجاح الوطنية، نابلس– فلسطين.

2024

الوعي والامتثال لتكميل حمض الفوليك بين النساء الحوامل وتوجيه الصيادلة في الضفة الغربية (قلقيلية)

إعداد

ربا باسم سليمان نزال

إشراف

د نهال الناطور

د مريم الطل

الملخص

المقدمة: في النساء الحوامل، يمكن التعرض لنقص حمض الفوليك وذلك يعود الى عوامل مثل زيادة الاحتياجات أثناء الحمل، ونقص التغذية الناجم عن الفقر، وانعدام الأمن الغذائي، وعدم المساواة بين الجنسين. علاوة على ذلك، فإن عدم كفاية المعرفة بالممارسات الغذائية المناسبة يزيد من المخاطر، مما يؤدي إلى زيادة نقص حمض الفوليك. يرتبط نقص حمض الفوليك بالنتائج السلبية مثل تسمم الحمل والولادة المبكرة وتشوهات الأنبوب العصبي والعيوب الخلقية والسكري من النوع 2 وسمنة الرضع.

الطريقة: قامت دراسة كمية أجريت في قلقيلية في الفترة من 1 أكتوبر 2021 إلى 7 يناير 2023، بتقييم الوعي والالتزام بمكملات حمض الفوليك بين 160 صيدليا و350 امرأة حامل. حقق الاستطلاع في وعي الصيادلة ومعرفتهم ومواقفهم، فضلا عن الامتثال والعقبات التي تواجهها النساء الحوامل فيما يتعلق بالمكملات الغذائية. قدم التحليل الكمي الشامل للبيانات رؤى حول المستويات الحالية من الوعي والالتزام بين كل من النساء الحوامل والصيادلة.

النتائج: أشارت النتيجة إلى أن 62.0٪ من حجم عينة المشاركين هم من سكان المدينة، و59.7٪ منهم تتراوح أعمارهم بين 25–35 عاما. و67.4٪ لم يعانون أبدا من فقر الدم، 44.9٪ من المشاركين لديهم مستوى الهيموغلوبين بين 10–12. كان لدى المشاركين مستوى معتدل من الوعي والمعرفة فيما يتعلق

بتناول حمض الفوليك والحديد، مع متوسط درجة (1.97 ± 0.32). كان مستوى الامتثال بين المشاركين تجاه تناول المكملات الغذائية متوسطا، وكان مستوى الحواجز التي تمنع النساء الحوامل من استخدام المكملات الغذائية متوسطا، مع متوسط درجة (1.99 ± 0.41). كان دور الصيادلة في إرشاد النساء وتثقيفهن على تناول حمض الفوليك متوسطا، مع متوسط درجة.(0.50 ± 2.25)

الخلاصة: أظهرت النساء الحوامل امتثالا معتدلا لمكملات الحديد وحمض الفوليك. شملت العوامل التي تؤثر على الالتزام توقيت بدء الرعاية السابقة للولادة، والوعي بفقر الدم، والتوجيه بشأن أهمية المكملات الغذائية، وعدد المكملات الغذائية المقدمة لكل زيارة، وعدد الأطفال، والمسافة إلى مرافق الرعاية الصحية من مواقع معيشة المشاركين والآثار الجانبية للمكملات الغذائية كان لها تأثير ضئيل على تناول مكملات حمض الفوليك. يعد تعزيز التثقيف الصحي لمقدمي الخدمات أمرا بالغ الأهمية. في حين أن النساء الحوامل لديهن معرفة جيدة، كانت مواقف المكملات الغذائية محدودة. يوصى بالتركيز على الدراسات السلوكية للحصول على رؤى قاطعة. تشمل التوصيات تعزيز الوعي من خلال البرامج التعليمية، وتنفيذ أنظمة التذكير، وتعزيز استخدام المكملات الغذائية في النساء الجامعيات، مع دور نشط للصيادلة في مجال الصحة العامة.

الكلمات المفتاحية: النساء الحوامل؛ الموقف، الصيادلة؛ الوعي؛ حمض الفوليك؛ المعرفة؛ الامتثال.

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