DOI: https://doi.org/10.4038/sljn.v2i2.29

SLJN, 2023
Vol. 2, No. 2 (pp. 8-21)

Research Article

Knowledge and Practices on Periconceptional use of Folic Acid for the Prevention of Neural Tube Defects Among Women in Childbearing Age in Boralesgamuwa Medical Officer of Health Area, Sri Lanka

Ariyadasa, M.A.S.R.[1], Nandana, W.W.W.Y.[1], Bogahawaththa, N.W.[1], Banda, R.M.S.K.[1], Nethsara, P.J[1], Senevirathna, D.M.N.D.[1] & Jayathilake, M.R.S.[2]

[1]*Department of Nursing and Midwifery, Faculty of Allied Health Sciences, General Sir John Kotelawala Defence University, Sri Lanka*
[2]*Department of Nursing and Midwifery, Faculty of Allied Health Sciences, University of Sri Jayewardenepura*

Abstract

Introduction: Neural Tube Defects (NTD) remain a major public health burden globally. It is widely acknowledged that folic acid plays a vital role to reduce the risk of developing NTDs. The study aimed to determine knowledge, and practice regarding periconceptional use of folic acid for the prevention of NTD among women in childbearing age at Boralesgamuwa Medical Officer of Health (MOH) area, Sri Lanka.

Methods: A descriptive cross-sectional study was carried out among randomly selected 422 women in childbearing age in the said MOH area. Data were collected through a pre-tested interviewer administered questionnaire. The overall knowledge level was classified as adequate (>75%), moderately adequate (50-75%) and inadequate (<50%).

Results: Out of 422 participants, the majority was Sinhalese (95.7%), married (66.8%) and unemployed (62.1%). Mean age was 32.02 ±8.625 years. Nearly 56 % had heard about NTDs and 95.5% had heard about folic acid. A majority (279, 66.1%) had 'inadequate' level of knowledge, 120 (28.4%) had 'moderately adequate' knowledge and only 5.5% (n=23) had 'adequate' knowledge. Approximately 60% had taken folic acid and out of them only 42.4% had started folic acid before pregnancy. Age ($p<0.001$), marital status ($p<0.001$), parity ($p<0.001$), educational qualification of participants ($p<0.001$), monthly household income ($p=0.004$) and where health services sought from ($p <0.001$) were associated with the level of knowledge.

Conclusions: Majority of participants had inadequate knowledge regarding periconceptional use of folic acid for the prevention of NTDs. However, out of those who have used FA, majority had started to take it before pregnancy. The study findings warrant more educational programmes on the topic bridging the gap of knowledge among women in childbearing age in the study setting.

Key words: *Folic acid, Neural Tube Defects, knowledge, periconceptional, practices*

Sri Lankan Journal of Nursing, 2023, 2 (2): 8 - 21
Correspondence: *M.R.S. Jayathilake, Department of Nursing & Midwifery, Faculty of Allied Health Sciences, University of Sri Jayewardenepura, Sri Lanka, Email: sjayathilake@sjp.ac.lk*
https://orcid.org/ 0000-0003-0361-7076
Received: 12th June 2022; Accepted: 4thAugust 2023; Published 30th December 2023

How to cite: Ariyadasa, M.A.S.R., Nandana, W.W.W.Y., Bogahawaththa, N.W., Banda, R.M.S.K., Nethsara, P.J, Senevirathna, D.M.N.D. & Jayathilake, M.R.S. (2023). Knowledge and practices on periconceptional use of folic acid for the prevention of neural tube defects among women in childbearing age in Boralesgamuwa medical officer of health area, Sri Lanka. *Sri Lankan Journal of Nursing, 2*(2), 8-17.

Introduction

Neural Tube Defects (NTDs) which are serious birth defects of the brain and spinal cord, remain a major public health burden globally and the second most prevalent congenital disorder worldwide (Medawar et al., 2019). It is estimated that around 300,000 infants are born each year with NTDs, and approximately 88,000 deaths occur due to NTDs (Zaganjor et al., 2016). In Sri Lanka, the estimated prevalence of NTDs is 1.21 per 1000 births and recurrence risk of NTDs as 2%-3% (Pathiraja & Prathapan, 2020).

NTDs are congenital malformations developed during early intrauterine life around 3-4 weeks of gestation by failure of closure of the neural tube results in NTDs (Dissanayake et al., 2010). Usually by the time which closure of the neural tube occurs, most women have not recognised their pregnancy (Safi et al., 2012). The growth of a child who has NTDs affects medical, economical, educational and health status resulting in a huge burden and low quality of life. These issues are interconnected with patient's personal interactions, health, daily work and self-esteem (Burke et al., 2009). Prevention of NTDs is important since it impacts not only the life of a child, but eventually the whole family as well as the community.

It is widely acknowledged that folic acid (FA) plays a vital role in reducing the risk of development of NTDs (Dessie et al., 2017; Kim et al., 2018; Pathiraja & Prathapan., 2020). As per the findings of the previous research, FA supplementation before pregnancy is crucial to reduce the risk of NTDs (De Wals et al., 2007; Denny et al., 2013; Kim et al., 2018). The existing literature shows that pre-pregnancy FA supplementation prevents about 70% of NTDs (McLone, 2003). Hence, FA intake before conception and during the first trimester of pregnancy (periconceptional period) is vital to reduce the risk of developing NTDs (Dessie et al., 2017). However, previous studies conducted in different parts of the world have reported that majority of participating women had poor knowledge of the role of FA regarding prevention of NTDs (Nosrat, 2012; Alanazi et al., 2021; Begashaw et al., 2022). The same is true for Sri Lanka, where a study focusing on knowledge about preconceptual use of FA using pregnant and non-pregnant women, revealed that participants' knowledge related to preconceptual use of FA was significantly low (Pathiraja & Prathapan., 2020).

Considering practices related to periconceptional use of FA, a study conducted in Thailand using 401 pregnant women reported that a small proportion of women (9.7%) had taken FA at the correct time (Nawapun & Phupong, 2006). Another study conducted in Sri Lanka aiming at assessing knowledge and practice on FA intake for prevention of NTDs using antenatal women, revealed that 44.81% women took FA during pregnancy. Furthermore, out of those only 17.92% were aware of the importance of periconceptional use of FA (Fahamiya et al., 2019). Thus, the existing local and international literature emphasizes the importance of raising awareness regarding the optimal time and

benefits of taking FA for the prevention of NTDs among women (Nosrat, 2012; Garcia et al., 2018; Pathiraja & Prathapan., 2020). The current study therefore is aimed to assess knowledge and practices regarding periconceptional use of FA among women in childbearing age in a selected MOH area in Sri Lanka.

Methods

Study design and setting

This descriptive cross sectional study was carried out among women in childbearing age at Boralesgamuwa Medical Officer of Health (MOH) area, Sri Lanka, which consists of 18 Grama Niladhari divisions. The participants were selected proportionately from each Grama Niladhari division. The inclusion criteria specified that women should be in childbearing age, between 15-49 years (WHO, 2020) and permanent residents of Boralesgamuwa MOH area. The women working in healthcare sector and those who were diagnosed with psychological disorders were excluded from the study.

Sample size and sampling

The calculated sample size was 422 (Lachenbruch et al, 1991). All the details including addresses of participants were collected from each Grama Niladhari division within the Boralesgamuwa MOH area. Accordingly, the total number of women in childbearing age in the study setting was 19841. Based on the year of birth, a list of the women in childbearing age was prepared. Systematic random sampling was employed to select the participants. Every person in the 47^{th} position on the prepared list was selected consequently. In case, if a selected woman from the list bears an exclusion criterion, or unwilling to participate, the next woman from the list was recruited.

Study instrument

The study instrument was an interviewer administered questionnaire developed primarily in English based on the previous literature. Its content validity (adequacy, relevance of the tool, cultural applicability) was ensured by two nursing academics who are experts in the area of study. English version was translated into Sinhala and Tamil versions with both language and subject experts. Further, clarity, applicability and flexibility of the questionnaire was confirmed through pre-testing with ten women from Mirihana in Kotte MOH area who have the similar inclusion criteria of participants in the main study. A few amendments were made in wording after the pre-test and the questionnaire was finalized. The questionnaire consisted of three sections. Section one consisted of 14 questions on socio demographic information; section two contained 22 questions regarding women's knowledge of periconceptional use of FA for the prevention of NTDs and section three contained 06 questions related to practices regarding periconceptional use of FA.

Data collection

Data collection was conducted from August to November 2020 after obtaining ethical approval and permission from the relevant authorities, including Provincial Director of

Health in the Western Province, and the Regional Director of Health and from the MOH Boralesgamuwa, Sri Lanka. The questionnaire was interviewer administered by five investigators who visited houses of prospective participants. Accordingly, 422 participants were recruited.

Data analysis

Data were analysed using Statistical Package for Social Sciences (SPSS) version 23.0. Descriptive statistics were used. Each correct response for knowledge questions was given one (01) mark and a zero (0) mark was given for an incorrect answer and knowledge score was calculated. The levels of knowledge was identified as adequate (>75% of total score), moderately adequate (50-75% of total score) and inadequate (<50% of total score). The cut-off values were decided based on the previous literature (Munthali et al., 2021; Sadiq & Hussein., 2022). The Chi square test/Fisher's exact test was employed to identify the associations between the level of knowledge and socio demographic variables. Statistical significance was considered as $p \leq 0.05$.

Ethical considerations

Ethical approval was obtained from the Ethics Review Committee, Faculty of Medicine, General Sir John Kothelawala Defence University (KDU) (RP/S/2020/30). Those who were willing to participate were given information of the study both verbally and through the written information sheet and written informed consent was obtained. Privacy and confidentiality of the participants were ensured at all stages of the study, emphasizing voluntary participation.

Results

Out of the 422 participants, majority (95.7%) was Sinhalese. The mean age was 32.02±8.625 years. Approximately two thirds of the participants 66.8% were married, 62.1% were unemployed, 72.5% had studied up to secondary or tertiary education and 63.5% were from a nuclear family. Importantly, although five participants had a family history of NTDs, only one had a child with NTD. Concerning the obstetric score, approximately 39% of participants were multiparous and a significant proportion of participants (45.3%) had never been pregnant (Table 1).

Knowledge regarding periconceptional use of FA for the prevention of NTDs

Out of 422 total sample, only 236 (55.9%) had heard about NTDs (Table 2). It is noteworthy that a considerable number of participants (n=186, 44.1%) had not heard about NTDs.

Out of the 236 women who had heard about NTDs, 201 (85.2%) knew what NDT was, and only 115 (48.7%) knew that the stage of pregnancy more prone to get NTD is early weeks of pregnancy, precisely three to four weeks of gestation. Besides, most participants (>34%) had not identified both high maternal BMI and having a history of childbirth with NTD as risk factors for developing NTDs. However, 140 (59.3%) had identified maternal age as a risk factor (Table 2).

Table 1: Socio demographic characteristics of the participants (N=422)

Characteristic	Category	Frequency	Percentage
Age group (years)	15-21	52	12.3
	22-28	114	27
	29-35	103	24.4
	36-42	96	22.7
	43-49	57	13.5
Marital status	Married	282	66.8
	Unmarried	140	33.2
Parity	Nullipara	191	45.3
	Primipara	67	15.9
	Multipara	164	38.9
Highest educational qualification	Primary	116	27.5
	Secondary	164	38.9
	Tertiary	142	33.6
Employment status	Employed	160	37.9
	Unemployed	262	62.1
Current residence	Own house	381	90.3
	Rented house	41	9.7
Monthly household income (LKR)	> 10,000	8	1.9
	10,000-30,000	87	20.6
	30,001-60,000	160	37.9
	>60,000	167	39.6
Having chronic diseases	Yes	37	8.8
	No	385	91.2
Having family history of NTD	Yes	5	1.2
	No	417	98.8
Having a child with NTD	Yes	1	0.2
	No	421	99.8
Health services sought from	Government	242	57.3
	Private	180	42.7

Table 2: Knowledge regarding NTDs

Item	Category	Frequency	Percentage
Heard about NTDs (n=422)	Yes	236	55.9
	No	186	44.1
What is NTD? (n=236)	Correct	201	85.2
	Incorrect	35	14.8
The time prone to get the NTDs (n=236)	Correct	115	48.7
	Incorrect	121	51.3
Risk factor/s for NTDs (n=236)			
Maternal age	Correct	140	59.3
	Incorrect	96	40.7
High maternal BMI	Correct	92	38.9
	Incorrect	144	61.0
Infant's gender	Correct	14	5.9
	Incorrect	222	94.1
History of childbirth with NTD	Correct	81	34.3
	Incorrect	155	65.7
Multivitamin consumption	Correct	176	74.6
	Incorrect	60	25.4
Use of alcohol	Correct	97	41.1
	Incorrect	139	58.9
Chronic diseases	Correct	94	39.8
	Incorrect	142	60.2
Exposure to second-hand smoking	Correct	135	57.2
	Incorrect	101	42.8
Marriage between blood relatives	Correct	107	45.3
	Incorrect	129	54.7

It is encouraging that more than 95% participants had heard about FA (Table 3). Despite this, only 148 (35.1%) participants knew the importance of FA during pregnancy and 104 (24.6 %) were aware of the importance of FA for development of the foetal brain. It is important to note that nearly two thirds of the participants 274 (64.9%) did not know the importance of FA during pregnancy even though they had heard about FA. The participants who had heard about FA, stated that midwives (n=131, 31%) were the most common source of information. Furthermore, 338 (80.1%) knew the form of FA supplementation as a tablet. Two hundred and twenty (52.1%) participants were aware of the recommended daily dose of FA. When questioned about whether there are any food items containing FA, 262 (62.1%) participants were unaware of it (Table 3).

Table 3: Knowledge regarding FA

Item	Category	Frequency	Percentage
Have you heard about folic acid? (n=422)	Yes	403	95.5
	No	19	4.5
Importance of FA during pregnancy (n=422)	For development of the nervous system	18	4.3
	For development of the brain	104	24.6
	To prevent defects in the nervous system	26	6.2
	Do not know	274	64.9
Are there any food items containing FA? (n=422)	Yes	160	37.9
	No	262	62.1
Selection of food containing FA (n=160)			
Dark green leafy vegetables	Correct	139	86.9
	Incorrect	21	13.1
Dried beans and peas	Correct	75	46.9
	Incorrect	85	53.1
Citrus foods and juices	Correct	143	89.4
	Incorrect	17	10.6
Dairy products	Correct	137	85.6
	Incorrect	23	14.4
Available forms of FA supplementation (n=422)	Correct	338	80.1
	Incorrect	9	2.1
	Do not know	75	17.8
Recommended daily dose of FA (n=422)	One tablet /day	220	52.1
	Do not know	202	47.9
The most crucial time that FA affects in foetal development (n=422)	Correct	241	57.1
	Incorrect	181	42.9
Side effects of FA (n=422)	Correct	15	3.6
	Incorrect	407	96.4

Concerning overall knowledge pertaining to both NDTs and FA, majority of the participants (n=279, 66.1%) had 'inadequate' level of knowledge, 120 (28.4%) participants had 'moderately adequate' level of knowledge and only 5.5% (n=23) had 'adequate' level of knowledge.

Practices regarding use of FA for the prevention of NTDs

In view of practices regarding preconceptional use of FA, 258 (61.1%) participants had taken FA, however, more than one third (n=164, 38.9%) had never taken FA (Table 4). From those who had taken FA, 179 (69.4%) had started to take it before conception and 77(29.8%) had taken it during the first trimester of pregnancy. Most participants (n=323, 76.5%) mentioned that they had no barriers for taking FA. The reason given by most of those who had barriers for not taking FA was poor awareness of the importance of taking FA (n=44, 44.4%).

Table 4: Practices regarding periconceptional use of FA

Variables	Category	Frequency (f)	Percentage (%)
Have you ever taken FA? (n=422)	Yes	258	61.1
	No	164	38.9
If Yes, when did you start taking FA? supplementation? (n=258)	Before pregnancy	179	69.4
	First trimester	77	29.8
	Second trimester	2	0.8
Who recommended to take FA? (n=258)	Doctor	152	58.9
	Midwife	106	41.1
How often did you take FA? (n=258)	Once a day	246	95.3
	Twice a day	11	4.3
	Once a week	1	0.4
Were there any barriers to take FA? (n=422)	Yes	99	23.5
	No	323	76.5
What are the barriers for not taking FA? (n=99)	Previous successful pregnancy without taking FA	7	7.1
	Discomfort in swallowing tablets	2	2.0
	Fear of side effects	9	9.1
	Poor guidance about FA intake	16	16.2
	Poor awareness of the importance of FA intake	44	44.4
	Negligence	12	12.1
	Forgetfulness	9	9.1

Table 5: Associations between demographic characteristics and knowledge (N=422)

Variables	Category	Knowledge			Chi-square	df	p- value
		<50%	50% - 75%	>75%			
Age group (years)	15-24	62	7	0	24.089	4	<0.0001*
	25-34	119	55	15			
	≥35	98	58	8			
Marital status	Married	158	105	19	38.801	2	<0.0001*
	Unmarried	121	15	4			
Parity	Nullipara	155	29	7	43.179	4	<0.0001*
	Primipara	28	35	4			
	Multipara	96	56	12			
Highest educational qualification	Primary	95	20	1	32.436	4	<0.0001*
	Secondary	108	51	5			
	Tertiary	76	49	17			
Employment status	Employed	101	47	12	2.415	2	0.299
	Unemployed	178	73	11			
Ethnicity	Sinhala	268	114	22	2.364	6	0.883*
	Tamil	6	2	0			
	Muslim	4	3	1			
	Others	1	1	0			
Family type	Nuclear family	185	72	11	4.022	2	0.134
	Extended family	94	48	12			
Monthly household income (LKR)	Below 30,000	74	21	0	10.984	2	0.004*
	≥30,000	205	99	23			
Health services sought from	Government	176	60	6	15.589	2	<0.0001
	Private	103	60	17			

p-value ≤0.05 *Fisher's exact test

Factors associated with the levels of knowledge on periconceptional use of FA

Significant associations were observed with age group (p<0.001), marital status (p<0.001), parity (p<0.001), educational qualification of the participants (p<0.001), monthly income (p=0.004) and from where health services were sought (p<0.001) (Table 5).

Discussion

Periconceptional use of FA plays a pivotal role in reducing risk of developing NTDs (Dessie et al., 2017). This study was conducted to assess knowledge and practice regarding peri conceptional use of FA for the prevention of NTDs among women in childbearing age.

Based on the results of the current study, majority of participants' overall knowledge on periconceptional use of FA was relatively inadequate, which emphasizes that improving knowledge about periconceptional use of FA among women in childbearing age is imperative. The results of the current study is consistent with another cross-sectional study conducted in India, which reported that knowledge about taking FA supplements periconceptionally was inadequate (Saxena et al., 2016). The Supportive results were found in a descriptive cross-sectional study conducted in Pakistan, using 400 married women, where they revealed that the participants' knowledge on FA was poor (Hisam et al., 2014). Similarly, a cross-sectional study from Nigeria showed that majority of the women had inadequate knowledge of FA (Anzaku, 2013).

The current study noted that almost every woman (95.5%) had heard about FA. Somewhat similar results were observed in another cross-sectional study conducted among teachers of childbearing age in the state of Qatar, where 88% had heard about FA and more than half of them had heard about NTDs (Selim et al., 2019).

According to the study results, surprisingly more than half of the women (58.5%) were not aware of the effectiveness of FA intake for the prevention of NTDs. Consistently, the study in Nigeria found only 29% of women were aware of the role of FA for the prevention of NTDs (Anzaku, 2013). Conversely, a cross-sectional analytic study done in Saudi Arabia found 71.2% women knew that FA deficiency during pregnancy could lead to NTDs (AlAhmadi, 2014).

As per the current study results, the common source of information of participants (31%) was midwives which is consistent with another Sri Lankan study focused on similar context, where 44% received information from midwives (Dissanayake et al., 2010). However, a different result observed in a study conducted in Thailand where the common source of information of participants was media (Nawapun & Phupong, 2006).

The present study reported that out of the participants who had taken FA, 42.4% started it before pregnancy and 18.2% started during the first trimester. This finding corroborates with a cross-sectional study conducted recently in similar context deploying pregnant and non-pregnant women where only 44.9% had been using FA before pregnancy and a little more than half had started taking FA during the first trimester of pregnancy (Pathiraja & Prathapan, 2020). Somewhat similar results were found in a study conducted in Italy among pregnant women, in which revealed

that majority (74.9%) of the women started FA during pregnancy (Maraschini., 2017).

When concerning the factors associated with knowledge regarding periconceptional use of FA for the prevention of NTDs, the identified factors through the current study were age group, marital status, parity, educational qualification of participants, monthly household income and from where they sought health services. Somewhat similar findings were observed in a study done in Colombo District, Sri Lanka which reported that ethnicity, parity and the level of education has been associated with an increased awareness, knowledge and use of FA and significantly high prevalence of daily folic acid intake (Pathiraja & Prathapan., 2020). Though ethnicity was a significant factor that contributes for level of knowledge in the cited study, in the current study, such an association was not seen. Lack of representation of different ethnic groups in the present sample could be a plausible reason. A previous study conducted in the USA and Europe showed a direct association between educational level of women in childbearing age and their knowledge on FA intake (Aronsson et al., 2013). Accordingly, women's educational level seems to be impacted periconceptional use of FA.

Limitations

One of the main limitations of the current study is generalizability of the results. This is because the current study was carried out in a particular MOH area and it may not represent elsewhere. Besides, involvement of five investigators in data collection may have had an effect on the consistency of data collection process. Interviewer administered nature of the study also might have an impact on the responses received.

Conclusions

The main finding of this study is the deficiency of knowledge among participants regarding periconceptional use of FA for the prevention of NTDs. However, majority who have used FA had started to take it before pregnancy. The findings highlight the critical importance of bridging the gaps of knowledge of women in childbearing age regarding periconceptional use of FA. It is recommended to conduct more educational programmes for women in childbearing age in the study setting to enhance their knowledge regarding periconceptional use of FA for the prevention of NTDs. It is further suggested that a cross-national study on this topic to better understand the issue in the Sri Lankan context.

Funding statement

This research received no specific grant from any funding agency.

Conflict of interest

The authors declare that they have no conflicts of interests.

References

Al-Ahmadi, R. S. (2014). Use of folic acid among pregnant women attending antenatal care clinic at Al-Hejrah primary health care center, Makkah Al-Mokarramah, SaudiArabia. *International Journal of Medical Science and Public Health*, *3*(8), 963-969. DOI: https://doi.org/10.5455/ijmsph.2014.020620141

Anzaku, A. S. (2013). Assessing folic acid awareness and its usage for the prevention of neural tube defects among pregnant women in Jos, Nigeria. *Journal of Basic and Clinical Reproductive Sciences*, *2*(1), 13-17. DOI: https://doi.org/10.4103/2278-960X.112574

Aronsson, C. A., Vehik, K., Yang, J., Uusitalo, U., Hay, K., Joslowski, G., Riikonen, A., Ballard, L., Virtanen, S.M., & Norris, J. M. (2013). Use of dietary supplements in pregnant women in relation to sociodemographic factors–a report from. The environmental determinants of diabetes in the young (TEDDY) study. *Public Health Nutrition*, *16*(8), 1390-1402. DOI: https://doi.org/10.1017/S1368980013000293

Begashaw, B., Tariku, Z., & Berhane, A. (2022). Preconception of folic acid supplementation knowledge among Ethiopian women reproductive age group in areas with high burden of neural tube defects: a community based cross-sectional study. *Journal of Nutritional Science*, *11*, e48. DOI: https://doi.org/10.1017/jns.2022.32

Burke, B.(2009). Preventing Neural Tube Birth Defects. [Atlanta, GA]: Centers for Disease Control and Prevention. DOI: https://www.cdc.gov/ncbddd/orders/pdfs/09_202063-A_Nash_Neural%20Tube%20BD%20Guide%20FINAL508.pdf

Denny, K. J., Jeanes, A., Fathe, K., Finnell, R. H., Taylor, S. M., & Woodruff, T. M. (2013). Neural tube defects, folate, and immune modulation. *Birth Defects Research Part A: Clinical and Molecular Teratology*, *97*(9), 602-609. DOI: https://doi.org/10.1002/bdra.23177

Dessie, M. A., Zeleke, E. G., Workie, S. B., & Berihun, A. W. (2017). Folic acid usage and associated factors in the prevention of neural tube defects among pregnant women in Ethiopia: cross-sectional study. *BMC Pregnancy and Childbirth*, *17*(1), 1-8. DOI: https://doi.org/ 10.1186/s12884-017-1506-2

De Wals, P., Tairou, F., Van Allen, M. I., Uh, S. H., Lowry, R. B., Sibbald, B., Evans, J.A., Van den Hof, M.C., Zimmer, P., Crowley, M. & Fernandez, B. (2007). Reduction in neural-tube defects after folic acid fortification in Canada. *New England Journal of Medicine*, *357*(2), 135-142. DOI: https://doi.org/10.1056/NEJMoa067103.

Dissanayake, N. N., Wickramasinghe, S. C., & Bandara, D. M. W. H. (2010). Study on neural tube defects of neonates and folic acid awareness at a teaching Hospital in Sri Lanka. *Sri Lanka Journal of Child Health*, *39*(1). file:///C:/Users/USER/Downloads/1628-5836-1-PB%20(5).pdf

Fahamiya, N., Farzana, M. U. Z. N., & Shiffa, M. S. M. (2019). Awareness and practice of folic acid intake for Neural Tube Defect prevention at antenatal clinic Rajamalwatta, Sri Lanka. DOI: https://doi.org/10.37591/rrjon.v7i1.966

Garcia, R., Ali, N., Griffiths, M., & Randhawa, G. (2018). Understanding the consumption of folic acid during preconception, among Pakistani, Bangladeshi and white British mothers in

Luton, UK: a qualitative study. *BMC Pregnancy and Childbirth*, *18*(1), 1-9. 18), DOI: https://doi.org/10.1186/s12884-018-1884-0

Hisam, A., Rahman, M. U., & Mashhadi, S. F. (2014). Knowledge, attitude and practice regarding folic acid deficiency; A hidden hunger. *Pakistan Journal of Medical Sciences*, *30*(3), 583. DOI: https://doi.org/10.12669/pjms.303.4716.

Kim, M. J., Kim, J., Hwang, E. J., Song, Y., Kim, H., & Hyun, T. (2018). Awareness, knowledge, and use of folic acid among non-pregnant Korean women of childbearing age. *Nutrition Research and Practice*, *12*(1), 78-84. DOI: https://doi.org/10.4162/nrp.2018.12.1.78

Lachenbruch, P. A. (1992). On the sample size for studies based upon McNemar's test. *Statistics in Medicine*, *11*(11), 1521-1525. DOI: https://doi.org/10.1002/sim.4780111110

Maraschini, A., D'Aloja, P., Lega, I., Buoncristiano, M., Kirchmayer, U., Ventura, M., & Donati, S. (2017). Do Italian pregnant women use periconceptional folate supplementation?. *Annali Dell'Istituto Superiore Di Sanita*, *53*(2), 118-124. DOI: https://doi.org/10.4415/ANN_17_02_07

Alanazi, A. M., Alanazi, A. J., Alanazi, Y. W., Alanazi, M. S., Rezk, G., & Hammad, S. M. (2021). Level of awareness and knowledge of folic acid intake among women in the reproductive age in ARAR Region, Saudi Arabia. *Journal of Pharmaceutical Research International*, *33*(58A), 287–297. https://doi.org/10.9734/jpri/2021/v33i58A34118

McLone, D. G. (2003). The etiology of neural tube defects: the role of folic acid. *Child's Nervous System*, *19*(7), 537-539. DOI: https://doi.org/10.1007/s00381-003-0793-2

Medawar, G., Wehbe, T., & Abou Jaoude, E. (2019). Awareness and use of folic acid among women of childbearing age. *Annals of Global Health*, *85*(1). DOI: https://doi.org/10.5334/aogh.2396

Munthali, M., Chiumia, I. K., Mandiwa, C., & Mwale, S. (2021). Knowledge and perceptions of preconception care among health workers and women of reproductive age in Mzuzu City, Malawi: a cross-sectional study. *Reproductive Health*, *18*(1), 1-10. https://reproductive-health-journal.biomedcentral.com/articles/10.1186/s12978-021-01282-w

Nawapun, K., & Phupong, V. (2007). Awareness of the benefits of folic acid and prevalence of the use of folic acid supplements to prevent neural tube defects among Thai women. Archives of Gynecology and Obstetrics, 276(1), 53-57. DOI: https://doi.org/10.1007/s00404-006-0305-1

Nosrat, S. B., Sedehi, M., & Golalipour, M. J. (2012). Knowledge and practice of urban Iranian pregnant women towards folic acid intake for neural tube defect prevention. JPMA. The Journal of the Pakistan Medical Association, 62(8), 785-789. http://eprints.goums.ac.ir/1981/1/Knowledge_and_practice_of_urban_Iranian_pregnant_women_towards_folic_acid_intake.pdf

Pathiraja, R., & Prathapan, S. (2020). Awareness, knowledge and the factors that affect the use of folic acid among pregnant and non-pregnant women in the reproductive age in a selected area in Colombo district, Sri Lanka. *Sri Lanka Journal of Obstetrics and Gynaecology*, *42*(3). DOI: http://doi.org/10.4038/sljog.v42i3.7956

Sadiq, Z. A., & Hussein, H. K. (2022). Assessment of knowledge and attitudes among pregnant women towards folic acid intake during pregnancy in a sample of women attending primary health care centers in Babylon province. Medical Journal of Babylon, 19(2), 142. DOI: https://doi.org/10.4103/MJBL.MJBL_72_21

Safi, J., Joyeux, L., & Chalouhi, G. E. (2012). Periconceptional folate deficiency and implications in neural tube defects. *Journal of pregnancy*, *2012*. DOI: https://doi.org/10.1155/2012/295083

Saxena, V., Naithani, M., Kumari, R., Singh, R., & Das, P. (2016). Peri-conceptional supplementation of folic acid-knowledge and practices of pregnant women and health providers. *Journal of Family Medicine and Primary Care*, *5*(2), 387. DOI: https://doi.org/10.4103/2249-4863.192374

Selim, N., Alkuwari, M., & Ismail, M. S. (2019). Knowledge and intake of folic acid among teachers of childbearing age in the State of Qatar: a cross-sectional study. BMJ Open, 9(4), e025005. DOI: https://doi.org/10.1136/ bmjopen-2018-025005

World Health Organization (2020). Sri Lanka - World Health Organization (WHO). https://cdn.who.int/media/docs/default-source/country-profiles/sri-lanka.pdf?sfvrsn=d3286a2a_2

Zaganjor, I., Sekkarie, A., Tsang, B. L., Williams, J., Razzaghi, H., Mulinare, J., Sniezek, J.E., Cannon, M.J., & Rosenthal, J. (2016). Describing the prevalence of neural tube defects worldwide: a systematic literature review. *PloS One*, *11*(4), e0151586. DOI: https://doi.org/10.1371/journal.pone.0151586