

Folic acid and neural tube defects: are Jordanian pregnant women aware?

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Summary

Objectives: To assess Jordanian pregnant women's awareness of folic acid and its contribution to neural tube defects (NTDs) prevention and to their folic acid intake. **Materials and Methods:** One thousand pregnant women were interviewed about their knowledge of folic acid for NTDs prevention and their folic acid intake using a questionnaire. **Results:** Of 1,000 women surveyed, 93.4% reported hearing of folic acid and 30.3% of NTDs. Only 16.2% knew that folic acid can reduce NTDs risk; 42.0% of those aware of folic acid believed it should be taken periconceptionally but only 16.9% did so. The most common information sources on folic acid were physicians (82.8%). **Conclusions:** Whereas a large percentage of pregnant Jordanian women were aware of folic acid, only a small proportion are aware that it prevents NTDs and should be taken periconceptionally. Also, there was a gap between awareness, knowledge, and intake of folic acid. Awareness and knowledge of NTDs was less prevalent among Jordanian women. Despite the efforts that have been undertaken, further effort is required to educate Jordanian women about folic acid contribution to NTDs prevention.

Key words: Folic acid; Jordan; NTDs prevention; Periconceptional; Trimester.

Introduction

Failure of accurate formation of the mammalian neural tube results in neural tube defects (NTDs) that may occur at the cranial and/or spinal levels and include a group of severe birth defects in humans [1]. There is no treatment for NTDs once the neural tube fails to close. Because neural tube closure is completed by day 28 of gestation in humans, prevention therapy must be initiated before and in the early days of pregnancy [2]. The benefits of prevention therapy were documented in trials of periconceptional multivitamin supplementation, utilizing women who had previously given birth to one or more infants with an NTD. Compared with 5.0% of the infants/fetuses of unsupplemented mothers, 0.6% of the infants/fetuses of the fully supplemented mothers had NTDs [3]. Prevention of the first occurrence of NTDs has also been seen using a multivitamin preparation containing folic acid prior to and during early pregnancy [4].

Clinical trials show that up to 70% of NTDs can be prevented by folic acid [5]. During the last few decades, there has been widespread awareness of the tangible role optimizing the levels of blood folic acid around the time of conception and during early weeks of pregnancy plays to minimize the possibility of having pregnancies affected by NTDs. This awareness has led to worldwide use of periconceptional folic acid supplementation following awareness campaigns in developed countries increasing folic acid use from 27% to 48% (UK), 5% to 36% (The Netherlands),

14% to 83% (Ireland), 19% to 43% (Western Australia), 32% to 40% (USA), and 17% to 28% (Canada) [6].

This shift in use frequency was accompanied by a shift in research orientations. Early research emphasized proving a positive effect for periconceptional intake on NTDs reduction or prevention. More recently focus has shifted towards understanding the best method to administer folic acid in the form of folic acid supplementation (400 µg/day) for all childbearing age women and four mg/day has been recommended in some countries for women who have already experienced an NTD-affected pregnancy [7].

The context of this study, Jordan, is a Middle Eastern country that has a population of approximately 5.5 million with a natural increase of 2.4%. It has a fertility rate of 3.5 (in urban areas) and 4.2 (in rural areas) with a birth rate of 29/1,000 population by 31.6 years as childbearing-women mean age [8]. Understanding Jordanian women's awareness and intake of folic acid in addition to its contribution to NTDs prevention is of a paramount significance given three facts: (1) almost half of them (43.4%) do not use any family planning method, which indicates a high percentage of unplanned pregnancy [9]; (2) the NTDs rate, which reaches up to 3.8 / 1,000 [10], is higher than international incidence; and (3) pregnancy termination of fetal anomalies is prohibited by law in Jordan [11].

In addition to launching a national 1.5 ppm-level flour fortification plan in 2002 in Jordan [11], much effort is undertaken by Maternal Child Health (MCH) services to increase women's health awareness. Nonetheless, health education services lack organization and comprehensiveness [12]. Particularly pertinent to the significance of folic

acid, there is little research, if any, to date that documents Jordanian women's awareness level of this crucial issue. Undeniably, the worldwide public health campaigns to increase women's awareness about folic acid are based on the premise that if women are well-informed about the gains of folic acid in preventing NTDs, the anticipated result is that they will follow the recommendations to take folic acid supplements [13]. Nonetheless, there is very little information available to determine whether the level of awareness Jordanian women have regarding folic acid significance goes in line with the current recommendations and whether they have a grasp of folic acid contribution to NTDs prevention.

There is an urgent need to better understand the awareness and behavior of Jordanian women regarding pregnancy and folic acid intake. This study is the first, to the best of the researchers' knowledge, to assess Jordanian women's knowledge and practice associated with folic acid at a wide scale using a representative sample from two major referral medical centers in one of the biggest cities in Jordan. Probably the closest study is that by Abu-Baker and Savage which was limited to awareness of folic acid by a small sample of 300 women [14, 15]. Similarly, it is a pioneer study in terms of linking pregnant Jordanian women's awareness of folic acid to their awareness of NTDs. It is hoped that the results of this study will provide valuable information about Jordanian women's level of knowledge regarding folic acid, its intake, and its contribution to NTDs prevention. This should help health promoters to develop focused awareness-spreading objectives.

Materials and Methods

The participants of the study were 1,000 women seeking routine prenatal care at two major referral medical centers in Amman (the capital of Jordan): (a) King Hussein Medical Center, which is the largest referral hospital in Jordan and one of the leading medical centers in the region [16] with more than 1,000 bed facilities to which all military and government insured patients are referred [17]; and (b) The University of Jordan Hospital, which is considered one of the oldest and largest hospitals in Jordan serving more than 0.5 million patients a year [18]. Inclusion in this study was limited to only pregnant Jordanian women in their third trimester.

A cross-sectional survey was carried out using face-to-face interviewer-administered questionnaire. The survey was carefully developed to ensure comprehensive coverage of both: (a) the characteristics of the participants and (b) the topic under investigation. The questionnaire was anonymous and on voluntary basis and developed by the researchers for the purpose of the study in light of a review of the extant literature. The questionnaire comprised three parts. Part 1 comprised of socio-demographic (age, occupation, residence, education, household income, etc.). Part 2 recorded clinical data (entry to prenatal care and total no. of pregnancies, etc.). Part 3 addressed participants' awareness, knowledge about and use of folic acid, as well as awareness and knowledge of NTDs. For this study, awareness of folic acid was assessed by asking participants if they had ever heard of folic acid. When the response was "yes", they were

asked follow-up questions. These included identification of the appropriate time for taking folic acid and the time they commenced folic acid intake. They were also asked more questions about their knowledge of folic acid. This procedure extends to asking about awareness of NTDs; follow-up questions were asked only to those who reported "yes." The face validity of the questionnaire was established through presenting it to a panel of three obstetrics and gynecology experts. Reliability was established through presenting the questionnaire to a group of women with the characteristics of the study population who were later excluded from the study, yielding a Cronbach alpha calculated coefficient of 0.85.

The data for this study was collected during the first three months of 2013. Following obtaining the IRB approval of the study instrument, women were approached in the two target medical centers during their waiting time to see the physician. Each participant was informed about the purpose of the study and a verbal consent was obtained from each prior to the interview. Collected data were fed into and analyzed for frequencies and percentages using the Statistical Package for Social Sciences (SPSS) 20.

Results

Table 1 shows the selected sociodemographic characteristics and clinical data of the interviewed women and the association with awareness, knowledge of the appropriate time for taking folic acid, and actual intake of supplementary folic acid. Among a total of 1,000 interviewed women, 93.4% reported that they had heard of folic acid.

Among the 93.4% who had heard of folic acid, the highest percentage was in the 25-29 year age group (98.3%) city residents (96.6%) with a diploma or higher (96.8%). Also, the percentage was higher (96.0%) among employed women (96.0%) with a household income of higher than 500 JD (96.2%) and two to three pregnancies (96.0%). Those who had entered the prenatal care after the first trimester were less aware of folic acid compared to those who entered before pregnancy (98.6%) or during the first trimester (93.8%).

Knowledge of the appropriate time for taking folic acid was associated with the age group of 25-34 years compared to younger or older women. High-income city citizens with higher education were also more knowledgeable, and so were those who had a higher number of pregnancies and entered in prenatal care before pregnancy. A higher periconceptional intake of folic acid was associated with the older age group (30 years and above). It was also associated with city residence, higher education, employment, higher income, more pregnancies, and earlier entry to prenatal care. Results of participants' awareness of NTDs indicate that pregnant Jordanian women's awareness of NTDs is higher among those educated (43.8%), employed (43.6%) woman with an age that ranges between 25 and 29 years (32.6%) living in a city (33.6%) with a household income higher than 500 JD (46.0%), with one pregnancy (34.2%). It was also higher among those who entered prenatal care periconceptionally (44.4%).

Table 1. — *Selected sociodemographic characteristics and clinical data of the interviewed women and the association with awareness, knowledge of appropriate time to take folic acid, starting folic acid intake, and awareness of NTDs (n = 1,000).*

Characteristics	Frequency (%)	Ever heard of folic acid	Appropriate time to take folic acid			Starting folic acid intake			Ever heard of NTDs
			Pericon-ceptional	1 st trimester	After 1 st trimester	Pericon-ceptional	1 st trimester	After 1 st trimester	
Age (years)									
≤ 24	259 (25.9)	234 (90.3)	79 (33.8)	140 (59.8)	2 (0.85)	25 (10.7)	197 (84.2)	2 (0.85)	75 (29.0)
25-29	347 (34.7)	341 (98.3)	154 (45.2)	150 (44.0)	2 (0.59)	49 (14.4)	264 (77.4)	8 (2.3)	113 (32.6)
30-34	228 (22.8)	212 (93.0)	96 (45.3)	99 (46.7)	0 (0.0)	50 (23.6)	155 (73.1)	1 (0.47)	69 (30.3)
≥35	166 (16.6)	147 (88.6)	63 (42.9)	68 (46.3)	3 (2.0)	34 (23.1)	98 (66.7)	9 (6.1)	46 (27.7)
Residence									
City	596 (59.6)	576 (96.6)	271 (47.0)	255 (44.3)	7 (1.2)	115 (20.0)	428 (74.3)	11 (1.9)	200 (33.6)
Village	404 (40.4)	358 (88.6)	121 (33.8)	202 (56.4)	0 (0.0)	43 (12.0)	286 (79.9)	9 (2.5)	103 (25.5)
Education									
High School or lower	504 (50.4)	454 (90.1)	145 (31.9)	250 (55.1)	7 (1.5)	51 (11.2)	360 (79.3)	14 (3.1)	86 (17.1)
Diploma or higher	496 (49.6)	480 (96.8)	247 (51.5)	207 (43.1)	0 (0.0)	107 (22.3)	354 (73.8)	6 (1.3)	217 (43.8)
Occupation									
Employed	328 (32.8)	315 (96.0)	167 (53.0)	131 (41.6)	0 (0.0)	78 (24.8)	223 (70.8)	3 (0.95)	143 (43.6)
Unemployed	672 (67.2)	619 (92.1)	225 (36.3)	326 (52.7)	7 (1.1)	80 (12.9)	491 (79.3)	17 (2.7)	160 (23.8)
Household income ^a									
≤ 500 JD	739 (73.9)	683 (92.4)	239 (35.0)	372 (54.5)	7 (1.0)	81 (11.9)	548 (80.2)	19 (2.8)	183 (24.8)
> 500 JD	261 (26.1)	251 (96.2)	153 (61.0)	85 (33.9)	0 (0.0)	77 (30.7)	166 (66.1)	1 (0.4)	120 (46.0)
Total no. of pregnancies									
1	231 (23.1)	212 (91.8)	75 (35.4)	118 (55.7)	0 (0.0)	29 (13.7)	175 (82.5)	2 (0.94)	79 (34.2)
2-4	499 (49.9)	479 (96.0)	202 (42.2)	246 (51.4)	2 (0.42)	70 (14.6)	376 (78.5)	9 (1.9)	161 (32.3)
≥ 5	270 (27.0)	243 (90.0)	115 (47.3)	93 (38.3)	5 (2.1)	59 (24.3)	163 (67.1)	9 (3.7)	63 (23.3)
Entry to prenatal care									
Before Pregnancy	72 (7.2)	71 (98.6)	51 (71.8)	13 (18.3)	0 (0.0)	47 (66.2)	21 (29.6)	0 (0.0)	32 (44.4)
First trimester	809 (80.9)	759 (93.8)	317 (41.8)	378 (49.8)	6 (0.79)	104 (13.7)	611 (80.5)	11 (1.4)	238 (29.4)
Second trimester	94 (9.4)	83 (88.3)	18 (21.7)	51 (61.4)	1 (1.2)	5 (6.0)	66 (79.5)	7 (8.4)	25 (26.6)
Third trimester	25 (2.5)	21 (84.0)	6 (28.6)	15 (71.4)	0 (0.0)	2 (9.5)	16 (76.2)	2 (9.5)	8 (32.0)

^aJ.D., Jordanian Dinar = USD 1.43.

Table 2 presents participants' responses on some selected questions pertinent to their awareness associated with what folic acid is. Asked to select one answer to the target question and in response to the question addressing their source of information about folic acid, no less than four-fifths (82.8%) reported it was from their doctors. Less contribution was reported to other sources (e.g., friend or relative, internet, or field of specialty), and the least was attributed to mass media (TV, radio, or magazines) (3.1% combined). In response to what folic acid is, almost four-fifths (79.3%) believed it was a vitamin whereas one-fifth either reported a wrong answer or did not know. Additionally, no less than half (52.6%) of the women who were aware of folic acid believed it could be obtained from liver, green vegetables, and beans. Yet it was difficult to identify folic-fortified items (e.g., bread, water, salt, or rice) as more than four-fifths (83.4%) did not know, with the correct answer (bread) identified by only 7.6%. More than half (53.9%) of the participants were aware of folic acid contribution to congenital malformation but no less than one-third (36.4%) were not. Around 10% reported it contributes to protection from anemia and bone deterioration. As to the necessity of folic

acid intake during pregnancy, the responses of the overwhelming majority (91.4%) was positive. The participants' awareness of NTDs was relatively low; two-thirds (67.9%) reported they never heard of it. The perceived need for obtaining more information about folic acid was conceived by a very high percentage (94.2%) of the participants.

To gain a deep insight of pregnant Jordanian women's knowledge of NTDs, further analysis addressed only those 303 who reported having heard of NTDs. Results (Table 3) indicate that less than half (44.9%) of them reported NTDs occurs during the first trimester compared to the second trimester (31.2%) or the third (3.3%). However, more than one-third (38.6%) did not know. In response to whether they had heard of any vitamin that can prevent NTDs in fetuses, the response of more than two-thirds (66.0%) was positive, which means that 200 out of the 303 who had heard of NTDs had also heard of a vitamin that can prevent it in fetuses.

When those 200 were asked to identify a vitamin (folic acid, Vitamin A, C, D, or E) that prevents NTDs in fetuses, four-fifths (81%) could identify folic acid as being the one. However, a much lower percentage (13.5%) selected other

Table 2. — Knowledge of interviewed pregnant women who ever heard of folic acid (*n* = 934).

Question	Frequency (%)
From which source did you get the information on folic acid?	
TV and radio	14 (1.5)
Magazine	15 (1.6)
Doctor	773 (82.8)
Friend or relative	51 (5.5)
Internet	38 (4.1)
Field of specialty	43 (4.6)
Do you know what folic acid is?	
Vitamin	741 (79.3)
Medicine	96 (10.3)
Mineral	34 (3.6)
Do not know	63 (6.7)
Which of the following foods are rich in folic acid?	
Liver, green vegetables, and beans	491 (52.6)
Milk products	214 (22.9)
Do not know	229 (24.5)
Which of the following items is fortified with folic acid in Jordan?	
Bread	71 (7.6)
Water	27 (2.9)
Salt	19 (2.0)
Rice	38 (4.1)
Do not know	779 (83.4)
Have you heard about NTDs?	
Yes	300 (32.1%)
No	634 (67.9%)
Which of the following diseases is prevented by taking folic acid?	
Protects from anemia	69 (7.4)
Prevents bone deterioration	22 (2.4)
Congenital malformation	503 (53.9)
Gestational diabetes	0 (0.0)
Do not know	340 (36.4)
Do you think it is necessary to take folic acid during pregnancy?	
Yes	854 (91.4)
No	80 (8.6)
Do you need more information about folic acid?	
Yes	880 (94.2)
No	54 (5.8)

vitamins, and a few (5.5%) reported they did not know. Of the 81% who linked folic acid intake to NTDs prevention, the majority (69.1%) began taking folic acid during the first trimester, others (29.0%) began periconceptionally, and few (1.9%) did not take it at all.

Discussion

In Jordan, where the NTDs incidence reaches up to 3.8 per thousand [10] with no possibility for pregnancy termination of fetal anomalies due to cultural values and law reg-

Table 3. — Knowledge of interviewed pregnant women who ever heard of NTDs (*n* = 303).

Question	Frequency (%)
During which trimester of pregnancy does NTDs occur?	
First trimester	136 (44.9)
Second trimester	40 (13.2)
Third trimester	10 (3.3)
Do not know	117 (38.6)
Have you heard about any vitamin that can prevent NTDs in fetuses?	
Yes	200 (66.0)
No	103 (34.0)
Which of the following vitamins can prevent NTDs in fetuses? ^a	
Folic acid	162 (81.0)
Vitamin C	5 (2.5)
Vitamin A	7 (3.5)
Vitamin D	15 (7.5)
Vitamin E	0 (0.0)
Do not know	11 (5.5)
When did you start taking folic acid? ^b	
Before pregnancy	47 (29.0)
First trimester	112 (69.1)
Second trimester	0 (0.0)
Third trimester	0 (0.0)
Did not take folic acid	3 (1.9)

^a Answered "Yes" when asked "Have you heard about any vitamin that can prevent NTDs in fetuses?" (*n* = 200)

^b Specifically answered "folic acid" when asked "Which of the following vitamins can prevent NTDs in fetuses?" (*n* = 162)

ulations [11], women's knowledge of folic acid contribution to NTDs prevention is quintessential. While 93.4% of the present participants indicated that they had heard of folic acid, less than one-third had heard of NTDs, and 16.2% knew that it can reduce the risk of NTDs.

The awareness of folic acid among Jordanian pregnant women was comparable to that of women in some countries: 84.0% (USA) [19], 91.0% (Saudi Arabia) [20], 92.0% (Ireland) [21], and 95% (Canada) [22]. However, it is relatively higher than women's awareness in some other countries (e.g., 22.0% (Turkey) [23], 35.8% (China) [13], 41.0% (UK), 46.6% (UAE), 54.0% (Qatar) [24], and 61.0 % (Germany) [25]. Moreover, the intake of folic acid of Jordanian women who were aware of folic acid is higher than that in other countries (20.3% in Qatar) [24], (33.0% in USA) [19], (57.0% in Scotland) [26], (67.9% in UAE) [27], and (68.0% in Spain) [13]. These findings are probably attributed to the fact that women in Jordan have a positive attitude toward folic acid, and when they are advised to take it, they do. Additionally, since the present sample was limited to those women who were seeking prenatal care, it is not surprising that their level of awareness was relatively high. This is especially true given the present results indicating that the majority of the women in this study began taking

folic acid during, rather than before, pregnancy. Of no less importance than these possible explanations is the fact that this sample was drawn from Amman, the capital city of Jordan. Probably the level of awareness would be lower in rural areas, where 17.4% of Jordan population resides [28], with a high rate of physician attrition and replacement with inexperienced physicians [29].

Whereas the above findings relate to general awareness of folic acid and intake, specific details about awareness are equally important. Regarding the appropriate time of folic acid intake, the present results indicate that the percentage of Jordanian pregnant women who believed folic acid should be taken periconceptionally (42.0%) reflects a higher level of awareness compared to many other countries. This percentage, for instance, was 5.0% in Nepal [30], 7.0% in USA [19], 8.5% in Norway [31], 10.0% in Saudi Arabia [20], 22.0% in Germany [25], and 39.0% in South Australia [32].

Despite these promising findings, the present results suggest that only a low percentage (16.9%) of those who heard about folic acid had begun folic acid supplementation before conception. This percentage is not drastically different from the percentage in other countries. Examples include 8.1% (Mediterranean area) [33], 9.7% (Thailand) [34], 14.0% (Lebanon) [6], fewer than 15.0% (China) [13], 15.6% (Taiwan) [35], 17.0% (Oslo) [36], 18.0% (Ireland) [21], 20.12% (Iran) [37], and 21.0% (Scotland) [26].

According to this finding, it should be noted that although folic acid is recommended before conception [38], the present participants' awareness of this crucial phase was relatively low, which has probably resulted in the low percentage of those who took folic acid periconceptionally. This finding might be attributed to several factors. First, married women typically visit obstetrics and gynecology clinics only in the case of conception failure or miscarriage incidents. Some do so only after they realize they are pregnant, which usually occurs after a month or so of pregnancy. Additionally, the major source of hearing about folic acid is physicians (82.8%), who are visited by a low percentage of women (7.2%) before pregnancy. One more possible explanation lies in the high percentage of unplanned pregnancies in Jordan [9], resulting in lack of specific information prior to conception.

The second major concern of the present paper, in addition to folic acid awareness, is assessment of Jordanian pregnant women's knowledge of folic acid contribution to NTDs. First, general awareness of NTDs in the present sample (30.3%) is relatively lower than its counterpart in developed countries such as USA (45%) [39] and Canada (62.7%) [40], but higher than women's awareness in some other countries, e.g., Nigeria (29.6%) [41]. Second, the percentage of those who could link folic acid to NTDs in the present study (16.2%) is comparable to the average percentage in other countries ranging between 13.0% and 17.0% [23, 42, 43]. The present findings suggest that those

of this sample who visited physicians periconceptionally are the ones who were: (a) more aware of folic acid, (b) more aware of the appropriate time for taking it, (c) higher users of folic acid periconceptionally, and (d) more aware of NTDs. The authors' experience suggests that Jordanian pregnant women are hesitant, if not reluctant, to take vitamin supplementation unless prescribed by a physician. Their delayed visits to doctors, during which they are informed about folic acid and its role in NTDs prevention, are probably the reason behind their delay in commencing folic acid intake. These results confirm previous findings reporting that in a study on 78 Jordanian mothers of neonates with NTDs in the north of Jordan, none took daily folic acid supplements prior to conception or during the first four weeks of pregnancy, nor did any attend antenatal clinic before less than six-week advance in pregnancy. This was attributed to the fact that it is not customary for women of reproductive age in Jordan to take folic acid supplements periconceptionally [44].

The present findings support research results indicating that despite folic acid significant contribution to eliminate NTDs, many periconceptional women are still not fully aware of its significance, and when they know some hardly follow supplementation recommendations to prevent NTDs [11]. This necessitates intervention. In USA, for example, only 52% of childbearing age women had heard of folic acid, 5% knew its contribution to preventing birth defects, and only 2% were aware it should be taken before pregnancy in 1995 [45]. Only two years after adopting an awareness-raising campaign, the percentage of those who heard of folic acid increased to 79% and those who distinguished its contribution to birth defects prevention reached 19% [45], and in 2005, awareness of folic acid reached 84%, with a lower percentage (19%) knowing it prevents birth defects [46]. The discrepancies between awareness, knowledge, and folic acid intake could be related to factors that stand behind behavioral change. Therefore, one way to spread awareness of folic acid significance is through including the problem of folic acid in the school curriculum, especially that of young women, in order to better reach the highest possible number of young women. In some countries, Germany for example, a teaching material entitled "Folic Acid and Pregnancy" has been prepared for this purpose. This can be extended to biology teachers [25]. Furthermore, continuous development and delivery of multi-level education strategies that emphasize timely-intake contribution of folic acid to NTDs prevention can also be beneficial. These can be accompanied by regular family planning consultations. Media should also participate in spreading awareness among women, particularly those unemployed, less-educated, village-resident women with an age younger than 30 years in low-income families.

Admittedly, social marketing theory entails that people's awareness and knowledge can be positively influ-

enced by mass media, but their behavior change demands health professionals' counseling intervention and interpersonal communication [47]. The present findings indicate heavy dependence on physicians in spreading folic acid awareness, with an increase in their undertaking this task [14]. This finding is not surprising given that Jordan, like many other Middle Eastern communities, still appreciates face-to-face communication. On the other hand, the role of mass media, as the present findings indicate is minimal, thus it has to be reconsidered.

Awareness-raising campaigns are also a necessity in Jordan, especially those targeting folic acid contributions to NTDs. Collaborative effort is required, therefore, from all stakeholder institutions and agencies to secure women's awareness of taking folic acid prior to pregnancy. In addition to awareness raising, daily supplementation and fortification of food with folic acid should be considered as the best way to improve the balance of folic acid in women of childbearing age of this special population with consanguineous marriages comprise one-third to one-half of all marriages, with first cousin marriage rates in the range of 20–30% [48].

This study is not without limitations. It targeted only those women who were seeking prenatal care in two major referral hospitals in Amman, the capital city of Jordan. Therefore, the findings fall short behind representing those pregnant women who do not seek prenatal care or women in other areas of Jordan. In addition, since this study focused on only folic acid taken as supplementation, other folic acid delivery methods of folic acid are not included in this study. The time of data collection was during the work time, which might have influenced the percentage of the employed and unemployed pregnant women in this sample.

Acknowledgement

This work was supported and funded by The University of Jordan, Amman, Jordan.

References

- [1] Wyszynski D.: "The embryonic basis of neural tube defects: In: Wyszynski D., (ed.), *Neural tube defects: from origin to treatment*. New York: Oxford University Press, 2006, 15.
- [2] Greene N.D., Copp A.J.: "Mouse models of neural tube defects: Investigating preventive mechanisms". *Am. J. Med. Genet. C. Semin. Med. Genet.*, 2005, 135, 31.
- [3] Smithells R.W., Sheppard S., Schorah C.J., Seller M.J., Nevin N.C., Harris R., et al.: "Possible prevention of neural-tube defects by periconceptional vitamin supplementation". *Lancet*, 1980, 1, 339.
- [4] Czeizel A.E., Dudas L.: "Prevention of the first occurrence of neural tube defects by periconceptional vitamin supplementation". *N. Engl. J. Med.*, 1992, 327, 1832.
- [5] Greene N., Copp A.: "Inositol prevents folate-resistant neural tube defects in the mouse". *Nat. Med.*, 1997, 3, 60.
- [6] Tamim H., Harrison G., Atoui M., Mumtaz G., El-Kak F., Seoud M., et al.: "Preconceptional folic acid supplement use in Lebanon". *Public Health Nutr.*, 2009, 12, 687.
- [7] Buttriss J.: "Strategies designed to increase awareness about folates and health, and to increase folate intake: a review". *Trends Food Sci. Technol.*, 2005, 16, 246.
- [8] Khalaf I.A., Abu-Moghli F.A., Mahadeen A.I., Callister L.C., Al-Hadidi M.: "Jordanian women's perceptions of postpartum health care". *Int. Nurs. Rev.*, 2007, 54, 288.
- [9] Mahadeen A.I., Khalil A.O., Hamdan-Mansour A.M., Sato T., Imoto A.: "Knowledge, attitudes and practices towards family planning among women in the rural southern region of Jordan". *East Mediterr. Health J.*, 2012, 18, 567.
- [10] Alfara H.Y., Alfara S.R., Sadiq M.F.: "Neural tube defects between folate metabolism and genetics". *Indian J. Hum. Genet.*, 2011, 17, 126. doi: 10.4103/0971-6866.92082.
- [11] Amarín Z.O., Obeidat A.Z.: "Effect of folic acid fortification on the incidence of neural tube defects". *Paediatr. Perinat. Epidemiol.*, 2010, 24, 349.
- [12] Gharaibeh M., Al-Ma'aiteh R., Al Jada N.: "Lifestyle practices of Jordanian pregnant women". *Int. Nurs. Rev.*, 2005, 52, 92.
- [13] Ren A.G., Zhang L., Li Z.W., Hao L., Tian Y.H., Li Z.: "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". *Reprod. Toxicol.*, 2006, 22, 431.
- [14] Abu-Baker N., Savage C.L.: "Knowledge and practices of folate and multivitamin supplementation among Jordanian pregnant women". *J. Res. Nurs.*, 2012, 17, 275.
- [15] Willmarth M.A.: "Review: knowledge and practices of folate and multivitamin supplementation among Jordanian pregnant women". *J. Res. Nurs.*, 2011, 17, 287.
- [16] Oweis R., Al-Widyan M., Al-Limoon O.: "Medical waste management in Jordan: A study at the King Hussein Medical Center". *Waste Manag.*, 2005, 25, 622.
- [17] El-Salem K., Al-Shimmery E., Horany K., Al-Refai A., Al-Hayk K., Khader Y.: "Multiple sclerosis in Jordan: a clinical and epidemiological study". *J. Neurol.*, 2006, 253, 1210.
- [18] Aburuz S., Bulatova N., Tawalbeh M., Gazawi M.: "The validity and reliability of the Arabic version of the EQ-5D: a study from Jordan". *Ann. Saudi Med.*, 2009, 29, 304.
- [19] Centers for Disease Control and Prevention (CDC): "Use of dietary supplements containing folic acid among women of childbearing age—United States". *MMWR Morb. Mortal Wkly. Rep.*, 2005, 54, 955.
- [20] Al-Holy M., Eideh A., Epuru S., Abu-Jamous D., Ashankyty I.: "Awareness of folic acid intake among women in the childbearing age in Hail Region—Saudi Arabia". *Food. Nutr. Sci.*, 2013, 4, 49. doi:10.4236/fns.2013.41008
- [21] O'Leary M., Donnell R.M., Johnson H.: "Folic acid and prevention of neural tube defects in 2000 improved awareness—low periconceptional uptake". *Ir. Med. J.*, 2001, 94, 180.
- [22] French M.R., Barr S.I., Milne R.L.: "Folate intakes and awareness of folate to prevent neural tube defects: a survey of women living in Vancouver, Canada". *J. Am. Diet. Assoc.*, 2003, 3, 1.
- [23] Unusan N.: "Assessment of Turkish women's knowledge concerning folic acid and prevention of birth defects". *Public Health Nutr.*, 2004, 7, 851.
- [24] Bener A., Al Maadid M.G., Al-Bast D.A., Al-Marri S.: "Maternal knowledge, attitude and practice on folic acid intake among Arabian Qatari women". *Reprod. Toxicol.*, 2006, 21, 21.
- [25] Potzsch S., Hoyer-Schuschke J., Seelig M., Steinbicker V.: "Knowledge among young people about folic acid and its importance during pregnancy: a survey in the Federal State of Saxony-Anhalt (Germany)". *J. Appl. Genet.*, 2006, 47, 187.
- [26] McGovern E., Moss H., Grewal G., Taylor A., Björnsson S., Pell J.: "Factors affecting the use of folic acid supplements in pregnant women in Glasgow". *Br. J. Gen. Pract.*, 1997, 47, 635.
- [27] Abdulrazzaq Y.M., Al-Gazali L.I., Bener A., Hossein M., Verghese M., Dawodu A., et al.: "Folic acid awareness and intake survey in the United Arab Emirates". *Reprod. Toxicol.*, 2003, 17, 171.
- [28] Ministry of Planning and International Cooperation /Department of Statistics/ Jordan www.dos.gov.jo.

- [29] Al-Qutob R., Nasir L.: "Provider perceptions of reproductive health service quality in Jordanian public community health centers". *Health Care Women Int.*, 2008, 29, 539. doi:10.1080/07399330-801949657.
- [30] Paudel P., Wing K., Silpakar S.K.: "Awareness of periconceptional folic acid supplementation among Nepalese women of childbearing age: a cross-sectional study". *Prev. Med.*, 2012, 55, 511. doi: 10.1016/j.ypmed.2012.09.001.
- [31] Daltveit A.K., Vollset S.E., Lande B., Oien H.: "Changes in knowledge and attitudes of folate, and use of dietary supplements among women of reproductive age in Norway". *Scand. J. Public Health*, 2004, 32, 264.
- [32] Chan A.C., van Essen P., Scott H., Haan E.A., Sage L., Scott J., *et al.*: "Folate awareness and the prevalence of neural tube defects in South Australia, 1966-2007". *Med. J. Aust.*, 2008, 189, 566.
- [33] Coll O., Pisa S., Palacio M., Quinto L., Cararach V.: "Awareness of the use of folic acid to prevent neural tube defects in a Mediterranean area". *Eur. J. Obstet. Gynecol. Reprod. Biol.*, 2004, 115, 173.
- [34] Nawapun K., Phupong V.: "Awareness of the benefits of folic acid and prevalence of the use of folic acid supplements to prevent neural tube defects among Thai women". *Arch. Gynecol. Obstet.*, 2007, 276, 53.
- [35] Jou H.J., Hsu I.P., Liu C.Y., Chung S.H., Chen S.M., Gau M.L.: "Awareness and use of folic acid among pregnant women in Taipei". *Taiwan J. Obstet. Gynecol.*, 2010, 49, 306. doi: 10.1016/S1028-4559(10)60066-6.
- [36] Braekke K., Staff A.C.: "Periconceptional use of folic acid supplements in Oslo". *Acta Obstet. Gynecol. Scand.*, 2003, 82, 620.
- [37] Nosrat S.B., Sedehi M., Ghalipour M.J.: "Knowledge and practice of urban Iranian pregnant women towards folic acid intake for neural tube defect prevention". *J. Pak. Med. Assoc.*, 2012, 62, 785.
- [38] Wald N.J.: "Folic acid and the prevention of neural-tube defects". *N. Engl. J. Med.*, 2004, 350, 101.
- [39] Chacko M.R., Anding R., Kozinetz C.A., Grover J.L., Smith P.B.: "Neural tube defects: knowledge and preconceptional prevention practices in minority young women". *Pediatrics*, 2003, 112, 536.
- [40] Geisel J.: "Folic acid and neural tube defects in pregnancy: a review". *J. Perinat. Neonatal. Nurs.*, 2003, 17, 268.
- [41] Eghwudjakpor P.O., Amadi C.E., Amusan E.O.: "Evaluation of the level of awareness of the role of folic acid in the prevention of neural tube defects amongst women of reproductive age in a tertiary health institution". *Niger. J. Med.*, 2011, 20, 207.
- [42] Kondo A., Kamiyama O., Shimotsuka Y., Okai I., Gotoh M., Ozawa H.: "Awareness of the role of folic acid, dietary folate intake and plasma folate concentration in Japan". *J. Obstet. Gynaecol. Res.*, 2005, 31, 172.
- [43] Bitzer J., von Stenglin A., Bannemerschult R.: "Women's awareness and periconceptional use of folic acid: data from a large European survey". *Int. J. Womens Health*, 2013, 5, 201. doi: 10.2147/IJWH.S40149.
- [44] Obeidat A.Z., Amarin Z.: "Neural tube defects in the north of Jordan: is there a seasonal variation?" *J. Child Neurol.*, 2010, 25, 864. doi: 10.1177/0883073809347596.
- [45] French M.R., Bar S.I., Levy-Milne R.: "Folate intakes and awareness of folate to prevent neural tube defects: a survey of women living in Vancouver, Canada". *J. Am. Diet. Assoc.*, 2003, 103, 181.
- [46] Green-Raleigh K., Carter H., Mulinare J., Prue C., Petrini J.: "Trends in folic acid awareness and behavior in the United States: The Gallup Organization for the March of Dimes Foundation Surveys, 1995-2005". *Matern. Child. Health J.*, 2006, 10, S177. doi:10.1007/s10995-006-0104-0.
- [47] Chivu C.M., Tulchinsky T.H., 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. Health Promot.*, 2008, 22, 237.
- [48] Obeidat B.R., Khader Y.S., Amarin Z.O., Kassawneh M., Al Omari M.: "Consanguinity and adverse pregnancy outcomes: the north of Jordan experience". *Matern. Child. Health J.*, 2010, 14, 283.

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