Original Article

Preconception care in Saudi women with diabetes mellitus

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ABSTRACT

Background: The rate of preexisting diabetes mellitus (DM) in Saudi Arabia is one of the highest in the world. The role of preconception care (PCC) is well-established as a means of improving pregnancy outcomes in DM. **Objectives:** To assess the rate of preconception counseling, the level of PCC knowledge, and the rate of unplanned pregnancies in Saudi women with DM. **Materials and Methods:** A cross-sectional study was conducted among 355 Saudi women aged 18–49 years with self-reported DM. The study questionnaire contained variables about the provision of preconception counseling, knowledge of PCC facts, and the number of unplanned pregnancies after developing DM. The level of PCC knowledge was evaluated using a modified Likert scale. Statistical Package for Social Sciences 20 was used for statistical analysis. Descriptive statistics, mean and standard deviation, and percentages were calculated; t-test was used for statistical significance. **Results**: About one-third of the participants had received preconception counseling after being diagnosed with DM. Counseling on PCC for older and married participants was significantly less. Of the 355 participants, 42.8% had little or no PCC knowledge. All pregnancies that occurred after developing DM were unplanned. **Conclusions:** The rate of preconception counseling, the level of PCC knowledge in the studied Saudi women with DM is suboptimal, and none of the pregnancies that occurred after developing DM was planned. The study highlights the need for PCC programs that target all Saudi women of child-bearing age with DM, and their families starting at the age of puberty and at diagnosis of type 2DM, to optimize women's health and improve pregnancy outcomes.

Key words: Diabetes mellitus, preconception care, preconception care knowledge, preconception counseling, unplanned pregnancies

INTRODUCTION

Preconception care (PCC) is a relatively new concept that was first described by Chamberlain in 1980.[1] The Centre for Disease Control and Prevention further expanded PCC, defining it as a set of interventions that aim to identify and modify biomedical, behavioral, and social risks to a woman's health or pregnancy outcome through prevention and management.[2] PCC in diabetes mellitus (DM) is important for several reasons: First, both types 1 and 2 preexisting DM (PDM) are associated with poor outcomes, and most congenital malformations occur before the 7th week of gestation and are related mainly to poor glycemic control.[3-6] Though progress has been made with the advent of insulin therapy and antenatal care, there is still considerable room for improvement.[7,8] Second, PCC is an evidence-based, cost-effective tool, which together with antenatal care, is proven to reduce diabetes-related maternal-fetal risks.[9-12] Third, there is a relationship between growth and development during fetal and infant life, and health in later years. Implementation

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of PCC to optimize women's health might, therefore, have a role in preventing adult diseases including DM.[13,14] Fourth, the increasing worldwide prevalence of DM,[15] will result in an increasing number of women of child-bearing age affected by DM, predominantly type 2 DM (T2DM). These women would usually be older with co-morbidities and therefore, frequently on multiple drugs that are potentially teratogenic, resulting in worse pregnancy outcomes than the background population and the occasional type 1 diabetes (T1DM).[6,8,16] Reports about PCC among women with DM from the developing countries that face the brunt of the diabetes epidemic are limited.[15]

In the Kingdom of Saudi Arabia (KSA), the prevalence of DM is rising too.[17] Furthermore, the prevalence of PDM in KSA is one the highest in the world, having increased 5-fold over the past 14 years.[18] In the same study, Wahabi *et al*.[18] showed that compared to Saudi women without DM those with PDM had significantly more miscarriages and an increased risk for emergency delivery by cesarean section. The neonates of the Saudi mothers with PDM were significantly heavier, more frequently to be macrosomic, delivered at <37 gestation weeks with low APGAR scores at 5 min. The rate of stillbirths was 2.6 times more among the women with PDM.[18]

Studies on PCC of Saudi women with DM are lacking, and such studies could be helpful in planning public health strategies aimed at improving pregnancy outcomes in women with PDM. This study was designed to explore the rate of preconception counseling, the level of PCC knowledge, and the rate of unplanned pregnancies in Saudi women of child-bearing age with DM.

MATERIALS AND METHODS

A cross-sectional study was conducted at the newly established Diabetes Care Center, between March and May 2012. Three hundred fifty-five Saudi Arabian women with self-reported DM, of child-bearing age, i.e., older than 18 and younger than 49 years, irrespective of their marital status or obstetric history were included. The local ethics committee of the hospital approved the study. The participants were randomly selected after being identified through the daily consultation schedules to the general female diabetes clinics if they met the age criteria. Every third woman was then invited to participate in the study. A trained team of nurses interviewed the participants in a patient-friendly environment after obtaining informed consent. The participants' responses given without prompting, were documented in the participant's individual questionnaire. An average of 4–6 women were interviewed daily. The authors developed a questionnaire in the Arabic language. The study questionnaire contained variables on demographic characteristics of the participants, duration, treatment, and comorbidities of DM. Participants were asked if they were ever counseled on PCC (i.e., provided with knowledge and advice on PCC and family planning) after being diagnosed with DM. A "yes" answer indicated that the participant had been given PC counseling.

The questionnaire included four questions about the awareness of the facts and issues of PCC essential to every preconception counseling curriculum according to the international guidelines.[11,19] The questions were phrased as follows:

1. Are you aware of the importance and benefits of planning pregnancy for the prevention of diabetes-related fetal and maternal risks such as malformations, spontaneous abortions, stillbirths, macrosomia, polyhydramnios, preeclampsia, deterioration of diabetes control and preexisting diabetic complications?
2. Are you aware of the value of strict glycemic control and self-care empowerment at least 3 months prior to conception for the improvement of the health of the fetus and yourself?
3. Are you aware of the need for clinical, biochemical examination of yourself and the need for screening and treatment of diabetes long-term macro- and micro-vascular complications in the period before pregnancy?
4. Are you aware of the need for the modification of diabetes, hypersensitive, and lipid-lowering therapy, as well as therapy for any other concurrent disorders and vitamin supplementation in the period before getting pregnant?

The answering "yes, I am" indicated that the patient recognized, and was aware of that particular PCC issue.

We developed a modified Likert scale to evaluate the level of PCC knowledge of the participants, in which five ranges of PCC knowledge defined by numbers from (1 = absent, to 5 = extensive) were used based on the Nursing Classification Outcomes.[20] Number one indicated the complete absence of PCC knowledge when the patient answered "I do not know" to all four questions. Number 2 indicated a limited level of PCC knowledge when the patient answered "yes, I am" to one of the four questions. Number 3 indicated a moderate level of PCC knowledge when the patient answered "yes, I am" to two questions. Number 4 indicated a substantial level of PCC knowledge when the patient answered "yes, I am" to three of the questions. Number 5 indicated an extensive level of PCC knowledge when the patient answered "yes, I am" to all of the four questions.

Another question included in the study questionnaire to evaluate PCC practices of the participants, was phrased as follows: Have you ever discussed PCC issues with your physician?

An additional question was included to evaluate the opinion of participants regarding utilization of contraceptive methods by women affected with DM and was phrased as follows: Since you have DM, how would you describe the use of contraceptive methods on your health? (1) Harmless, (2) harmful, (3) do not know.

The last question was to estimate the rate of unplanned pregnancies among the participants, and was phrased as follows: Have you become pregnant after developing DM? If the answer is "yes," how many of the pregnancies were planned? How many of the pregnancies were unplanned?

A pilot study was conducted to test the study procedures. Results are presented as mean ± standard deviation and percentages. Correlation between the variables was calculated using Pearson's correlation coefficient; *t*-test was used to compare means. The confidence interval (CI) was fixed at 95%. For all the tests, a $p = 0.05$ or less was used for statistical significance. The data was analyzed using IBM SPSS statistics for Windows,Version 20.0 Armonk, NY: IBM Corp.

RESULTS

All participants were of Saudi Arabian nationality and resided in Riyadh, KSA. Table 1 presents the characteristics of studied participants. It is likely that the majority of them had T2DM, since 75.8% of them were either on oral hypoglycemic agents (OHA) or combined insulin and OHA, the mean age at onset of DM was 31.7 ± 9.2 years, and that 86.8% of them had developed DM after the age of 20 years. About two-thirds of the participants had little education, were either illiterate (i.e., unable to read and write) or only had primary school education.

Less than one-third of the participants (29.3%) were provided with preconception counseling after being diagnosed with DM. Table 2 presents a comparison of the provision of preconception counseling according to marital status, age at onset of DM ≤20 or >20 years, and the presence or absence of a history of at least one pregnancy after developing DM.

Table 3 presents the levels of PCC knowledge among studied participants. About 43% of the participants had either limited or no PCC knowledge, and 22.8% of the participants had an extensive level of PCC knowledge.

Table 1: Characteristics of study participants (*n*=355)

Characteristics	*N* (%)
Age (years)	
Mean±SD 38.9±7.8	
Range 18 - 49	
Marital status	
Single	39 (11.0)
Married	272 (76.6)
Divorced	26 (7.3)
Widow	18 (5.1)
Education	
Illiterate	48 (13.5)
Primary school	201 (56.6)
Secondary school	79 (22.3)
Higher education	27 (7.6)
Duration of diabetes (years) 7.2±6.1	
Age at onset of DM (years)	31.7±9.2
≤20	47 (13.2)
>20	308 (86.8)
History of pregnancy after DM	184 (58.2)
Treatment of DM	
OHA	199 (56.1)
Insulin	86 (24.2)
Combined insulin and OHA	70 (19.7)
Treatment of co-morbidities	
Antihypertensive therapy	104 (29.3)
Lipid-lowering therapy	101 (28.5)

Results are presented as mean±SD or percentages (%). DM: Diabetes mellitus; OHA: Oral hypoglycemic agents; SD: Standard deviation

There was a significant positive correlation between the level of PCC knowledge and the level of education, and the age of the participants (0.115, $P < 0.03$), (0.123, $P < 0.021$), respectively. However, the extensive level of PCC knowledge was significantly higher among illiterate participants than those with secondary school education (1.83 ± 0.40, 1.71 ± 0.46), $P < 0.001$.

Table 4 shows comparison of preconception counseling provision between illiterate participants who have extensive level of PCC knowledge and those with secondary school education who also have extensive level of PCC knowledge according to preconception counseling provision. Majority of the participants (80.4%) had never discussed preconception matters with their physicians. An analysis of the opinions of participants regarding the utility of contraceptive methods by women who had DM, revealed that 53% of the participants regarded it as harmful to their health because of DM and 36.6% regarded it as harmless, while 9% of the participants answered: Do not know.

Of the 355 participants in the study, 184 women had a history of at least one pregnancy after developing DM. All the pregnancies of the 184 participants were unplanned (100%).

Table 2: Comparison of preconception counseling provision among participants according to the following factors: (1) marital status, (2) age at onset of diabetes mellitus ≤20 or >20 years, and (3) the presence or absence of a history of pregnancy after developing diabetes mellitus

	Preconception counseling provision to participants according to factors 1, 2 and 3					
	(1) Marital status		(2) Age at onset of DM		(3) History of pregnancy after DM	
	Single	Married	≤20 years	>20 years	Yes	No
Mean±SD	1.87±0.3	1.65±0.5	1.85±0.4	1.68±0.5	1.68±0.5	1.67±0.5
p	<0.0001		<0.0001		<0.695	

The mean difference is significant at the 0.05 level. DM: Diabetes mellitus; SD: Standard deviation

Table 3: The rates of various levels of preconception care knowledge among the participants

Levels of PCC knowledge	No	%	± SD	95% CI
Nil	29	8.2	±2.85	5.35-11.05
Limited	123	34.6	±4.95	29.65-39.55
Moderate	65	18.3	±4.02	14.28-22.32
Substantial	57	16.1	±3.82	12.28-19.92
Extensive	81	22.8	±4.36	18.44-27.16

PCC: Preconception care; CI: Confidence interval; SD: Standard deviation

Table 4: Comparison between illiterate participants and those with secondary school education, who have extensive level of preconception care knowledge according to preconception counseling provision

	Participants with extensive level of PCC knowledge	
	PC counseling not provided	PC counseling provided
Illiterate	1.89±0.31	1.93±0.24
Secondary school	1.95±0.22	1.79±0.4
p	<0.024	<0.0001

The mean difference is significant at the 0.05 level. PCC: Preconception care; PC: Preconception

DISCUSSION

Our study demonstrated that the rate of preconception counseling for the participants is suboptimal. Moreover, participants who developed DM after the age of 20 years, and represented the majority of women in the study (86.8%), most of whom had T2DM, had little counseling on PCC. The finding is alarming as the prevalence of PDM in Saudi Arabia, as shown by Wahabi *et al*.,[18] has increased over the past 14 years, and most of the women with PDM in that study were older and had T2DM. The prevalence of PDM in Saudi Arabia is projected to further increase, as reported by ALquaiz *et al*.[21] That study indicated that Saudi Arabian women are potentially at a greater risk of developing cardiovascular diseases and DM, with a notable increase in obesity compared to men than they had a decade ago. Previous studies have demonstrated that the rate of preconception counseling and uptake are low among women with DM, ranging between 19.8%, 38.2%, and 50%, and is especially low among women with T2DM, of lower socioeconomic status and ethnic minorities.[6,8,22,23] The changes in the trends of T2DM morbidity at an earlier age, which is characteristic to the DM epidemic, and imply that more women of child-bearing age shall have T2DM,[15,16] have been not met with changes in PC counseling practices, which for a long time have been perceived as a service to younger women with T1DM.

The level of PCC knowledge among the participants was inadequate. This is in agreement with reported suboptimal levels of awareness and knowledge of PCC among women with DM regardless of age.[24-27] An analysis of the relationship between PCC knowledge and the level of education of the participants revealed that 13.5% of studied participants were illiterate. This rate is similar to the nationally reported rates of illiteracy of 13.7% in the general population, ranging between 14.7% and 31.6% among Saudi women, depending on the region of residence.[28] There was a positive correlation between the level of PCC knowledge and the level of education; however, the extensive level of PCC knowledge was higher among illiterate patients than the participants with secondary school education. Further analysis revealed that illiterate participants with extensive level of PCC knowledge had higher preconception counseling. This result emphasizes the importance of providing preconception counseling, which seems to compensate for the inadequate conventional education of the women. This is especially relevant for the developing countries where the rates of illiteracy are still high particularly among women. A recent randomized controlled study has shown that improving PCC knowledge through counseling and boosters of PCC counseling program have long-term sustaining effects on the beliefs of teenagers with DM and their intentions to initiate discussions on family planning with Health Care Providers (HCP).[29] Therefore, more effort is urgently needed to enhance, promote, and make PC counseling for women with diabetes more comprehensive starting at puberty in patients with T1DM, and at diagnosis of T2DM in women of child-bearing age in Saudi Arabia.

Although about one-third of the participants in our study had preconception counseling, and about one quarter had extensive levels of PCC knowledge, it seems that the quality of counseling programs was deficient and that translating the acquired knowledge into practice is still inadequate. This was reflected by the fact that majority of participants had not discussed preconception matters with their HCP, and only one-third thought of the use of contraceptive methods as harmless to the health of women with DM. Reported rates of unplanned pregnancies among women with DM remain high and range between 33% to 50%, and as high as two-thirds of women with DM.[6,10,30] This is not surprising, as Reddy *et al*.[31] recently showed that the rates of family planning were overall still low in women of reproductive age, with no significant difference for women with cardiovascular risk factors including DM. However, the result of our study with respect to the rate of unplanned pregnancies at 100% among the participants is extremely alarming. This implies that family planning services are not only poorly provided to women with DM, but there might be other inhibiting factors. These might include poor training of providers, lack of time, misconceptions about the safety of the use of contraception in patients with DM, or even social beliefs or cultural prohibitions. This poor result should stimulate further research to identify and overcome the potential barriers to implementing family planning. Obstetricians and Gynecologists are known to be more often involved in family planning. This is evidenced by the study by Reddy *et al*.[31] in which women of reproductive age who practice family planning had higher frequencies of adult patients, private insurance use and obstetrician/gynecologist specialty care. However, we demonstrated that women who had a history of at least one pregnancy after developing DM did not have higher rates of preconception counseling than participants with no history of pregnancy after developing DM, which indicates that Obstetricians in our community are not actively involved in providing preconception counseling for women with DM. The strength of our study was the opportunity of obtaining the data from Saudi women with DM through direct interviews.

Limitations of the study might be that all participants were from a single specialized center that serves a limited geographic area. The absence of a question in the study questionnaire about the socioeconomic status of the participants and the source of PCC knowledge might also be another limitation of the study.

Although studies about PCC for Saudi women in the general population are lacking, Seidahmed *et al*.[32] study of neural tube defects in neonates of Saudi women demonstrated that only 2% of the mothers in the study had taken preconception folic acid and only 10% of them have had it during the first 4 weeks of gestation. These results demonstrate that even in the general population PCC is poorly provided.

The results of our study highlight the need for a culturally sensitive, easily accessible preconception counseling program that targets all women of child-bearing age with DM, their spouses and families, starting at the age of puberty and at diagnosis of DM, aiming at optimizing women's health and improving outcomes of PDM. The provision of preconception counseling to women with DM should be responsibility of all HCP including, primary care physicians, family physicians, obstetricians, pediatricians, internists, diabetologists, endocrinologists, and diabetes educators. Integration of efforts by HCP of various specialties through PCC program might lead to optimization of women's health in the preconception period and the prevention of diabetes-related maternal-fetal risks.

CONCLUSION

In summary, this study demonstrated that Saudi Arabian women of child-bearing age with DM, who participated in the study, were not empowered to avoid DM-related maternal-fetal risks. The rate of preconception counseling of the participants and the level of PCC knowledge were suboptimal, and the rate of unplanned pregnancies was 100%. Further studies on larger numbers of Saudi women with DM, bearing the type of DM in mind, and the socioeconomic status of women, and to explore barriers to providing preconception counseling and implementation of acquired PCC knowledge are warranted. In addition, studies are urgently needed to explore misconceptions on the use of contraceptive methods and family planning in women with DM.

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Chamberlain G. The prepregnancy clinic. Br Med J 1980;281:29-30.
2. Centers of Disease Control and Prevention. Recommendations to improve preconception health and health care – United States. A report of the CDC/ATSDR Preconception Care Work Group and the Select Panel on Preconception Care. MMWR Recomm Rep 2006;55:1-23.

3. Mills JL, Baker L, Goldman AS. Malformations in infants of diabetic mothers occur before the seventh gestational week. Implications for treatment. Diabetes 1979;28:292-3.
4. Macintosh MC, Fleming KM, Bailey JA, Doyle P, Modder J, Acolet D, *et al.* Perinatal mortality and congenital anomalies in babies of women with type 1 or type 2 diabetes in England, Wales, and Northern Ireland: Population based study. BMJ 2006;333:177.
5. Negrato CA, Mattar R, Gomes MB. Adverse pregnancy outcomes in women with diabetes. Diabetol Metab Syndr 2012;4:41.
6. Gizzo S, Patrelli TS, Rossanese M, Noventa M, Berretta R, Di Gangi S, *et al.* An update on diabetic women obstetrical outcomes linked to preconception and pregnancy glycemic profile: A systematic literature review. Scientific World Journal 2013;2013:254901.
7. Yang J, Cummings EA, O'connell C, Jangaard K. Fetal and neonatal outcomes of diabetic pregnancies. Obstet Gynecol 2006;108(3 Pt 1):644-50.
8. Hewapathirana NM, Murphy HR. Perinatal outcomes in type 2 diabetes. Curr Diab Rep 2014;14:461.
9. Wahabi HA, Alzeidan RA, Bawazeer GA, Alansari LA, Esmaeil SA. Preconception care for diabetic women for improving maternal and fetal outcomes: A systematic review and meta-analysis. BMC Pregnancy Childbirth 2010;10:63.
10. Kitzmiller JL, Buchanan TA, Kjos S, Combs CA, Ratner RE. Pre-conception care of diabetes, congenital malformations, and spontaneous abortions. Diabetes Care 1996;19:514-41.
11. Kitzmiller JL, Block JM, Brown FM, Catalano PM, Conway DL, Coustan DR, *et al.* Managing preexisting diabetes for pregnancy: Summary of evidence and consensus recommendations for care. Diabetes Care 2008;31:1060-79.
12. Peterson C, Grosse SD, Li R, Sharma AJ, Razzaghi H, Herman WH, *et al.* Preventable health and cost burden of adverse birth outcomes associated with pregestational diabetes in the United States. Am J Obstet Gynecol 2015;212:74.e1-9.
13. Barker DJ. In utero programming of chronic disease. Clin Sci (Lond) 1998;95:115-28.
14. Gluckman PD, Hanson MA, Cooper C, Thornburg KL. Effect of in utero and early-life conditions on adult health and disease. N Engl J Med 2008;359:61-73.
15. International Diabetes Federation. Diabetes-Atlas. 6th ed. Brussels, Belgium: International Diabetes Federation; 2013. Available from: http://www.idf.org/diabetesatlas. [Last accessed on 2015 Jul 15].
16. Lawrence JM, Contreras R, Chen W, Sacks DA. Trends in the prevalence of preexisting diabetes and gestational diabetes mellitus among a racially/ethnically diverse population of pregnant women, 1999-2005. Diabetes Care 2008;31:899-904.
17. Al-Daghri NM, Al-Attas OS, Alokail MS, Alkharfy KM, Yousef M, Sabico SL, *et al.* Diabetes mellitus type 2 and other chronic non-communicable diseases in the central region, Saudi Arabia (Riyadh cohort 2): A decade of an epidemic. BMC Med 2011;9:76.
18. Wahabi HA, Esmaeil SA, Fayed A, Al-Shaikh G, Alzeidan RA. Pre-existing diabetes mellitus and adverse pregnancy outcomes. BMC Res Notes 2012;5:496.
19. Mahmud M, Mazza D. Preconception care of women with diabetes: A review of current guideline recommendations. BMC Womens Health 2010;10:5.
20. Moorhead S, Johnson M, Maas M, Swanson E. Nursing Outcomes Classification (NOC) Measurement of Health Outcomes. 5th ed. St. Louis: Elsevier; 2013.
21. Alquaiz AM, Siddiqui AR, Qureshi RH, Fouda MA, Almuneef MA, Habib FA, *et al.* Women health in Saudi Arabia: A review of non-communicable diseases and their risk factors. Pak J Med Sci 2014;30:422-31.
22. Tripathi A, Rankin J, Aarvold J, Chandler C, Bell R. Preconception counseling in women with diabetes: A population-based study in the north of England. Diabetes Care 2010;33:586-8.
23. Glinianaia SV, Tennant PW, Crowder D, Nayar R, Bell R. Fifteen-year trends and predictors of preparation for pregnancy in women with pre-conception Type 1 and Type 2 diabetes: A population-based cohort study. Diabet Med 2014;31:1104-13.
24. Chuang CH, Velott DL, Weisman CS. Exploring knowledge and attitudes related to pregnancy and preconception health in women with chronic medical conditions. Matern Child Health J 2010;14:713-9.
25. Charron-Prochownik D, Sereika SM, Wang SL, Hannan MF, Fischl AR, Stewart SH, *et al.* Reproductive health and preconception counseling awareness in adolescents with diabetes: What they don't know can hurt them. Diabetes Educ 2006;32:235-42.
26. Moura ER, Evangelista DR, de Castro Damasceno AK. The knowledge of women with diabetes mellitus regarding preconception care and maternal-fetal risks. Rev Esc Enferm USP 2012;46:22-9.
27. Downs JS, Arslanian S, de Bruin WB, Copeland VC, Doswell W, Herman W, *et al.* Implications of type 2 diabetes on adolescent reproductive health risk: An expert model. Diabetes Educ 2010;36:911-9.
28. Achievement of the Development Plans Facts and Figures Twenty-Fifth Issue 1390-1429H1970-2008G. Ministry of Economics and Planning, Kingdom of Saudi Arabia; 2008. Available at: http://services.mep.gov.sa/themes/BlueArc/index. [Last accessed on 2009 Apr 30].
29. Charron-Prochownik D, Sereika SM, Becker D, White NH, Schmitt P, Powell AB 3rd, *et al.* Long-term effects of the booster-enhanced READY-Girls preconception counseling program on intentions and behaviors for family planning in teens with diabetes. Diabetes Care 2013;36:3870-4.
30. Schwarz EB, Maselli J, Gonzales R. Contraceptive counseling of diabetic women of reproductive age. Obstet Gynecol 2006;107:1070-4.
31. Reddy SM, Ramachandran A, Cabral H, Kazis L. Provision of family planning to women with cardiovascular risk factors. J Am Board Fam Med 2015;28:105-14.
32. Seidahmed MZ, Abdelbasit OB, Shaheed MM, Alhussein KA, Miqdad AM, Khalil MI, *et al.* Epidemiology of neural tube defects. Saudi Med J 2014;35 Suppl 1:S29-35.