Introduction

Teratogens are environmental agents that may disturb the normal fetal development when the mother is exposed to them, resulting in prenatal mal-development or death.[4] Previously, it was believed that congenital anomalies were only genetic until Murphy discovered that environmental agents can also cause congenital defects.[5] Recently, it is known that a majority of the congenital anomalies have a multifactorial pathogenesis, implicating both genetic and environmental basis.[6] It is estimated that almost 15% of all congenital malformations are due to environmental teratogens[7] which include metabolic conditions, physical, chemical, and infectious agents.[8] As most of these can be considered as modifiable exposures, awareness regarding teratogenic risks among women is crucial in ensuring a safe pregnancy and a healthy fetus. Our study revealed inadequate knowledge of teratogens among the participants which implies an urgent need to increase awareness of mothers regarding the harmful effects of common teratogens.

ABSTRACT

Aim: To investigate the knowledge of Saudi women regarding the teratogenic effects of environmental agents such as fever, some chronic conditions and medications and its association with certain socio-demographic factors. Materials and Methods: A survey based cross-sectional study was conducted on 315 Saudi women of childbearing age visiting OB/GYN clinics at a large tertiary care centre in Riyadh, Saudi Arabia. Knowledge of subjects on teratogenic risk of common entities was measured and nonparametric Mann–Whitney and Kruskal–Wallis tests were used to associate knowledge score with various predictors. Results: The response rate was 75%. Most of the participants were between 28 and 37 years. Knowledge on teratogenic risk was generally poor with specifically higher knowledge regarding insulin intake and isotretinoin. Older age, higher education, being employed, and having a high monthly income were significantly associated with a higher knowledge score (P < 0.05). Conclusion: Women's knowledge regarding teratogenic risks is crucial in ensuring a safe pregnancy and a healthy fetus. Our study revealed inadequate knowledge of teratogens among the participants which implies an urgent need to increase awareness of mothers regarding the harmful effects of common teratogens.

Keywords: Childbearing age, knowledge, Saudi Arabia, teratogens

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medications and epilepsy medications. Awareness of women showed insufficient knowledge regarding the teratogenicity of gestational diabetes mellitus, thyroid diseases and medications and epileptic medications. In general, medication use and safety during pregnancy is a highly debatable subject. Throughout the literature, it is evident that women’s awareness on teratogenic medications is inadequate. A Saudi study assessing the beliefs, knowledge, and use of medications among pregnant women showed that the majority expressed awareness regarding cautious use of medications during pregnancy. Another study assessing knowledge of folic acid intake among women of childbearing age found that most of them were aware of folic acid and its preventive effect on neural tube defects. Other teratogens include rubella, the first teratogenic virus to be described. A Saudi study conducted in Al-Khobar demonstrated that more than half of the women lacked information about the adverse effects of rubella infection during pregnancy. Furthermore, the teratogenicity of radiation exposure during pregnancy is well established through many studies. Teratogenicity of radiation awareness in a Saudi study showed a high awareness regarding exposure to during pregnancy.

Most of the literature in this domain of women’s awareness of teratogenic risk focuses on one type of exposure whether be it radiation, medication, etc. In this study we aimed to assess women’s knowledge among Saudi women of childbearing age in a tertiary care centre in Saudi Arabia on the teratogenic risks posed by several entities including fever, diabetes mellitus, thyroid, and antiepileptic medications in addition to determine its association with socio-demographic factors. Such study is highly justified since some patients are believed to make deliberate decisions regarding their medication use, based on their beliefs about the disease and its treatment. Effective counselling has been associated with better and positive outcomes in terms of knowledge and practice of the safe and utilization of drugs and the understanding of many medical conditions that may happen during pregnancy.

Materials and Methods
Study design, setting, and subjects
An analytical cross-sectional study using a self-administered questionnaire was conducted at a large tertiary care centre in the capital city of Saudi Arabia from January 2018 to December 2018. Saudi women of childbearing age (18–45 years) visiting the obstetrics and gynaecology (OB/GYN) clinic and were willing to participate were included using convenience sampling technique. Women in labour were excluded. The recommended sample size as computed using the Rao soft online calculator was 297 with 95% confidence level, 5% margin of error and a response distribution of 50%.

Study instrument and data collection
Data were collected using an Arabic-pre-validated self-administered questionnaire. Content validation of the tool was performed by 2 content experts and a pilot study involving 30 women who fit the inclusion criteria was conducted. Unclear items and words were modified based on the comments of the pilot study subjects. Reliability analysis of the pilot data yielded a Cronbach’s alpha coefficient of 0.7 which indicated acceptable reliability.

The questionnaire consisted of 27 items, including 10 questions pertaining to socio-demographic data and 17 statements assessing the participants’ knowledge of teratogenic agents (2 items on physical agents, 3 items on infectious agents, 5 on metabolic agents and 7 items on chemical agents) using a 5-point Likert scale as follows: 0 as Don’t know, 1 as Strongly disagree, 2 as Disagree, 3 as Agree, and 4 as Strongly agree. For negative statements in which the disagreement was the correct answer, reverse coding was performed. The overall knowledge score ranged from 0 to 17.

The co-investigators visited the OB/GYN clinic over a period of 2 months and distributed the surveys manually to the women in the waiting area and were collected immediately after they were filled. Interviews using the same structured tool were performed for illiterate women.

Ethical considerations
The study was ethically approved by the Institutional Review Board (IRB) at King Abdullah International Medical Research Centre (KAIMRC) with approval number RYD-17-419812-92225 on June 12, 2017. Informed voluntary consent was taken from each participant and information was obtained from each participant in a private setting. The data was accessible only by the principal investigator and co-investigators and confidentiality was ensured throughout the study.

Data analysis
Data were entered on Microsoft Excel and analysed using SPSS, Version 22.0 (IBM Corporation, Armonk, NY, USA). For the descriptive analysis, frequencies, and percentages were used to describe the categorical variables. Median and interquartile range (IQR: 25th percentile-75th percentile) were used to describe the knowledge scores. The association between the sociodemographic variables and knowledge score was determined using the non-parametric Mann–Whitney U and Kruskal Wallis tests. A P value of less than 0.05 was considered statistically significant for all tests used.

Results
The study included 315 women of childbearing age. The majority of women (55.6%) were 28–37 years old, and 94% were married; 57.8% of the participants had university education, 34% had high school education or less, 5.4% were postgraduates, and 2.9% were illiterate. More than half of the participants (56.2%) were housewives, and 20.4% were in education-related professions. Most of them (64.8%) were pregnant, and 46.8% participants had 3 or more children, while 19.6% were nulliparous. Regarding miscarriages, 53.2% had no previous miscarriages, and 12.5%
of the participants had 3 or more miscarriages previously. Only 7.9% women had a child with congenital defects, and almost half (43.4%) had a monthly income ranging between 5,000 and 9,999 SR. The demographic characteristics of the participants are presented in Table 1.

Concerning knowledge questions on teratogenic risks as shown in Table 2, responses regarding the effect of fever showed that the majority (70%) were aware of the significance of treatment of fever; however, they were less aware of the potential of fever leading to congenital malformations (31%). On whether German measles and herpes simplex infections during pregnancy can cause congenital defects, 40% and 37% agreed, respectively. Regarding syphilis, 36% women agreed that syphilis in pregnancy may affect the fetus. When asked about gestational diabetes mellitus, 38% of the participants agreed that gestational diabetes mellitus can affect the fetus, and 35% agreed that there is a relationship between abnormal blood sugar level and congenital anomalies. Participants showed relatively good knowledge regarding insulin use during pregnancy, and 61% of them responded negatively to the statement, “Insulin use can harm the fetus”. Regarding thyroid diseases, 35% of the participants agreed that there is a relationship between thyroid abnormalities and congenital defects, and 30% disagreed that stopping thyroid medications in pregnancy is important for fetal safety.

As for medication use, when asked about anti-epileptics, 42% agreed that using these medications can harm the fetus, and only 24% disagreed that pregnant women should not take anti-epileptics even if they were needed. Concerning vitamin A intake, 59% of the women agreed that vitamin A is important during pregnancy. However, only 28% agreed with the statement that high intake of vitamin A can cause congenital anomalies. Most of the women (72%) agreed that pregnant women should not take isotretinoin as it might cause congenital defects. Regarding psychiatric medications, 46% of participants agreed that medications for mental illnesses can harm the fetus, but only 13% disagreed that medications for mental illnesses should be stopped during pregnancy.

The overall median knowledge score was 7. The relationship between the median scores and the independent variables, which included age, educational level, profession, and monthly income were statistically significant with P values of 0.04, 0.01, 0.01, and 0.001, respectively. Older age, a higher education level and monthly income, and being employed were associated with better knowledge on teratogens. Other variables, namely marital status, current/previous pregnancy, miscarriages, and having a child with congenital malformation, were not statistically significant. The associations between the median knowledge score and the predictors are presented in Table 3.

**Discussion**

Women's awareness of teratogens is of high importance as it can decrease preventable congenital anomalies. This study explored women's awareness regarding the teratogenic risk posed by various entities. Regarding fever's potential to create congenital anomalies, poor knowledge was demonstrated which may be due to the fact that fever rarely cause congenital anomalies. However, due to it being more common knowledge, most of them agreed that fever must be treated in pregnancy. As there are no studies addressing women's awareness in terms of fever, the results could not be compared. On the other hand, nearly half of the study's participants were aware that German measles has harmful effects on the fetus. Similarly, another local study carried out in Al-Khobar showed that 43% of participants were aware of the teratogenic effects of German measles.

Despite the participants’ poor awareness of the probable teratogenicity of rubella, herpes simplex, and syphilis, more correct responses were observed for teratogenicity of infectious agents than for fever. In this category, the effect of rubella on
Table 2 Knowledge of females on common teratogenic risks

| Statement                                                                 | Strongly disagree | Disagree | Do not know | Agree | Strongly agree |
|--------------------------------------------------------------------------|-------------------|----------|-------------|-------|---------------|
| Fever in pregnancy can lead to congenital malformations                  | 14 (4.4)          | 70 (22.2)| 134 (42.5)  | 85 (27.0)| 12 (3.8)      |
| A pregnant female with fever does not need treatment because fever is    | 108 (34.6)        | 111 (35.6)| 59 (18.9)  | 28 (9.0) | 6 (1.9)       |
| not associated with malformations                                        |                   |          |             |       |               |
| If pregnant female has German measles, fetus can develop malformations   | 14 (4.5)          | 22 (7.0) | 150 (47.8)  | 102 (32.5)| 26 (8.3)      |
| Syphilis in pregnancy does not affect the fetus                         | 52 (16.6)         | 61 (19.5)| 147 (47.0)  | 43 (13.7) | 10 (3.2)      |
| Herpes infection in pregnancy can lead to congenital malformations       | 8 (2.6)           | 47 (15.1)| 138 (44.4)  | 96 (30.9) | 22 (7.1)      |
| There is no association between gestational diabetes and congenital      | 41 (13.1)         | 80 (25.6)| 73 (23.3)   | 102 (32.6)| 17 (5.4)      |
| malformations                                                            |                   |          |             |       |               |
| There is a relationship between irregular BSL and congenital malformations| 19 (6.1)          | 77 (24.9)| 104 (33.7)  | 87 (28.2) | 22 (7.1)      |
| Insulin use in pregnancy can harm the fetus                             | 67 (21.3)         | 125 (39.8)| 91 (29.0)  | 28 (8.9)  | 3 (1.0)       |
| Thyroid problems in pregnancy have no effect on the fetus               | 28 (9.0)          | 80 (25.7)| 124 (39.9)  | 74 (23.8) | 5 (1.6)       |
| Stopping thyroid medication in pregnancy is important for fetal safety   | 40 (12.8)         | 56 (17.9)| 130 (41.5)  | 74 (23.6) | 13 (4.2)      |
| Using antiepileptics during pregnancy can harm the fetus                | 4 (1.3)           | 27 (8.7) | 145 (46.6)  | 109 (35.0) | 26 (8.4)      |
| Pregnant should not use antiepileptics even if she needs it             | 16 (5.2)          | 60 (19.4)| 146 (47.1)  | 69 (22.3) | 19 (6.1)      |
| Vitamin A is an important vitamin to take in pregnancy                  | 16 (5.1)          | 32 (10.3)| 76 (24.4)   | 163 (52.4)| 24 (7.7)      |
| There is no association between Vitamin A intake in pregnancy and        | 33 (10.6)         | 55 (17.7)| 164 (52.7)  | 52 (16.7) | 7 (2.3)       |
| congenital malformations                                                |                   |          |             |       |               |
| In pregnancy planning, Ro‑Accutane tabs should be stopped               | 10 (3.2)          | 6 (1.9)  | 67 (21.6)   | 88 (28.4) | 139 (44.8)    |
| Medications for mental illnesses can cause congenital malformations     | 4 (1.3)           | 20 (6.4) | 141 (45.2)  | 109 (34.9)| 38 (12.2)     |
| All medications for medical illnesses should be stopped in pregnancy    | 6 (1.9)           | 34 (10.9)| 124 (39.7)  | 106 (34.0)| 42 (13.5)     |

Table 3: Bivariate associations of various predictors and teratogen knowledge score

| Variables                     | Knowledge score Median (Q1-Q3) | P    |
|-------------------------------|--------------------------------|------|
| Age                           | 7 (4‑9)                        | 0.04*|
| 18‑37 years old               | 8 (6‑10)                       |      |
| 38‑45 years old               |                                |      |
| Marital status                | 8 (6‑10)                       | 0.29 |
| Single                        | 7 (5‑9)                        |      |
| Ever Married                  | 9 (8‑11)                       |      |
| Educational level             | 7 (5‑9)                        | 0.01*|
| Low                           | 9 (8‑11)                       |      |
| High                          |                                |      |
| Profession                    | 7 (4‑9)                        | 0.01*|
| Unemployed                    | 8 (5‑10)                       |      |
| Employed                      |                                |      |
| Current pregnancy             | 8 (5‑9)                        | 0.60 |
| No                            | 7 (5‑9)                        |      |
| Yes                           |                                |      |
| Previous pregnancies          | 8 (4‑9)                        | 0.90 |
| None                          | 7 (5‑9)                        |      |
| ≥1                            |                                |      |
| Miscarriages                  | 7 (4‑9)                        | 0.20 |
| None                          | 7 (5‑9)                        |      |
| ≥1                            |                                |      |
| Child with congenital         | 7 (5‑9)                        | 0.90 |
| malformation                  | 7 (5‑9)                        |      |
| Monthly income                | 8 (6‑11)                       |      |
| <5,000 SR                     | 6 (4‑8)                        | 0.001*|
| 5,000‑15,000 SR               | 7 (5‑9)                        |      |
| >15,000 SR                    |                                |      |

*P < 0.05 for statistically significant. Q1: 25th percentile, Q3: 75th percentile

Participants showed relatively good knowledge regarding the importance of vitamin A intake during pregnancy, yet poor awareness regarding the effect of increased intake of vitamin A during pregnancy. The result could not be compared as there are no other studies addressing the awareness of vitamin A intake. Women showed good knowledge regarding the importance of discontinuing isotretinoin during pregnancy, which could be due to the fact that it is widely prescribed for women of childbearing age for acne treatment. Awareness regarding the potential teratogenicity of psychiatric medications was poor, and there are no other studies to compare this result with. This could be
because psychiatric medications are not commonly discussed during medical consultations.

Older participants had better knowledge suggesting a relation between median knowledge score and age. This might be explained by the fact that they are more experienced and might have been exposed to more sources for knowledge. Employment was also associated with better knowledge which is probably related to more exposures to medical information and terminology. In addition, high income was related to better knowledge, which could be due to easier access to healthcare facilities or being able to educate oneself on preventive measures in women’s health.

Limitations of this study include being a single-centre study, which limits the generalisability of the findings. Furthermore, the study participants might not have been familiar with some of the medical terminologies used. This could have led to an over or underestimation of the participants’ true awareness of these agents. Furthermore, this study included few agents that rarely cause teratogenicity, such as diabetes mellitus and fever.

Finally, this study showed that participants’ awareness of the explored teratogenic agents was generally insufficient, and the median knowledge score was significantly correlated with age, employment status, and monthly income. Thus, the authors strongly recommend conducting awareness campaigns in the community and encouraging patients to seek information from their physicians regarding the harmful effects of teratogens. It should also be emphasized that women should never start or discontinue medication on their own especially if pregnant. It is also recommended that physicians highlight the most common teratogens to patients and individualise their advice based on each patient’s medical condition. In conclusion, inadequate knowledge of teratogens among the participants was revealed which is alarming and might pose potential risks on a safe and healthy pregnancy.

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Conflicts of interest
There are no conflicts of interest.

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