Prevalence and Associated Demographic Characteristics of Gestational Diabetes Mellitus in Gaza

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ABSTRACT: The aim of the study was to identify the prevalence and sociodemographic characteristics of gestational diabetes mellitus (GDM) in Gaza. A retrospective case-control study that included 189 GDM women were compared with 189 non GDM delivered in 2010 in Gaza. The available data were obtained from 2011 United Nations Relief and Works Agency (UNRWA) primary health care clinics in Gaza. WHO criteria were used for diagnosing GDM. The multivariate logistic regression test was used to identify the odds ratios (ORs) with 95% confidence intervals (CI), and controlling confounder variables. The overall prevalence of GDM women was 1.8%. The mean age and standard deviation for GDM cases was (34.1 yr ±6.56) while for the control group was (34.2 yr ±6.77). The GDM cases showed a similar mean and standard deviation (162.4±5.42) of height in comparison to the control group (162.3 cm ±5.39). The mean and standard deviation of weight (81.1 kg ±13.16) in GDM women was statistically different with a *p*-value < 0.001 compared to control. The most GDM significant associated demographic factors with a p value <0.005 were low income (OR 0.35, CI 0.14, 0.84) and being overweight before pregnancy (OR 1.07, CI 1.04, 1.09). The prevalence of GDM was found to be average (1.8%) and is increasing. Appropriate interventions are required for individuals matching these socioeconomic characteristics.

Keywords: Complications, Gaza , gestational diabetes mellitus (GDM), morbidity, pregnancy, prevalence.

Introduction

GDM is an important public health issue and women with gestational diabetes mellitus (GDM) are more likely to develop type II diabetes up to six times compared with women with a normal glucose tolerance during pregnancy (Anna *et al*., 2008; Xiang *et al*., 2011). GDM complicate approximately 1-14% of all pregnancies (Sultan *et al*., 2004). The overall prevalence of GDM in Washington, DC, USA is lower (2.8%) than that of India (18.9%) and in Italy (22%) (Anna *et al*., 2008). In contrast, the prevalence rate in most European countries including United Kingdom is about 1-2% (Sultan *et al*., 2004). The high prevalence rate was found among Asian women at 11.9% especially Indian and Chinese women (Haroush *et al*., 2003; Odar *et al*, 2004). The prevalence rate for GDM is increased approximately six fold in Arab countries (Odar *et al*, 2004; Agarwal *et al*., 2007). A high prevalence of GDM rate was reported in some Arab countries such as the United Arab Emirates, Kuwait and in Saudi Arabia with a range from 12-20% (Sultan *et al*., 2004; Elshair *et al*., 2012). These variations in prevalence can be due to different utilization of screening and diagnostic criteria for GDM in different populations (Ferara, 2007).

According to previous studies, Asian women have higher prevalence rates of GDM related to increase body overweight regardless the BMI (Deurenberg *et al.,* 2002; Chu *et al*., 2009). Hence, increased maternal weight may be a better indicator of risk for glucose intolerance than BMI in Asian populations (Chu *et al*., 2009). In particular, impending motherhood with GDM is a risk condition that increases with obesity, parity, and a positive family history of GDM (Ben *et al.*, 2004; Sadikot, 2009; Yang *et al*., 2009).

There have been numerous studies on the association between GDM and contributing factors such as age, weight, and family history. Hence, studies on the prevalence of GDM and sociodemographic characteristics in Gaza are very limited (Shaath, 2001). Consequently, the present study provides a clear understanding of prevalence and sociodemographic determinant of GDM which may afford the opportunity to reduce the incidence of and prevent future development of type II diabetes in later life.

Material and Methods

A retrospective record review was used to calculate the overall prevalence rate of GDM while case-control design was used to determine the associated factors of GDM. The data used in this paper were obtained from the primary health care clinics registered under the 2011 UNRWA for Palestinian refugees.

Data Collection

Data were collected in UNRWA primary postnatal health care clinics in Gaza. UNRWA is the main provider for most of the basic services (education, health, relief and social services) for registered Palestinian refugees in Gaza, covering about 70% of the local population (UNRWA,2009). Data were collected by using a questionnaire after informed consent were obtained from the participants. Using the WHO criteria, a total of 200 GDM participants [women aged 18 years and above, with no history of medical disease (diabetes, cardiac, and hypertension), who were already diagnosed with GDM in a previous pregnancy, and who had delivered in 2010] were initially selected for the study. Out of these participants, 11 were excluded because of incomplete record information. This made the actual number of participants to be 189 as cases. For control, 189 non GDM participants delivered in 2010 in Gaza were recruited and were matched for age group and place of residence. The two groups (case and control) were then compared.

For an alpha error of 5%, for a power of 80%, assuming the prevalence of gestational diabetes in Gaza was underestimation according to previous studies (Naing, 2010). The author used a value of 0.5 as an estimation of the population proportion as the test is most accurate when sample size (the population proportion) is close to 0.5. Epi-info software was applied to determine the required sample size. The minimum sample size was estimated to be 166 per group (cases and controls). The total postnatal records for the year 2010 were used as a reference to calculate the total prevalence rate of GDM in Gaza.

This study was approved by the relevant authorities [Research Ethics Committees, Universiti Sains Malaysia (USM), Ministry of Palestinian Health, Palestine and UNRWA]. Data collection was commenced from March 2011 to June 2011. Informed consent was obtained from the participants after a thorough explanation of the aims, objectives of the study with the understanding that all collected information would be confidential and the implications for them, given by the first researcher.

The instruments of survey used was internally and externally prevalidated, and a pilot study was undertaken to ensure that the questionnaire was understood by the 30 participants. The pilot test revealed the questionnaire need slight modifications, which were added. To achieve better face and content validity, the amended questionnaire was evaluated by experts in the Obstetrics and Gynecology disciplines; and academic in diabetes research in USM and Gaza.

All pregnant women who attended the UNRWA primary health care clinics had a routine screening for GDM, according to WHO criteria by 24-28 gestational weeks of pregnancy. The WHO criteria define GDM as either diabetes with fasting plasma glucose of ≥7.0 mmol/L or at 2 hours 75 g oral glucose tolerance test (OGTT) of at least ≥11.1 mmol/L) (Genuth *et al*., 2003). Pre-pregnancy weight was determined as recorded in the first antenatal visit (before eight weeks gestation) of pregnancy. Body Mass Index (BMI) was classified as (underweight <18.5 kg/m^2; normal, 18.5–24.9 kg/m^2; overweight, 25–29.9 kg/m^2; obesity, ≥30 kg/m^2). Family income was categorized as low [< 500 USD, moderate (500- 1000 USD), and high (> 1000 USD)] according to an index established by the Palestinian Central Bureau of Statistics (Palestinian Centre Bereau of statistic, 2012).

Height was measured in centimeters and weight in kilograms by using a traditional manual scale. Education was defined as: Non-schooled (no formal education), preparatory level of education (completed the first nine grades), secondary level (completed high school) and graduate level (completed four years at a university or two to three years with a diploma). Parity was defined as the number of viable pregnancies after 24 weeks of gestation, with the number of gravida defined as the number of times the women had been pregnant. Both parity and gravida were categorized into less than 2 times, 2- 4 times, and more than 4 times pregnant or delivered.

Statistical Analysis

Statistical computations were facilitated using the SPSS version 18 for Windows (Statistical Package for Social Sciences Inc., Chicago, IL). All numerical variables: age, height, and weight were expressed as mean ± standard deviation (SD). Frequency and percentage were used for categorical variable of levels of education, number of family members, number of parity and pregnancies, job status, and family income. Chi-squared and independent t-test was applied to test the significant association between selected sociodemographic variables. Multiple logistic regression was used to test the relationship between associated factors attributed to GDM and independent effect of each individual. The adjusted odds ratio (OR) and the 95% confidence interval (CI) were derived from the coefficient of the logistic model and its standard error. Significance was assumed if the *P*-value was less than 0.05.

Results

Table 1: Prevalence of GDM in Gaza (n =200)

Place of Residency	Total number of GDM post natal women	Total number of deliveries	Percent (%)
North Gaza	60	3723	1.6%
Gaza City	51	3140	1.6%
Middle Zone	40	1952	2.0%
South Gaza	49	2426	2.0%
Total	**200**	**11241**	**1.8%**

Table 1 shows that out of 11241 post deliveries in the year 2010, the overall prevalence rate of GDM was 1.8%. However, the results showed that the prevalence rate in Middle Zone and South Gaza was higher (2.0%) in comparison to North Gaza and Gaza City (1.6%).

Table 2 : Sociodemographic characteristics (categorical variables) associated with GDM (n= 378)

Variables	Non GDM n (%)	GDM n (%)	X2 statistic	*P*-value
Residency				
North Gaza	60 (31.7)	61 (32.3)	2.51	.473
Gaza City	40 (21.2)	40 (21.2)		
Middle Zone	40 (21.2)	50(26.5)		
South Gaza	49 (25.9)	38 (20.1)		
Level of education				
Illiterate	12 (6.3)	26 (13.8)		
Preparatory	29 (15.3)	50 (26.5)	15.78	.001
Secondary	77 (40.7)	63 (33.3)		
Graduate	71 (37.6)	50 (26.5)		
Job status				
Working	83 (43.9)	64 (33.9)	4.01	.045
Not working	106 (56.1)	126 (66.1)		
Income				
Low	38 (20.1)	55 (29.1)	5.96	.050
Moderate	104 (55.0)	82 (43.4)		
High	47 (24.9)	52 (27.5)		
Family member				
< 4	122 (64.6)	75 (39.7)	23.59	.000
4 -6	58 (30.7)	96 (50.8)		
> 6	9 (4.8)	18 (9.5)		
Previous pregnancy				
< 2	98 (51.9)	37 (19.6)	44.45	.000
2-4	71 (37.6)	107 (56.6)		
> 4	20 (10.6)	45 (23.8)		
Number of parity				
< 2	60 (31.7)	28 (14.8)	15.42	.000
2-6	82 (43.4)	107 (56.6)		
> 6	47 (24.9)	54 (28.6)		

Body Mass Index (BMI)				
< 18.5	102(53.9)	28 (14.9)		
18.5 - 24.9	64(33.9)	75 (39.7)	80.53	.000
25 - 29.9	23 (12.2)	80 (42.3)		
> 30	0 (0.0)	6 (3.1)		

P-value <0.05, X^2 Chi-square statistical tests

Results of chi-square test showed that there is no significant difference between GDM cases and control in term of following variables: place of living (chi square= 2.51, p = 0.473) , income (chi square = 5.96, p = 0.50). However same results showed a significant association between GDM cases and control in term of following variables: level of education [illiteracy] (chi square= 15.78, p=0.001); job status (chi square=4.01, p = 0.045); family member (chi square=23.59 p= □0.001); previous pregnancies (chi square=44.45, p = < 0.001); previous parity (chi square=15.42, p = < 0.001) and increase BMI (chi square = 80.53, p= < 0.001). Results are displayed in **Table 2**.

Table 3: Anthropometry differences between the two groups (n = 378)

Variables	**GDM (n=189) Mean (SD)**	**No GDM (n=189) Mean (SD)**	**Mean differ. (95% CI)**	***t statistic***	***P value***
Age	34.1(6.56)	34.2(6.77)	.122(-1.22,1.47)	.177	0.859
Height	162.4(5.42)	162.3(5.39)	-0.052(1.14,1.04)	-.095	0.924
Weigh	81.1(13.16)	69.0(14.15)	-12.08(-14.85,-9.32)	-8.59	.000

P-value <0.05, Standard Deviation (SD)

Table 3 shows that there is no significant differences between the mean age and standard deviation (34.1 yr ±6.56) among GDM cases and the mean age and standard deviation (34.2 yr ±6.77) of the control group with *P*-value =0.859. The results revealed that GDM cases had similar mean and standard deviation (162.4±5.42) of height in comparison to mean and standard deviation (162.3 cm ±5.39) of height in the control group. However, the results showed a significant difference in term of weight (81.1 kg ±13.16) in GDM cases in comparison to mean and standard deviation of weight (69.0kg± 14.15) in the control group with *P*-value less than 0.001.

Table 4: Sociodemographic associated factors of GDM by Univariate Simple Logistic Regression Model

Variable	Regression Coefficient (B)	Crude Odd Ratio (95%CI)	Wald Statistic	*P*-value
Place of residency				
North Zone	0	1		
Gaza City	0.017	1.01(0.52,1.78)	0.03	0.954
Middle Zone	-0.207	0.81(0.47,1.40)	0.54	0.460
South Zone	0.271	1.31(0.75,2.28)	0.91	0.338
Height	0.002	1.00(0.965,1.04)	0.09	0.924
Weight at present	0.070	1.07(1.05,1.09)	53.59	0.000
Weight before last pregnancy	0.080	1.08 (1.06, 1.10)	62.75	0.000
BMI	0.141	1.15(1.10,1.20)	36.77	0.000
Age in Last pregnancy (years)				
<30 years	0	1		
30 - 35 years	-0.446	0.64(0.41,0.99)	3.89	0.048
> 35 years	0.333	1.39(0.48,4.02)	0.38	0.537
Education level				
Graduated	0	1		
Secondary Level	0.136	1.14(0.07,1.87)	0.29	0.589
Preparatory Level	0.907	2.47(1.45,4.22)	11.05	0.001
No Education (Illiterate)	1.58	4.90(0.97,24.58)	3.73	0.053
Job Status				
Working	0	1		
Non-working	-0.425	0.65(0.43,0.99)	4.00	0.045
Income per Month (USD)				
High (> 1000 USD)	0	1		
Moderate (500 -1000 USD)	-0.284	0.75(0.46,1.22)	1.32	0.249
Low (< 500 USD)	1.21	3.36(1.75,6.43)	13.42	0.000

Previous Pregnancy				
< 2	0	1		
2 - 4	0.648	1.9(0.59,6.10)	1.19	0.274
> 4	1.779	5.92(1.88,18.63)	9.25	0.002
Previous Parity				
< 2	0	1		
2 - 4	-0.728	0.48(0.22,1.01)	3.65	0.056
> 4	0.174	1.19(0.56,2.49)	0.21	0.646

Table 4 shows no significant association between the following factors of place of residence, height, age, and education level and developing GDM. However the results of simple logistic regression showed that weight of participants increased a woman`s risk of having GDM by odds 1.07 times (OR1.07, *P*=0.000, CI=1.05-1.09). BMI by odds 1.15 times (OR 1.15, *P*=0.000, CI=1.10-1.20). Job status not working women by odds 0.65 times (OR 0.65, *P*=0.045, CI=0.43-0.99). Family income less than 1000 Shekel by the odds 3.36 times (OR 3.36, *P*=0.000, CI=1.75-6.43). Number of pregnancies more than 4 by the odds 5.92 times (OR 5.92, *P*=0.002, CI=1.88-18.63). Weight of women before their last pregnancies by odds 1.08 times (OR 1.08, *P*= 0.000, CI=1.06-1.10).

Table 5: Sociodemographic correlated factors of GDM by Multivariable Logistic Regression Model

Variable	**Regression Coefficient (B)**	**Adjusted Odd Ratio (95%CI)**	**Wald Statistic**	***P*-value**
Income (USD)				
High (> 1000 USD)	0	1		
Moderate(500 -1000 USD)	-1.12	0.32(0.15,0.69)	8.32	0.004
Low (< 500 USD)	-1.04	0.35(0.14,0.84)	5.53	0.019
Weight before Last Pregnancy	0.06	1.07(1.04,1.09)	29.31	0.000

Multiple logistic regressions were applied after confounder adjustment (job status, previous pregnancy, and BMI). Having a family income less than 500 USD decrease the odds time by

0.35 times (aOR0.35, *P*=0.019, CI=0.14-0.84) and being overweight before pregnancy increase the odds by 1.07 times (aOR1.07, *P*=0.000, CI= 1.04-1.09). Results are displayed in **Table 5**.

Discussion

From reviewing previous literatures and research data, several studies indicated that there has been an increase in the prevalence of GDM all over the world (Hunt *et al*., 2007; Lamberg *et al*., 2010). The findings of the present study revealed that the prevalence of GDM among refugees Gaza women was found to be 1.8% the average population. Our results varied with other international or regional results according to the different use of diagnostic criteria. Our present results are closer with other Arab countries in the same region that used the same diagnostic criteria as Syria, with a prevalence rate of GDM of 2.7%, Jordan at 4.0%, and Lebanon at 5.2% (UNRWA,2009). Our results showed a lower prevalence of GDM in comparison to other Arab countries in the Middle East, such as Saudi Arabia with a prevalence rate of 11%, United Arab Emirates vary from 8% to 24.9%, and Bahrain at 15.5% (Sadikot, 2009; Agarwal *et al*.,2010). This difference could be due to a diverse lifestyle (variations in obesity, daily activity, and type of diet). It has been reported that a high prevalence of GDM was detected in Zuni Indian women (14.3%), Chinese women (13.9%), Indian-born women in Melbourne Australia (15%), and Asian women (11.9%) (Ben *et al*., 2004). Variations in numbers among the results in Arab and other countries could have resulted due to diversity in the diagnostic criteria and procedure used. In Gaza, all cases of GDM were detected by WHO criteria recommendations where the screening was performed during the 24^{th} and 28^{th} weeks of gestation.

Our results in univariate analysis confirmed that there was no significant relationship between place of residence, height, age, with developing GDM. However, our finding was not consistent with previous classical studies that considered advanced age more than 35 years of the mother as one of the major correlation factors for developing GDM (Petry, 2010; Rivas *et al*., 2010; The *et al*.,2011). Otherwise, this finding was consistent with recent recommendations of the United Kingdom National Institution for Health and Clinical Excellence Guidelines (NICE) which excluded the advanced age of the mother during pregnancy as a correlating factor of GDM screening (Simmons *et al.,* 2010).

Another study conducted in Kuwait reported that GDM was strongly associated with women aged less than 45 years (Sultan *et al*., 2004). Such similarity explains that all age groups, not only advanced-reproductive-age women, are at higher risk for developing GDM. The height of women was also found to have no association with GDM. These results were in agreement with other studies that stated similar findings (Zargar *et al.*, 2004; Garshasbi *et al.*, 2008).

Few studies have examined the association between the height and GDM. A cross-sectional study in Greece showed that women with GDM and type II diabetes are shorter in stature than women without GDM (Anastasiou *et al*., 1998). The discrepancies between these studies have no clear explanation because height can be affected by genetic, environmental, and nutritional factors (Aronovitz and Metzger, 2006). Several studies reported that the main associated factors for GDM are obese and increased BMI (Sultan *et al*., 2004; Aronovitz and Metzger, 2006) and our results agree with these findings.

A recent systematic review included 20 articles related to obesity and maternal outcomes published from 1980 to 2006. Eight out of these 20 studies were conducted in the USA; the other 12 was conducted in Canada, Australia, Italy, France, United Arab Emirates, Finland, and the UK (Chu *et al.,* 2007). The reviewed declared that the risk of having GDM is about twofold, fourfold, eightfold higher among overweight, obese, and severely obese reproductive women, respectively, compared with normal-weight women. Hence, being overweight and obese increase the incidence of GDM, and has serious public health implications. Regarding others variables, our findings revealed that there was a significant association between the number of parity, previous pregnancies, family members with diabetes mellitus, educational level, type of job, family income, pregnancy and parity number, and development of gestational diabetes.

Few studies examined the correlation between level of education and job status and prevalence to develop GDM. Bo *et al.* (2002) in a case-control study in Turin, Italy reported that lower levels of education were associated with an increased risk of GDM (Bo *et al.*, 2002). Our results are comparable with other studies that assured the relationship between metabolic disturbances in women and lower educational levels (Lee *et al*., 2005; Negrato *et al*., 2008).

After confounders adjustment, the results verified that family income and weight before pregnancy strongly correlated towards the risk for developing GDM. Similar publications in New South Wales, Australia between the years 1995-2005 examined the association between sociodemographic characteristics and GDM. With regard to our study findings, women living in the lowest socioeconomic status were about two-thirds more likely to have GDM rather than women who lived in a higher socioeconomic status. It has been reported that the inverse relationship of socioeconomic status was noticeable across all ethnic groups (Anna *et al*., 2008). A study has been conducted to identify the socioeconomic status with GDM in Hong Kong and China. Lower socioeconomic classes (classified by either occupational or educational level) were found to be an additional risk factor for glucose intolerance in both male and female populations (Ko *et al.,* 2001). Unfortunately, this study has some limitations to be addressed. First, it was based on GDM postnatal women in Gaza. Second, a review of the collected data from record yielded some missing and inconsistent information. Therefore, the findings are probably applicable to the refugee population which makes it difficult for the result to be generalized.

Conclusion

From the findings of this study, we conclude that according to WHO criteria the prevalence of childbearing aged women to develop GDM in Gaza was 1.8% is average and is increasing. Therefore, optimum intervention for a significant positive effect on both maternal and infant outcomes in pregnancy needs to be given important attention.

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Author contributions

Areefa S.M. AlKasseh developed the study parameters, collected the data, participated in the data analysis and write the manuscript. Soon Lean Keng, Nik Mohammed Zaki, Nik Mahmood, and Yousef, I.Aljeesh review all aspects of the project and was the overall supervisors. Soon Lean Keng provided the editorial advice and critical review; and contributed to the writing and completion of the article.

Competing interests

The authors declare no conflicts of interest.

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