Glucose Tolerance During and After Pregnancy in Nondiabetic Women in an Urban Population in Tanzania

JANET K. LUTALE, MMED
AAFKE JUSTESEN, MRCOG
ANDREW B.M. SWAI, MMED
K. GEORGE M.M. ALBERTI, FRCP
DONALD F. MCLARTY, MRCP

OBJECTIVE — It is generally accepted that glucose tolerance deteriorates during pregnancy in the developed world. Several small studies have suggested that this may not be the case in sub-Saharan Africa. This study was designed to investigate changes in glucose tolerance in nondiabetic African women during pregnancy in Dar es Salaam, Tanzania.

RESEARCH DESIGN AND METHODS — Women (n = 89) seen before the 14th wk of pregnancy without known diabetes were recruited: 58 had a 75-g OGTT in the 1st, 2nd, and 3rd trimesters and postpartum.

RESULTS — Mean FBG levels were 3.9, 3.5, 3.6, and 3.7 mM in the 1st, 2nd, and 3rd trimesters and postpartum period, respectively. Values were significantly lower in the 2nd and 3rd trimesters than in the 1st and 2nd trimesters compared with postpartum. Mean 2-h blood glucoses were 4.7, 4.4, 4.3, and 4.2 mM, respectively. The 1st trimester value was significantly higher than in the 3rd trimester and postpartum. Fifteen (26%) of the 58 women showed a decreased or unchanged 2-h blood glucose during the course of pregnancy, 5 (9%) showed an increase, and no clear pattern was seen in 38 (67%). Values for fasting glucose showed similar trends.

CONCLUSIONS — We conclude that women during pregnancy in an urban African setting show little change in glucose tolerance. This contrasts with women in both the developed world, where glucose tolerance worsens, and in a rural African environment, where glucose tends to improve.

FROM THE DEPARTMENT OF MEDICINE, DEPARTMENT OF OBSTETRICS AND GYNECOLOGY, MUHIMBILI MEDICAL CENTRE, UNIVERSITY OF DAR ES SALAAM, TANZANIA; AND THE DEPARTMENT OF MEDICINE, UNIVERSITY OF NEWCASTLE UPON TYNE, UNITED KINGDOM.

ADDRESS CORRESPONDENCE AND REPRINT REQUESTS TO K.G.M.M. ALBERTI, FRCP, DEPARTMENT OF MEDICINE, THE MEDICAL SCHOOL, FRAMLINGTON PLACE, NEWCASTLE UPON TYNE, NE2 4HH, UK.

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OGTT, ORAL GLUCOSE TOLERANCE TEST; WHO, WORLD HEALTH ORGANIZATION; ANOVA, ANALYSIS OF VARIANCE; FBG, FASTING BLOOD GLUCOSE; BMI, BODY MASS INDEX.

Carbohydrate tolerance deteriorates during pregnancy in women in the developed world, although only a small proportion develop overt diabetes (1–3). These results contrast with the few studies of glucose metabolism in pregnancy in the African population. Thus, Jackson (4) in South Africa concluded that glucose tolerance was not often impaired in the course of normal pregnancy. In Kenya, Fraser (5), using the 50-g OGTT, showed an improvement in glucose homeostasis with advancing pregnancy, whereas Swai et al. (6) in a cross-sectional rural community-based study in Tanzania showed similar improvement. Famuyiwa et al. (7) studied 20 normal, pregnant Nigerian women in each trimester and in the postpartum period, and found the highest mean blood glucose levels in the 2nd and 3rd trimesters. This prospective sequential study was performed in a larger group of women, and WHO criteria were used to determine if glucose tolerance changes during pregnancy in nondiabetic Tanzanian women in Dar es Salaam, Tanzania.

RESEARCH DESIGN AND METHODS

— Pregnant women seen before the 14th wk of pregnancy were transferred to a special antenatal clinic. Known diabetic patients and those with serious medical and obstetric conditions were excluded. On the first visit, the aim of the study was explained to the patients, and their cooperation was requested. Of 89 healthy women recruited, 58 had a 75-g (glucose monohydrate) OGTT (8) in the 1st (<14 wk), 2nd (14–29 wk), and 3rd trimesters (≥30 wk), and in the postpartum period.

Data analysis

Comparisons were made with the χ^2 test, Student's t test, Kendall τ-c correlation coefficient, and ANOVA as appropriate. Deterioration in glucose tolerance was considered to have occurred if the fasting or 2-h blood glucose levels rose sequen-

Table 1—*OGTT: mean blood glucose levels by trimester*

Time after glucose load	Blood glucose (mM)			
	1st trimester	2nd trimester	3rd trimester	Postpartum
0 h (fasting)	3.9 ± 0.08	3.5 ± 0.08	3.6 ± 0.07	3.7 ± 0.07
1 h	5.4 ± 0.15	5.3 ± 0.17	5.3 ± 0.15	4.2 ± 0.09
2 h	4.7 ± 0.12	4.4 ± 0.16	4.3 ± 0.12	4.2 ± 0.09

Values are means ± SD.

tially during the 3 trimesters, whereas improvement in glucose tolerance was considered to have occurred if the fasting or 2-h blood glucose levels fell sequentially from the 1st trimester onwards. For analysis requiring grouped data, parity was classified as primigravida, 1–3, and >3 deliveries. Birth weight was classified as <2.5 kg, 2.5–3.4 kg, and ≥3.4 kg.

RESULTS — Mean age of the women in this study was 23 yr (range 15–44 yr); 24 (41%) were primigravidae. Mean blood glucose values for all trimesters are shown in Table 1. All individual values were within the WHO normal range, except in one woman who had impaired glucose tolerance in the 2nd and 3rd trimesters and postpartum.

The mean FBG in the first trimester (3.9 mM) was significantly higher than in the 2nd (3.5 mM, $P < 0.0001$) and 3rd trimesters (3.6 mM, $P = 0.001$). Mean FBG in the 2nd trimester (3.5 mM) was significantly lower than in the postpartum period (3.7 mM, $P = 0.037$). The mean 2-h blood glucose level in the first trimester (4.7 mM) was higher than in the 3rd trimester (4.3 mM, $P = 0.040$) and postpartum (4.2 mM, $P = 0.07$).

Of the 58 women, 15 (23.7%) showed a progressive decrease or no change in FBG with progression of pregnancy, and 14 (25.4%) showed a progressive decrease or no change in 2-h blood glucose levels (Table 2). Only one woman (2%) showed a progressive increase in FBG, and 5 (8.5%) in 2-h blood glucose levels. The mean weight gain from the 1st trimester to the 3rd trimester was low (mean 6.5 kg; range 1–10 kg). No relationship was found between BMI, weight gain, and blood glucose values. Age, BMI, birth weights, and parity of subjects who showed improved glucose tolerance were no different from subjects whose glucose tolerance did not improve.

CONCLUSIONS — Our results thus show that in pregnant urban African women, mean FBG was highest in the 1st trimester and then decreased slightly, although changes were small. These results are not dissimilar to those in Europids where Lind et al. (2) found that mean FBG did not change during pregnancy, although values were lower than in nonpregnant women; these findings were similar to those of Hurwitz and Jensen (11). Of more direct relevance to our findings, Famuyiwa et al. (7) also reported that in Nigerian women, FBG levels in the three trimesters and postpartum were significantly lower when compared with nonpregnant control subjects. In a more recent cross-sectional community survey in rural African women, we found that the mean FBG decreased progressively throughout pregnancy (6). The lower FBG values in pregnancy are presumably attributable to increased glucose utilization by the enlarging uteroplacental-fetal mass.

The mean 2-h blood glucose values, however, showed results that differ from those obtained in Europids. In our study, all mean 2-h blood glucose levels were within normal limits according to WHO criteria, and did not differ between trimesters. We saw no evidence of a progressive deterioration in blood glucose levels with advancing gestation. By contrast, Hurwitz and Jensen (11), for example, showed abnormally high 2-h values in 29, 52, and 45% of women in the 3 trimesters, respectively. Only 5 of 58 women (8.6%) showed a progressive increase in 2-h blood glucose values. This still contrasts with our data in rural women where we found that the 2-h blood glucose values after a 75-g glucose load decreased progressively. Similar, apparent improvement has also been noted by Famuyiwa et al. (7) among Nigerians and by Fraser (5) in Kenyan women. The possible reasons for these urban-rural differences are unclear.

Table 2—*Blood glucose trends in pregnant women*

Blood glucose trend	n	%
FBG		
Decrease or no change*	14	24.1
Increase†	1	1.7
No clear pattern	43	73.1
Blood glucose 2 h after glucose load		
Decrease or no change*	15	25.9
Increase†	5	8.6
No clear pattern	38	65.5

*Blood glucose value in the 1st trimester > blood glucose value in the 2nd trimester > blood glucose value in the 3rd trimester.

†Blood glucose value in the 1st trimester < blood glucose value in the 2nd trimester < blood glucose value in the 3rd trimester.

Deterioration in glucose tolerance in pregnancy has been postulated to be caused by endocrinological changes leading to progressive insulin resistance. Some (12–14) but not all (15) studies have suggested that pregnancy has an effect on insulin kinetics (13–15). Increased placental insulin degradation does not occur in sufficient amount to alter total body insulin metabolism (16).

Major possibilities for the differences in the pattern of glucose responses in Africans and Europids include differences in weight gain and changes in physical activity. African women are usually active and even when pregnant continue to work hard until labor. They are also lean, and weight gain during pregnancy is moderate. In this study, the mean BMI was 21.5 kg/m^2, and the mean weight gain was only 6.5 kg. Pregnant Europid women tend to be heavier and less active, and weight gain is greater, a mean of 12.5 kg (17) having been reported. Physical inactivity and obesity are strongly associated with glucose intolerance. This also could explain the rural-urban differences, with rural women more likely to continue hard physical activity until the end of pregnancy. Ethnic differences also might explain the differences in glucose tolerance responses during pregnancy.

Whatever the reasons for these differences, the lack of deterioration in glucose tolerance in pregnant African women stresses that such deterioration is not normal in the African setting, by contrast with findings in most developed countries.

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