



<http://www.elsevier.com/locate/jegh>

# Predictors of Ramadan fasting during pregnancy



Lily A. van Bilsen <sup>a,1</sup>, Ary I. Savitri <sup>b,\*</sup>, Dwirani Amelia <sup>c</sup>,  
Mohammad Baharuddin <sup>c</sup>, Diederick E. Grobbee <sup>b</sup>,  
Cuno S.P.M. Uiterwaal <sup>b</sup>

<sup>a</sup> *Leiden University College The Hague, Faculty of Governance and Global Affairs, Leiden University, The Hague, The Netherlands*

<sup>b</sup> *Julius Center for Health Sciences and Primary Care, Julius Global Health, University Medical Center Utrecht, Utrecht, The Netherlands*

<sup>c</sup> *Maternal and Child Care, Budi Kemuliaan Hospital, Jakarta, Indonesia*

Received 25 February 2016; received in revised form 20 May 2016; accepted 5 June 2016

Available online 30 June 2016

## KEYWORDS

Motivations;  
Predictors;  
Pregnancy;  
Ramadan fasting

**Abstract** Although the health effects of Ramadan fasting during pregnancy are still unclear, it is important to identify the predictors and motivational factors involved in women's decision to observe the fast. We investigated these factors in a cross sectional study of 187 pregnant Muslim women who attended antenatal care visits in the Budi Kemuliaan Hospital, Jakarta, Indonesia. The odds of adherence to fasting were reduced by 4% for every week increase in gestational age during Ramadan [odds ratio (OR) 0.96; 95% confidence interval (CI) 0.92, 1.00;  $p = 0.06$ ] and increased by 10% for every one unit increase of women's prepregnancy body mass index (BMI) (OR 1.10; 95% CI 0.99, 1.23;  $p = 0.08$ ). Nonparticipation was associated with opposition from husbands (OR 0.34; 95% CI 0.14, 0.82;  $p = 0.02$ ) and with women's fear of possible adverse effects of fasting on their own or the baby's health (OR 0.47; 95% CI 0.22, 1.01;  $p = 0.05$  and OR 0.43; 95% CI 0.21, 0.89;  $p = 0.02$ , respectively), although they were attenuated in multivariable analysis. Neither age, income, education, employment, parity, experience of morning sickness, nor fasting during pregnancy outside of Ramadan determined fasting during pregnancy. Linear regression analysis within women who fasted showed that the number of days fasted were inversely associated with women's gestational age, fear of possible adverse effects of fasting on their own or the fetal health, and with opposition from husbands. In conclusion, earlier gestational age during Ramadan, husband's opinion

\* Address: University Medical Center Utrecht, Division Julius Centrum Huispost Stratenum 6.131, PO Box 85500, 3508 GA Utrecht, The Netherlands.

E-mail address: [a.i.savitri@umcutrecht.nl](mailto:a.i.savitri@umcutrecht.nl) (A.I. Savitri).

<sup>1</sup> Contributed equally to the manuscript.

Peer review under responsibility of Ministry of Health, Saudi Arabia.

<http://dx.doi.org/10.1016/j.jegh.2016.06.002>

2210-6006/© 2016 Ministry of Health, Saudi Arabia. Published by Elsevier Ltd.

This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

and possibly higher prepregnancy BMI, influence women's adherence to Ramadan fasting during pregnancy. Fear of adverse health effects of Ramadan fasting is common in both fasting and non-fasting pregnant women.

© 2016 Ministry of Health, Saudi Arabia. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

## 1. Introduction

Ramadan is a month according to the Islamic calendar when adult Muslims perform daylight intermittent fasting. Among the approximately 1.6 billion Muslims worldwide [1], we estimate that there are some 300–400 million Muslim women of childbearing age. Although obligatory for all healthy adults and adolescents, Islamic law exempts pregnant and breastfeeding women from fasting. As Ramadan lasts for 1 month in a Lunar calendar, Ramadan fasting will overlap with pregnancy in every three of four births accounting for ~1 billion Muslims alive today who were *in utero* during Ramadan [2]. Despite the exemption, most pregnant women still fast.

There could be health effects of fasting on mothers and fetuses, although no consensus was established on the matter. Several studies showed that prenatal exposure to Ramadan fasting may result in lower birth weight, increased risk of hyperemesis gravidarum, urinary tract infections, and reduction in fetal breathing movements [2–5]. By contrast, many other studies showed no effect of fasting on intrauterine growth, birth weight, birth-time indices, and amniotic fluid index [6]. It has been suggested that fasting during pregnancy may also have long-term implications for the health of offspring, possibly through fetal programming [7]. *In utero* exposure to Ramadan has also been reported to be associated with children's lower cognitive test and math scores and fewer working hours in adulthood [8].

Given the lack of consistent health information about Ramadan fasting and the high proportion of pregnant women that adhere to fasting, it is important to know the motivations for or against fasting during pregnancy. There is a gap of knowledge concerning motivations for the decision of pregnant women to fast during Ramadan. Most research focuses on attitudes and knowledge on the exemption law [9]. For women insisting to fast, it is crucial that knowledge is assembled to understand their motivations. This will prove useful for doctors and health workers, religious advisors, and women's peers, to adequately counsel Muslim pregnant women with regard to Ramadan fasting. In the present study of pregnant women, we

evaluate factors that influence women's adherence to Ramadan fasting.

## 2. Material and methods

### 2.1. Study population

This cross sectional analysis was conducted within an established prospective cohort of pregnant women in a private hospital specializing in maternal and child health services, Budi Kemuliaan Hospital, Jakarta, Indonesia. Pregnant women were recruited to the cohort during their regular first visits for antenatal care. All pregnant women attending visits were invited to join the study and if agreed, signed written informed consent. Participants were examined and interviewed by midwives according to standard clinical care and were followed up until they gave birth. This study was ethically approved by the Institutional Review Board of Budi Kemuliaan Hospital. Women, who paid an antenatal care visit before or during the month of Ramadan (from 10 July 2013 to 7 August 2013), were also asked to join this study. After the midwives gave an explanation, women who agreed gave their informed consent.

### 2.2. Data collection

Data on women's fasting adherence were collected using a daily self-administered questionnaire. During their antenatal care visit, women were provided with a questionnaire. They were asked to fill in the questionnaire every day during the month of Ramadan, indicating whether they fasted per day. After Ramadan, the women were asked to return the questionnaire to the midwives.

Furthermore, at their visit during the month of Ramadan, these women were also interviewed about factors that influenced their decision to fast or not to fast. Women were given several alternative answers for their motivations, which they ticked if they agreed with the statement. If their motivations were not included in the questionnaire, women were allowed to provide their own answer.

Women who indicated that they had fasted for 1 day or more were classified as having adhered to Ramadan fasting during pregnancy, while women

who did not fast at all during pregnancy were classified as having not adhered to Ramadan fasting.

Maternal age was calculated as the difference between her date of birth and the date of her first antenatal care visit. Gestational age was calculated in weeks by subtracting the 1st day of the last menstrual period from the last day of Ramadan. Education was categorized as low education (elementary school or junior high school), intermediate education (senior high school), and high education (university or above).

### 2.3. Data analysis

Women's clinical and demographic data were tabulated by fasting adherence groups for descriptive purposes. All clinical, demographic, and motivation-related variables were considered as predictors of fasting adherence. Univariable logistic regression was first performed to evaluate the unadjusted relation between each predictor and fasting adherence. Furthermore, we selected the statistically significant predictors from the univariable analysis and evaluated them using a multivariable logistic regression. To further refine the effect of these predictors on the number of days women had fasted, we performed a (univariable/multivariable) linear regression analysis within women who had fasted for at least a day. Results are expressed as odds ratios (ORs) or linear regression coefficients with 95% confidence intervals (CIs) and corresponding *p* values. Statistical significance was considered to be a 2-sided *p* value <0.05. All analyses were done with SPSS version 22.0 for Mac (SPSS Inc., Chicago, IL, USA).

### 3. Results

Of the 187 pregnant women included in the study, 149 (80%) fasted during Ramadan and 38 did not fast at all. [Table 1](#) shows the demographic characteristics of the study population separately for fasting and non-fasting women. Women in the fasting group did not differ from the non-fasting group with respect to all characteristics, except in their gestational age during Ramadan, where fasted women had on average 4 weeks younger pregnancies. They were also more likely to be in the first or second trimester during Ramadan. All women were married, with a mean age of 29.1 years. Furthermore, most women and their husbands completed senior high school in both groups. Approximately half of the women were not employed and had a household income of <2.5 million Indonesian Rupiah. In both groups, the proportions of primiparity and ethnic

groups were also similar. The mean prepregnancy BMI was slightly higher in the fasted group than in the non-fasted group.

As in [Table 2](#), the results were found to be statistically significant when cross-tabulated with certain motivations and predictors. All of the women who did not partake in Ramadan fasting were aware of their pregnancy during that time. The non-fasted group was proportionately more concerned that fasting during Ramadan will affect the baby's health and their own health in comparison to the fasting group. For the women who did not fast, more than half of their husbands held the opinion that women should not fast. In the fasted group, 28.9% of the husbands had that point of view. By contrast, the percentage of women whose husband thought they should fast was higher in the fasted group (14.8%) compared to the non-fasted group (10.5%). Morning sickness was as common in the fasted group as in the non-fasted group.

As shown in [Table 3](#), several factors such as women's age, family income, women's education, husband's education, women's employment, ethnic groups, parity, experience of morning sickness, and fasting during pregnancy outside of Ramadan had little or no influence on whether a woman partook in Ramadan fasting during pregnancy. Earlier gestational age was related to a greater likelihood of participating in Ramadan. Additionally, a higher prepregnancy BMI predicted fasting in multivariable analysis, although borderline statistically significant. Women who expressed fear that fasting during pregnancy may affect their own health or the health of their baby had a lower chance of partaking in Ramadan, however, this relationship was no longer statistically significant in multivariable analysis. When the husband believed a woman should not fast during pregnancy, according to the multivariable regression, the probability that she partook in fasting decreased by >65%.

Analysis within women who fasted for at least a day, further, showed that those factors also influence the number of days women had fasted ([Table 4](#)). A husband's opposition and fear of possible adverse effects of Ramadan on the health of mothers or their babies was consecutively associated with 6 fewer fasted days and 4 fewer fasted days, respectively. Similarly, a higher gestational age during Ramadan was associated with fewer fasted days.

The fasted and non-fasted groups answered separate questions regarding their motivations to fast or not to fast. These additional motivations are described in [Tables 5 and 6](#). The majority of the fasted group indicated that they believed they were exempted from fasting but wanted to try it

**Table 1** Baseline characteristics of the study population.

Variable	Ramadan fasting		<i>p</i>
	Yes ( <i>n</i> = 149)	No ( <i>n</i> = 38)	
Women's age (y)	29.1 (5.7)	29.0 (5.6)	0.88 <sup>c</sup>
Gestational age at the last day of Ramadan (wk)	25.3 (10.1)	29.5 (9.8)	0.02 <sup>c</sup>
Family income (IDR) <sup>a</sup>			0.66 <sup>d</sup>
<2.5 million	70 (47.0)	22 (57.9)	
2.5–5 million	58 (38.9)	11 (28.9)	
>5 million	12 (8.1)	3 (7.9)	
Refused to answer	9 (6.0)	2 (5.3)	
Women's education <sup>b</sup>			0.92 <sup>d</sup>
Low	17 (11.5)	4 (10.5)	
Intermediate	92 (62.2)	25 (65.8)	
High	39 (26.4)	9 (23.7)	
Husband's education <sup>b</sup>			0.74 <sup>d</sup>
Low	12 (8.1)	3 (7.9)	
Intermediate	96 (64.9)	27 (71.1)	
High	40 (27.0)	8 (21.1)	
Women's employment			0.77 <sup>d</sup>
Not working	86 (57.7)	20 (52.6)	
Nonformal job	8 (5.4)	3 (7.9)	
Formal job	55 (36.9)	15 (39.5)	
Women's ethnic groups			0.15 <sup>d</sup>
Javanese	42 (28.2)	11 (28.9)	
Sundanese	35 (23.5)	11 (28.9)	
Betawi	36 (24.2)	13 (34.2)	
Other	36 (24.2)	3 (7.9)	
Parity			0.99 <sup>d</sup>
Primiparity	62 (42.4)	16 (42.1)	
Multiparity	85 (57.8)	22 (57.9)	
Trimester			0.18 <sup>d</sup>
1st	22 (14.8)	3 (7.9)	
2nd	61 (40.9)	12 (31.6)	
3rd	66 (44.3)	23 (60.5)	
Prepregnancy BMI (kg/m <sup>2</sup> )	22.8 (4.0)	21.6 (3.2)	0.11 <sup>c</sup>

Data are presented as mean (standard deviation) in case of continuous variables and *n* (%) in case of frequencies.

BMI = body mass index; CI = confidence interval.

<sup>a</sup> Estimated monthly family income.

<sup>b</sup> Low education, completed elementary and junior high school; intermediate, completed senior high school; high, completed university or above.

<sup>c</sup> Independent samples *t* test.

<sup>d</sup> Chi-square test.

anyway. In addition, approximately half of the women who participated in Ramadan fasting had the perception that fasting during pregnancy is not harmful. Among the women who did not fast during pregnancy, perceived difficulty was the most frequent motivator. None of these women indicated that they did not fast because of the exemption granted to pregnant women. Few women acknowledged that their decisions were influenced by their friends and family or by the fear that fasting would affect their own health.

## 4. Discussion

### 4.1. Overview results from the study

The findings in this study among pregnant Indonesian women suggest that adherence to Ramadan fasting was associated with earlier gestational age during Ramadan and higher prepregnancy BMI. Nonparticipation to Ramadan fasting was associated with opposition from husbands and with

**Table 2** Women's motivation for Ramadan fasting.

Variable	Ramadan fasting		<i>p</i> <sup>a</sup>
	Yes <i>n</i> = 149	No <i>n</i> = 38	
Aware of pregnancy during Ramadan	134 (89.9)	38 (100)	0.04
Experienced morning sickness	53 (35.6)	15 (39.5)	0.66
Afraid fasting during pregnancy may affect fetal health	63 (42.3)	24 (63.2)	0.02
Afraid fasting during pregnancy may affect own health	32 (21.5)	14 (36.8)	0.05
Husband's opinion regarding fasting during pregnancy			0.02
Women should not fast	43 (28.9)	21 (55.3)	
Women should fast	22 (14.8)	4 (10.5)	
No opinion	81 (54.4)	13 (34.2)	
Unknown	3 (2.0)	0 (0.0)	
Fasted outside of Ramadan during pregnancy	19 (12.8)	1 (2.6)	0.07

Data are presented as *n* (%) from the frequency variables.

<sup>a</sup> Chi-square test.

women's expressed fear of adverse health effects on their own health or their unborn child. Among women who fasted during pregnancy, higher gestational age, fear of possible adverse effects of fasting on own and baby's health, and husband's opposition were related to less number of days fasted.

#### 4.2. Strengths and limitations

This study is among the first to investigate motivational predictors of pregnant women's adherence to Ramadan fasting. The study population, which comprised Indonesian women living in an urban area (Jakarta), was diverse in terms of ethnic group and socioeconomic background. Women's characteristics were based on medical records while motivational factors of Ramadan fasting were collected through individual interview to assure confidentiality and women's freedom in giving response to each question. The interviews were performed during Ramadan, when the women were still pregnant, to avoid possible recall bias. Data on the number of fasted days were collected after Ramadan, thereby allowing for gathering of the accurate number of days fasted by the women. However, in the analysis, we classified women who fasted for at least a day during Ramadan as part of the fasted group. We are aware that the effect estimate of association between predictors and Ramadan fasting may vary slightly by this classification. We ran the logistic regression with 10 days of fasting as the cutoff and the same results were found.

To our knowledge, studies investigating motivational predictors of Ramadan are scarce. Currently, studies had focused on women's knowledge of the exemption in Islamic law and their perceived harm of fasting during pregnancy, mainly physiological factors that influence women's decision to fast

[9,10]. Social, religious, and spiritual context are key in discussing the medical implication of fasting in pregnant women. The inquiry regarding motivational factors during pregnancy is thus a strength of this study. Many studies do not take into account the different support networks of the family, such as the husband, family, and friends.

#### 4.3. Interpretation of the results

In the present study, 80% of pregnant women fasted at least 1 day during Ramadan, with the median number of days fasted of 15.0 days. The proportion of women who fasted a full month, almost a full month (21–28 days), half a month (11–20 days), and a few days (1–10 days) were 14%, 16%, 19%, and 30%, respectively. Similarly, in a study of Singaporean women, 87% of pregnant women fasted at least 1 day during Ramadan [10]. In another study, 88% of Pakistani women fasted during their pregnancies [9]. In contrast to our study, the majority of the fasted groups fasted for a whole month in both of these studies (33% and 42.5%, respectively) [9,10].

Our finding showed that women in earlier gestational age during Ramadan were more likely to fast. This is supported by several other studies which reported higher adherence to Ramadan fasting among women who were in the first trimester, as compared to those in the second or third trimester [11,12], although another study [13] found a similar adherence of Ramadan in women from various trimesters of pregnancy. The higher rate of fasting adherence in women in earlier gestational age could partly be explained by the fact that some women were not aware of their pregnancy when they performed Ramadan fasting, or that they found out about their pregnancy later during Ramadan. Furthermore, perhaps women who were still

**Table 3** Predictors of Ramadan fasting during pregnancy.

Variable	Univariable		Multivariable	
	OR (95% CI)	<i>p</i>	OR (95% CI)	<i>p</i>
Women's age (y)	1.01 (0.94, 1.07)	0.88		
Gestational age at the last day of Ramadan (wk)	0.96 (0.92, 1.00)	0.03	0.96 (0.92, 1.00)	0.06
<i>Family income (IDR)<sup>a</sup></i>				
<2.5 million	Reference			
>2.5 million	1.57 (0.74, 3.32)	0.24		
Refused to answer	1.41 (0.28, 7.04)	0.67		
<i>Women's education<sup>b</sup></i>				
Low	Reference			
Intermediate	0.87 (0.27, 2.81)	0.81		
High	1.02 (0.28, 3.77)	0.98		
<i>Husband's education<sup>b</sup></i>				
Low	Reference			
Intermediate	0.89 (0.23, 3.38)	0.86		
High	1.25 (0.29, 5.47)	0.77		
<i>Women's employment</i>				
Not working	Reference			
Nonformal job	0.62 (0.15–2.55)	0.51		
Formal job	0.85 (0.40–1.81)	0.68		
<i>Maternal ethnic groups</i>				
Javanese	0.33 (0.09, 1.26)	0.33		
Sundanese	0.40 (0.10, 1.65)	0.40		
Betawi	0.31 (0.08, 1.19)	0.31		
Other	Reference			
<i>Parity</i>				
Primiparity	Reference			
Multiparity	1.00 (0.49, 2.07)	0.99		
Prepregnancy BMI (kg/m <sup>2</sup> )	1.09 (0.98, 1.21)	0.11	1.10 (0.99, 1.23)	0.08
Aware of pregnancy during Ramadan (yes/no)	<sup>c</sup>			
Experienced morning sickness (yes/no)	0.85 (0.41, 1.76)	0.66		
Afraid fasting during pregnancy may affect fetal health (yes/no)	0.43 (0.21, 0.89)	0.02	0.71 (0.29, 1.73)	0.45
Afraid fasting during pregnancy may affect own health (yes/no)	0.47 (0.22, 1.01)	0.05	0.74 (0.29, 1.89)	0.53
<i>Husband's opinion regarding fasting during pregnancy</i>				
No opinion/Unknown	Reference		Reference	
Women should not fast	0.32 (0.15, 0.69)	<0.01	0.34 (0.14, 0.82)	0.02
Women should fast	0.85 (0.25, 2.87)	0.80	0.96 (0.27, 3.44)	0.95
Also fasted outside of Ramadan (during pregnancy) (yes/no)	5.41 (0.70, 41.75)	0.11		

Data are presented as OR from (univariable or multivariable) logistic regression coefficients with 95% confidence intervals for every one-unit increase in the predictor or for positive predictor.

BMI = body mass index; CI = confidence interval; IDR = Indonesian Rupiah; OR = odds ratio.

<sup>a</sup> Estimated monthly family income.

<sup>b</sup> Low education, completed elementary and junior high school; intermediate, completed senior high school; high, completed university or above.

<sup>c</sup> Cannot be analyzed because there were too few cases in the fasted or non-fasted women.

**Table 4** Associations between predictors and the number of fasting days within pregnant women who fasted during Ramadan.<sup>a</sup>

Variable	Univariable		Multivariable	
	No. of days (95% CI)	<i>p</i>	No. of days (95% CI)	<i>p</i>
Gestational age at the last day of Ramadan (wk)	-0.15 (-0.32, 0.02)	0.08	-0.18 (-0.33, -0.02)	0.03
Prepregnancy BMI (kg/m <sup>2</sup> )	0.04 (-0.40, 0.48)	0.87	0.29 (-0.10, 0.68)	0.14
Afraid fasting during pregnancy may affect fetal health (yes/no)	-7.89 (-11.12, -4.64)	<0.01	-4.28 (-7.79, -0.77)	0.02
Afraid fasting during pregnancy may affect own health (yes/no)	-7.82 (-11.82, -3.82)	<0.01	-3.82 (-7.71, 0.07)	0.05
Husband's opinion regarding fasting during pregnancy				
No opinion/unknown	Reference		Reference	
Women should not fast	-6.76 (-10.55, -2.98)	<0.01	-6.21 (-9.77, -2.64)	<0.01
Women should fast	1.46 (-3.33, 6.24)	0.55	1.73 (-2.80, 6.26)	0.45

BMI = body mass index; CI = confidence interval.

<sup>a</sup> Results are linear regression coefficients with 95% confidence intervals for every one-unit increase in the predictor or for positive predictor.

**Table 5** Motivations to perform Ramadan fasting among the fasted pregnant women.

Variable	Frequency <i>n</i> = 149
According to Islam, pregnant women are obliged to fast	39 (26.2)
According to Islam, I do not have to fast but I want to anyway	91 (61.5)
Ramadan fasting during pregnancy is not harmful	77 (52.0)
Ramadan fasting during pregnancy is healthy	73 (49.3)
Because my husband told me to fast	17 (11.5)
Because I do not want to have to make up the fasting later	23 (15.5)
Because I want to share spiritual and social experiences with my family	72 (48.6)
Because I used to fast during Ramadan	84 (56.8)
Because I did not know I was pregnant during Ramadan	16 (10.8)
Because I also did Ramadan fasting on my previous pregnancy(ies) and there is no problem at all	27 (18.2)
Because my midwife and doctor told me that Ramadan fasting during pregnancy is not harmful	25 (16.9)

Data are presented as *n* (%) from the frequency variables.

**Table 6** Motivations not to perform Ramadan fasting among the non-fasted pregnant women.

Variable	Frequency <i>n</i> = 38
Fasting is too difficult to be done during pregnancy	32 (84.2)
I am not used to fasting (also when I was not pregnant)	0 (0.0)
Because I am afraid that it will affect my baby's health	16 (42.1)
Because I am afraid that it will affect my own health	6 (15.8)
Because my husband told me not to fast	16 (42.1)
Because my family and friends suggest me not to fast	2 (5.3)
Because my midwife and doctor told me not to fast	12 (31.6)
Because according to Islam, pregnant women do not have to fast	0 (0.0)
Because I have other illness or pregnancy complications	5 (13.2)

Data are presented as *n* (%) from the frequency variables.

in the early stage of pregnancy perceived the burden as less severe or are less fearful of harmful health effects than women in a later stage of their pregnancy. Morning sickness, which is common in

these women, could also provide some ease to perform fasting, since they do not wish to eat anyway, although severe morning sickness may discourage women from fasting.

In addition, our study shows that women who fasted had on average a higher prepregnancy BMI. This suggests that women with different BMIs may perceive the burden of fasting differently. In accordance with our finding, an Iranian study showed that the fasted group had a significantly higher BMI than the non-fasted group [14]. The authors suggest that women with a higher BMI may perceive the burden of pregnancy as less severe. For this reason, they may feel healthier, and thus are more likely to fast than women with a lower BMI who may be more concerned about their health. In contrast to our study, a previous study showed no significant differences in women's BMI at the beginning of pregnancy with respect to their fasting status [15]. This could be attributed to the significantly higher proportion of overweight women in that study as compared to ours.

Women with higher prepregnancy BMIs might also consider Ramadan fasting as a means for losing weight or to control their gestational weight gain. It is important to note that weight loss through Ramadan fasting could put a woman's unborn child at risk. Maternal weight loss during pregnancy was associated with a lower birth weight and reduced fat and lean mass in neonates [16]. In overweight and obese women, weight loss during pregnancy was associated with some improved maternal and neonatal outcomes, although this effect was lessened by increased odds of small for gestational age status and preterm delivery [17].

Ramadan fasting has been reported to decrease women's weight [18], although on the contrary, a study in Saudi families showed a reported weight gain after Ramadan [19]. Excess weight gain, especially in the first trimester, increases gestational diabetes mellitus risk among women in the study. This needs more attention from healthcare providers as this may represent a modifiable risk factor for gestational diabetes mellitus [20].

It is also important to recognize the role of gender in Muslim society. Our study suggests that the husband's opinion influences a woman's decision to fast. Women were more likely to not fast if their husbands were opposed to it. In the fasted group, most husbands had no opinion, whereas in the non-fasted group, most husbands thought women should not fast. In one study, the majority of the husbands and family units were supportive and only 7% of spouses were against their wives fasting during pregnancy [10]. The opposition could be explained by their concern for the women's or the child's health. Furthermore, husbands' education level also appeared to influence their view regarding fasting obligation during pregnancy.

Husbands with high education were more likely to oppose fasting during pregnancy as compared to those with low or intermediate education (data not shown). About 46% of highly educated husbands had opinions which discouraged fasting during pregnancy, but only 33% and 30% of low and intermediate educated husbands, respectively, had this view ( $p = 0.06$ ).

Our study provides evidence of considerable fear that fasting is harmful for fetal health and mother's own health, both in the fasted and non-fasted women, although more common in the non-fasted women. This fear can be manifested as (psychological) stress in the pregnant women, which could affect pregnancy outcomes. High stress and anxiety levels in pregnant women are associated with an increased risk for spontaneous abortion, preterm labor, and growth retardations in offspring [21]. Furthermore, stress during pregnancy may influence the fetal programming of brain function resulting in grave implications for the offspring. One study found that pregnancy-specific anxiety is a predictor of lower mental and motor development in infants [22].

In our study, women's parity was not associated with women's fasting adherence. In another study, however, multiparous women were reported to fast more than nulliparous women [23]. Similar to our study, employment did not differ between the Ramadan fasted group and non-fasted group in Lebanese women [15]. Considerable variations in ethnic group and socioeconomic background were present in our study population, however these factors did not seem to influence women's fasting adherence. Furthermore, maternal education did not differ between Iranian women who fasted and those who had not [14].

In the absence of a consensus on health outcomes of Ramadan fasting during pregnancy, healthcare personnel face the difficult task of accurately counseling this group of women. The clinical and medical implications of fasting in pregnant women are complex, entrenched by the social, religious, and spiritual context in which health beliefs and practices are affected. Understanding the health beliefs, motivations, and perceptions regarding women's choices to fast, provides valuable insight into healthcare providers to appropriately counsel these women and address their respective medical, social, and religious needs. To some extent, evidence provided from this study could apply in other populations of pregnant Muslim women, or even in other contexts where pregnant women may change their dietary habits during pregnancy.

## 5. Conclusions

In conclusion, earlier gestational age during Ramadan, husband's opinion, and possibly higher prepregnancy BMI influence women's adherence to Ramadan fasting during pregnancy. Fear of adverse health effects of Ramadan fasting is common in both fasting and non-fasting pregnant women.

## Conflicts of interest

The authors declared no potential conflicts of interest with respect to the authorship and/or publication of this article.

## Acknowledgments

The authors gratefully acknowledge Ika Widyaningrum, Eka Irdianty, Nurulia Rachmat, and Erna Rahmawati for organizing data collection. We thank all midwives in Budi Kemuliaan Hospital and Budi Kemuliaan Petojo for their contribution in this study. Finally we would like to thank all women who have participated in this study.

## References

- [1] Pew Research Center. The future of the global Muslim population. Projections for 2010–2030. *Popul Sp Place* 2011;13:1–221.
- [2] Almond D, Mazumder B. Health capital and the prenatal environment: the effect of Ramadan observance during pregnancy. *Am Econ J* 2011;3:56–85.
- [3] Rabinerson D, Dicker D, Kapzan B, Dekez A. Hyperemesis gravidarum during Ramadan. *J Psychosom Obstet Gynecol* 2000;21:189–91.
- [4] Bandyopadhyay S, Thakur JS, Ray P, Kumar R. High prevalence of bacteriuria in pregnancy and its screening methods in north India. *J Indian Med Assoc* 2005;103:259–66.
- [5] Mirghani HM, Weerasinghe SD, Smith JR, Ezimokhai M. The effect of intermittent maternal fasting on human fetal breathing movements. *J Obstet Gynaecol (Lahore)* 2004;24:635–7.
- [6] Khalaf M, Tammam AE, Ibrahim I, Habib DM, Abdellah MS, Bahlol M, et al. Effect of Ramadan fasting on amniotic fluid index in last month of pregnancy. *Middle East Fertil Soc J* 2015;20:54–6.
- [7] Alwasel SH, Harrath A, Aljarallah JS, Abotalib Z, Osmond C, Al Omar SY, et al. Intergenerational effects of in utero exposure to Ramadan in Tunisia. *Am J Hum Biol* 2013;25:341–3.
- [8] Majid MF. The persistent effects of in utero nutrition shocks over the life cycle: evidence from Ramadan fasting. *J Dev Econ* 2015;117:48–57.
- [9] Mubeen SM, Mansoor S, Hussain A, Qadir S. Perceptions and practices of fasting in Ramadan during pregnancy in Pakistan. *Iran J Nurs Midwifery Res* 2012;17:467–71.
- [10] Joosop J, Abu J, Yu SL. A survey of fasting during pregnancy. *Singapore Med J* 2004;45:583–6.
- [11] Arab M, Nasrollahi S. Interrelation of Ramadan fasting and birthweight. *Med J Islam Acad Sci* 2001;14:91–5.
- [12] Hizli D, Yilmaz SS, Onaran Y, Kafali H, Danişman N, Mollamahutoğlu L. Impact of maternal fasting during Ramadan on fetal Doppler parameters, maternal lipid levels and neonatal outcomes. *J Matern Fetal Neonatal Med* 2012;25:975–7.
- [13] Ozturk E, Balat O, Ugur MG, Yazıcıoğlu C, Pence S, Erel Ö, et al. Effect of Ramadan fasting on maternal oxidative stress during the second trimester: a preliminary study. *J Obstet Gynaecol Res* 2011;37:729–33.
- [14] Kavehmanesh Z, Abolghasemi H. Maternal Ramadan fasting and neonatal health. *J Perinatol* 2004;24:748–50.
- [15] Awwad J, Usta IM, Succar J, Musallam KM, Ghazeeri G, Nassar AH. The effect of maternal fasting during Ramadan on preterm delivery: a prospective cohort study. *BJOG* 2012;119:1379–86.
- [16] Catalano PM, Mele L, Landon MB, Ramin SM, Reddy UM, Casey B, et al. Inadequate weight gain in overweight and obese pregnant women: what is the effect on fetal growth? *Am J Obstet Gynecol* 2014;211:137, e1–e137.e7.
- [17] Yee LM, Cheng YW, Inturrisi M, Caughey AB. Gestational weight loss and perinatal outcomes in overweight and obese women subsequent to diagnosis of gestational diabetes mellitus. *Obesity* 2013;21:770–4.
- [18] Al-Hourani H, Atoum M. Body composition, nutrient intake and physical activity patterns in young women during Ramadan. *Singapore Med J* 2007;48:906–10.
- [19] Bakhotmah BA. The puzzle of self-reported weight gain in a month of fasting (Ramadan) among a cohort of Saudi families in Jeddah, Western Saudi Arabia. *Nutr J* 2011;10:84.
- [20] Hedderson MM, Gunderson EP, Ferrara A. Gestational weight gain and risk of gestational diabetes mellitus. *Obstet Gynecol* 2010;115:597–604.
- [21] Mulder EJH, de Medina PGR, Huizink AC, Van den Bergh BRH, Buitelaar JK, Visser GHA. Prenatal maternal stress: effects on pregnancy and the (unborn) child. *Early Hum Dev* 2002;70:3–14.
- [22] Huizink AC, De Medina PGR, Mulder EJH, Visser GHA, Buitelaar JK. Stress during pregnancy is associated with developmental outcome in infancy. *J Child Psychol Psychiatry* 2003;6:810–8.
- [23] Firouzbakht M, Kiapour A, Jamali B, Kazeminavaei F, Taghlilin F, Gorji AMH. Fasting in pregnancy: a survey of beliefs and manners of Muslim women about Ramadan fasting Full Text Introduction. *Ann Trop Med Public Heal* 2013;6:536–40.