Short Communication

Association between Socioeconomic Status and Homeostasis Model Assessment-Insulin Resistance Index and Mediating Variables at the First Trimester of Pregnancy

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Abstract

Background: Some studies have shown that Socioeconomic Status (SES) is positively related to insulin resistance among different population groups, except for pregnant women. Therefore, we examined the relationship between SES and Homeostasis Model Assessment-Insulin Resistance (HOMA-IR) index as well as mediating variables. **Materials and Methods:** This study was performed on 138 primiparous healthy women at 6–10 weeks of pregnancy. The association between SES and HOMA-IR was analyzed by regression analysis, and mediating variables were determined by mediation analysis. **Results:** SES score was positively correlated with HOMA-IR index [$\beta = 0.02$, $t_{101} = 2.20$, $p = 0.03$, 95% CI: (0.00–0.05]. The higher percentage of mediation was related to maternal weigh (70.80%). Job activity had a protective effect on the association between SES and HOMA-IR (-62.50%). The total percentage of two mediators was 25%. **Conclusions:** The positive relationship between SES and (HOMA-IR) in early pregnancy may provide a way to control this condition.

Keywords: *Insulin resistance, mediation analysis, occupations, social class*

Introduction

As the pregnancy progress to the third trimester, resistance to the normal action of insulin occurs, which leads to usage of fats by maternal tissues and maintenance of carbohydrate for growing fetus.[1] This physiological state can lead to gestational diabetes, which has side effects for both mother and fetus. In Brazilian young adults with high Socioeconomic Status (SES), high recreational screen time and low fruit and vegetable consumption were significantly associated with metabolic syndrome.[2] However, a review was conducted with 191 studies involving obese persons confirmed that the lower SES was associated with insulin resistance.[3] Despite much efforts to find the early determinants of gestational insulin resistance, few studies have been performed to investigate the relationship between SES and IR index during pregnancy. In addition, determining the mechanism of this relationship requires finding intermediates that are correlated with both variables.

The association between nutritional status and HOMA-IR index has been previously studied,[4] and the results showed that maternal occupational activity score, weight, systolic blood pressure, and intakes of α-linolenic acid and maltose were associated with both of SES and IR. Therefore, in this paper, which is part of a study on the association between nutritional status and HOMA-IR[4], we assessed the relationship between SES (predictor variable) and HOMA-IR index (outcome variable) as an insulin resistance score at the first trimester of gestation. Also, we determined the mediating role of correlated variables with both of SES and IR.

Materials and Methods

This cross-sectional study was performed on 138 primiparous healthy women aged 18–40 years at 6–10 weeks of pregnancy in Isfahan, Iran, between June 2017 and September 2019. Assuming $\alpha = 0.05$ or a significant level of 0.95%, $\beta = 0.20$ or power of 0.80%, and $p = 0.03$ as the least acceptable correlation in terms of performance, minimum sample size with a 10% drop rate was estimated 134. Exclusion

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criteria included twin or higher-order multiple pregnancy, medical problems affecting body weight (untreated thyroid disease), drug-related hypertension, type 1 or 2 diabetes mellitus, addiction, nutritional problems, being on a special diet, chronic illness, kidney disease, anemia, and body mass index (BMI) ≥35 kg/m^2. Stratified sampling was considered to take into account the effect of participants' socioeconomic conditions on study results.

Individual and family characteristics were collected using a researcher-administered questionnaire. The ultrashort version of SES tool (SES-Iran) was used to estimate SES. After obtaining written consent, participants' weight and prepregnancy BMI were measured by a digital scale. We measured blood pressure twice at 5 min intervals using an automatic BP monitor. The physical activity score as the confounding variable was determined by a pregnancy physical activity scale.[5] The HOMA-IR index was calculated by fasting insulin (micro unit/mL) multiplied by fasting glucose (mg/deciliter) divided on 405.[6]

Then, we investigated the relationship between SES and HOMA-IR index by regression analysis. Mackinnon's product-of-coefficients test was used to analyze whether this relationship were mediated by maternal occupational activity score, weight, systolic blood pressure, and intakes of α-linolenic acid and maltose. To use mediation analysis model, the predictor variable needs to be significantly associated with outcome variable. Also, mediators need to be significantly correlated with both predictor and outcome variables. The sum of the individual mediated effects [Σ(a × b)] was used to obtain the total mediated effect. The mediated percentages were computed as the mediation effect divided by the total effect (path c) [(a × b)/c] and [Σ(a × b)/c] [Table 1]. We calculated total effects through regression models without the possible mediators. Standard errors were considered to make the 95% confidence intervals for the direct and total effects. The SPSS version 20 (SPSS Inc., Chicago, IL USA) displayed bootstrap, which modified confidence intervals applied for indirect and mediated effects. The probable mediators with the mentioned criteria were entered in the final multiple mediator model to estimate mediation effects and mediated percentage

Table 1: Results from the mediation analyses in the association between SES and HOMA-IR index (part 1), and from the multiple mediation analyses considering two significant mediators simultaneously (part 2)

(Part 1: Mediation analyses) Mediator	SES* effect on mediator (path a, X→**** M******)				Single mediator model -mediator effect on HOMA-IR** (path b, M→Y*******)				Indirect effect (a×b, X→M→Y)		Direct effect (path c', X→Y_{adj} M***)			Percentage mediated ($a^{\$}$×$b^{\$\$}$ $c^{\$\$\$}$) %
	Beta	95% CI	t=df	p	Beta	95% CI	Statistical test	p	Beta	95% CI	Beta	95% CI	Statistical test	p	
Weight (kg)	1.06	(0.33, 1.79)	t_{102}=2.87	0.005	0.02	(0.01, 0.02)	t_{101}=6.62	<0.001	0.02	(0.00, 0.031)	0.01	(-0.01,0.03)	t_{101}=0.70	0.482	70.80
Systolic blood pressure (mm Hg)	0.38	(-0.36, 1.12)	t_{96}=1.01	0.312	0.00	(-0.00, 0.01)	t_{95}=1.20	0.232	0.01	(-0.00, 0.007)	0.02	(-0.00,0.04)	t_{95}=1.71	0.089	-
Job-activity (met/hour)	0.79	(0.35, 1.20)	t_{97}=3.59	0.005	-0.02	(-0.03,-0.00)	t_{96}=-3.78	<0.001	-0.01	(-0.03, -0.00)	0.04	(0.01,0.06)	t_{96}=3.26	0.001	-62.50
Linolenic fat intake (gr)	0.01	(0.00, 0.02)	t_{98}=3.20	0.002	0.54	(-0.06, 1.14)	t_{97}=1.78	0.078	0.01	(-0.00,0.01)	0.01	(-0.00,0.04)	t_{97}=1.47	0.144	-
Maltose intake (gr)	-0.07	(-0.17, 0.22)	t_{95}=-1.52	0.131	-0.03	(-0.08, 0.02)	t_{94}=-1.24	0.218	0.00	(-0.00,0.00)	0.02	(-0.00,0.05)	t_{94}=1.87	0.064	-
(Part 2 Multiple mediation Analyses) Mediator	**Multiple mediator model – mediator effect on HOMA-IR (path b, M→Y)**								**Indirect effect (a×b, X→M→Y)**		**Direct effect (path c× $^{\$\$\$\$}$ X→Y adj ***M)**				**Percentage mediated ($a^{\$}$×$b^{\$\$}$ $c^{\$\$\$}$) %**
	Beta	95% CI		p				Beta	95% CI		Beta	95% CI	t	p	
Weight (kg)	0.02	(0.01, 0.02)		0.001				0.01	(0.00, 0.03)						
Job-activity (met/h)	-0.01	(-0.02, -0.00)		0.007				-0.00	(-0.03, -0.00)						
Total								0.00	(-0.01, 0.02)		0.02	(-0.00,0.04)	t_{95}=1.65	0.102	25

*: socioeconomic status; **: homeostasis model assessment-insulin resistance; ***:adjusted; X****: predictor variable; Y*******: outcome variable; M******: mediator variable; $a^{\$}$: association between (X) and potential mediator (M1, M2, M3, M4, and M5); $b^{\$\$}$: association between potential mediator and (Y); $c^{\$\$\$}$: overall association between predictor variable (X) and outcome variable (Y); $c'^{\$\$\$\$}$: direct effect (unmediated) of predictor variable (X) on outcome variable (Y)

Ethical considerations

Written consent obtained, and the study protocol was approved by Ethic Committee of School of Public Health of Shahid Sadoughi University (IR.SSU.SPH.REC.1395.13).

Results

The results indicated that SES was positively associated with HOMA-IR index [β = 0.02, t_{101} =2.20, p = 0.03, 95% CI: (0.00–0.04] [Figure 1]. Every 0.02 increase in SES score was related to one-unit enhancement in IR (path-c). As shown in the second column of Table 1 (part 1), SES was associated with maternal weight and job-activity level at 6–10 weeks of gestation (path-a). The fourth column

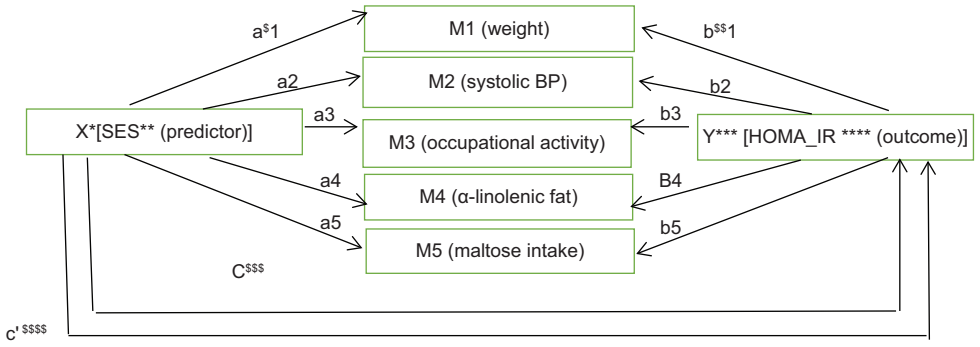

Figure 1: Multiple mediator mode
X*: Predictor variable; **: socio economic status; Y*: Outcome variable; M: Mediator variable ****: homeostasis model assessment-insulin resistance;a$: Association between (X) and potential mediator (M1, M2, M3, M4, and M5); b$$: Association between potential mediator and (Y); c$$$: Total association; c: Overall association between predictor variable (X) and outcome variable (Y); c'$$$$: Direct effect (unmediated) of predictor variable (X) on outcome variable (Y).**

indicates the calculated mediation effects. Statistically significant indirect effects were positive for maternal weight and negative for job activity. The last column of Table 1 provides mediated percentages, whereas the higher percentage is related to maternal weigh (70.80%). Job activity had a negative (protective) effect on the association between SES and HOMA-IR (-62.50%). The total percentage of the complete effect mediated by two mediators was 25%.

Discussion

Higher SES increases HOMA-IR index by maternal weight in the first trimester of gestation, while the occupational activity has a protective effect. The total percentage of the overall effect mediated by two variables was 25%. We obtained no mediation effects for systolic blood pressure and intakes of α-linolenic acid and maltose. We previously showed that nutrients' intake and the components of physical activity were not correlated with SES and insulin resistance index, except for occupational activity and intakes of α-linolenic acid and maltose.[4] Therefore, the association between high SES and insulin-resistance index during pregnancy is not entirely due to nutrients intake and physical activity, as some studies have suggested.[7] Similarly, another study showed that SES was positively related to IR; and usual risk factors such as sleep duration, diet, and physical activity were poor predictors of IR.[8] The first limitation is a cross-sectional design that limits cause–effect interpretations. The second is small sample size.

Conclusion

The positive relationship between SES and insulin resistance in early pregnancy may provide a way to control this condition. Also, this study could be a guide to clarifying the mechanism of this relationship, as it determined up to 25% is related to weight and job activity.

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Conflicts of interest

Nothing to declare.

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