

# **POJ Nursing Practice & Research**

# Research Article

# Mediators of Food Insecurity and Obesity in Female Heads-of-Household with Children

#### **Emily Havrilla\***

Assistant Professor, Passan School of Nursing, Wilkes University, 84 W. South Street, Wilkes-Barre, PA, USA

\*Corresponding Author: Emily Havrilla, PhD, CRNP, ANP-BC, CRRN, Assistant Professor, Passan School of Nursing, Wilkes University, 84 W. South Street, Wilkes-Barre, PA, USA, 18766, Tel: 570-408-4069; Fax: 570-408-7807; Email: emily.havrilla@wilkes.edu

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#### **Abstract**

**Background:** The prevalence of obesity is a significant issue in the United States. Among vulnerable populations, obesity exists in the presence of household food insecurity; however the mechanisms of the relationship are not well understood. General perceived stress and general self-efficacy were evaluated as mediators of the relationship between food insecurity and obesity in female heads-of-household with children.

**Methods:** A cross-sectional correlational design with mediation model testing was used. Subjects (N = 86) were recruited through convenience sampling. Data were collected using a demographic questionnaire, the Core Food Security Module (CFSM), the General Perceived Stress Questionnaire (PSQ), and the General Self-Efficacy Scale (SES). Body mass index and waist —to-hip circumference were calculated from measured data.

**Results:** Significant relationships were found between food insecurity and general perceived stress, general perceived stress and obesity, and general self-efficacy and obesity. Mediation models' testing was not completed due the lack of a significant correlation between food insecurity and obesity. Post hoc analysis was completed using bootstrapping and a revised mediation model process.

**Conclusion:** General perceived stress and general self-efficacy are associated with obesity in female heads-of-household with children who are food insecure.

**Keywords:** Food insecurity, Obesity, Stress, Self-efficacy, Vulnerable populations, Quantitative research, Socioeconomic factors

#### Introduction

Obesity in the United States has been described as a national epidemic [1]. CDC data demonstrate a marked increase in the prevalence of obesity over the past 25 years [2]. The significance of the problem is underscored when trends in obesity prevalence in the United States are examined. Data from the National Health and Nutrition Examination Survey indicate that age-adjusted adult obesity rose from 30.5% in the 1999-2000 data period to 37.7% in the 2013-2014 data period [3]. Although this upward trend stabilized between 2011-2013 data and 2013-2014 data, the prevalence rate remains serious.

The fundamental processes associated with obesity are unclear; however, it has been recognized that the etiology of obesity includes physical, environmental, behavioral, and societal factors [4]. Examination of social determinants of health and their influence on obesity may provide information about the etiology of obesity and evidence to support programmatic interventions to decrease the prevalence of obesity.

Among vulnerable populations, obesity exists in the presence of household food insecurity, yet the mechanisms of the relationship are not well understood [5,6]. Furthermore, gender differences have been noted in food insecure households with more households headed by single women identified as food insecure than households headed by single men [7]. Concurrently, women who are food insecure are more likely to be obese than food secure women [6,8].

The participants in the 2010 Institute of Medicine workshop entitled "Workshop on Understanding the Relationship between Food Insecurity and Obesity" reached consensus that "food insecurity does not in and of itself explain or cause obesity"

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[9]. It was suggested that food insecurity may be associated with other factors through joint causality or mediation in influencing obesity. Therefore, this study examined two factors, general perceived stress, and general self-efficacy, as possible mediators of the relationship between food insecurity and obesity in female heads-of-household with children.

# **Background**

Obesity exists in the presence of food insecurity which has been described as the food insecurity-obesity paradox [8]. The United States Department of Agriculture (USDA) defines food insecurity as "a household-level economic and social condition of limited or uncertain access to food" [7]. Food insecurity is a recurrent phenomenon rather than a continual state. The prevalence of food insecurity has been estimated each year by the USDA through data obtained from the Food Security Supplement (FSS) to the Current Population Survey (CPS) [10]. In 2014, 14% of U.S. households were food insecure at some time during the year [11]. Gender differences were noted among households with children less than 18 years of age with 35.3% of households headed by a single woman compared to 21.7% of households headed by a single man classified as food insecure [11]. Linkages between food insecurity and obesity in women have been identified [5,6,8,12,13].

Factors associated with food insecurity such as poverty, food quality, diet sensitive chronic disease, and stress are not fully explored nor are the potential linkages of these aspects to obesity determined [14]. Franklin and colleagues reviewed literature in which mediators between food insecurity and obesity were investigated [7]. Their analysis identified gender, marital status, stressors, and food stamp participation as mediators of the food insecurity and obesity relationship. Other potential mediators include: cyclic eating, changes in energy efficiency associated with cyclic eating, substitution of energy dense foods, and psychological consequences of food insecurity such as stress, anxiety, and depression [5,6,13]. Martin and Ferris recognized the relationship between societal economic factors, female-headed households, food insecurity, and obesity [15]. However, they inferred that there are other factors, aside from poverty, that increase the risk for obesity in the presence of food insecurity. The literature supports the need to identify mechanisms that mediate the relationship between food insecurity and obesity.

Empirical research has explored the relationship between stress and obesity, supporting the exploration of perceived stress as a mediator of food insecurity and obesity [16,17]. Perceived stress is defined as an individual's appraisal of a life event as threatening and the perception that coping resources are insufficient to address the threat [18]. In the presence of chronic perceived stress the hypothalamic-pituitary-adrenal axis becomes hyperactive with subsequent inhibition of growth hormone and the hypothalmo-pituitary-gonadal axes. This

results in increased adrenocorticotropin hormone and cortisol levels. This system ultimately leads to metabolic changes which include insulin resistance, compensatory hyperinsulinemia and the redistribution of lipids to central adipose tissue [19]. Congruent with these metabolic changes, Levenstein and colleagues proposed that life situations, as perceived by the individual, have psychosomatic influences which lead to physical changes in the body [20]. Environmental factors, such as food insecurity, may be appraised by an individual as a threat that will trigger the hypothalamic-pituitary-adrenal axis, further supporting evaluation of perceived stress as a mediator between food insecurity and obesity [14].

Self-efficacy is the belief that one can successfully perform a behavior required to produce specific outcomes [21]. General self-efficacy reflects the ability to respond to many stressful situations; it is a belief in overall competence or capability to perform in a variety of contexts [22,23]. General self efficacy has been investigated in studies related to weight, supporting the exploration of general self-efficacy as a mediator of the relationship between food insecurity and obesity [24,25,26].

The theoretical framework that integrates the study of food insecurity, general perceived stress, general self efficacy and obesity is the Vulnerable Populations Conceptual Model (VPM). The VPM relates resource availability and relative risk to health status [27]. The model posits that a lack of resources increases relative risk, increased risk factor exposure leads to increased morbidity and mortality relative to health status in a population group, and morbidity and mortality in a community may impact resource availability. Within the model resource availability refers to access to socioeconomic resources and environmental resources. It is availability of these resources that leads to differential vulnerability in population groups [27].

# **Research Questions**

In female heads-of-household between the ages of 18 and 59 living with one or more children under 18 years of age: (1) What is the relationship between food insecurity and the dependent variables of general self-efficacy and perceived stress? (2) What is the relationship between the dependent variable of obesity and the independent variables of (a) food insecurity, (b) general self-efficacy, and (c) perceived stress? (3) What is the relationship between food insecurity and obesity when either general self-efficacy or perceived stress is controlled for statistically?

# **Methods**

A cross-sectional, correlational design was used to explore the identified relationships in female heads-of-household with children. General perceived stress and general self-efficacy were tested as mediators of the relationship between food insecurity and obesity following Baron and Kenny's four step method for testing mediation [28].

# **Sampling and Inclusion Criteria**

A convenience sample was recruited from two food pantries and one community action agency in the Northeastern United States during November 2015 through February 2016. Inclusion criteria were: (a) female head-of-household with one or more children under the age of 18, (b) age 18 to 59, (c) able to read and speak English. A required sample size of 85 subjects for statistical analysis was determined through power analysis with a significance level of 0.05 and a moderate effect size. The study received approval from the Institutional Review Board.

#### Measures

#### **Demographic Characteristics**

A demographic questionnaire was developed by the investigator to collect data to describe the study sample. Variables included: age, race/ethnicity, work status, education, annual household income, household composition, number of children residing in the household, and number of total individuals residing in the household.

# Obesity

Obesity was defined as a Body Mass Index (BMI) of  $\geq 30 \text{ kg/m}^2$  (NIH, 1998). The dependent variable of obesity was measured through calculation of BMI using measured height and weight obtained by the investigator using the Seca Portable Stadiometer 213 and the Seca Digital Flat Scale 803. Waist to hip circumference ratio was calculated from measured waist and hip circumference following the World Health Organization protocol [29]. The waist to hip circumference ratio served as an indicator of central adipose tissue deposits that occur with the endocrine reaction associated with prolonged stress. It further served as a surrogate measurement of this reaction [19,30].

# **Food Security**

Food security was measured at the household level using the Core Food Security Module (CFSM) [31]. The CFSM was developed to be administered via interview. The instrument is constructed using a three-stage design with screeners. The complete instrument consists of 10 questions for households with only adults present and two additional stages for households with one or more children totaling 18 questions. The number of food insecure conditions and behaviors are totaled to calculate a score of 0 to 18. Households with children are classified as having marginal food security with a score of 1 to 2; low food security with a score of 3 to 7; and very low food security with a score of 8 to 18. Households with five or more food insecure conditions among children are considered to have very low food security among children [31].

#### **General Perceived Stress**

General perceived stress was measured using the General Perceived Stress Questionnaire (PSQ). The General PSQ measures the degree to which individuals experience psychosocial factors proven to correlate with physical symptoms [20]. This instrument measures stress that has occurred over

the time frame of up to two years. The thirty item questionnaire is designed to identify subtle psychosomatic influences related to stress on structural alterations in the body. Each item is ranked as almost never (1), sometimes (2), often (3), or usually (4). Subjects are instructed to circle the number that describes how often each item applies to them in general, during the last year or two. Questionnaire items are scored as 5 minus the circled number for eight positive items and the circled number for the other items. The values for each item are then totaled to yield the raw score. The PSQ Index is calculated as the raw score minus 30 which is then divided by 90 to obtain an index score ranging between 0 and 1 [20].

# **General Self-Efficacy**

General self-efficacy was measured by the self-administered General Self-Efficacy Scale (GSE Scale) [32]. The instrument consists of 10 items, each with a four-point response scale of (1) not at all true, (2) hardly true, (3) moderately true, and (4) exactly true. The values of the responses are totaled with final scores ranging from 10 to 40. Higher scores indicate a stronger sense of generalized self-efficacy [33].

# **Data Analysis**

A database was created using IBM Statistical Package for the Social Sciences, Version 22. Descriptive analysis of the demographic data was completed for all variables. Scores on the CFSM, GSE Scale and General PSQ were calculated and internal consistency reliability values of the instruments were evaluated. Household food security status raw scores were transformed into the household food security status categories. The scores for the 10-item GSE Scale were evaluated. One participant was missing one response. As all items are equivalent in the measure, the GSE Scale score was calculated for this participant through the use of the participant's mean responses. The scores for the 30-item General PSQ were calculated after reverse coding of items following instrument scoring instructions [20]. Eight participants were missing one response item. The General PSQ scores for these participants were calculated through the use of mean responses as all scale items are equivalent. Height and weight measurements were used to calculate BMI. The BMI scores were subsequently transformed into the weight status categories of underweight (BMI < 18.5 kg/m²), normal (BMI 18.5 to 24.9 kg/m<sup>2</sup>), overweight (BMI 25.0 to 29.9 kg/m<sup>2</sup>), and obese (BMI 30.0 to 34.9 kg/m<sup>2</sup>). Additionally, participants' BMI scores were categorized by obesity class if applicable (Class 1 = BMI 30.0 to 34.9 kg/m<sup>2</sup>; Class II = BMI 35.0-39.9 kg/m<sup>2</sup>; Class III = BMI  $\geq$  40 kg/m<sup>2</sup>) [34]. Waist and hip circumference measurements were used to calculate the waist to hip circumference ratio (WHCR).

Data were assessed for normality using Fisher's skewness and kurtosis measures. The GSE Scale scores were mildly skewed and not transformed to facilitate interpretation. Correlation analysis was performed using Pearson Product Moment Correlation to asses the direction and strength of the relationships between

study variables. A conservative two-tailed test of significance was set at p < 0.05 even if the hypothesized relationship was directional. General Perceived Stress and General Self-Efficacy were evaluated as mediators of the relationship between food insecurity and obesity using Baron and Kenny's method for testing mediation [28]. This method includes both correlational and regression analysis as appropriate.

#### **Results**

Potential subjects were screened for eligibility to participate in the study by agency personnel. After review of the study consent form, consent was obtained and data collection performed. The investigator completed the CFSM through interview and obtained physical measurements. Subjects completed the self-administered demographic questionnaire, General Perceived Stress Scale and General Self-Efficacy Questionnaire. Subjects received a fifteen dollar grocery store gift card as an incentive to participate in the study.

A total of 86 subjects who met the inclusion criteria were recruited for the study. Demographic characteristics of the sample are reported in Table 1. During the participant recruitment process, participants who had self-identified as head of household were included in the study sample. On analysis, household composition varied with husband (25.6%) or long-term partner (15.1%) living in the household most frequently in addition to children.

Table 1

Demographic Characteristics of Sample (N = 86)

Variable	Mean	SD	N	%
Age	35.88	9.750	84	
Racial/Ethnic Group			86	100%
Black (not Hispanic)			6	7%
White (not Hispanic)			66	76.7%
Hispanic			6	7%
Asian or Pacific Islander			2	2.3%
Other			6	7%
Highest level of school completed			86	100%
Some high school			13	15.1%
High school			31	36%
Some college			23	26.7%
Completed college			15	17.4%
Some grad school			1	1.2%
Completed grad school			3	3.5%
Work status			86	100%
Retired/Not working			51	59.3%
Working part-time			18	20.9%
Working full-time			17	19.8%
Income from all sources before taxes			85	98.8%
\$4,999 or less			28	32.6%
\$5,000-\$9,999			18	20.9%
\$10,000-\$19,999			19	22.1%

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\$20,000-\$29,999			14	16.3%
\$30,000-\$39,999			3	3.5%
\$50,000-\$59,000			1	1.2%
\$60,000-\$69,000			1	1.2%
\$70,000-\$79,000			1	1.2%
\$100,000 or more			0	0%
Head of Household			86	100%
Yes			86	100%
Living in Household			86	100%
Husband			22	25.6%
Long-term partner			13	15.1%
Roommate			1	1.2%
Parent/s			4	4.7%
Child/children			84	97.7%
Grandchild/grandchildren			7	8.1%
Other family members			7	8.1%
Number of children less than 18 years of age in household	2.16	1.136		
Number of individuals in household	3.92	1.512		

#### **Descriptive Analyses**

Descriptive statistics of the study variables are presented in Table 2. The mean BMI score in the sample was 32.83 kg/m2 (SD = 8.46), indicating that on average participants were obese. BMI categories further illustrated the degree of obesity within the sample with 60.5% obese, 20.9% overweight, 16.3% normal weight and 2.3% underweight. Subjects with BMI scores above 30 kg/m2 were further categorized as Class I, 25.6%; Class II, 14%; and Class III, 20.9% of the total sample [34]. The mean food security score in the sample was 6.97 (SD = 4.08) indicating that, on average, study participants were residing in households that were food insecure. The degree of household food insecurity

among the sample population was further delineated through analysis of the household food security categories of high food security, 9.3%; marginal food security, 10.5%; low food security, 30.2% and very low food security, 50%. Scores on the General PSQ for the study population yielded a mean of .50 (SD = .18). The scores indicate that on average, study participants were experiencing a moderate level of stress during the last year or two [20]. General self-efficacy was measured by the GSE Scale with a mean score of 31.05 (SD = 4.97) for the study sample, indicating that on average study participants had a higher sense of general self-efficacy [33].

Table 2
Descriptive Statistics of Study Variables

Variable	Mean	SD	Score		
			Minimum	Maximum	
CFSM	6.97	4.08	0	15	
General PSQ	.50	.18	.07	.92	
GSE Scale	31.05	4.97	13	40	
ВМІ	32.83	8.46	16.83	54.50	

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WHCR	.86	.06	.73		1.02	
Weight Status Cate	gories	N			%	
Underweight		2		2.3%		
Normal weight		14			16.3%	
Overweight		18		20.9%		
Obese		52		60.5%		
Class I		22		25.6%*		
Class II		12		14%*		
Class III		18		20%*		

<sup>\*</sup>Obesity class percentages based on total sample (N = 86).

Household Food Security	N	%
High Food Security	8	9.3%
Marginal Food Security	9	10.5%
Low Food Security	26	30.2%
Very Low Food Security	43	50%

# **Inferential Analyses**

Bivariate correlational analyses were performed to determine if a significant relationship was present between any of the demographic variables and obesity (BMI) prior to hypothesis testing. Demographic variables at the categorical level were recoded into dichotomous variables based on frequency distributions. Subsequent correlational analysis of demographic variables and the dependent variable obesity demonstrated that highest level of education (r = -.288, p < 0.01) and annual income before taxes (r = -.221, p < 0.05) were inversely, significantly related to obesity. However, the relationship between food insecurity and obesity was not significant in hierarchical regression analysis performed controlling for education level and annual income. The demographic variable of "living in household" was recoded and analyzed to evaluate the effect of the presence of a husband or partner in the household. This variable was not significantly correlated with any of the study variables. Additionally, internal consistency reliability coefficients for the CFSM (.859), General PSQ (.935), and GSE Scale (.899) were acceptable.

Relationships between study variables were evaluated and are presented in Table 3. Food insecurity was not significantly related to obesity in the study sample. Additional correlational

analyses were performed based on the classifications of food security and obesity. The relationship between household food security and obesity was not significant in all classifications of the variables. Because the independent variable food insecurity was not significantly related to the dependent variable obesity, the mediation models could not be further tested through regression analysis [28]. Food insecurity was positively and significantly related to general perceived stress (r = .507, p = 0.000); general perceived stress was positively and significantly related to obesity (r = .221, p = 0.04); and general self-efficacy was inversely and significantly related to obesity (r = .224; p = 0.038). A relationship between food insecurity and general self-efficacy was not supported. The waist-to-hip ratio was not significantly correlated with study variables.

Lastly, because of the significant inverse correlation between general perceived stress and general self-efficacy (r = -.342; p = 0.001) a mediation model to evaluate general self-efficacy as a mediator between general perceived stress and obesity was tested [28]. Hierarchical regression revealed that when general self-efficacy was controlled for statistically, the relationship between general perceived stress and obesity was no longer statistically significant, indicating mediation.

Table 3
Correlation Coefficients of Study Variables

	Household Food Security	General PSQ	WHCR	GSE Scale	Obesity
Household Food Security					
Pearson Correlation	1				
Sig. (2-tailed)					

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General PSQ					
Pearson Correlation	.507**	1			
Sig. (2-tailed)	.000				
WHCR					
Pearson Correlation	.005	.097	1		
Sig. (2-tailed)	.966	.374			
GSE Scale					
Pearson Correlation	203	342**	055	1	
Sig. (2-tailed)	.061	.001	.614		
Obesity					
Pearson Correlation	.142	.221*	.129	224*	1
Sig. (2-tailed)	.191	.041	.235	.038	

<sup>\*</sup>significant at the 0.05 level; \*\*significant at the 0.01 level

# **Post Hoc Analysis**

The absence of a significant relationship between food insecurity and obesity in this study prevented the methodological progression to testing of the proposed mediation models through regression analysis [28]. Although the procedure for testing mediation outlined by Baron and Kenny has been used in analyses for over 25 years, flaws in the method have been identified [28,35]. In discussion of mediation analysis, Kenny, Kashy, and Bolger state that correlation of the causal variable (food insecurity) with the outcome variable (obesity) is not mandatory [36]. This discussion suggests that general perceived stress may be considered a mediator of the relationship between food insecurity and obesity.

Alternate approaches to mediation model analysis have been recommended [35,37]. In bootstrapping, the sample is viewed as a smaller version of the population. The sample is resampled with replacement to create an approximation of the sampling distribution of the indirect effect. These estimates are used to create a percentile-based bootstrap confidence interval. If zero is not between the lower bound and upper bound, then the statement may be made that the indirect effect is not zero with the percent of confidence equivalent to the selected confidence interval [38].

Post hoc analyses of the study data were performed using the PROCESS macro for SPSS [39]. A bias-corrected bootstrap confidence interval was generated from 5,000 bootstrap samples to test each proposed mediation model at a 95% level of confidence. The indirect effect of food insecurity on obesity through general perceived stress was estimated as (a x b) = 0.21. The bias corrected bootstrap confidence interval for the mediation was -0.0520 to 0.5015. The hypothesis that general perceived stress mediates the relationship between food insecurity and obesity was not supported because zero

was contained within the confidence interval. The indirect effect of food insecurity on obesity through general self efficacy was estimated at (a x b) = 0.0855. The bias corrected bootstrap confidence interval for the mediation was -.0052 to 0.2818. As zero was within the confidence interval, the hypothesis general self-efficacy mediates the relationship between food insecurity and obesity could not be supported.

# Discussion

#### **Findings**

There are conflicting findings in this study related to the selected analysis method. Analysis of study data via classic mediation testing and via bootstrapping did not support general perceived stress or general self-efficacy as mediators of food insecurity and obesity [28,39]. However, the presence of positive correlation between food insecurity and general perceived stress and general perceived stress and obesity indicates a need for further investigation of general perceived stress as a mediating variable based upon modification of recommendations for mediation analysis by Kenny, Kashy, and Bolger [36]. Additionally, general self-efficacy was found to have a mediating effect between general perceived stress and obesity in the study.

The results suggest that food insecurity may be an experience that exceeds coping resources leading to general perceived stress. Individuals in the study population who are food insecure experience general perceived stress. Secondly, there was a significant correlation between general perceived stress and obesity in the study sample. However, the small effect size (r = 221, p < 0.05) suggests that the variance in obesity may be associated with other factors in addition to general perceived stress. Additionally, general self-efficacy, as a mediator between perceived stress and obesity, may decrease the presence

of obesity. These findings, viewed within the context of the Vulnerable Populations Model, reflect the potential of many factors to influence the prevalence of obesity in female heads-of-household with children.

The self-identification of study participants as "head-of-household" while indicating the presence of a husband (n = 22, 25.6%) or a long-term partner (n = 13, 15.1%) living in the household identifies the need for future research relative to the multiple definitions of "head-of-household".

#### **Limitations and Recommendations**

Study limitations included the use of a cross-sectional, convenience sampling method from three community-based sites. Study sites were selected to provide a sample with multiple levels of household food security and a sufficient number of subjects who were food insecure. This recruitment strategy did not generate diversity in the study sample. The cross sectional design limited data collection to one point in time. Despite the use of instruments to evaluate general perceived stress and general self-efficacy, this may not adequately reflect the relationship of these variables to food insecurity and obesity over time. A longitudinal design and a stratified sampling method may improve the validity of study results.

#### Conclusion

Findings from this study suggest that women who are heads-of-household in food insecure households with children experience general perceived stress and that general perceived stress is associated with obesity. Also, general self-efficacy mediated the relationship between general perceived stress and obesity. When viewed within the context of the Vulnerable Populations Model, these factors have the potential to influence the relative risk of obesity in this population. Systematic efforts to increase resource availability and decrease relative risk would serve to improve health status. There is a need to design and implement programmatic interventions to decrease perceived stress and increase self-efficacy for food insecure women with children.

This vulnerable population often seeks healthcare at free clinic settings. However, food pantries and community action agencies may be additional sites for increased access to healthcare services for food insecure women with children. Programs designed to provide health promotion services and wellness activities delivered in the context of the food pantry would provide more effective outreach, broader access, and improved health status for vulnerable women and children. There is a need for health policy advocacy for change in the distribution of resources to provide services at non-traditional sites. A shift in the delivery of services has the potential to facilitate achievement of health outcomes including a decrease in obesity prevalence in the target population.

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# **Declarations**

#### **Conflict of Interest**

The author reports no conflicts of interest.

# **Ethical Approval**

This study was approved by the Rutgers University Institutional Review Board through expedited review. Reference # Pro20150002304.

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