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Association Between Socioeconomic Status, Food Security, and Dietary Diversity Among Sociology Students at the Central University of Venezuela

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Venezuela is currently in a difficult social, political, and economic situation that has exposed people to many factors, including socioeconomic disadvantages, food insecurity, and lack of access to healthy and nutritious foods. These factors are associated with low dietary diversity, especially for economically dependent university students. In this study, we aimed to identify the associations between socioeconomic status, food security, and dietary diversity among sociology students at the Central University of Venezuela (UCV). This cross-sectional study was conducted between June and November 2016 on a simple random sample of 270 students. Indicators were calculated using data collected by the Mendez-Castellano socioeconomic questionnaire, the Community Childhood Hunger Identification Projects Scale of Food Security adapted and validated for Venezuelans (Cronbach's alpha = 0.898), and the validated dietary diversity scale for individuals. The rate response was 100%. It was observed that most of the sample is located between the socioeconomic status of the rich and middle class (82.6%), presents some degree of food insecurity (85.9%), and maintains a diet with low dietary diversity (54.8%). Our main finding is that the socioeconomic status in the households of those students is not associated with either their food security level or their dietary diversity, but these constructs are related in a significant statistical way. In particular, the odds of a student household having a diverse diet instead of a monotonous diet are 3.92 (95% CI: 2.91; 4.93) times greater for those in food security instead of moderate/severe food insecurity. It is concluded that these students have a multifactorial critical food situation, in which the food right is violated, which could affect their permanence and academic performance.

Keywords: Venezuela, university students, socioeconomic status, dietary diversity, food security

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INTRODUCTION

Food security (FS) is a construct defined by the Food and Agriculture Organization of the United Nations as "the situation when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preference for an active and healthy life" (FAO, 2020). Therefore, food insecurity is the lack of food security, and it may occur when access to or availability of sufficient amounts of healthy, culturally appropriate, and

nutritious foods is compromised, when individuals cannot access these foods in socially acceptable ways or when nutrient utilization is compromised (Gallegos et al., 2014; Terragni et al., 2020). FS is commonly assessed using different measurement tools or applying different classification criteria (Shi et al., 2021). It could be classified at different severity levels: low insecurity when a household worries about not having enough food; moderate insecurity when a household sacrifices food quality more frequently; and severe insecurity when a household cuts back on the food quantity or experiences hunger (Lorenzana and Mercado, 2002).

In light of the last 8-year events in Venezuela such as massive protests, unemployment, poverty, low wages, hunger, and malnutrition (Doocy et al., 2019), it is not possible to ignore the existence of a difficult social, political, and economic situation that reduces many families' chances to meet their minimum caloric requirements. According to an international report on food (FAO, 2020), there were nearly 6.8 million people in hunger, and more than 70% of the population is food insecure in Venezuela. Most recently, an independent study (UCAB, 2020) states that this percentage is higher, especially due to the COVID pandemic, reporting 97% of food insecurity in the population.

In this food crisis, the need for food competes with other necessities such as health services, transportation, housing, etc. (Tapia et al., 2017). For this reason, socioeconomic status is also relevant for having good food (Gupta and Mishra, 2018). Some studies have found that wealthier households have the resources to purchase more and diverse food than poor households (Codjoe et al., 2016).

A food-insecure household often decreases the quality and quantity of food, which directly affects nutrient adequacy (Lorenzana and Mercado, 2002). Dietary diversity (DD) is another construct defined as the number of different foods or food groups consumed by the household over a reference period, not regarding consumption frequency (FAO, 2011). As a result, DD can be used as a proxy measure of the diet's nutritional quality when it is used in children or adults, in an individual measuring, using a 24-h recall (Steyn et al., 2006).

DD has been identified as a key predictable element of high-quality diets in terms of nutrient adequacy globally, and it probably reflects the economic accessibility of different food items (Wanyama et al., 2019). Resource-poor communities usually experience difficulty achieving DD as they typically consume a monotonous diet (Ruel, 2003a). The National Survey on Living Conditions (ENCOVI, by its Spanish acronym) is a study conducted by three major Venezuelan universities, Universidad Central de Venezuela, Universidad Católica Andrés Bello, and Universidad Simón Bolívar, to provide an independent set of national social indicators; this study reports a monotonous diet, plenty of starches with little fish, meat, egg, vegetables, and fruits (Landaeta-Jiménez et al., 2018).

DD is positively linked with FS and socioeconomic status, and it is much easier and cheaper to use than traditional food security measures (FAO, 2011). Additionally, households with higher total monthly expenditure on food are expected to have higher DD and FS (Ruel, 2003a). However, there are different ways to define and measure DD that operate with different methods and background assumptions, and it is difficult to compare DD score methods between studies (Ruel, 2003b).

For university students, food choice and food consumption are determined by taste, health, and economic reasons (Ukegbu et al., 2019). This group of people could be vulnerable regarding food because they are vulnerable to poor socioeconomic status, poor eating patterns, and undernutrition (Gallegos et al., 2014). It is in individuals' and universities' interests to address this, given the possible impact of food insecurity on health and academic outcomes. Some students come from different Venezuelan regions and live in rental accommodation, have additional study-related expenses, and have lower-income due to less time to work and having lower-paid jobs due to lower skills. A cross-sectional study states that in comparison with students living in their parents' homes, students living in rental accommodation were 2.4 times more likely to be food insecure. Also, compared with postgraduate students, undergraduate students were 3.5 times more likely to be food insecure (Whatnall et al., 2019).

While the association between sociodemographic factors and dietary practices has been established in different settings (Hoddinott and Yohannes, 2002; Ali et al., 2019), several studies have suggested that the association of DD with structural factors like FS in the local context is needed (Ruel, 2003b; FAO, 2011). There is limited evidence about the relation between household food security, DD, and socioeconomic status among university students in Venezuela. Therefore, the present study was carried out to identify the possible association between those constructs among sociology students at the Central University of Venezuela (UCV).

MATERIALS AND METHODS

Sampling

This is a cross-sectional study among a representative sample of university students at the Sociology School of the Central University of Venezuela. It was decided to use only one school because of certain difficulties and logistics due to the students' protests around the country and limited financial resources for research at the university. The study took place in the first academic semester of the year 2016 when there was a total of 905 students registered from the first semester until the tenth semester of sociology. Because we have no information on the proportion of university students in food insecurity or low DD, we initially assumed that 50% of the households have these conditions to estimate the sample size. Considering this assumption, a 95% confidence level, and a 5% margin of error to estimate the proportion of students in food insecurity and/or low DD, the required minimum sample size was 270 students (with finite population correction). Students were randomly selected from a sample frame of student IDs. In total, 270 students answered the interview-based questionnaires, so the response rate was 100%. The data collection was performed from September 19, 2016 to November 25, 2016.

All students gave written consent to participate. The study was conducted according to the Declaration of Helsinki guidelines and ethical guidelines for research and approved by the Institutional Ethical Committed under the number 1204-16

protocol. Data were collected by trained enumerators in face-to-face interviews, using a pre-established questionnaire. The survey consisted of four modules: 1—items regarding students' identification, 2—a socioeconomic status section, 3—a food security module, and 4—a dietary diversity section. Each part is described below.

Socioeconomic Status

The construct socioeconomic status (SES) was measured by using the Mendez-Castellano and Mendez (1994) socioeconomic questionnaire, which includes items about the occupation of the head of the family, mother's educational level, income source, and accommodation conditions. Household SES is calculated by the summation of the score in each item. This method results in a categorical indicator that classifies households into five strata: I or richest (score 4–6), II or rich (score 7–9), III or middle (score 10–12), IV or poor (score 13–16), and V or poorest (score 17–20). The numerical indicator of SES is denoted by SES# and the categorical one by SES5.

Food Security

Household food security, in the last 6 months, was determined using the Community Childhood Hunger Identification Projects Scale of Food Security adapted and validated for Venezuelans by Lorenzana and Sanjur (2000).

The scale has 12 questions related to worry about lack of food, insufficient quality and quantity meals, and going to sleep hungry, both in adults and children of the household. For each item, the respondent may select a frequency of the experience (never, rarely, sometimes, or always). The maximum score possible is 36, which would represent the highest level of food insecurity. Therefore, if a household has zero points, it indicates food security; if it has between 1 and 12 points, there is low insecurity; from 13 to 24 points, it has moderate insecurity; and, based on this score, the home is considered severely insecure if it gets more than 24 points. We denote the numerical indicator of FS by FS# and the categorized version by FS4.

Dietary Diversity

DD was measured using a single 24-h recall of the student, using only unquantified data. A licensed nutritionist and dietitian administered the qualitative 24-h recall. All recalls reported 54 food types that were categorized into nine different standardized food groups: (1) cereal-based and tubers; (2) dark green leafy vegetables; (3) vitamin A-rich fruits and vegetables; (4) other fruits and vegetables; (5) organ meat; (6) fleshy meat and fish; (7); eggs; (8) legumes, nuts, and seeds; and (9) milk and dairy products, according to FAO's guidelines (FAO, 2011). With this measure, food items such as oil and fat are excluded, as their contribution to micronutrient density is limited (FAO, 2011).

The nine food groups were dichotomized. A score of one (1) was given to each food group consumed and zero (0) when certain that no foods in that group were eaten in a single day. Dietary diversity score was calculated, for each person, by the summation of the number of times different food items under each food group was eaten on a day. There are no established cutoff points in terms of the number of food groups to indicate adequate or inadequate dietary diversity. However, we establish three categories, considering that the maximum is a score of 9. The student had low DD if three or fewer groups were eaten on the addressed day, four and five food groups as medium DD, and six or more food groups indicated high DD. The numerical indicator of DD is denoted by DD# and the categorized version of the variable by DD3.

Data Analysis

The approach we used was descriptive and exploratory. Instead of assuming the existence of a possible causal relationship between the constructs considered (SES, FS, and DD), we aimed to find a possible multivariate interdependency among them in the particular context of a sample of Venezuelan university students.

Descriptive characteristics of the categorical versions of SES, FS, and DD were assessed by percentage distribution to highlight the important differences across all household characteristics. We also summarized the joint distribution of counts of the categorical versions in a three-way contingency table.

To establish how the categorized version of three variables SES#, FS#, and DD# are related, we performed an analysis using log-linear modeling to determine the significant associations between variables (Agresti, 2018). A log-linear model is a way to represent how each expected count of a contingency table depends on levels of the categorical variables included in the table and of the associations and interactions among these variables. For a three-dimensional table for variables X, Y, and Z, the saturated log-linear model, that is the model which perfectly fits the data, can be written as follows:

$$\log\left(\mu_{ijk}\right) = \lambda + \lambda^{X} + \lambda^{Y} + \lambda^{Z} + \lambda^{XY} + \lambda^{XZ} + \lambda^{YZ} + \lambda^{XYZ}$$

We can see that the natural log of the ijk cell count is explained by the main effects of variables X, Y, and Z ($\lambda^{X}, \lambda^{Y}, \lambda^{Z}$), two-way interaction effects ($\lambda^{XY}, \lambda^{XZ}, \lambda^{YZ}$), and a three-way interaction effect (λ^{XYZ}). This model is written in shorthand notation as $[XYZ]$. A smaller model in short notation, for example $[X][YZ]$, is a model in which

$$\log\left(\mu_{ijk}\right) = \lambda + \lambda^{X} + \lambda^{Y} + \lambda^{Z} + \lambda^{YZ}$$

which says that the ijk cell count is explained by the three main effects of variables X, Y, and Z ($\lambda^{X}, \lambda^{Y}, \lambda^{Z}$) and the two-way interaction effect λ^{YZ}. In other words, we are saying that variable X is independent of Y and Z, but that Y and Z are dependent variables. Log-linear models have been used in this particular way in other studies on nutritional status (Gupta and Borkotoky, 2016; Ngwira et al., 2017; Kassie and Workie, 2019) and consumer attitudes (Brosig and Bavorova, 2019). However, to our knowledge, this is the first study analyzing food security and dietary diversity associations with a log-linear model.

Since we did not assume any directional associations among the variables, we did not assign the role of explained or explicative variables to the categorized version of SES#, FS#, and DD#. We fitted the eight possible log-linear reduced versions of the model with all main effects and interaction terms necessary to produce a good fit for the three-way table of counts. To select

TABLE 1 | Socioeconomic characteristics of students' households in Caracas, 2016.

Variable	Categories	*n* = 270	Percentage (%)
Student characteristics			
Sex	Female	179	66.3
	Male	91	33.7
Household socioeconomic characteristics			
Occupation of the head of the family	University profession	109	40.4
	Higher technical profession	52	19.3
	Employees without profession	72	26.7
	Specialized workers	30	11.1
	Unskilled	7	2.6
Mother's educational level	University and workers above	129	47.8
	Complete secondary education	83	30.7
	Incomplete secondary education	47	17.4
	Complete primary education	11	4.1
Income source	Fortune	1	0.4
	Freelance fees	57	21.1
	Monthly salary	176	65.2
	Weekly salary	33	12.2
	Donations	3	1.1
Accommodation conditions	Luxury home	7	2.6
	Housing in optimal conditions	118	43.7
	Housing in good condition	133	49.3
	Housing with some deficiencies	12	4.4
Socioeconomic status (no students in stratum V)			
Strata	I	20	7.4
	II	122	45.2
	III	101	37.4
	IV	27	10
Food security			
Levels	Secure	38	14.1
	Low insecurity	200	74.1
	Moderate insecurity	29	10.7
	Severe insecurity	3	1.1
Dietary diversity			
Levels	High	4	1.5
	Middle	118	43.7
	Low	148	54.8

the model that best fits the data, we used three criteria: (1) acceptance of the null hypothesis that the model explains as well as the saturated model of the table's counts using a likelihood ratio goodness-of-fit chi-squares test, (2) parsimony, and (3) the smallest value of the Bayesian information criterion (BIC). The same model was obtained using conditional tests of log-linear models embedded in hierarchical chains. We did all statistical analyses using the SPSS® software (version 21.0). Results were considered significant at the 0.05 level.

RESULTS

The mean (±SD) age of the participants was 21.6 ± 3.2 years, and 66.3% were female. **Table 1** summarizes household socioeconomic characteristics and the relative frequencies of SES5, FS4, and DD3.

About 22.2% of students come from outside Caracas, 18.9% do not live with their family, and only 7% were heads of the family. Most households have three or four members (54.4%), followed by 32.3% with five or more members.

Of sociology students, 85.9% were categorized as food insecure. The mean (±SD) DD# score was 3.5 ± 0.9, and 54.8% of students had low DD (**Table 1**). The internal consistency of the FS scale was 0.898 using the Cronbach's alpha coefficient.

As shown in **Table 2**, most households experienced a lack of money to buy food (67.4%) or that some of their members eat less than they want due to the lack of money (65.9%). Those questions about the decrease in children's dietary quantity and quality were less frequent in the sample.

Figure 1 represents the patterns of consuming food from the nine groups evaluated in a single day. The graphic shows that food groups with the highest levels of consumption by students were starches from cereals and tubers, followed by fleshy meat/fish, and milk and milk products. Those with a high DD (those who consumed six to nine food groups in a day) represented only 1.5% of the sample. Most students ate three or fewer food groups on the evaluated day (**Figure 2**).

Table 3 shows the cross-classification of the categorized version of FS#, DD#, and SES#. Due to low numbers in the severely food insecure and the high food diversity categories, they were joined together into one with moderate food insecurity (FS3) and middle dietary diversity (DD2), respectively. There were no student household in stratum V, so we denote the categorical version of SES# used in the analysis as SES4. The raw data can be found in **Supplementary Data Sheet 1**.

The relationship between SES4, FS3, and DD2 was analyzed by obtaining the best log-linear model, which fits the three-way contingency table as shown in **Table 4**. We considered all the log-linear models that can be obtained with these three variables with the exception of the saturated model. We selected the log-linear model [SES4][FS3•DD2] as the model that best fits the three-way table in which socioeconomic status (SES4) is jointly independent of dietary diversity (DD2) and food security (FS3). Furthermore, the pair FS3 and DD2 is dependent. There are several good models (see **Table 4**). When testing the sequence of hierarchical models 1, 2, 6, and 8, we found that all of them fit better than complete independence. However, testing model 6 against model 8 shows no reason to select the larger model. The same can be said about [SES4] [FS3•DD2] against [SES4•FS3] [FS3•DD2].

Furthermore, the model selected has the smallest value of BIC (Bayesian information criterion). Also, it has fewer terms and can

TABLE 2 | Frequency of occurrence on indicators of the Venezuelan Food Security Scale of student's households in Caracas, 2016.

Variables	Frequency			
	Never *n* (%)	Rarely *n* (%)	Sometimes *n* (%)	Always *n* (%)
Lack of money at home to buy food	88 (32.6)	137 (50.7)	36 (13.3)	9 (3.3)
The number of meals for an adult decreases due to a lack of money to buy food	135 (50.0)	103 (38.1)	27 (10)	5 (1.9)
The number of usual meals at home decreases due to lack of money to buy food	112 (41.5)	123 (45.6)	25 (9.3)	10 (3.7)
Some adults eat less at the main meal because food is not enough for everyone	124 (45.9)	103 (38.1)	35 (13.0)	8 (3.0)
Some members of the household eat less than they want due to lack of money in the household	92 (34.1)	117 (43.3)	42 (15.6)	19 (7.0)
Less essential food for children is bought because the money is not enough	220 (81.5)	20 (7.4)	22 (8.1)	8 (3.0)
A child goes to bed hungry because they can't afford food	259 (95.9)	9 (3.3)	2 (0.7)	0 (0.0)
Decreases the number of meals per child due to lack of money to buy food	250 (92.6)	19 (7.0)	0 (0.0)	1 (0.4)
Some children eat less at the main meal because the foods are not enough for everyone	246 (91.1)	21 (7.8)	3 (1.1)	0 (0.0)
A child complains of hunger due to a lack of food at home	247 (91.5)	14 (5.2)	6 (2.2)	3 (1.1)
An adult goes to bed hungry because they can't afford food	167 (61.9)	75 (27.8)	21 (7.8)	7 (2.6)
An adult complains of hunger due to a lack of food at home	130 (48.1)	85 (31.5)	40 (14.8)	15 (5.6)

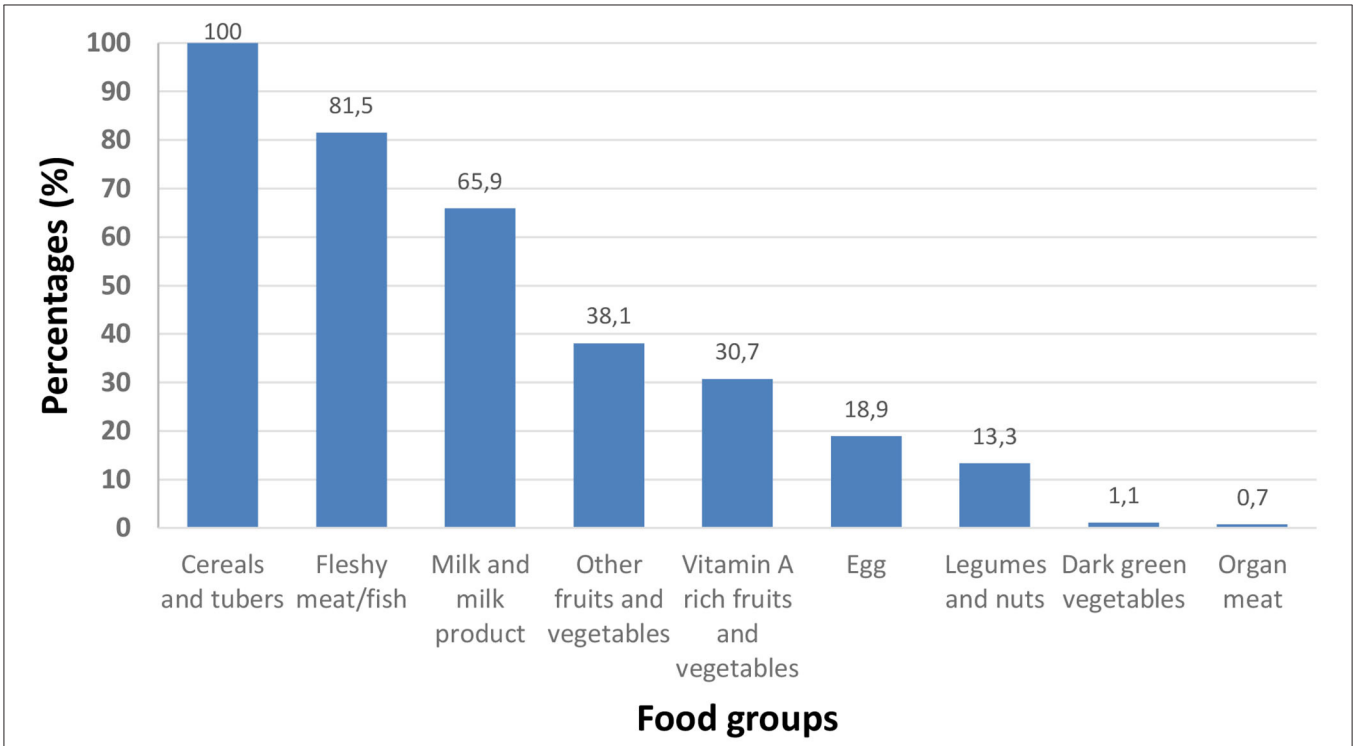

FIGURE 1 | The proportion of consumed foods groups in the past 24 h in sociology students of Caracas, 2016.

be easily interpretable. **Table 4** shows the results of comparing the different models fitted.

According to **Table 5**, which we generated by collapsing on SES4, the odds of a student household being in food security instead of low food security when the household has a diverse diet are 1.87 (95% CI: 1.17; 2.58), about twice as large as the odds of a household that has a food intake with a monotonous diet.

Similarly, the odds of a student having a diverse diet instead of a monotone diet is 3.92 (95% CI: 2.91; 4.93) times greater for those who are in food security instead of moderate/severe food

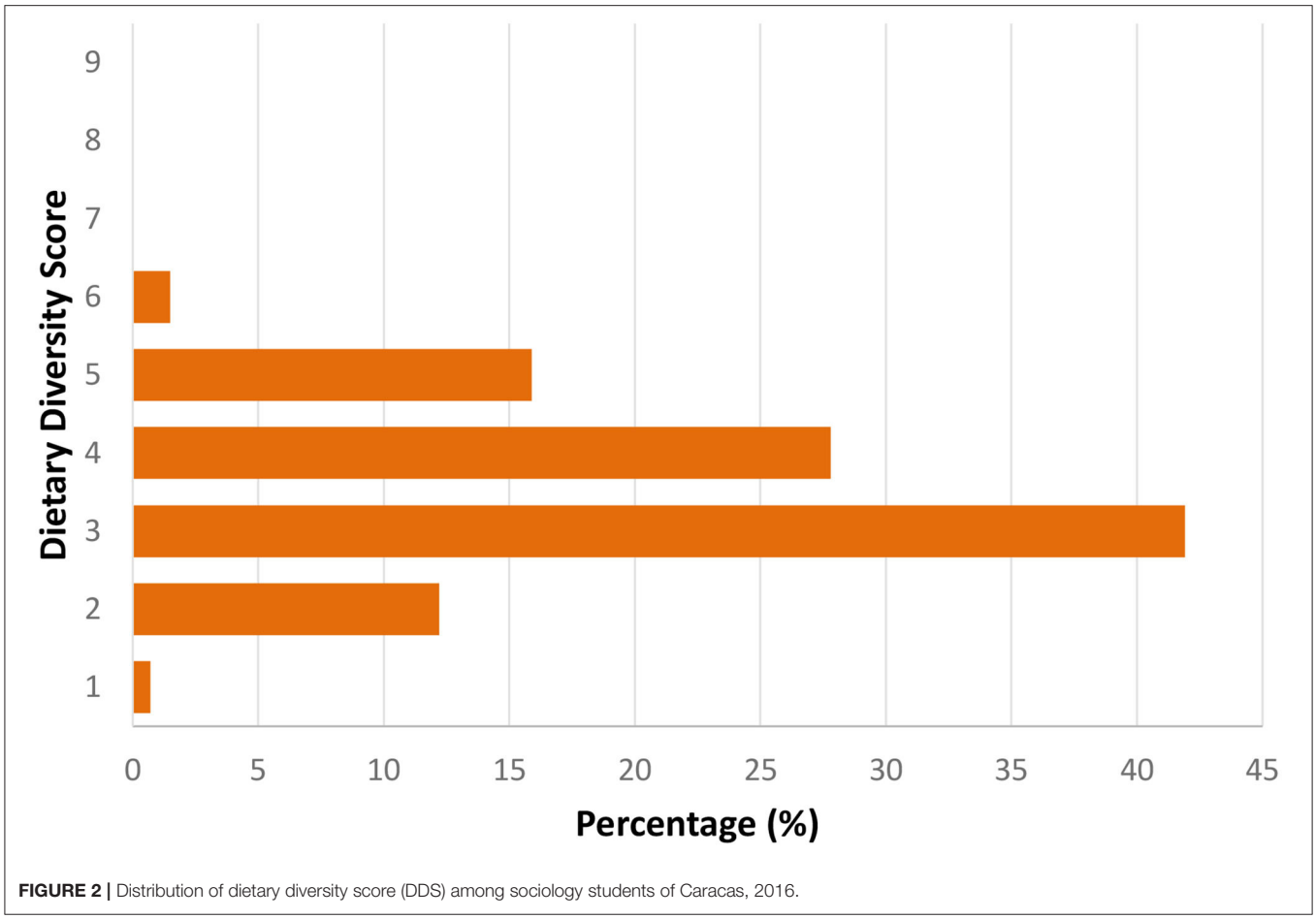

FIGURE 2 | Distribution of dietary diversity score (DDS) among sociology students of Caracas, 2016.

TABLE 3 | Cross classification of FS3, DD2, and SES4.

Socioeconomic status (SES4)	Dietary diversity (DD2)	Food security (FS3)			Total
		Secure	Low insecurity	Severe–moderate insecure	
Strata I	High–middle	4	3	1	8
	Low	4	8	0	12
Strata II	High–middle	12	41	5	58
	Low	5	49	10	64
Strata III	High–middle	5	36	3	44
	Low	4	44	9	57
Strata IV	High–middle	2	10	0	12
	Low	2	9	4	15
	Total	38	200	32	270

insecurity. Furthermore, the odds of a student household being in low security instead of moderate/severe insecurity when the household has a diverse diet are 2.09 (95% CI: 1.27; 2.91) times greater for those who have a diverse diet than for those who have a monotonous diet.

DISCUSSION

The present study was designed to examine associations among socioeconomic status, household food security, and dietary diversity among a sample of university students in Caracas, Venezuela. Most of the sociology students of the UCV were strata II and III in the categorized version of SES, in some categories of food insecurity and low DD. Notably, we found an association between FS3 and DD2. These findings may help us understand the complex interaction among these factors in university students. It represents a start for other important questions related to the consequences of these conditions over academic performance.

This study supports evidence from other observations about SES in Venezuelan university students. Ledezma et al. (2016), showed that most of the UCV student households evaluated were in strata II and III, both in the years 2013 and 2014, with 64.77 and 81.11%, respectively. Additionally, Arteaga and Bastidas (2017) found that in medical students of Carabobo, Venezuela, 77.4% were in strata II and III. We report an 82.6% of sociology students between strata II and III. None of these studies mentioned report university students in strata V or extreme poverty. This could be related to students' basic needs of food, economy, and housing. Those students in strata

TABLE 4 | Log-linear models adjusted to explain the relationship structure among SES4, FS3, and DD2.

Model	Log-linear model	Degrees of freedom	G^2	*p*-value	R^2 adjusted	BIC
1	[SES4] [FS3] [DD2]	17	27.53	0.051	0.00	−13.81
2	[SES4] [FS3•DD2]	15	19.99	0.172	0.27	−16.47
3	[FS3] [SES4•DD2]	14	26.92	0.020	0.02	−7.12
4	[DD2] [SES4•FS3]	11	16.27	0.131	0.41	−10.48
5	[SES4•DD2] [FS3•DD2]	12	19.39	0.079	0.30	−9.78
6	[SES4•FS3] [FS3•DD2]	9	8.74	0.462	0.68	−13.14
7	[SES4•FS3] [SES4•DD2]	8	15.66	0.047	0.43	−3.79
8	[SES4•FS3][SES4•DD2][FS3•DD2]	6	7.47	0.279	0.73	−7.12

Expression [SES4] [FS3•DD2] represents a model with main effects of SES4, FS3, and DD2 and one interaction term between FS3 and DD2. This model can be interpreted as saying that SES4 is independent of FS3 and DD2, but FS3 and DD2 are dependent.

TABLE 5 | Student's distribution between FS3 and DD2 categories.

			Dietary diversity (DD2)		Total
			High–middle	Low	
Food security (FS3)	Secure	*n*	23	15	38
		%	60.5	39.5	100
	Low insecurity	*n*	90	110	200
		%	45.0	55.0	100
	Moderate–severe insecurity	*n*	9	23	32
		%	28.1	71.9	100
	Total	*n*	122	148	270
		%	100	100	100

V cannot meet their needs, so they will be unable to engage in the higher-level learning required of them in university (Raskind et al., 2019).

Instability in acquiring food necessary for daily consumption is reflected in 85.9% of students' households with food insecurity. In Venezuela, there are very few studies that evaluated the food insecurity status among university students. Hernández et al. (2011) described that 70.5% of children and adolescents' households in Caracas' sub-urban areas were in some level of food insecurity. In contrast, Aliaga et al. (2015) found 57% of food insecurity in adolescents between 11 and 13 years old of a rural state in Venezuela. Additionally, the ENCOVI survey (Landaeta-Jiménez et al., 2017), the most important study in socioeconomic status among Venezuelans, with national representation, shows that 93.3% of Venezuelan households were in food insecurity for the year 2016. These results evidence the degree of inflation at the national level, the difficulties of access to food due to the shortage, and irregularities that occur in its distribution, such as the appearance of secondary, unofficial markets, which has produced negative scenarios involving inequitable access to food for all Venezuelans.

The DD construct is hardly evaluated in Venezuela. We did not find studies about DD in Venezuelan university students. In this study, the DD was low. The mean DD# for all households is 3.5 foods, which suggests that on average, every household consumed almost four different food groups (out of nine) the day before the survey. This confirms the theory of a monotonous diet in the country (Landaeta-Jiménez et al., 2018). According to this, the population consumes only a few foods with a high rate of satiety and calories as cereals and fats.

In this observational study, a log-linear modeling analysis was used. This technique has the advantage of assessing all high-order interactions and, in doing so, rule out a result known as Simpson's paradox by which, for example, conclusions from two-dimensional marginal tables can be contradicted by the three-dimensional information (Christensen, 1997).

The fitted model indicates that SES4 is independent of FS3 and DD2 in a statistically significant way. In contrast, a recent study conducted by Wanyama et al. (2019) established that households with higher socioeconomic status have better food security and that derives from a healthier diet with the inclusion of more kinds of foods.

Besides, we found that FS3 is related to DD2. A result which is in line with some studies that proposed that dietary diversity score is a proxy measure of food security and *vice versa* (Ruel, 2003b; Hasan-Ghomi et al., 2015; Schwei et al., 2017), so a low dietary diversity could indicate a potential risk for food insecurity.

A possible explanation for the joint independence of SES4 with FS3 and DD2 might be the harmonization of the diet due to the low income and food scarcity that affects Venezuela (Landaeta-Jiménez et al., 2018). This finding is contrary to previous studies, which have suggested that DD is associated with higher socioeconomic status (Lo et al., 2012). However, in this case, food scarcity could play a relevant role in food choice. If food is not available, the socioeconomic status does not matter because everyone will eat the same, simply what is available. For those reasons, one can infer that these students' food situation is multifactorial and critical, in which the food right is violated, which could affect their academic performance and permanence in university studies.

These data must be interpreted with caution because the association does not mean causation. Being limited to the sociology students of only one public university, these findings are based on a small sample of participants and can neither be extrapolated to all the UCV students nor the population of

university students of Venezuela. We use a single 24-h recall period that does not indicate a student's habitual diet. The selected FS instrument asks several questions about children, which could affect the household FS measurement in the 20% of students living away from home, especially those from outside the region. The study data analysis uses qualitative variables, which may differ from a quantitative approach, e.g., through standard regression models or structural equation modeling. We have not had the opportunity to adjust for sex, age, living arrangements, or other potential confounder variables. Future research should include how each gender influences some of these items. Additionally, it was not possible to assess the biochemistry and nutritional anthropometric status; therefore, despite its exploratory nature, this study offers some insight into the food and dietary indicators among some university students.

The study concludes that there is an association between food security and dietary diversity among a sample of sociology students at the Central University of Venezuela. Whereas, the socioeconomic status in households of those students was not associated with their food security level or dietary diversity. Most of them are in food insecurity with a low dietary diversity, which could affect their nutritional status, academic performance, and permanence in the university.

Ensuring appropriate systems, services, and support for university students at UCV should be a priority for the educational systems, especially in this crisis context. Reactivation of the university dining at UVC should be considered a priority strategy to improve food security and dietary diversity.

Further studies are required to fully understand the multifactorial food situation of Venezuelan university students. Other types of nutritional assessment indicators could be included such as dimension and composition anthropometric indicators along with blood concentration of iron, retinol, and folate.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the Ethics Review Committee of the Central University of Venezuela. The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fsufs.2021.623158/full#supplementary-material

REFERENCES

Agresti, A. (2018). *An Introduction to Categorical Data Analysis, 3rd Edn*. Washington, DC: Wiley.

Ali, N. B., Tahsina, T., Hoque, D., Hasan, M. M., Iqbal, A., Huda, T. M., et al. (2019). Association of food security and other socio-economic factors with dietary diversity and nutritional statuses of children aged 6-59 months in rural Bangladesh. *PLoS ONE* 14:e0221929. doi: 10.1371/journal.pone.0221929

Aliaga, C., Sifontes, Y., Landaeta, M., and Mendez, B. (2015). Nutritional status, food consumption and food security in rural Venezuelan adolescents. *Arch. Latinoam. Nutr*. 65, S346–S347.

Arteaga, E., and Bastidas, G. (2017). Context and subject in the attitude of the student of medicine of the University of Carabobo (Valencia, Venezuela) on his academic performance. *Dialogica* 14, 208–229.

Brosig, S., and Bavorova, M. (2019). Association of attitudes towards genetically modified food among young adults and their referent persons. *PLoS ONE* 14:e0211879. doi: 10.1371/journal.pone.0211879

Christensen, R. (1997). *Log-Linear Models and Logistic Regression*, *2nd Edn*. New York, NY: Springer.

Codjoe, S. N. A., Okutu, D., and Abu, M. (2016). Urban household characteristics and dietary diversity: an analysis of food security in Accra, Ghana. *Food Nutr. Bull*. 37, 202–218. doi: 10.1177/0379572116631882

Doocy, S., Ververs, M.-T., Spiegel, P., and Beyrer, C. (2019). The food security and nutrition crisis in Venezuela. *Soc. Sci. Med*. 226, 63–68. doi: 10.1016/j.socscimed.2019.02.007

FAO (2011). *Guidelines for Measuring Household and Individual Dietary Diversity*. Rome: Food and Agriculture Organization of the United Nations.

FAO, IFAD, UNICEF, WFP, and WHO (2020). *The State of Food Security and Nutrition in the World 2020*. Transforming Food Systems for Affordable Healthy Diets. Rome: Food and Agriculture Organization of the United Nations.

Gallegos, D., Ramsey, R., and Ong, K. W. (2014). Food insecurity: is it an issue among tertiary students? *High Educ*. 67, 497–510. doi: 10.1007/s10734-013-9656-2

Gupta, A., and Borkotoky, K. (2016). Exploring the multidimensional nature of anthropometric indicators for under-five children in India. *Indian J. Public Health* 60, 68–72. doi: 10.4103/0019-557X.177319

Gupta, A., and Mishra, D. K. (2018). Measuring food security through dietary diversity: insights from a field survey in rural Uttar Pradesh, India. *Indian Econ. J*. 66, 347–364. doi: 10.1177/0019466220922386

Hasan-Ghomi, M., Mirmiran, P., Asghari, G., Amiri, Z., Saadati, N., Sadeghian, S., et al. (2015). Food security is associated with dietary diversity: Tehran lipid and glucose study. *Nutr. Food. Sci. Res*. 2, 11–18.

Hernández, R., Herrera, H., Pérez, A., and Bernal, J. (2011). Nutritional status and Household food security in children and adolescents in suburban areas of Baruta and El Hatillo, Caracas. *An. Venez. Nutr*. 24, 21–26.

Hoddinott, J. F., and Yohannes, Y. (2002). *Dietary Diversity as a Food Security Indicator*. Food consumption and nutrition division discussion paper 136. Washington, DC: International Food Policy Research Institute.

Kassie, G. W., and Workie, D. L. (2019). Exploring the association of anthropometric indicators for under-five children in Ethiopia. *BMC Public Health* 19:764. doi: 10.1186/s12889-019-7121-6

Landaeta-Jiménez, M., Herrera-Cuenca, M., Ramírez, G., and Vásquez, M. (2017). The food of Venezuelans. National survey of living conditions 2016. *An. Venez. Nutr*. 30, 99–111.

Landaeta-Jiménez, M., Herrera-Cuenca, M., Ramírez, G., and Vásquez, M. (2018). The precarious food conditions of Venezuelans. National Survey of Standard Living Conditions 2017. *An. Venez. Nutr*. 31, 13–26.

Ledezma, T., Rodriguez, Z., Infante, R., and Ortega, A. (2016). Socioeconomic conditions and food consumption of students of the UCV. 2006-2015. *Tribuna del Investigador*. 17, 154–173.

Lo, Y. T., Chang, Y. H., Lee, M. S., and Wahlqvist, M. L. (2012). Dietary diversity and food expenditure as indicators of food security in older Taiwanese. *Appetite* 58, 180–187. doi: 10.1016/j.appet.2011.09.023

Lorenzana, P., and Mercado, C. (2002). Measuring household food security in poor Venezuelan households. *Public Health Nutr*. 5, 851–857. doi: 10.1079/PHN2002377

Lorenzana, P., and Sanjur, D. (2000). The process of adapting and validating a perceived household food security scale in a poor community. *Arch Latinoam Nutr*. 50, 334–340.

Mendez-Castellano, H., and Mendez, M. C. (1994). *Society and Stratification. Graffar Mendez Castellano Method*. Caracas: Fundacredesa.

Ngwira, A., Munthali, E., and Vwalika, K. (2017). Analysis on the association among stunting, wasting and underweight in malawi: an application of a log-linear model for the three-way table. *J. Public Health Afr*. 8:620. doi: 10.4081/jphia.2017.620

Raskind, I. G., Haardörfer, R., and Berg, C. J. (2019). Food insecurity, psychosocial health and academic performance among college and university students in Georgia, USA. *Public Health Nutr*. 22, 476–485. doi: 10.1017/S1368980018003439

Ruel, M. T. (2003a). Operationalizing dietary diversity: a review of measurement issues and research priorities. *J. Nutr*. 133, 3911S−3926S. doi: 10.1093/jn/133.11.3911S

Ruel, M. T. (2003b). Is dietary diversity an indicator of food security or dietary quality? A review of measurement issues and research needs. *Food Nutr. Bull*. 24, 231–232. doi: 10.1177/156482650302400210

Schwei, R., Tesfay, H., Asfaw, F., Jogo, W., and Busse, H. (2017). Household dietary diversity, vitamin A consumption and food security in rural Tigray, Ethiopia. *Public Health Nutr*. 20, 1540–1547. doi: 10.1017/S1368980017000350

Shi, Y., Lukomskyj, N., and Allman-Farinelli, M. (2021). Food access, dietary acculturation, and food insecurity among international tertiary education students: a scoping review. *Nutrition* 85:111100. doi: 10.1016/j.nut.2020.111100

Steyn, N. P., Nel,. J. H., Nantel, G., Kennedy, G., and Labadarios, D. (2006). Food variety and dietary diversity scores in children: are they good indicators of dietary adequacy? *Public Health Nutr*. 9, 644–650. doi: 10.1079/phn2005912

Tapia, M. S., Puche, M., Pieters, A., Marrero, J. F., Clavijo, S., Socorro, A. A. G., et al. (2017). "Food and nutritional security in venezuela. The agrifood abduction of a country: vision and commitment" in *Challenges and Opportunities for Food and Nutrition Security in the Americas: The View of the Academies of Sciences*, eds M. Clegg, E. Bianchi, J. McNeil, L. Herrera, and K. Vammen (Mexico: The Inter American Network of Academies of Sciences. The Federal Ministry of Education and Research. German National Academy of Sciences-Leopoldina), 566–607.

Terragni, L., Arnold, C., and Henjum, S. (2020). Food skills and their relationship with food security and dietary diversity among asylum seekers living in Norway. *J. Nutr. Educ. Behav*. 52, 1026–1034. doi: 10.1016/j.jneb.2020.05.009

UCAB (2020). *Encuesta nacional de condiciones de vida 2018-2020*. Available online at: https://www.proyectoencovi.com/ (accessed January 15, 2020).

Ukegbu, P., Nwofia, B., Ndudiri, U., Uwakwe, N., and Uwaegbute, A. (2019). Food insecurity and associated factors among university students. *Food Nutr. Bull*. 40, 271–281. doi: 10.1177/0379572119826464

Wanyama, R., Gödecke, T., and Qaim, M. (2019). Food security and dietary quality in African slums. *Sustainability* 11:5999. doi: 10.3390/su11215999

Whatnall, M. C., Hutchesson, M. J., and Patterson, A. J. (2019). Predictors of food insecurity among Australian university students: a cross-sectional study. *Int. J. Environ. Res. Public Health* 17:60. doi: 10.3390/ijerph17010060

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