

**Citation:** Brown, N.I.; Buro, A.W.; Jones, R.; Himmelgreen, D.; Dumford, A.D.; Conner, K.; Stern, M.; DeBate, R. Multi-Level Determinants of Food Insecurity among Racially and Ethnically Diverse College Students. *Nutrients* **2023**, *15*, 4065. <https://doi.org/10.3390/nu15184065>

cure compared to their non-Hispanic White and Asian counterparts [3,10,18]. In a recent secondary analysis of a single university's National College Health Assessment 2020 data, 44.5% of students reported FI. Statistically significant differences were observed in FI by race/ethnicity ( $p$

(93.5%) consented, and 685 (85.2%) completed the survey (non-Hispanic Black ( $n = 203$ ), Hispanic/Latino/a ( $n = 357$ ); non-Hispanic White ( $n = 125$ )). A total of 97 responses were removed due to missing data, with the final sample including 588 participants.

### Conceptual Framework

The National Institute on Minority Health and Health Disparities (NIMHD) research framework [31] served as the conceptual framework for the current study. The NIMHD research framework serves as a vehicle in encouraging research that addresses the multi-faceted nature of minority health that spans multiple domains of influence (i.e., health outcomes, behaviors, environment, socio-cultural environment) within multiple levels of influence (i.e., individual, interpersonal, community) [31].

### 2.2. Measures

A web-based survey was developed to assess domain-specific determinants of FI among racially/ethnically diverse college students across multiple levels of influence based on the NIMHD research framework [31]. Constructs assessed by level of influence and domain were as follows. (a) Individual level of influence: health domain—food insecurity [35]; psychological distress [36]; loneliness [37]. (b) Individual level of influence: behavioral domain—food insecurity coping and academic progress [38,39]; cooking behaviors and skills [38,39]. (c) Individual level of influence: socio-cultural domain—sociodemographics and cultural identity. (d) Interpersonal level of influence: socio-cultural environmental

*and (I/we) didn't have money to get more." Was that often, sometimes, or never true for (you/your household) in the last 12 months?)* indicate higher food insecurity levels. Possible food security scores range from 0 to 6, with higher scores indicating lower levels of food security (i.e., FI). Scores were categorized as 0–1 = marginal food security; 2–4 = low food security; 5–6 = very low food security. This measure has demonstrated validity in food insecurity among college students [7] and acceptable reliability (Cronbach  $\alpha = 0.87$ ) [43].

**Psychological Distress.** The Kessler Psychological Distress scale (K6, 6 items) [36] measures psychological distress by asking how frequently the respondent experienced symptoms of psychological distress (e.g., nervous, hopeless) during the past 30 days. Responses to the items are assessed on a 5-point Likert scale (0 = none of the time to 4 = all the time) and summed to yield a total score ranging from 0 to 24. Higher scores are indicative of high levels of psychological distress. This scale has demonstrated acceptable reliability (Cronbach  $\alpha = 0.89$ ) [36].

**Loneliness.** The UCLA Loneliness Scale [37] is a 3-item measure that assesses the lack of companionship, feeling left out, and feeling isolated from others on a 3-point Likert scale (1 = hardly ever to 3 = often). A total score is generated, ranging from 3 to 9, with higher scores indicating higher levels of loneliness. This scale has shown acceptable internal reliability (Cronbach  $\alpha = 0.72$ ) [37].

#### 2.2.2. Individual Level of Influence Measures: Behavioral Domain

**Coping Mechanisms Food Insecurity.** The coping strategies scale (CSS, 29 items) [38,39]

pus/university, parent/guardian, off-campus, couch surfing, don't have a place) and with whom they lived (roommates, significant other, family, self).

**Cultural Identity.** Five survey questions captured students' gender identity (woman/female, man/male, trans man, genderqueer, agender, genderfluid, non-binary), sexual orientation (straight/heterosexual, bisexual, gay, lesbian, queer, questioning, other, prefer not to respond), sex assigned at birth (female, male, intersex), race (White, Black/African American), and ethnicity (Hispanic vs. non-Hispanic).

#### 2.2.4. Interpersonal Level of Influence Measures: Socio-Cultural Environmental Domain

**Experiences of Discrimination.** The Experiences of Discrimination Scale assessed self-reported experiences of discrimination (Cronbach  $\alpha = 0.74$  or greater) [40]. The Discrimination Ever subscale [40] is a 9-item measure that assesses whether an individual has ever experienced discrimination in nine situations (e.g., at school, at work, getting service in a store) due to their race, ethnicity, or color. A total score is calculated ranging from 0 to 9, with higher scores indicating greater instances of ever experiencing discrimination. The Day-to-Day Unfair Treatment sub-scale measures the frequency of self-reported experiences of discrimination in everyday life (e.g., treated with less courtesy, less respect, people acted as if they are afraid of you, you have been called names) using a 10-item, 4-point Likert scale (1 = four or more times to 4 = never). A total sum score is calculated, with higher scores indicating higher discrimination in everyday situations. The Major Experiences of Discrimination scale is a 9-item measure that assesses whether an individual has experienced unfair treatment (i.e., unfairly fired, unfairly stopped, unfairly discouraged by a teacher). A sum score is calculated to reflect the number of situations in which an individual has experienced unfair treatment in relation to a racial reason with possible scores ranging from 0 to 9, with higher scores indicating greater instances of experiencing unfair treatment.

**Social Network.** The Lubben Social Network Scale [41] is a 12-item measure of social engagement from family (6 items) and friends (6 items). This instrument uses a 6-point Likert scale (0 = less social engagement to 5 = more social engagement) with a total score calculated as the sum of all items. The total score can range between 0 and 30 for each of the two social support scales (family and friends), with higher scores indicating more social engagement. These scales have demonstrated acceptable internal reliability (Cronbach  $\alpha = 0.84$ – $0.89$  for family and  $0.80$ – $0.82$  for friends) [44].

#### 2.2.5. Community Level of Influence Measures: Socio-Cultural Environmental Domain

**Cultural familiarity, validation, humanized environment, holistic support.** The Culturally Engaging Campus Environments (CECE) is a scale that measures campus environments and student experiences using a 5-point Likert scale (1 = strongly agree to 5 = strongly disagree) [42,45]. This scale consists of two subconstructs of cultural relevance (cultural familiarity and cultural validation) and two subconstructs of cultural responsiveness (humanized educational environment and holistic support). Cultural familiarity is composed of 3 items that measure students' opportunities to connect with various agents on campus (e.g., faculty administrators, staff, and peers) who are like them in terms of background and experiences. Responses from this scale range from 0 to 15. The total score (maximum) is 15.



Table 2. Cont.

	Non-Hispanic Black	Hispanic	Non-Hispanic White	Total
Sex (assigned at birth)				
Female	127 (72.6)	206 (72.0)	88 (69.3)	421 (71.6)
Male	47 (26.9)	80 (28.0)	39 (30.7)	166 (28.2)
Intersex	1 (0.6)	0 (0.0)	0 (0.0)	1 (0.2)
Gender identity				
Woman/female	127 (72.6)	197 (68.9)	80 (63.0)	404 (68.7)
Man/male	45 (25.7)	79 (27.6)	39 (30.7)	163 (27.7)
Trans man	0 (0.0)	0 (0.0)	1 (0.8)	1 (0.2)
Genderqueer	1 (0.6)	1 (0.3)	2 (1.6)	4 (0.7)
Agender	0 (0.0)	1 (0.3)	0 (0.0)	1 (0.2)
Genderfluid	1 (0.6)	3 (1.0)	2 (1.6)	6 (1.0)
Non-binary	1 (0.6)	5 (1.7)	3 (2.4)	9 (1.5)
Sexual orientation				
Straight/heterosexual	137 (78.3)	209 (73.1)	86 (67.7)	432 (73.4)
Bisexual	16 (9.1)	42 (14.7)	29 (22.8)	87 (14.8)
Gay	5 (2.9)	3 (1.1)	0 (0.0)	8 (1.4)
Lesbian	2 (1.1)	9 (3.1)	4 (3.1)	15 (2.6)
Queer	5 (2.9)	8 (2.8)	3 (2.4)	16 (2.7)
Questioning	3 (1.7)	5 (1.7)	0 (0.0)	8 (1.4)
Other	5 (2.9)	2 (0.7)	3 (2.4)	10 (1.7)
Prefer not to respond	2 (1.1)	8 (2.8)	2 (1.6)	12 (2.0)
Student status				
Full-time	158 (90.3)	257 (89.9)	118 (92.9)	533 (90.6)
Part-time	17 (9.7)	27 (9.4)	9 (7.1)	53 (9.0)
Undergraduate level				
Freshman	26 (14.9)	43 (15.0)	24 (18.9)	93 (15.8)

Table 2. Cont.

	Non-Hispanic Black	Hispanic	Non-Hispanic White	Total
Relationship status				
Single	120 (68.6)	135 (47.2)	51 (40.2)	306 (52.0)
Dating	14 (8.0)	27 (9.4)	16 (12.6)	57 (9.7)
Girlfriend/boyfriend	39 (22.3)	114 (39.9)	52 (40.9)	205 (34.9)
Married/partnered	2 (1.1)	10 (3.5)	5 (3.9)	17 (2.9)
Divorced/annulled	0 (0.0)	0 (0.0)	3 (2.4)	3 (0.5)
Employment status				
Yes, <20 h/week	68 (38.9)	109 (38.1)	42 (33.1)	219 (37.2)
Yes, >20 h/week	41 (23.4)	65 (22.7)	42 (33.1)	148 (25.2)
No	65 (37.1)	112 (39.2)	42 (33.1)	219 (37.2)
Financial Support <sup>a</sup>				
Parents/family	106 (60.6)	173 (60.5)	63 (49.6)	342 (58.2)
Loans	62 (35.4)	71 (24.8)	44 (34.6)	177 (30.1)
Grants/scholarships	117 (66.9)	192 (67.1)	82 (64.6)	391 (66.5)
Working	106 (60.6)	177 (61.9)	86 (67.7)	369 (61.5)
Federal Pell Grant				
Yes	114 (65.1)	133 (46.5)	44 (34.6)	291 (49.5)
Meal plan				
Yes	49 (28)	71 (24.9)	34 (26.8)	154 (26.2)
Physical/learning disability				
Yes	13 (7.4)	31 (10.8)	24 (18.9)	68 (11.6)

Note: <sup>a</sup> Participants could choose more than one source of financial support. Abbreviations: BMI, body mass index.

### 3.2. Associations between FI and Constructs

Pearson correlation coefficients are presented in Table 3. FI was significantly associated with all constructs ( $p < 0.05$ ) except for social support from friends, frequency of cooking for self and others, and perceived cooking skills. The strongest relationships found were between food insecurity and FI coping strategy—saving ( $r = 0.367$ ) and FI coping strategy—food intake ( $r = 0.344$ ).

Table 3. Pearson correlation matp808ENo





**Table 4.** Differences in food insecurity and multi-level construct scores for a sample of college students by race/ethnicity ( $n = 588$ ) based on one-way analyses of variance (ANOVAs) and Tukey's post-hoc tests.

	Non-Hispanic Black	Hispanic	Non-Hispanic White	Total	<i>p</i> -Value
Sum Scores	M (SD)	M (SD)	M (SD)	M (SD)	

**Table 5.** Linear regression analyses of food insecurity and multi-level determinants among college students (*n* = 588).

Predictor	Model 1		Model 2		Model 3		Model 4	
	All Students		Non-Hispanic Black		Hispanic		Non-Hispanic White	
	p-Value		p-Value		p-Value		p-Value	
Psychological Distress Sum Score	<b>0.028</b>	<b>0.007</b>	0.018	0.818	0.103	0.084	0.060	0.500
Loneliness Sum Score	0.001	0.985	0.015	0.850	0.026	0.647	0.055	0.510
FI Coping (Saving) Sum Score	<b>0.063</b>	<b>&lt;0.001</b>	0.09	0.250	<b>0.074</b>	<b>&lt;0.001</b>	<b>0.102</b>	<b>&lt;0.001</b>
FI Coping (Intake) Sum Score	<b>0.084</b>	<b>0.002</b>	0.164	0.063	<b>0.084</b>	<b>0.027</b>	<b>0.136</b>	<b>0.012</b>
FI Coping (Selling) Sum Score	0.043	0.0304	0.083	0.314	0.010	0.864	0.103	0.244
Discrimination Ever Experience Sum Score	0.035	0.431	0.109	0.272	0.046	0.416	0.029	0.724
Discrimination Major Sum Score	0.058	0.181	<b>0.203</b>	<b>&lt;0.001</b>	0.075	0.185	0.046	0.575
Day-to-Day Unfair Treatment	0.047	0.300	0.146	0.107	0.039	0.483	0.002	0.982
Cultural Familiarity Sum Score	0.035	0.392	0.041	0.620	0.048	0.425	0.014	0.860
Cultural Validation Sum Score	0.026	0.517	0.002	0.979	0.030	0.613	0.015	0.858
Humanized Educational Experience Sum Score	0.025	0.541	0.073	0.364	0.037	0.522	0.042	0.602
Holistic Support Sum Score	0.004	0.928	0.118	0.146	<b>0.051</b>	<b>0.007</b>	0.120	0.133
Academic Progress Sum Score	0.025	0.560	0.116	0.146	0.013	0.819	0.006	0.944
Social Support (Family) Sum Score	0.060	0.151	0.042	0.606	0.099	0.081	0.056	0.499
Social Support (Friends) Sum Score	0.019	0.631	0.142	0.073	0.056	0.347	0.092	0.245
Age	<b>0.027</b>	<b>0.026</b>	0.054	0.509	0.079	0.154	0.055	0.497
BMI	<b>0.018</b>	<b>0.009</b>	0.010	0.905	<b>0.030</b>	<b>0.017</b>	<b>0.053</b>	<b>0.019</b>
Sex (Female)	0.006	0.873	0.036	0.647	0.047	0.399	0.005	0.953
Race (Black)	<b>0.301</b>	<b>0.003</b>	-	-	-	-	-	-
Ethnicity (Hispanic)	0.003	0.961	-	-	-	-	-	-
Currently Employed	0.034	0.571	0.113	0.156	0.042	0.452	0.075	0.353
Parents/Family Financially Support	0.046	0.266	0.074	0.359	0.059	0.290	0.114	0.156
Loans Financially support	0.038	0.340	0.036	0.653	0.028	0.608	0.133	0.103
Grants/Scholarships Financial Support	0.003	0.944	0.021	0.790	0.017	0.752	0.034	0.675
Working to Financially Support	<b>0.205</b>	<b>0.038</b>	0.118	0.137	0.058	0.305	0.048	0.554
Pell Grant	0.008	0.849	0.005	0.955	0.010	0.856	0.132	0.095
Meal Plan	0.042	0.325	0.070	0.380	0.097	0.087	0.025	0.757
Disability	0.021	0.605	0.025	0.758	0.080	0.148	0.038	0.635
Health Status (Poor/Fair)	0.049	0.251	0.031	0.704	0.028	0.631	0.150	0.068
Cooking for Self/Others	0.075	0.079	0.072	0.369	0.039	0.508	0.088	0.289
Perceived Cooking Skills	0.011	0.780	0.002	0.978	0.027	0.634	0.053	0.519
Enrollment (FT/PT)	0.001	0.982	0.064	0.423	0.015	0.783	0.003	0.966
Freshman	0.010	0.809	0.150	0.061	0.063	0.252	0.012	0.877
Sophomore	0.029	0.475	0.003	0.970	0.028	0.617	0.035	0.664
Junior	0.038	0.346	0.055	0.495	0.016	0.776	0.115	0.160
Senior	0.007	0.875	0.059	0.456	0.062	0.272	0.090	0.263
Campus/University Housing	0.031	0.463	0.068	0.394	0.072	0.200	0.015	0.856
Living with Parent/Guardian	0.037	0.366	0.058	0.467	0.019	0.741	0.068	0.392
Off Campus/Non-University Housing	0.054	0.187	0.029	0.721	0.071	0.216	0.064	0.425

Note: Statistically significant values (*p* < 0.05) and corresponding coefficients are bolded. Abbreviations: BMI, body mass index; FI, food insecurity; FT, full-time; PT, part-time. Adjusted R<sup>2</sup>: Model 1 = 0.208; Model 2 = 0.078; Model 3 = 0.240; Model 4 = 0.323.

### 3.5. Summary of Main Findings

A summary of the study findings is presented in Table 6.

**Table 6.** Highlights of key study findings.

No statistically significant differences were observed for FI by racial and ethnic group.
Regardless of race or ethnicity, working 20 h per week to financially support oneself and race (Black) are among the strongest predictors of FI among college students.
Discrimination major was the sole predictor of FI for non-Hispanic Black students.
Coping mechanisms for FI (savings, reduced intake) and BMI were predictors of FI for Hispanic and non-Hispanic White students.
Decreased holistic support from faculty and staff was observed as a predictor of FI in Hispanic students.

## 4. Discussion

Underserved and underrepresented students are at greater risk of FI and associated health and academic issues [1,4,7,10]. Addressing FI among racial/ethnic minority college students requires an examination of determinants that span various domains within and among socio-ecological levels of influence to inform the development of interventions aimed at decreasing FI disparities [11,30]. To our knowledge, this is the first known study to employ a multi-dimensional model to understand and address health disparities among a large group of racially and ethnically diverse college students [31]. Results from the study revealed three critical findings with regard to FI among college students. When examining potential predictors of FI among all college students, regardless of race and ethnicity, we found significant multi-level/domain determinants, some of which support previous work (i.e., coping mechanisms, age, BMI, race). Subsequently, the significant finding that race was a predictor revealed the need for separate models by race and ethnicity.

First, although the current study revealed no statistically significant differences between racial/ethnic groups regarding intrapersonal-level health and behavioral domains of influence, differences were observed within the interpersonal-level socio-cultural and the community-level socio-cultural domains. Within both levels and domains, the current study revealed that Non-Hispanic Black participants reported experiencing more discrimination and less social support (support from family and friends), cultural familiarity (opportunities to connect with faculty administrators, staff, and peers with similar background and experiences), cultural validation (campus cultures that validate the cultural backgrounds, knowledge, and identities of diverse students), and humanized educational experience (availability of opportunities for students to develop meaningful relations with members of faculty and staff who care about and are committed their success) as compared with their Hispanic and Non-Hispanic White counterparts. These findings are consistent with the literature on college students, with minority students reporting disproportionate discrimination. Specifically, Black/African American students experience a higher incidence of discrimination in comparison to non-Hispanic White individuals [47] and Hispanic individuals [48]. Non-Hispanic Black students had significantly lower cultural familiarity scores than both non-Hispanic White and Hispanic individuals. While the literature supports the lack of a sense of belonging and culture on college campuses among minority college students [49], it is unclear if this aspect affects food security.

Second, the current study revealed differences in multi-level determinants of FI between racially and ethnically diverse college students. When assessed collectively, our study supports the work of others in that working 20 h per week to financially support oneself [3,7] and race/ethnicity are among the strongest predictors of FI among college students [25]. These findings support the current literature and highlight the influence of

social determinants on FI, especially among racial and ethnic minority college students. In a previous study, students who reported that they were employed were roughly two-times more likely to be food insecure [7], indicating that their income was not sufficient to meet their basic needs. Moreover, previous studies examining FI among college students have included food-secure and food-insecure students and have found significant differences in FI among racial and ethnic minority students [10]. Specifically, Black/African American and other racial/ethnic minority students are significantly more likely to be at risk of FI or be categorized as FI when compared to non-Hispanic White students [10,50]. Our findings support these previous studies, as Black race was found to be a statistically significant and the strongest predictor of food insecurity, when controlling for other factors and the other model determinants.

Third, perhaps one of the most important findings from the current study is the support hhe hwork-259(hf)-258(cBurk)-259(het-249(aml,-259(hwo)-259(hfbservd)-259(amn-259(

students. As food insecurity has been associated with negative health-related outcomes including an increased risk of obesity [53], other chronic diseases [54], and poor mental health [55], institutions across the U.S. are implementing supports and programs to address food insecurity among students. Beyond providing access to campus food pantries, efforts have been focused on providing students with culturally responsive information about additional resources, such as Supplemental Nutrition Assistance Program (SNAP) benefits [56]. However, further efforts that address multi-level determinants are necessary as obstacles arise for students.

Findings of discrimination indicate a need for (1) qualitative research to gather rich data on students' lived experiences, (2) multi-level culturally appropriate interventions developed in collaboration with Black students, and (3) the investigation of additional multi-level determinants, including relevant policies.

**Author Contributions:** Conceptualization, R.D.; writing—original draft preparation, N.I.B.; writing—review and editing, A.D.D., R.D., M.S., D.H., A.W.B., K.C. and R.J. All authors have read and agreed to the published version of the manuscript.

**Funding:** N.I.B. and A.W.B.'s work was funded by the National Cancer Institute while postdoctoral fellows at the H. Lee Moffitt Cancer Center and Research Institute (T32CA090314; MPIs: S.T. Vadaparampil and V.N. Simmons).

**Institutional Review Board Statement:** The study was conducted in accordance with the declaration of Helsinki and approved by the study site's Institutional Review Board.

**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

**Data Availability Statement:** Data can be provided upon request from the authors.

**Conflicts of Interest:** The authors declare no conflict of interest.

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