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Abstract

**Purpose:** To explore the association between developmental assets (characteristics, experiences, and relationships that shape healthy development) and food insecurity among adolescents from a low-income, urban community.

**Methods:** This mixed methods study occurred in two phases. In Phase 1, using a census approach, 2350 6-12th graders from the public school district completed an anonymous survey that included the Development Assets Profile (DAP), youth self-report form of the Core Food Security Module, and demographic questions. Logistic and multinomial regression analyses determined independent associations between developmental assets and food security adjusting for demographics. In Phase 2, 20 adult key informant interviews and four semi-structured student focus groups were performed to explain findings from Phase 1.

**Results:** On average, DAP scores were consistent with national norms. Food insecurity was prevalent; 14.9% reported low food security and 8.6% very low food security (VLFS). Logistic regression revealed that higher DAP was associated with lower odds of food insecurity (OR=.96, 95% CI=.95-.97); family assets drove this association (OR=.93, 95% CI=.91-.95). In multinomial regression modeling, these associations persisted and, paradoxically, higher community assets were also associated with VLFS (OR_{VLFS}=1.08, 95% CI=1.04-1.13). Qualitative analyses suggested that greater need among VLFS youth led to increased connections to community resources despite barriers to access such as stigma, home instability, and cultural differences.

**Conclusion:** Food insecurity is a pervasive problem among adolescents from low-income communities and is associated with lower developmental assets, particularly family assets. That community assets were higher among VLFS youth underscores the importance of community-level resources in struggling areas.
Glossary of Abbreviations:
PYD—Positive Youth Development
DAP—Developmental Assets Profile
A-CFSM—youth report form of the Core Food Security Module
FS—food secure
LFS—low food secure
VLFS—very low food secure
Summary of Team Member Roles

Zoë Shtasel-Gottlieb: I assisted in the quantitative and qualitative data analysis, drafted the original manuscript, and edited and approved the final manuscript of the submitted paper.

Elizabeth Goodman: Dr. Goodman conceptualized and designed the study. She supervised the data collection, supervised and performed data analyses, edited and revised the manuscript, and approved the final manuscript of the submitted paper. Dr. Goodman also served as my mentor for the Scholars in Medicine project. In this role, she assisted in the writing and submission of my IRB for the project, edited and approved my initial project proposal in the spring of 2012 and my final project proposal in the summer of 2014, supervised and assisted in my analyses of the data, and oversaw the drafting of the manuscript for publication as well as this final report.

Deepak Palakshappa: Dr. Palakshappa assisted in the design of and oversaw the qualitative portion of the study, collected and analyzed qualitative data, and made critical revisions to and approved the final manuscript of the submitted paper.

Fanyu Yang: Ms. Yang collected and analyzed qualitative data and made critical revisions to and approved the final manuscript of the submitted paper.

Becca Rector: Ms. Rector assisted with data collection and entry during Phase 1 of the study.
**Section 1: Introduction**

Growing up in a low-income community presents many challenges. Food insecurity, with its well-documented detrimental effects on adolescent development, is one of the most serious obstacles for youth in these communities (1-11). Defined as “limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways” (12), food insecurity has been linked to deficits in physical, psychological, and social wellbeing in adolescents. (1-11). For example, youth from food insecure households are more likely to have impaired social skills and to suffer from anxiety, depression, and suicidality than their food secure peers (1-3, 11). Given that food insecurity is often a source of stress for children and families, it has been hypothesized that this relationship may in part be due to a stress-induced increase in cortisol levels; a sustained, heightened level of cortisol over time has been associated with “depression, cognitive deficits, and atrophy of brain structures” that are essential to development (5). Indeed, considering food insecurity as a source of stress in low-income households is essential when taking into account the myriad factors affecting healthy adolescent development, as research has shown that risk factors for negative developmental outcomes in children may be additive (1).

In addition to its effects on psychological wellbeing, food insecurity may also be associated with problematic cognitive development and behavioral problems in adolescents. Some studies have found that youth from food insecure households have significantly poorer academic performances, more tardiness, and higher numbers of absences from school than their food secure peers (1, 8, 13). Additionally, children with low or very low food security may be more prone to anxious, irritable, aggressive and oppositional behaviors than their peers, regardless of socioeconomic status (6). It has been hypothesized that such behavioral issues may impact adolescents’ abilities to function in a school environment, thus indirectly impacting their cognitive development as well (13).

That food insecurity has been shown to have such a profound effect on adolescent development is significant in light of the persistent and growing prevalence of food insecurity in the United States. In 2012, 20% of households with children were affected by food insecurity and in 50% or 3.9 million households, a child experienced food insecurity that year (14).
Children and/or adults in 463,000 of these households experienced ‘very low food security,’ formerly referred to as ‘food insecurity with hunger’ (14). Poor families are at greatest risk for food insecurity: among households with children, 20.7% with incomes below 1.85 times the income-to-poverty ratio experienced food insecurity, compared to only 3.6% of those with higher incomes (14). Given recent economic and political trends in the US -- rising inequality, slow growth after the Great Recession of 2008, and reduction of both unemployment benefits and federal food and nutrition assistance programs-- it is likely food insecurity will remain a serious threat to healthy development for many families across the nation.

In addition to economic concerns and the erosion of social safety net programs, age appears to be an important risk factor for food insecurity. Adolescents are disproportionately affected by food insecurity in contrast with younger children (15). For example, in 2007, low food security and very low food security were 2.4 and 5.7 times as prevalent, respectively, in households with adolescents compared to those in which the oldest child was eight years or younger (15). Whether this is because parents protect younger children from the effects of food insecurity (16) or because adolescents develop greater awareness of familial challenges is unknown. Additionally, it remains unclear why some youth from low-income families are food secure while others are not. Understanding such resiliency is important in developing interventions to alleviate food insecurity and its sequelae.

Positive Youth Development (PYD) is a developmental systems science theory that can provide a useful framework for such studies. PYD is centered on the notion that youth have internal and external “developmental assets” that help them to develop into healthy, successful and socially engaged adults (17). Developmental assets include characteristics and behaviors that reflect positive personal and psychological development, as well as the experiences, relationships, support, and encouragement youth receive from peers, parents, teachers, neighbors, and other adults. Instead of focusing on youths’ weaknesses, the PYD approach seeks to align youths’ internal and external strengths with those of the community in an effort to maximize their developmental potential (17, 18). PYD posits that youth develop optimally and are most resilient when their developmental assets are aligned with their environments (19). PYD has been successfully applied in the development of interventions to decrease alcohol and substance abuse among adolescents and to address sexual and reproductive behaviors within this age group.
Furthermore, Healthy People 2020 specifically highlighted PYD as a promising approach to adolescent health risks (22).

The goal of our team’s study was to apply the PYD framework to the problem of food insecurity in adolescence. A relationship between PYD and food insecurity is plausible given that structural and economic disadvantage, particularly the stressors of poverty and economic insecurity, are fundamental causes of both. Figure 1 describes our conceptual model for this cross-sectional study. We hypothesized that having fewer developmental assets would be associated with greater food insecurity, and that this relationship would remain consistent across the different domains of developmental assets.

The goals of my portion of this study were as follows: to perform a literature review in order to develop a thorough understanding of the existing knowledge surrounding food insecurity, particularly in minority populations, and how it may be linked to adolescent development; to learn the basics of statistical analysis using SPSS software; to perform the frequency and bivariate analyses of the Phase 1 data; to present the Phase 1 data to leaders in the study community; to present the Phase 1 analyses at a national meeting; to assist in the qualitative data analysis of Phase 2; and to first author the paper describing our project, which has since published in the *Journal of Adolescent Health*. 

Section 2: Methods

Study Design and Team Roles:

Because social disadvantage shapes both developmental assets and food insecurity, the study was based in a low-income, predominantly minority urban community of approximately 47,000 located five miles outside of a major northeastern city. Although a historically white, working-class population, this community has recently undergone rapid demographic changes: its Hispanic population has more than tripled in the last decade. Amongst middle and high school students in 2009-2010, 45% were white, 40% were Hispanic, and 7% were Asian. Between 2000 and 2009, the percentage of residents with a first language other than English increased from 28% to 45%, while the percentage of low-income residents increased from 42% to 71% (23). Despite these vulnerabilities, the community has an active coalition working to address youth health risks, particularly obesity and substance use. Thus, we felt this community would have enough variation in youth development and socio-environmental risks to enable us to explore the association between PYD and food insecurity.

The study was conceptualized and overseen by Dr. Elizabeth Goodman and occurred in two phases, both of which were approved by the Partners Institutional Review Board. Phase 1 began prior to my joining the study team. Between Jan-Mar 2012, anonymous paper and pencil surveys containing measures of developmental assets and food security were administered to students in the community’s four middle schools (grades 6-8) and single high school (grades 9-12) during the school day. Becca Rector was particularly involved in this phase of the work. She scanned completed surveys into a database using SNAP V10 software (SNAP Surveys, LTD, Portsmouth, NH).

My role in the study began in the summer of 2012, during which time I assisted in the analysis of the Phase 1 data. However, prior to the data analysis, I conducted an extensive literature review primarily using PubMed and EMBASE. I searched for papers that focused on the relationship between food insecurity and different features of childhood/adolescent development, including behavioral, social, psychological and physiological outcomes. I also reviewed studies that examined the different tools used to assess food insecurity from both household and adolescent-centered approaches. I then searched for studies assessing the utility of
the Developmental Assets Profile (DAP) and PYD in addressing other adolescent health risks, such as substance abuse, sexual behavior, and resiliency after exposure to violence. Only after I developed a more thorough understanding of the context of our study did I begin to work on the data analysis, with the assistance and oversight of Dr. Goodman.

Phase 2 of the study occurred during the 2012-2013 academic year through the summer of 2013. This phase employed an explanatory follow up mixed methods approach. The team explored Phase 1 results through 20 key informant interviews with adult community members (24, 25) and four student focus groups (26), one at each school. I assisted in the design of the recruitment materials for the student focus groups as well as the interview and focus group guides. Data for this phase were collected by Dr. Palakshappa during the 2012-2013 school year and analyzed by Dr. Palakshappa and Fanyu Yang during the summer of 2013. I assisted in further analyses of these materials during the winter of 2014.

Study participants:

Per the school district’s request, a census approach with a parental opt-out option was used for Phase 1. All enrolled students were invited to participate. Only 3% (N=78) were opted out by a parent. Overall, 2,516 students returned a survey, 2,442 (97%) of which were sufficiently complete to be usable. Of the 2,442 usable surveys, 2,350 (93%) provided adequate information to score both the food insecurity and developmental assets measures. I assisted in the process of determining the final sample based on these requirements using SPSS. Youth who completed these 2,350 surveys comprise the Phase 1 study sample.

For Phase 2, students who had participated in Phase 1 were recruited for focus groups during school lunch periods during the fall and winter of 2012. Twelve students from each school (total N=48) were randomly selected from the pool of interested students. Parental consent was obtained for 32 of these students. These 32 students participated in the school-specific focus groups, facilitated by Dr. Palakshappa. Potential key informants were identified by Dr. Goodman, who had worked extensively with the study community prior to this project. During recruitment for interviews, snowballing was used to increase the pool of potential key informants. The final 20 key informants included members of school staff, parents, government officials, church officials, community organizers, and local health providers.
Measures:

Demographics: Students self-reported gender, grade, race and Hispanic ethnicity. Response categories used in analyses were White, Black, Hispanic, Asian, or Other due to small sample sizes for some racial/ethnic groups.

Developmental Assets: Developmental assets were assessed using the Developmental Assets Profile (DAP) (27). This widely used, reliable, and validated 58-item Likert-type scale was developed for use in 11-18 year olds and has a possible range of 0-60, with higher scores representing more assets (27). In addition to the total score, the context scoring method was used to derive asset subscale scores (27). This method creates five subscales, each reflecting assets of a unique context within the adolescent’s life: personal, social, family, school, and community (see Figure 2 for examples of context subscale items) (27). Context subscale scores range from 0-30. The DAP and its subscales have excellent internal consistency (Cronbach’s alphas all >0.8) and test-retest reliability (27).

Food Security: Most existing literature examines youth’s food security from the perspective of parents (1, 4, 10, 11, 28-31). However, recent work suggests parents may overestimate their children’s food security (29). We therefore relied on adolescent self-report of food security using the United States Department of Agriculture’s Core Food Security Survey Module for Children Ages 12 Years and Older, hereafter referred to as A-CFSM (available at www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/survey-tools.aspx#youth) (32). The A-CFSM consists of nine dichotomous questions about access to food, modified eating behavior, concerns about food availability and hunger levels within the past year. Each positive response is given a score of 1; scores are then summed across the nine items to give a total score ranging from 0-9. Individuals with scores of 0-1 are considered food secure (FS); those with scores of 2-9 are food insecure. Among food insecure individuals, a score of 2-5 indicates low food security (LFS) and 6-9 indicates very low food security (VLFS) (32).
Data Analysis

In Phase 1, data were analyzed using SPSS software v22. I first performed frequency analyses to better understand the demographic, DAP, and food insecurity profiles of our study participants. I then performed bivariate analyses to determine relationships between demographic characteristics, DAP scores and food security categories. Multivariable regression analyses performed by Dr. Goodman determined independent associations between developmental assets and food security, adjusting for demographics. In regression models, ‘food secure’ was used as the reference category. Logistic regression was run first to assess the association of developmental assets with food security as a dichotomous variable. Multinomial regression was then run to explore potential differences between the LFS and VLFS groups compared to the FS group. For both logistic and multinomial regression, two sets of analyses were performed: the first used the total DAP score and the second used context subscales. I worked alongside Dr. Goodman as she performed these analyses. She also ran regression diagnostics for the subscale analyses to ensure that multicollinearity was not affecting the models.

For Phase 2, both focus groups and key informant interviews were transcribed by Ms. Yang. Twenty percent of transcriptions were checked for validity. Transcriptions were each reviewed by 2-3 investigators (including myself) and analyzed for emerging themes. The investigative team met periodically to discuss and review themes. Through this iterative, reflective process, final themes were agreed upon and representative quotations pulled from the transcripts.
Section 3: Results

Phase 1: Survey Findings

A description of the Phase 1 study population can be found in Table 1. Half were female and 41.9% identified as Hispanic. Scores for the total DAP and context subscales were consistent with national norms (27) and followed similar associations with demographic characteristics. Total DAP scores were lower in boys than girls ($\mu_{\text{boys}}=38.4$ vs. $\mu_{\text{girls}}=39.4$, $p=0.009$) and decreased as grade increased (Spearman’s rho= -.23, $p<.001$). Additionally, total DAP scores were significantly lower in minority students than in white students ($p<0.001$). This trend was particularly notable among Asian students, whose total DAP scores were significantly lower ($\mu_{\text{Asian}}=35.0$) than all other racial/ethnic groups ($\mu_{\text{white}}=40.2$, $\mu_{\text{black}}=38.7$, $\mu_{\text{Hispanic}}=38.0$, $\mu_{\text{Other}}=39.2$). DAP scores also varied across the four participating schools. In order to protect the anonymity of the study population, the three middle schools will hereafter be referred to as M1, M2, and M3. Total DAP scores were lower at the high school (HS) than at any of the three middle schools ($\mu_{\text{HS}}=34.3$ vs. $\mu_{\text{M1}}=38.4$, $\mu_{\text{M2}}=39.3$, $\mu_{\text{M3}}=38.7$, $p<.001$).

Food insecurity was common. Nearly one quarter (23.5%, $n=271$) were food insecure, with 8.6% reporting VLFS. Concerns regarding food availability were prevalent among both FS and food insecure students [Figure 3]. Most notably, students from all three categories reported that, at some point during the last 12 months, their family’s limited budget caused worry that food would run out, and noted meals that included only cheap foods as well as lack of access to balanced meals. A small number of FS students reported instances of food actually running out. Questions reflecting greater food insecurity, such as whether a family’s limited finances resulted in reduced meal size, having to eat less, skipping meals, or going hungry, were answered positively only by LFS and VLFS students. Only VLFS students reported instances of not eating for a full day. In bivariate analyses (Table 2), food insecurity differed by race/ethnicity, grade and school, but not gender. Food insecurity was more common among minority students, particularly Asian and black students.

Association of Developmental Assets with Food Security
As hypothesized, bivariate analyses showed that DAP scores were highest among FS students and lowest among VLFS students (Table 2). Multivariable analyses to adjust for demographic factors are presented in Table 3. In logistic regression modeling, the association between total DAP score and food insecurity persisted (OR=0.96, 95% CIs= 0.95-0.97). This suggests that, for each point increase in the DAP score, there was a corresponding 4% decrease in the odds of being food insecure. Modeling of the context subscales revealed that the family subscale drove this association (OR=0.93, 95% CIs= 0.91-0.95). No other context subscale was significantly related to food insecurity in logistic regression modeling. These relationships were also demonstrated in multinomial regression modeling. Furthermore, multinomial regression modeling revealed that, in addition to the family subscale, the community subscale was also a significant correlate of VLFS. In contrast to our hypothesis, higher community assets were associated with increased odds of VLFS (OR=1.08, 95% CIs 1.04-1.13). This may be interpreted to suggest, for example, that a three point difference in the community assets subscale would mean that youth with the higher score would have an increase in the multinomial odds of 1.24 compared to the youth with the lower score.

Phase 2: Explanatory Follow up Key Informant Interviews and Focus Groups

We conducted key informant interviews and focus groups to help us better understand the Phase 1 findings, particularly the paradoxical association between higher community assets and VLFS. Key informant interviews and focus group discussions were semi-structured and guided by four open ended questions addressing: 1) where youth get most of their meals; 2) where parents get food for their families; 3) how youth deal with food insecurity; and 4) the role of school food assistance programs. The key informant interviews included two additional questions in which the findings regarding the respective relationships between family and community assets and food insecurity were explored. Three themes emerged from these discussions: 1) food insecurity is a recognized community concern, primarily among adults; 2) community-level resources are crucial for food insecure youth; 3) barriers prevent families from accessing community resources.
Food insecurity is a recognized community concern, primarily among adults

Most adult respondents were not surprised by the prevalence of food insecurity in the community (“I would think it would be higher”), and many noted the lengths that some families must go to in order keep food on the table (“families aren’t really focusing on [whether] the foods…[are] healthy. They’re just trying to get food for their children so they can at least have something to eat.”). Alternatively, while some students acknowledged problems with food access among their peers, most were unaware that food insecurity was prevalent in their community.

Community-level resources are crucial for food insecure youth

Many participants attributed our finding of higher community assets among VLFS youth to a heightened knowledge of and reliance on available community resources. Specifically, they suggested that the absence of a supportive home environment, reflected in lower family asset scores, motivated youth to reach out to the community (“Because they don’t have their parents [to support them] maybe they turn to their community and each other more”). Respondents also emphasized the support and empathy young people offered to each other and suggested that accessing community resources enhanced food insecure youths’ connection to other community members (“[Youth] are seeking other ways …to get food through community places [where] they’re meeting people from different cultures and hence being open to others… which [gives] them…a sense of connection and tie to the community”).

Adult respondents felt that diverse community level resources, such as local food pantries, school breakfast and lunch programs, and summer nutritional programs were helping to address the needs of food insecure youth. In particular, they emphasized the importance of school meal programs (“school programs for some families are the foundation of their food [and] their capacity to provide food”), without which they believed many children would face even greater food insecurity. In contrast, many students believed that school meal sizes were insufficient given scarcity at home ("[Portions of school meals] are very important…sometimes that’s the only meal for some kids …and some of the lunches here [are] under 1000 calories…some kids just don’t have enough food and it really hurts them").
Barriers prevent families from accessing community resources

Despite the availability of community resources, barriers to access create considerable challenges. Pride emerged as one such barrier (“For some families it might be a pride issue for them not to go. I think people feel like they’re failing their families if they can’t provide them the basic needs”). Similarly, students noted that the stigma and embarrassment surrounding hunger might prevent them from reaching out to peers (“That’s where embarrassment comes in…If I didn’t have enough food and I had [to ask my friend], I would feel extremely embarrassed”). In this vein, some participants emphasized the need for more open dialogue about food insecurity (“People could start talking to each other and … to people who are too scared to even say that they don’t have food”). Another emergent theme was instability at home (“domestic violence, drug and alcohol abuse, [or] absentee parents”), which may have contributed to the correlation between low family assets and food insecurity. Respondents also suggested that parents might have difficulty navigating resources, particularly due to language barriers and cultural differences (“There are a ton of resources out there but they aren’t in one central place”; “there are a lot of immigrant families and [certain ethnic groups] are really isolated a lot of times too”).

Use of Study Materials for Academic Purposes

During the 2012-2013 academic year, I used our Phase 1 findings to draft an abstract and create a poster. Dr. Goodman supervised this process and edited both items. I first presented these materials at Soma Weiss Day at the Harvard Medical School in January of 2013. We also submitted the abstract to the Pediatric Academic Societies (PAS) annual meeting. In May 2013, I attended this conference in Washington DC, where I presented the abstract and poster describing our work to date at that point.

In addition to these efforts, I began to draft a manuscript describing our work at the end of the summer of 2012. During the winter of 2014, I revised this initial version and wrote a complete draft. Dr. Goodman was integral in this process, offering guidance and frequently assisting in the editorial process. Dr. Palakshappa and Ms. Yang also assisted in editing and revising this document. At the end of January 2014, our team submitted the manuscript for publication in Pediatrics. Although the paper was not accepted, this process was helpful in elucidating problematic components of the paper. We used the constructive feedback we
received from the Pediatrics reviewers to thoroughly revise our manuscript. Dr. Goodman provided significant guidance and oversight as I worked to make the appropriate edits. Drs. Goodman and Palakshappa and Ms. Yang also helped to edit and revise the manuscript, which was submitted for publication to the Journal of Adolescent Health in April 2014. In July 2014 we received detailed responses from five reviewers. Dr. Goodman and I met to discuss our responses to these suggestions. I then drafted an initial response to reviewers that was subsequently edited and revised by Drs. Goodman and Palakshappa (see Appendix A for the final version). Edits to the paper as well as the Response to Reviewers were approved by all members of the study team. The paper was then resubmitted for publication. In October 2014, we were informed that the paper was accepted for publication pending minor revisions. Dr. Goodman and I discussed these minor changes, which were made during our meeting. Dr. Goodman then resubmitted the paper, which was accepted for publication within the following weeks. In November 2014, we received the proofs for the paper. I reviewed the document and made the appropriate modifications, which were subsequently reviewed and approved by Dr. Goodman. The paper was published in the journal’s February 2015 issue (Shtasel-Gottlieb Z, Palakshappa D, Yang F, Goodman E. The Relationship Between Developmental Assets and Food Security in Adolescents From a Low-Income Community. J Adolesc Health. 2015; 56:215-22.)
Discussion:

The purpose of this study was to explore the relationship between developmental assets and food security in adolescents. In this sample of 6-12\textsuperscript{th} graders from a Northeastern urban community with developmental assets mirroring national norms, we found a disturbingly high prevalence of food insecurity. Nearly one quarter of students were food insecure and nearly one in 10 had very low food security; these statistics are higher than those found in the Northeast in 2012, when 16.7\% of households with children were found to be food insecure (14).

Additionally, we demonstrated an association between developmental assets and food insecurity. We found that having fewer developmental assets correlated with higher food insecurity. Context analyses revealed that lower family assets, rather than school, personal, or social assets, drove this association. We also found that higher community assets were associated with very low food security but not low food security.

The relationship observed between lower family assets and greater food insecurity was consistent with our hypothesis as well as the existing literature (3, 11, 31). However, the relationship between greater community assets and higher odds of very low food security was paradoxical. Follow up qualitative analyses in the explanatory phase of this study suggested that VLFS youth, who were more likely to have lower family assets, may be more resourceful and/or more dependent on community resources than their food secure peers. This is consistent with the buffering effect of high social cohesion against food insecurity that has been shown in other studies (33). Furthermore, that this association existed for very low food secure students but not for low food secure students—in other words, that the link to community assets manifested only at the highest levels of food insecurity—suggests a floor effect. This has important implications for development of PYD interventions to address food security. In this community, interventions addressing community assets would be most appropriately targeted toward VLFS youth.

Our qualitative findings also suggested that school breakfast and lunch programs were key protective community resources for students in this community. In the 2011-2012 academic year, breakfast was available to all students, 64.3\% of students in this district received free lunch, and 10.7\% received discounted lunch (23). While these statistics are not limited to the town’s
middle and high schools and do not include the actual percentage of students receiving free or discounted breakfast, they nonetheless reflect the needs of the majority of students in this district’s public school system. Additionally, the impact of these free meals on perceived food security is likely considerable. Although many students in our focus groups considered the meals available at school to be insufficient, if these meals had not been available it is likely that more students would have identified as food insecure. This buffering effect of school food assistance programs is important to consider in the context of widespread budget cuts within the public sector, especially in communities already facing economic hardship. Moreover, that previous studies have shown that school-based food supplementation programs moderate the relationship between food insecurity and scholastic difficulties further underscores the importance of such programs in communities like that of our study population (34).

Despite its pervasiveness among adolescents in low-income communities, food insecurity often goes unrecognized, as it did among many students in this study. Adults, however, were better able to acknowledge the seriousness of the problem in this community. This finding highlights the importance of adult support networks in addressing the problem of food insecurity, particularly for adolescents who may be overlooked in favor of younger children in relation to nutritional assistance (15, 16). PYD programming, which is youth-specific and aims to build and sustain such networks, offers one avenue for addressing this major public health issue.

The adolescent healthcare system could also serve as a supportive adult network for food insecure youth. Just as shame may impede discussions of food insecurity with peers, teens may also hesitate to bring up issues related to food security at health care visits. Thus, providers should specifically ask adolescents if they are concerned about food availability or experiencing hunger, in addition to other social risks (35). Moreover, given that food insecurity may be associated with other pressing health issues for adolescents such as depression, anxiety and obesity (2, 3, 11, 36-38), its identification may offer providers an opportunity to address these health concerns from a different perspective. These types of discussions provide an opportunity to address patients’ basic psychosocial needs through the primary care visit, which is consistent with the medical home model (39, 40).
Study Limitations:

This study has important limitations. Firstly, because of its cross sectional design, this study cannot determine whether food insecurity was the result or cause of differences in developmental assets. However, whilst determining such causal effects is an important objective, such a determination was not our goal. Indeed, we specifically conceptualized the relationship between developmental assets and food insecurity as bi-directional not only because of our cross sectional design, but more importantly, because we believe the relationship between developmental assets and food security to be recursive (Figure 1). Determining the causal nature of this association will require further study. Additionally, our results are representative of only one community. It is unclear how generalizable these data are to other communities, particularly those with different socioeconomic and racial/ethnic composition. These limitations are countered by this study’s strengths: use of measurement tools proven to be both valid and reliable and which allowed us to ask adolescents directly about their food security, rather than relying on parental report; a census-based survey sampling with very low parental opt-out; and our explanatory mixed methods approach.

Personal Limitations:

Upon starting the project, I had limited experience with statistical analysis. However, Dr. Goodman was aware of this and was very helpful as I learned to use SPSS. She also guided me in interpreting the results of the analyses. Additionally, the writing of the manuscript was challenging, as this was the first scientific paper I have ever written. Dr. Goodman was extremely helpful in teaching me what was best to focus on, what figures and tables would be important to include, and which pieces of the project we wanted to focus on in our Discussion section.

Conclusions and Implications:

This study demonstrated an association between developmental assets and food security. In particular, we found that fewer family assets were associated with both low and very low food security, and that, paradoxically, greater community assets were also associated with very low food security among adolescents. Our findings, both quantitative and qualitative, highlight the
importance of community resources and adult support networks for vulnerable youth. Moreover, they underscore the importance of integrating psychosocial factors such as food insecurity into adolescent primary care.

Our findings also serve as a foundation for future, larger scale studies that aim to explore the relationship between developmental assets and food security in greater detail. While the goal of our study was to determine the existence of a relationship rather than causality, future efforts to elucidate the directionality of this relationship are imperative. Longitudinal studies exploring how food security status and developmental assets relate over time could be instrumental in achieving this goal as well as in the development of PYD-based interventions.
References:


Tables and Figures

Figures:

Figure 1: Conceptual Model. In this model, economic insecurity and poverty are identified as shared, root causes of food insecurity and developmental assets. The current study’s area of focus, the relationship of between food insecurity and developmental assets, is highlighted. This relationship is conceptualized as bidirectional.
Figure 2: Context View of the Developmental Assets Profile. Each context includes descriptions of the items used in its assessment.
Figure 3: Distribution of Students’ Responses to Items on the Core Food Security Module by Food Security Category (N=2350). Responses reflect students’ experiences at any point in the past 12 months.
Tables:

Table 1: Description of Demographic Characteristics and Developmental Assets of the Study Population (N=2350)

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<td>41.9</td>
</tr>
<tr>
<td>Asian</td>
<td>119</td>
<td>5.1</td>
</tr>
<tr>
<td>Other</td>
<td>289</td>
<td>12.3</td>
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<tr>
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<td>134</td>
<td>5.7</td>
</tr>
<tr>
<td><strong>School</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M1</td>
<td>375</td>
<td>15.9</td>
</tr>
<tr>
<td>M2</td>
<td>410</td>
<td>17.4</td>
</tr>
<tr>
<td>M3</td>
<td>414</td>
<td>17.6</td>
</tr>
<tr>
<td>High School</td>
<td>1154</td>
<td>49.0</td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade*</td>
<td>8.7</td>
<td>2.0</td>
</tr>
<tr>
<td>Subscales</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>--</td>
<td>---</td>
</tr>
<tr>
<td>Total</td>
<td>38.9</td>
<td>10.2</td>
</tr>
<tr>
<td>Personal</td>
<td>19.4</td>
<td>5.2</td>
</tr>
<tr>
<td>Social</td>
<td>19.9</td>
<td>5.4</td>
</tr>
<tr>
<td>School</td>
<td>19.6</td>
<td>6.2</td>
</tr>
<tr>
<td>Family</td>
<td>21.8</td>
<td>6.6</td>
</tr>
<tr>
<td>Community</td>
<td>16.9</td>
<td>6.0</td>
</tr>
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</table>

SD=standard deviation
*N=48 were missing grade
Table 2: Association of Demographic Characteristics and Developmental Assets to Food Security Category

<table>
<thead>
<tr>
<th></th>
<th>Food secure (N=1797)</th>
<th>Low food secure (N=350)</th>
<th>Very low food secure (N=203)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>857</td>
<td>75.6</td>
<td>173</td>
</tr>
<tr>
<td>Female</td>
<td>916</td>
<td>77.2</td>
<td>176</td>
</tr>
<tr>
<td><strong>Race/Ethnicity</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>610</td>
<td>82.7</td>
<td>82</td>
</tr>
<tr>
<td>Black</td>
<td>63</td>
<td>73.3</td>
<td>14</td>
</tr>
<tr>
<td>Hispanic</td>
<td>729</td>
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<tr>
<td>Asian</td>
<td>83</td>
<td>69.7</td>
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<tr>
<td>Other</td>
<td>211</td>
<td>73.0</td>
<td>48</td>
</tr>
<tr>
<td><strong>School</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M1</td>
<td>288</td>
<td>76.8</td>
<td>64</td>
</tr>
<tr>
<td>M2</td>
<td>318</td>
<td>77.6</td>
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<td>M3</td>
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<tr>
<td>High School</td>
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<td>76.8</td>
<td>150</td>
</tr>
<tr>
<td><strong>Mean SD</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade *</td>
<td>8.7</td>
<td>2.0</td>
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</tr>
<tr>
<td>DAP</td>
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<tr>
<td>Total*</td>
<td>39.9</td>
<td>10.0</td>
<td>37.3</td>
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Table 3: Logistic and Multinomial Regression Analyses of the Relationship of Developmental Assets to Food Security

<table>
<thead>
<tr>
<th>Subscales</th>
<th>Logistic Regression#†</th>
<th>Multinomial Regression#†</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Food Insecure</td>
<td>Low Food Secure</td>
</tr>
<tr>
<td></td>
<td>OR</td>
<td>95% CI</td>
</tr>
<tr>
<td><strong>DAP</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>0.96***</td>
<td>0.95-0.97</td>
</tr>
<tr>
<td>Subscales</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal</td>
<td>0.98</td>
<td>0.95-1.02</td>
</tr>
<tr>
<td>Social</td>
<td>0.99</td>
<td>0.95-1.04</td>
</tr>
<tr>
<td>School</td>
<td>0.99</td>
<td>0.97-1.03</td>
</tr>
<tr>
<td>Family</td>
<td>0.93***</td>
<td>0.91-0.95</td>
</tr>
<tr>
<td>Community</td>
<td>1.02</td>
<td>0.99-1.05</td>
</tr>
</tbody>
</table>

SD=standard deviation.
*p < .001
**p<.05

<table>
<thead>
<tr>
<th>Subscales</th>
<th>19.8</th>
<th>5.1</th>
<th>18.6</th>
<th>5.1</th>
<th>16.8</th>
<th>5.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social*</td>
<td>20.4</td>
<td>5.4</td>
<td>19.1</td>
<td>5.3</td>
<td>17.1</td>
<td>6.0</td>
</tr>
<tr>
<td>School*</td>
<td>20.1</td>
<td>6.1</td>
<td>18.9</td>
<td>6.2</td>
<td>16.7</td>
<td>6.6</td>
</tr>
<tr>
<td>Family*</td>
<td>22.6</td>
<td>6.2</td>
<td>20.8</td>
<td>6.6</td>
<td>16.7</td>
<td>8.0</td>
</tr>
<tr>
<td>Community*</td>
<td>17.2</td>
<td>6.0</td>
<td>16.2</td>
<td>5.8</td>
<td>15.2</td>
<td>5.9</td>
</tr>
</tbody>
</table>
CI=confidence interval; OR=odds ratio.

** 0.01 ≥ p > .001, *** p ≤ .001

# Models adjust for gender, race/ethnicity, and grade.
† Food Secure is the reference category for both logistic and multinomial regressions.
Appendix A: Response to Reviewers from the *Journal of Adolescent Health*

*I assisted the study team in drafting and editing the responses to all questions except for the following: The response to Reviewer 4, Question 2 was written exclusively by Dr. Goodman and does not reflect my contribution. It has therefore been removed from this report. Components of the response to Reviewer 5 have also been removed for this reason.*

Reviewer #1: This manuscript is well written, clear, and in an area no previously studied. It is a mixed methods study with a quantitative drive and a qualitative thrust that further explains answers received from the quantitative portion. It is based on a theoretical framework that guides the study. It is original in its research subjects as well as its theoretical use for this phenomenon of concern. This is vital information that needs to be published.

*We thank the reviewer for appreciating our theory-based, mixed methods approach and for believing the research is original and important.*

Just a few thoughts:
1. I would state the hypotheses more formally and more highlighted in the paper. You talk about supporting and not supporting in several areas, but the only place that I am finding a hypothesis referred to is on page 3 of the body of the paper, line 12.

*We appreciate your recommendation. We have rephrased the hypothesis to include both the DAP as a whole as well as the subscales in the last paragraph of the introduction, as follows: “We hypothesized that having fewer developmental assets would be associated with greater food insecurity, and that this relationship would remain consistent across the different domains of developmental assets.”*

2. It would be helpful to have definitions of very low food secure, low food secure and food secure. This could even be done in the form of a table.

*We are sorry the reviewer felt our explanation of the A-CSFM scoring in the initial submission (“Individuals with scores of 0-1 are considered food secure (FS); those with scores of 2-9 are food insecure. Among food insecure individuals, a score of 2-5 indicates low food security (LFS) and 6-9 indicates very low food security (VLFS).”) was not adequate. We have retained this text and, in order to help better define these terms, we have added the following in the paragraph in the Measures section under the subheading “Food Security”: “The A-CSFM consists of nine dichotomous questions about access to food, modified eating behavior, concerns about food availability and hunger levels within the past year. Each positive response is given a score of 1; scores are then summed across the nine items to give a total score ranging from 0-9.”*
3. In Phase 2 or the qualitative portion of the study, you refer to focus groups and key informants. You should probably cite where these terms are from and define them. Again a small table to do this would be fine. The typical anthropological definitions are key and general informants, where the key informants would have been those youth who participated in the focus groups (those who are part of the culture) and the general informants would actually be who you are calling the key informants. They are people who know something about the culture but are not directly a part of the culture under study. If you are going to use other than a traditional definition, then I would cite whose definition you are using.

Thank you for this suggestion. We believe the terms “focus groups” and “key informant interviews” are common in the literature, including JAH publications and particularly in relation to community-based work. Thus, we believe these do not need further definition. To comply with the reviewer’s request, we have included citations that describe and define these terms in detail for interested readers. See the Study Design section: “In Phase 2, using an explanatory follow up mixed methods approach, we explored Phase 1 results through 20 key informant interviews with adult community members (23,24) and four student focus groups (25), one at each school.” See references below. (1, 2)(3) Given the length restrictions and restrictions on number of tables/figures for JAH publications, we did not add a table. We also wish to highlight for the reviewer that the culture we were assessing was the community at large, not the youth sub-culture within that community. PYD is based on the notion that the interaction between youth and his/her environment is critical to development. Thus, the social environment (the community) is key. In addition, food insecurity is dependent on the family and community resources, making information on those aspects also key to this work. Thus, we feel we are using the traditional definition of key informant—individuals who are part of the culture, and who have special knowledge and understanding, and who “can provide insight on the nature of problems” (2)

4. Did you get permission or purchase the measurement tools that you used in this study?

Our research group purchased the DAP from the Search Institute. We then created our own scannable copies for distribution in schools and scoring by our study team. The A-CFSM is freely available in the public domain.

5. A bit more about the community context, other than what you gave in the first paragraph might be useful to the reader. (I know you are right at your 3500 word limit, and I am not seeing something else that can legitimately be left out). As I was reading, I wondered what community resources were available, as well as a bit more about the environment in which these people lived. In particular because you mentioned language barriers and cultural differences in the last paragraph of your results section, it would be interested to know the languages spoken in this community as well as the variation in cultures. Were there some in the community who were non-English speaking? To me this sentence implied a fair amount of diversity within the community that influenced them accessing resources.
We agree with the reviewer about the community’s diversity. In the first paragraph of the Methods section of the initial submission under the heading ‘Study Design,’ we discuss the population’s size and the most recently reported racial/ethnic profile of public middle and high school students. We also noted changes in the percentage of residents with a first language other than English and changes in the percentage of low-income residents between 2000 and 2009:

“This study took place in a community of approximately 47,000, located five miles outside of a major northeastern city. Although a historically white, working-class population, this community has recently undergone rapid demographic changes: its Hispanic population has more than tripled in the last decade. Amongst middle and high school students in 2009-2010, 45% were white, 40% were Hispanic, and 7% were Asian (22). Between 2000 and 2009, the percentage of residents with a first language other than English increased from 28% to 45%, while the percentage of low-income residents increased from 42% to 71%.”

This language has been retained in the revision. We are unable to disclose any more detailed information due to concerns of deductive disclosure for the community. We believe that the language barriers and cultural differences discussed in the qualitative phase of the study reflect the community’s diversity. As noted above, 45% of residents in 2009 were non-English speaking.

6. Check your format. On page 1, the first sentence of your paragraphs don't have indents, but they do throughout the remainder of the paper.

Thank you for pointing this out. The formatting is now consistent throughout the manuscript.

Again, let me say, I really enjoyed reading this manuscript, and learned from it.

Thank you very much for your feedback!

Reviewer #3: This study is well-done, with appropriate methods and analysis, but suffers from its core hypothesis which, I believe, is not consistent with the scope of the JAH. Food insecurity is certainly a problem in the US, particularly for teens, and of course does affect their health, but its solutions are not obviously in the health care realm. Furthermore, although Developmental Assets provide a rich source of information about teens and resilience in the face of difficult life situations, as the authors note, the present study cannot distinguish cause/effect and thus is limited in its ability to guide adolescent health care providers in ways to assist teens who suffer from food insecurity. The paradoxical relationship between greater community assets and higher odds of very low food security is very interesting and deserves further study, but seems more appropriate for a social sciences than health journal.

We appreciate that the reviewer considered this to be a well-done study. However, we respectfully disagree with the reviewer regarding appropriateness for publication in this journal, given that JAH is a multidisciplinary journal that focuses on health, psychosocial, and community-related issues for adolescents and young adults. While we agree that we are not able to establish cause/effect given the cross-sectional nature of this study, we respectfully point out
that this was not our goal. Instead, we sought to explore whether or not a relationship existed between developmental assets and food insecurity, with hopes that our findings could guide future, larger-scale studies designed to better understand this relationship and develop appropriately targeted, effective interventions.

Reviewer #4: This manuscript examines the relationship between developmental assets and food insecurity among 2,350 adolescents in a low-income community in New England. The manuscript is generally clear and well-written and there are several notable methodological strengths of the study that are worth highlighting:

- The study tests a novel relationship that could yield important insights about sources of resilience and buffers against food insecurity, a critical issue for adolescents.
- Survey data collection appears to have been very successful, with high response rates that are likely to be representative of youth in the study community.
- The study conducted focus group interviews, which adds interesting insights and texture to the study findings.

*We thank the reviewer for appreciating these strengths of our study.*

However, there are three very crucial issues that raise concern about the study findings and interpretation. In my view, each of these issues must be addressed for successful revision.

1. Conceptually, the link between developmental assets and food insecurity is unclear. Whereas initiation of drugs and alcohol and other risky behaviors is likely to be directly caused by low levels of developmental assets (such as a safe loving home or a supportive school environment), food insecurity is typically seen as having a more structural basis (i.e. resource deprivation) rather than being caused by low levels of developmental assets. Indeed, to the extent that there is a relationship between food insecurity and developmental assets, the causal order could just as likely be reversed (a lack of food in the family erodes the supportive family environment or causes individuals to become less motivated to participate in school). Or, for that matter, both food insecurity and developmental assets could be simultaneously caused by a shared exposure to social stressors stemming from poverty or economic instability. To be clear: I am not claiming that there is no plausible direct link from developmental assets to food insecurity, but rather arguing for a much more explicit and comprehensive overview of potential mechanisms in the introduction. Although the authors state that they are not estimating a causal relationship, the associations that they are examining would only be plausible and compelling if it were likely to have some causal interpretation.

*We appreciate this thoughtful feedback and apologize that the conceptual model on which this study is based was not clearly articulated in the initial submission. With regard to the question of causal direction between developmental assets and food security, we posit that, because developmental assets and food insecurity are complex behavioral and social phenomena, their relationship is recursive rather than unidirectional. We have added a figure (Figure 1) and further explanation of the conceptual model to the last paragraph of the Introduction: “A*
relationship between PYD and food insecurity is plausible since structural and economic disadvantage, particularly the stressors of poverty and economic insecurity, are fundamental, root causes of both.” We hope these revisions provide the clarity the reviewer was requesting. As Figure 1 details, we agree with the reviewer that food insecurity does indeed have a structural basis. PYD also has a structural basis. This shared exposure shaped our choice of community, as we note in the first sentence of the “Study Design” section: “Because social disadvantage is a shared root cause of both developmental assets and food insecurity, the study was based in a low-income, predominantly minority urban community of approximately 47,000 located five miles outside of a major northeastern city.”

Although we agree that establishing causality is a worthy goal, we felt that is was important to first establish that a relationship between developmental assets and food security exists, as discussed in our response to Reviewer 3. Ultimately, we hope that these findings will provide a foundation for more complex, longitudinal and interventional studies that could determine causality as well as effective ways to both promote positive youth development and decrease food insecurity. We have included in the limitations section the following to make sure readers understand the limitations of our design as well as our rationale: “Whilst determining such causal effects are important objectives, such a determination was not the goal of this study. Indeed, we specifically conceptualized the relationship between developmental assets and food security as bi-directional not only because of our cross sectional design, but more importantly, because we believe the relationship between developmental assets and food security to be recursive (Figure 1). Determining the causal nature of this association will require further study.”

3. While the use of a focus group can be a useful way to deepen the interpretation of quantitative results, I have some concerns about the validity of the focus group findings. My understanding is that focus group respondents were told the survey results, and asked to reflect upon those results in their own responses. Is that true? If that is true, it seems very likely that focus group respondents would focus on explanations that would be consistent with the survey results. Put differently, if the survey results had instead suggested that community assets were positively associated with food security, focus group respondents might have focused on explanations that are more supportive of that idea. Given that the focus group data are already collected, the best that can be done is to underscore that focus group responses could be sensitive to the framing of questions and that they are best interpreted as a means of generating new hypotheses, not as a test of the quantitative results.

We absolutely agree with the reviewer that the focus group and key informant interview findings should be interpreted as a means of generating new hypotheses, not as a test of the quantitative results. This is consistent with our explanatory mixed methods approach (see response to Reviewer 7, #1 below). The focus groups and key informant interviews were intended to help us better understand the findings from the survey portion of the study, not to validate them. Discussions for both key informant interviews and focus groups were semi-structured, guided by four open ended questions. In order to gain insight from key informants regarding our findings, key informant interviews also included two additional questions in which the findings regarding
the relationships between family assets and food insecurity and those between community assets and very low food security were explained. Additionally key informants only (not focus group participants) were informed of the prevalence of food insecurity among our study participants. Focus group participants were informed only that “students told us that sometimes their families run out of food at home or there is not enough to go around because their families do not have enough money to buy food”. We added the following to the introduction to Phase 2 text to provide more details for the reader: “Discussions for both key informant interviews and focus groups were semi-structured, guided by four open ended questions addressing: 1) where youth get most of their meals; 2) where parents get food for their families; 3) how youth deal with food insecurity; and 4) the importance of school breakfast and lunch. The key informant interviews included two additional questions in which the findings regarding the respective relationships between family and community assets and food insecurity were explored.”

Other comments (these are more minor, but would be helpful to consider in revision):
4. Developmental assets should be briefly defined in the abstract, it is not a concept known to a general adolescent health readership.

We have added the following sentence to the Purpose section of the Abstract: “To explore the association between developmental assets (characteristics, experiences, and relationships that shape healthy development) and food insecurity among adolescents from a low income, urban community.”

5. Health care providers are mentioned in the contribution statement and the discussion, but apart from eliciting information about food security, what can providers actually do to address this issue? Perhaps the author could mention the potential linkage of social assistance to medical care (for example, organizations such as Health Leads that facilitate referrals to community food resources).

Thank you for this suggestion. We have integrated this important concept into our discussion of the role of health care providers in the fifth paragraph of the Discussion section: “A connection between an adolescent and his/her health care provider may be one such adult network to support youth.” .......“These types of discussions provide an opportunity to address patients’ basic psychosocial needs through the primary care visit, which is consistent with the medical home model (34,35),”

We also changed the last sentence of the discussion of the study’s implications in the final paragraph of the Discussion section: “Moreover, they underscore the importance of integrating psychosocial components of health and well-being into primary care, particularly in high-risk communities.”

6. What was the profile of focus group students, and how did they differ from the main study respondents? Were these mainly the high-achieving students that school administrators turn to when they need individuals whom they perceive to be articulate and thoughtful?
Focus group participants were recruited in the cafeteria during the school lunch period. Study staff hung a large poster with the following text: “Do you care about the health development of students in [your town]? Do you want to make a positive impact in your community? Come talk to us! We want to hear what you think!” The only requirement for participation was that students had also participated in Phase 1. All interested students were put into a pool and, in order to minimize bias, randomly selected to participate. Participation required parental consent. Because the focus groups were anonymous, we do not have demographic or other information to profile the participants. We have added further explanation of the recruitment to the Methods section under the subheading “Study Participants”: “Twelve students from each school (total N=48) were then randomly selected from the pool of interested students. Parental consent was obtained for 32 of these students. These 32 students participated in the school-specific focus groups.”

7. In some broad sense all the students are from the same community, so it seems peculiar to test for community differences. I think it would be helpful to explain that these students come from different neighborhoods or social groups. That nuance is missing from the manuscript.

We apologize that we did not make clear that we are not testing for community differences, but for differences in community assets, a sub-domain of developmental assets. Additionally, per request of the school board of the participating community, this study used a census-based approach. This allowed us to understand the community as a whole. While we agree that additional information about students’ neighborhoods or social groups would help us to better understand differences within the community, such an investigation would have required additional assessments and multi-level modeling, both of which were beyond the scope of this exploratory project.

8. Social desirability bias seems like a potential problem. Both developmental assets and food security ask about stigmatized issues, and students may be reluctant to disclose either of these issues in a survey leading to higher reporting of both than might actually exist in the population and creating measurement error that would bias the study findings toward null results.

We agree with the reviewer in that social desirability can be a problem with any survey assessment. However, we believe that anonymity of the survey and the census nature of the sample minimized potential bias.

In summary, this paper examines an important question, but also has some serious methodological problems that must be addressed if the authors are offered the opportunity for revision.

We hope that our revision and answers provided herein address all the reviewers’ concerns.

Reviewer #5:
Comments to the Author(s):

Overview. The main aim of this paper was "to explore the association between developmental assets and food insecurity among adolescents from a low-income, urban community. This mixed methods study occurred in two phases. In Phase 1, using a census approach, 6-12th graders (N=2350) completed an anonymous survey that included the Development Assets Profile (DAP), youth report form of the Core Food Security Module, and demographic questions. Logistic and multinomial regression analyses determined independent associations between developmental assets and food security adjusting for demographics. In Phase 2, 20 adult key informant interviews and four semi-structured student focus groups explored paradoxical findings from Phase 1." Race, gender and grade differences are explored but the rationale or explanation of these analyses and findings is not well developed. While the manuscript is written well, it still falls short in many areas.

Literature Review. Overall the current manuscript is organized and well-written. The largest limitation of this analysis is that it is cross-sectional in nature. The authors argue that developmental assets are linked to lower food security, or in other words higher food insecurity. However, these relationships are endogenous in nature and a cross-sectional analysis does not propel the literature in this field ahead. Why would having parents who are good at communicating lead to or be related to lower food security? Or could it be that families who have more hunger could be poorer communicators? This rationale is not clear. In particular, why do you think the subscales may vary and why is it that only family and community matters? This is the main argument of the paper and needs to be further developed. Why is the question that needs to be answered? What is the process? And why is it important for adolescents?

We agree with the reviewer that the cross sectional study design is a limitation and have clearly stated so in the limitations paragraph in the Discussion. However, we respectfully disagree that a cross sectional study cannot propel the field forward. As this exploratory study is the first to apply the PYD approach to food security, we felt this study design was appropriate. We could not justify a more time intensive and expensive longitudinal cohort study without first providing evidence that the relationship existed. This study provides such evidence and therefore, does provide the foundation for more intensive investigations.

We also agree with the reviewer that these relationships are endogenous in nature. Please see response to Reviewer 4, #1 above regarding the rationale. We hope that the new figure and changes to the manuscript clarify our rationale. With regard to the example raised by the reviewer regarding family communication, we believe both scenarios described by the reviewer are possible and will provide explanations for that belief. Prior studies have demonstrated that parents tend to underestimate their children’s experiences of food insecurity. It is possible that parents who are poor communicators whose children are food insecure may be unaware of the extent of their children’s food insecurity. This could be part of the mechanism underlying the association of lower family assets to food security. It is also possible that the stress of food insecurity impairs parent–child communication, which could also influence the family assets-food security association. These examples highlight the bi-directional nature of this association,
consistent with our conceptual model (Figure 1). We hypothesized that all developmental asset domains would function similarly. We did not expect variation between subscales in the relationship to food security. We are still trying to understand why family and community contexts were the only subscales with significant associations; the qualitative portion of our study was intended to help us answer this question.

Finally, we hope that this revision makes our argument for the paper more strongly (see also our response to Reviewer 4, #1 above). We respectfully note that Reviewer 1 felt this was “vital information that needs to be published.”

Methods & Analyses. The sample and measures section is nicely organized and well-written. However, more is needed about the qualitative analysis conducted in this paper. Who are the key informants? Could there information about community assets vary from how the adolescents' view community assets?

We thank the reviewer for commenting positively on the writing and organization of the paper. In response to Reviewers 1 and 4, we have added more details about the qualitative methods and analyses. Key informants were a diverse group including, among others, two pastors at local churches (one of which housed a food pantry), a school social worker, a leader of the community coalition, the Project Bread neighborhood organizer for the town, an NP from the school district, and a community health center nutritionist. We described this group in general terms in the initial submission in the last sentence of the Study Participants section. In order to protect the anonymity of the study community, we are unable to include additional information regarding the identities of key informants due to the potential for deductive disclosure. The last sentence of the Study Participants section now reads: “The final 20 key informants included members of school staff, parents, government officials, church officials, community organizers, and local health providers.”

We heartily agree that information from key informants could differ from that from adolescents. We conducted our key informant interviews with adult members of the community and our focus groups with adolescents in order to understand both of these perspectives. This is consistent with an explanatory mixed methods approach in which the qualitative component seeks to explore the quantitative findings, not validate them. We apologize if this was not clear in the initial submission (see response to Reviewer 7, #1 below).

In addition, why is there a section on barriers? This does not appear in the literature review or as a research question/hypothesis.

Our literature review and research question/hypotheses related to Phase 1 of our study—a quantitative examination of the association of developmental assets to food security. Because some of our results were unexpected (direct association of community assets to very low food
security) we employed an explanatory mixed methods design—the Follow Up Explanatory Model. Thus, following the quantitative phase, we conducted exploratory, hypothesis-generating work (Phase 2 of the study) in the form of focus groups and key informant interviews to help us gain insight into our findings. Barriers to food access emerged during Phase 2 as a relevant theme and were therefore included in the Results and Discussion sections of the paper.

My largest concern is that the analyses do not include family income. Would the developmental assets be negated if family income or parental employment was controlled for in the analyses? Do you have any information about household socioeconomic status that could be added to the models?

While we agree that family income is an important factor affecting both food security and developmental assets, we respectfully do not agree that lack of adjustment is a serious problem. We assume that the reviewer is particularly concerned about economic insecurity and poverty (low family income). As noted in response to Reviewer 4, #1, and in the conceptual model added to the paper (Figure 1), economic insecurity is a shared root cause of both developmental assets and food security. Indeed, the definition and measurement of food security specify a lack of family money for food as a cause. Thus, because it is a shared root cause which occurs earlier in the causal chain, low family income should not be adjusted for in the regression modeling. Doing so would be over-controlling. For this reason, and because adolescents are not able to reliably report family income, we did not assess family income on the survey.

Discussion. The discussion section is a bit of rehashing of the results and does not provide an explanation of the findings. Why do you think the community effect is a floor effect? The information about health care providers appears to be a stretch for the implications of the work. The results revolve around family and community. What do you need to do within these two developmental assets to decrease food insecurity? As the discussion is currently written, it overstates the implications based on these very few findings.

We have revised the Discussion section substantially and hope the revision does not rehash or overstate the results but enhances them. With regard to the floor effect, we have added the following clarifying text to the Discussion: “That this association existed for very low food secure students but not for low food secure students—in other words, that the link to community assets manifested only at the highest levels of food insecurity—suggests a floor effect. This has important implications for development of PYD interventions to address food security. In this community, interventions addressing community assets would be most appropriately targeted toward VLFS youth.”

On re-reading the paper, we agree with the reviewer that we may have overstated the implications of our findings. We apologize for this and have modified the implications section and the paragraph of the Discussion regarding the role of the health care provider to tone down this language. See response to Reviewer 4, #5 above.
Regarding the reviewer’s question about intervention, as this was an exploratory, cross-sectional study, we do not know if improving these assets would decrease food security or vice versa, nor how to effectively intervene. We hope that our findings provide the foundation for future studies that are able to address these very important questions.

In short, the lack of theoretical and developmental rationale in the framing of the paper, do not overcome the unique, two-phased, time-intensive observations utilized in this project and thus the manuscript does not contribute strong substantial new results relevant to the field of food security during adolescence.

We respectfully disagree with the reviewer and note that we provided a clear theoretical and developmental framework for this work (PYD) in the Introduction. Reviewer 1 noted this theoretical basis in his/her review. We also respectfully disagree with the reviewer with respect to this study’s contribution to the field; we believe this study does contribute strong substantial new results relevant to the field of food security in adolescence. We very much appreciate this reviewer’s feedback and hope that our revision alters his/her impression of our study.

Reviewer #7:
This manuscript was an ambitious approach toward understanding potential determinants food insecurity in an adolescent population. Enhanced understanding of factors surrounding food insecurity is essential to program development and community outreach. There is a growing body of knowledge related to the role of Positive Youth Development in impacting positive adolescent behavior outcomes and the assessment of developmental assets in association with food security is timely and well grounded in the literature.

Although the manuscript was generally well written, there were several areas that required additional discussion for clarification purposes.

Study Design:
1.) Although Mixed Methods is mentioned in the abstract, there is no formal discussion of the design or of the specific Mixed Methods approach used for this investigation (i.e. Explanatory, Triangulated, Embedded, etc.). This discussion should be consistent between abstract, methods and discussion sections.

We used an explanatory model—in particular, we used a Follow Up Explanations Model per Creswell. (4) We have tried to be consistent in using the explanatory language throughout the revision.

2.) Although the interview/focus groups are mentioned, more detail is necessary regarding how each of these sessions were structured. For example, were semi-structured, open ended questions used? Additionally, provision of questions used would be helpful. How did the structure differ from the interviews and focus groups?
Please see our response to Reviewer 4, #3. We used semi-structured, open-ended questions in both the focus groups and key informant interviews. The focus groups were conducted following a focus group guide, which included questions about where youth in the community obtained the majority of their meals, how youth in the community dealt with being food insecure, and youths’ perceptions about the importance of school meals. The key informant interviews were conducted following an interview guide and included similar questions to the focus group guide. The interview guide also included additional questions about the respective associations between family and community developmental assets and food insecurity that were found in the quantitative portion of Phase 1 of the study.

3.) The sentence describing transcription/analysis should be moved to the data analysis section with more detail regarding the process that was taken to analyze the transcriptions. Was a specific qualitative process followed? What steps were taken to ensure the integrity/trustworthiness of this process?

Thank you for this suggestion. We have moved this sentence as suggested and provided further information on the process for qualitative analyses.

Study Participants:
How did you determine adequacy of sample size for the quantitative and qualitative aspects of the investigation?

A census-based approach was used per request of the district superintendant. Thus, for Phase 1, there was no sample size calculation as we were asked to include the full school population. For the qualitative portion of the study, we guided our sample based on prior similar studies. We aimed to include 6-12 participants in each focus group but did have one with only 4 participants.

Measures:
1.) Please describe how demographic data was collected (i.e. written, computer entry, verbal, etc.).

Pencil and paper surveys were administered during the school day (we added this to paragraph 2 of the Methods section under the subheading ‘Study Design’).

2.) Please add details regarding the DAP scale: (i.e. likert scale? Interpretation of high vs. low score).

In our description of the measure, we have added that this is a Likert-type scale and that higher scores represent more assets.

3.) What type of scale is the A-CFSM?
The A-CFSM is a summative scale which is then categorized. We have added further explanatory details to the manuscript. Please see our response to Reviewer 1, #2 above.

Data Analysis:
1.) As above- please add a discussion regarding the analysis of qualitative data.

As above, we have added such a discussion.

Results:
1.) Description of Table 2 should be enhanced/stand alone.

We apologize, but we do not understand this comment. We clarified in the text that Table 2 provides the results of bivariate analyses. We believe this table does stand alone.

Discussion:
Overall, well written with interesting findings.

Thank you very much.

Discussion of "relationships/associations" could be more descript.

We apologize but we do not understand the reviewer’s final comment.

References