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ORIGINAL PAPER

# COVID-19 and food insecurity in the Blackfeet Tribal Community

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**Abstract**
To examine the impact of the COVID-19 pandemic on food insecurity in the Blackfeet American Indian Tribal Community. American Indian adults residing on the Blackfeet reservation in Northwest Montana (n = 167) participated in a longitudinal survey across 4 months during the COVID-19 pandemic (August 24, 2020- November 30, 2020). Participants reported on demographics and food insecurity. We examined trajectories of food insecurity alongside COVID-19 incidence. While food insecurity was high in the Blackfeet community preceding the pandemic, 79% of our sample reported significantly greater food insecurity at the end of the study. Blackfeet women were more likely to report higher levels of food insecurity and having more people in the household predicted higher food insecurity. Longitudinal data indicate that the COVID-19 pandemic exacerbated already high levels of food insecurity in the Blackfeet community. Existing programs and policies are inadequate to address this public health concern in AI tribal communities.

**Keywords** American Indian · Health disparities · Food insecurity · Rural health

## 1 Introduction

At the start of 2021, more than 25.6 million Americans have been diagnosed with COVID-19 and 428,000 have died (Center for Disease Control and Prevention Statistics, 2021). Consistent with previous pandemics and infectious disease outbreaks, COVID-19 incidence and mortality are disproportionately high in racial and ethnic minority groups, including American Indians (AIs) (Center for Disease Control Newsroom release, 2021). The Center for Disease Control and Prevention (CDC) found that in 23 selected states, the incidence of laboratory confirmed COVID-19 cases for AIs was 3.5 times higher than the incidence of COVID-19 observed in non-Hispanic Whites, and that AIs are nearly twice as likely to die from COVID-19 compared to non-Hispanic Whites (Center for Disease Control Newsroom release, 2021). The disproportionate impact of COVID-19 on AIs and other racial and ethnic minority groups is believed to be a consequence of social determinants of health, including the physical and socioeconomic characteristics of the environment (e.g. geographic isolation and poverty). (Abrams & Szelfer, 2020). In addition, AIs may be more negatively affected by COVID-19 because of high incidence of chronic health conditions in these communities. It is important to acknowledge that observed high rates of poverty and disproportionately high incidence of chronic health conditions are in large part products of colonialism and its associated historical trauma and loss, along with ongoing racism and discrimination (Gone et al., 2019).

Public policy seeking to mitigate the transmission of COVID-19 (e.g., shutdowns) has produced economic challenges for communities across the US including dramatic rises in unemployment (United States Bureau of Labor Statistics, 2020). While these economic challenges adversely affected all communities, the negative implications are particularly pronounced for AI communities given the noted high levels of poverty. The Blackfeet Indian reservation is located in Northwest Montana and is home to the approximately 17,000 member Blackfeet nation. Data from a 2017 community health assessment indicated that 37% of the Blackfeet community were below the federal poverty level in the preceding 12 months (Blackfeet Community Health Assessment, 2017). The COVID-19 pandemic and

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accompanying economic challenges brought increased financial uncertainty to a community that was already suffering from significant economic deprivation.

One important consequence of economic strife and challenge is food insecurity, which is defined as limited access to sufficient and nutritious food needed for a healthy life. Experiencing food insecurity can lead people to intentionally limit food consumptions in unhealthy ways (e.g., skip meals) in an attempt to preserve or elongate access to meals. These food restriction strategies—although often necessary—can produce long-term health consequences. The experience of food insecurity is related to high levels of psychological stress and has negative implications for both mental and physical health (Gundersen & Ziliak, 2015). Food insecurity is strongly correlated with malnutrition, being underweight, obesity, and Type 2 diabetes (Gundersen & Ziliak, 2015). For example, skipping meals is posited to increase risk for obesity by making one more likely to consume low quality, calorie rich foods (Dhurandhar, 2016). Furthermore, individuals who are more food insecure have less success with obesity prevention and Type 2 diabetes management efforts (Adams et al., 2003; Dinour et al., 2007; Finney et al., 2010; Martin & Ferris, 2007; Seligman et al., 2010;Seligman et al., 2007), and as food insecurity increases, consumption of fruit and vegetables decreases, thereby increasing risk for cardiovascular disease (Mook et al., 2016). The relationship between food insecurity and risk for obesity, Type 2 diabetes, and cardiovascular disease are particularly problematic for AI communities given the already disproportionately high incidence of these outcomes observed in these communities (Center for Disease Control & Prevention tribal data release, 2021).

Since the onset of the COVID-19, the United States has observed greater levels of food insecurity than those observed in recent decades, including the high rates observed during the great recession of 2008 (Wolfson & Leung, 2020). Specifically, national estimates of food insecurity are three times higher than the estimates observed in the 5 years preceding the pandemic (Wolfson & Leung, 2020). The COVID-19 pandemic has negatively affected labor mobility and access to food markets, which has consequently produced distribution issues and reduced affordability of food (Devereux et al., 2020; Health, 2020; O'Hara & Touissant, 2021). The implications of increasingly expensive food and reduced food distribution for food insecurity may be particularly pronounced for tribal communities, which are often geographically isolated and suffer from persistently high rates of poverty.

Food insecurity on the Blackfeet reservation was higher than national averages prior to the pandemic. In 2017, 69% of Blackfeet community members surveyed reported some level of food insecurity (Blackfeet Community Health Assessment, 2017), a statistic which is likely in large part a result of high poverty levels and limited food resources (i.e. two grocery stores serving the entire community). With such high levels of pre-pandemic food insecurity and the increasing financial insecurity and economic uncertainty associated with the COVID-19 pandemic (U.S. Bureau of Labor Statistics, 2020), it is important to understand whether and to what degree food insecurity was further exacerbated over the course of the pandemic for the Blackfeet community.

The Blackfeet Tribal Council shut down the borders to the Blackfeet reservation in March of 2020, in response to initial observations that AIs across the nation were disproportionately affected by the virus and because of limited health care services on the reservation. With this shutdown, the Blackfeet reservation went approximately 100 days without a single diagnosed case of COVID-19. Unfortunately, cases began to rise in September and continued to surge. By mid-October, there were 390 active cases on the reservation and the rate of new cases on the reservation was one of the fastest observed across the United States (Mabie, 2021) (See Fig. 1).

Using a Community Based Participatory Research (CBPR) approach, which emphasizes an equitable partnership between researchers and community stakeholders (John-Henderson et al., 2019; Woodbury et al., 2019), we examined food insecurity in the context of the COVID-19 pandemic in the Blackfeet community during the four-month period when COVID-19 cases and deaths reached their highest peak on the reservation (August 2020-November 2020) (Mohr, 2020; USA Facts, 2020).

Montana State University's Center for American Indian and Rural Health (CAIRHE) has a Community Engagement Core which is dedicated to helping researchers establish effective community-investigator partnerships. The Community Engagement Core helped set up conversations between the investigators and community members who were interested in contributing to research projects focused on the effects of past and current stressors on health-relevant outcomes. Through this process, a Community Advisory Board (CAB) comprised of 4 members of the Blackfeet community formed. Since its establishment in 2016, the CAB has been critically involved in the development and oversight of a number of projects in the Blackfeet community. The research questions, methods, and measures for the current project were selected and reviewed by the CAB. These decisions were based on the issues and strengths which the CAB members felt characterized the Blackfeet community. The CAB was also involved in the interpretation and decisions about dissemination of the research findings.

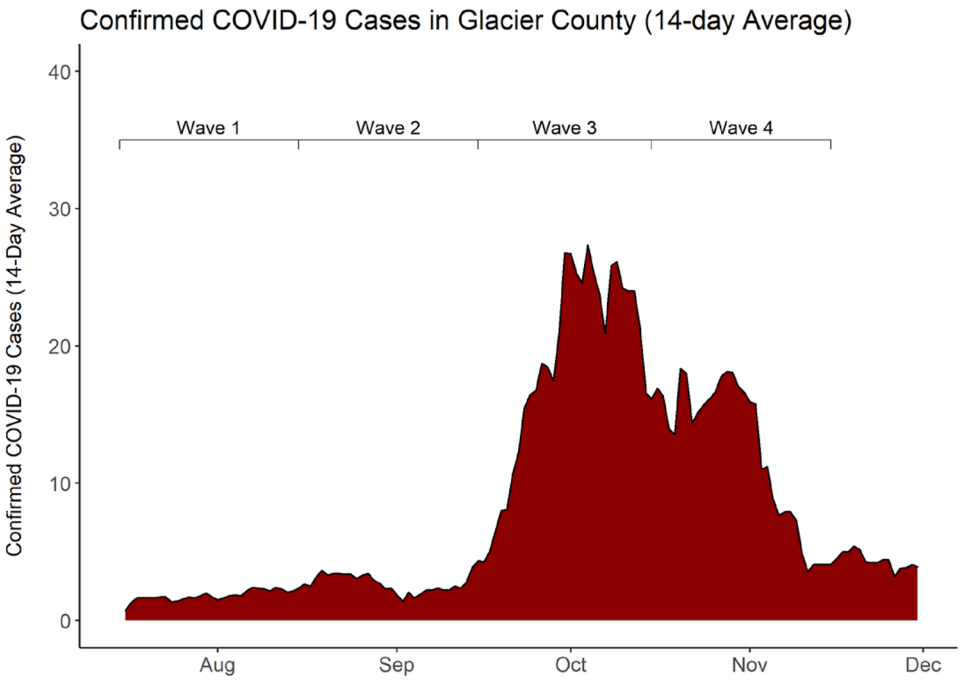


**Fig. 1** Confirmed COVID-19 Cases in Glacier County from August 2020 to December 2020

Based on the input and direction from the CAB, the current study had three aims. The first aim was to examine the rate of growth in food insecurity among members of the Blackfeet Tribe between August and November of 2020, a period which was marked by a drastic increase in both confirmed COVID infections and deaths on the Blackfeet reservation (Mohr, 2020; USA facts, 2020). We hypothesized that in the context of the COVID-19 pandemic, with increasing concerns about the future of the economy and employment, and concerns about increasingly limited access to food (due to the shutdown), food insecurity would increase over the four months in a pattern similar to the increasing rates of COVID-19 cases on the Blackfeet reservation. The second aim was to examine individual differences in food insecurity to identify Blackfeet community members whose level of food insecurity was most affected by the pandemic. For example, past research has shown that women are more likely to experience food insecurity compared to men, potentially due to gender differences in family care and feeding responsibilities (Broussard, 2019; Ivers & Cullen, 2011). Further, individuals who live with more people may also experience greater food insecurity given the higher strain on food-related resources. It was therefore hypothesized that women and those with a higher number of family members within the household would be more likely to experience increases in food insecurity. The third aim was to explore demographic differences in the rate of change of food insecurity across the four months without confirmatory hypotheses.

## 2 Methods

### 2.1 Participants and procedure

Members of the CAB were convened in April of 2020 to discuss COVID-19 related challenges to the Blackfeet community. Based on these discussions, food insecurity was identified as an issue of central importance and concern to the Blackfeet community. With the shutdown and increasing uncertainty about the economy and its future, the CAB felt it was likely that food insecurity would increase across the community, and that it was important to highlight the need for resources and intervention to help those who are most at risk. The research was approved by the Blackfeet Institutional Review Board. All participants were recruited using advertisements placed at community centers, at the Blackfeet Community college and on community social media sites. Eligibility criteria included current residence on the Blackfeet reservation and self-identification as American Indian (AI).

All participants (N = 167) were recruited during the first two weeks of August, 2020. There were 4 waves of data collection (Wave 1: The last 2 weeks of August, 2020, Wave 2: The last 2 weeks of September, 2020, Wave 3: The last 2 weeks of October, 2020, and Wave 4: The last 2 weeks of November, 2020). Upon confirmation of eligibility, participants were sent questionnaires using the Qualtrics platform. The surveys were available to participants to complete at each wave of data collection during

the respective 2-week time-period. Upon completion of the survey, participants were emailed an amazon gift card with increasing incentives in order to promote retention (Wave 1: $20, Wave 2: $25, Wave 3: $30, and Wave 4: $40).

## 2.2 Measures

### 2.2.1 Food insecurity

Food insecurity status was measured using the United States Department of Agriculture's validated six-item short form Food Security Survey Module (FSSM) (Blumberg et al., 1999). Participants reported on whether they experienced five distinct aspects of food insecurity in the past month, with one item assessing the frequency at which these behaviors occurred. Specifically, items assessed participants ability to *replenish* food ("The food that we bought just didn't last and we didn't have money to get more"), afford *balanced meals* ("We couldn't afford to eat balanced meals"), tendency to *skip meals* ("Did you ever cut the size of your meals or skip meals because there wasn't enough money for food?"), eat *smaller portions* ("Did you ever eat less than you felt you should because there wasn't enough money for food"), and tendency to *remain hungry* (Were you ever hungry but didn't eat because there wasn't enough money for food?"). Consistent with the FSSM scoring instructions, responses options were given either on a yes/no or often true/sometimes true/never true scale, with all questions containing a "don't know" option. A total score was calculated based on instructions from the FSSM (USDA, 2012) to create an overall index of food insecurity (ωs = 0.77-0.74). Given that food insecurity can manifest in several different behaviors (e.g., inaccessibility versus preservation of available food), items were also examined separately to explore whether trends varied based on the specific aspect assessed.

### 2.2.2 Demographic characteristics

Participants also reported on their demographic characteristics, including self-reported their age and biological sex at Wave 1 and reported the number of people including themselves that lived in their current residence.

## 2.3 Analytic technique

Bivariate correlations were used to examine unadjusted associations between all study variables. Intra-class correlation coefficients (ICCs) were used to characterize within and between person change in food insecurity. To help interpret the magnitude of change in food insecurity, difference scores were used to describe the change in food insecurity between August and November. Generalized linear mixed-effect models were then used to estimate growth in food insecurity over the course of 4 months during which COVID infections and deaths peaked in the Blackfeet community. Sequential growth models were estimated with the linear effect of time modeled as a Level-1 independent variable (model 1) and both the linear and quadratic effect of time modeled as Level-1 independent variables (model 2). Chi-square tests were used to determine if adding the quadratic term provided a better fit to the data. Once the nature of growth was established, a second series of models were estimated to examine individual differences in food insecurity growth. To examine general differences in food insecurity across the four months, sex, and number of people in household were added as independent variables. To examine individual differences in the growth of food insecurity, interactions were specified among sex, number of people in the household, and time. Separate models were used to examine trends in overall food insecurity and specific components of food insecurity. Random effects for time and subject were modeled and allowed to covary for all analyses. Additionally, age was entered as a covariate to isolate effects of sex and number of people in the household. False Discovery Rates were used to adjust for multiple testing (Benjamini & Hochberg, 1995). Missing data was minimal for food insecurity (n = 7) and demographic characteristics (n = 1). GLMEs can accommodate missing data in dependent variables and the individual missing data on demographic characteristics was excluded.

# 3 Results

Table 1 displays the sample characteristics and Table 2 displays the bivariate correlations for all study variables. Having more members within the household was

**Table 1** Descriptive statistics for all study variables

| | *M* (N) | *SD* (%) |
|---|---|---|
| Demographics | | |
| Age | 33.99 | 7.68 |
| Sex: Female | (100) | (60.00) |
| [#]Household | 3.35 | 1.52 |
| Food Insecurity | | |
| Overall Food Insecurity | 2.47 | 1.18 |
| Replenish | 0.79 | 0.22 |
| Balanced Meal | 0.63 | 0.28 |
| Skip Meal | 0.19 | 0.27 |
| Smaller Portion | 0.36 | 0.31 |
| Remain Hungry | 0.46 | 0.31 |

[#]*Household* the number of people living in the household

**Table 2** Bivariate correlations for all study variables

| Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| 1. Age | | | | | | | | |
| 2. Sex | .08 | | | | | | | |
| 3. Household | -.29** | -.11 | | | | | | |
| 4. Overall Food In | -.19* | .12 | .36** | | | | | |
| 5. Replenish | -.14 | -.00 | .30** | .71** | | | | |
| 6. Balanced Meal | -.13 | .08 | .30** | .81** | .60** | | | |
| 7. Skip Meal | -.18* | .09 | .20* | .76** | .38** | .50** | | |
| 8. Smaller Portion | -.14 | .15 | .34** | .87** | .48** | .65** | .63** | |
| 9. Remain Hungry | -.15 | .15 | .34** | .82** | .53** | .56** | .47** | .66** |

Food insecurity represents averages across the week

* indicates $p < .05$; ** indicates $p < .01$

correlated with all measures of food insecurity. Food insecurity items were moderately correlated with one another (rs = 0.38 to 0.66), indicating that they represent related yet distinct components of food insecurity. ICCs were used to examine within and between-person variability in food insecurity between August 2020 – November 2020. Overall, between 24 to 66% of the variance in food insecurity was explained by between-person effects and 34% to 76% of the variance was explained by within-person effects. Thus, there was substantial inter and intra-individual variability in food insecurity over time.

## 3.1 Growth in food insecurity in Blackfeet Community

A series of generalized linear growth models were used to examine growth in food insecurity over the course of the four months spanning heightened COVID-19 infections and death in the Blackfeet community. Figure 2 displays Spaghetti plots of within-person change in food insecurity. The quadratic model of time provided a better model fit compared to the linear model for overall food insecurity ($\Delta\chi^2 = 18.2$ [1], $p < 0.001$) and for the remaining hungry item ($\Delta\chi^2 = 5.87$ [1],

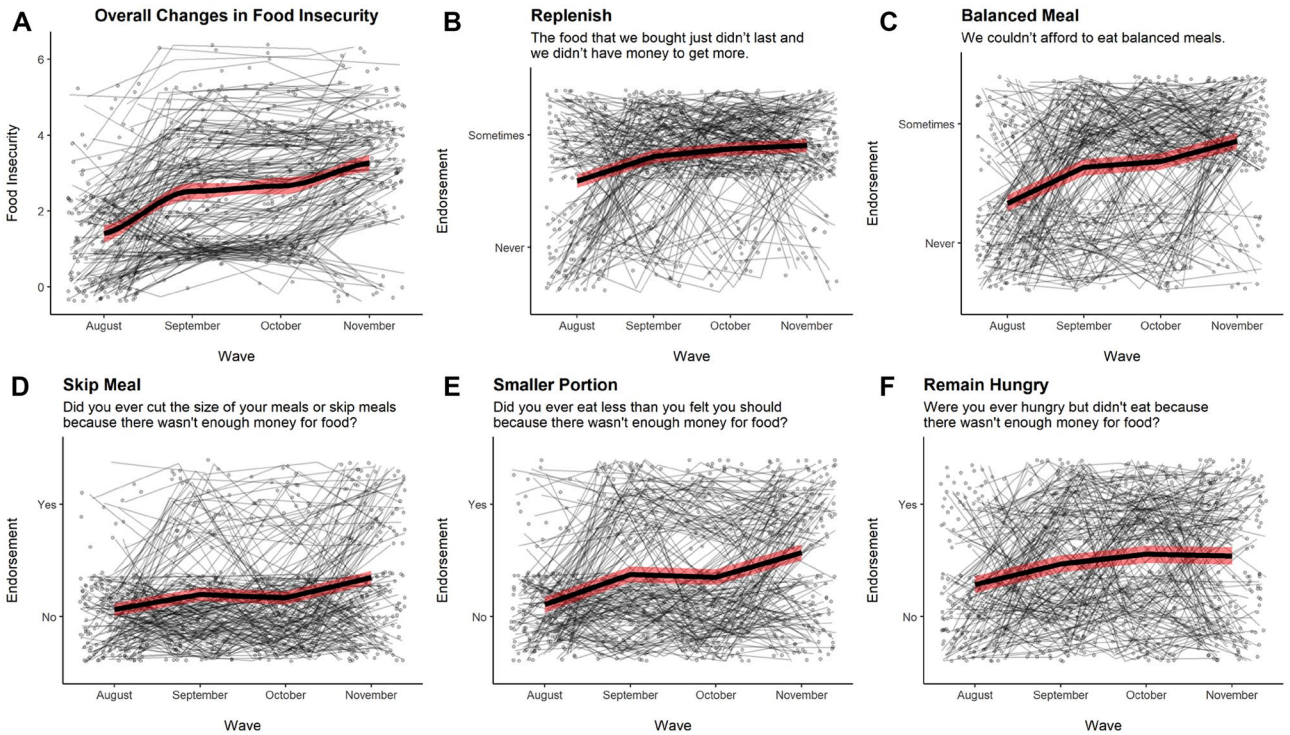


**Fig. 2** Spaghetti plots displaying within-person changes in food insecurity. **A** Changes in overall food insecurity. **B** Changes in replenishing. **C** Changes in balanced meal. **D** Changes in skip meal. **E** Changes in smaller portion. **F** Changes in remaining hungry

$p = 0.015$). The quadratic model did not improve model fit for all other indicators of food insecurity ($\Delta\chi^2 = 0.001$ to 3.66 [1], $ps < 0.06$ to 0.97) and thus only the linear effect was retained.

Table 3 displays model estimates for unconditional and conditional general linear growth curves. Overall food insecurity demonstrated a linear increase from August to September, remained stable from September and October, and then increased again from October to November. When examining individual components of food insecurity, being unable to replenish food, afford balanced meals, skipping meals, and reducing portion size demonstrated linear increases from August to November. Remaining hungry increased from August to October and remained stable from October to November.

Across the four months, 79% of the sample demonstrated greater food insecurity in November compared to August. Additionally, 38% of the sample began to sometimes experience instances of not being able to replenish food and 58% began to sometimes experience instances where they could not afford balanced meals in November compared to August. Further, 31% of the sample began shrinking or skipping meals due to lack of resources, 51% began reducing portion sizes, and 37% started to remain hungry because they lacked enough money for food in November compared to August.

### 3.2 Individual differences in food insecurity

Table 3 displays estimates from the conditional growth models examining demographic differences in overall food insecurity. Women were more likely to experience higher overall food insecurity, were less likely to afford balanced meals, were more likely to eat smaller portions, and were more likely to remain hungry relative to men. Further, having a greater number of people in the household was associated with higher overall food insecurity as well as greater food insecurity in each domain. A second series of models were used to examine whether the rate of change in food insecurity varied by demographic characteristics (see Supplemental File). After adjusting for multiple testing, demographic characteristics did not significantly moderate the effects of time in any model.

## 4 Discussion

To our knowledge, the current research is the first to focus on prospective changes in food insecurity in a tribal community in the context of the COVID-19 pandemic. This issue is of great public health concern given the already high rates of food insecurity observed in these communities prior to the onset of this pandemic (Blackfeet Community Health Assessment, 2017; Wolfson & Leung, 2020). Furthermore, the findings here have important implications for downstream health outcomes including obesity, Type 2 Diabetes and cardiovascular disease, all of which were already observed at disproportionately high levels in AI tribal communities, including the Blackfeet community (Blackfeet Community Health Assessment, 2017; Center for. Disease Control and Prevention Tribal Data Release, 2021).

The focus of this study is the Blackfeet community, a tribal community in Northwest Montana, which had high rates of poverty and food insecurity prior to the declaration of the COVID-19 pandemic. Our findings indicate a substantial increase in food insecurity in a sample of Blackfeet adults over the four-month period when COVID-19 confirmed cases and deaths reached their peak within this community (Mohr, 2020; USA facts, 2020). Effect sizes for these increases were consistent and notable, with overall food insecurity doubling in this population over four months and significant increases across all dimensions of food insecurity. While individual trajectories of changes in food insecurity varied across the sample of Blackfeet adults, 79% of our sample reported some degree of food insecurity, highlighting the prevalence of this issue in the Blackfeet community. Previous research indicates that increases in food insecurity following an adverse life event are slow to subside. As an example, previous work focused on the effects of Hurricane Katrina on food insecurity found that effects of the natural disaster on food insecurity were evident 5 years later (Clay et al., 2018).

The pattern of growth observed in food insecurity over the four-month period in the Blackfeet community seemed to parallel increases in COVID-19 diagnoses and mortality observed on the reservation, with the greatest incidence in October of 2020. As such, it is possible that rising incidence of COVID-19 on the reservation sparked concerns about the implications for extended shutdowns and subsequent effects on economic security and food insecurity. These concerns may have caused community members to begin preparing for food shortage by skipping meals or eating less in efforts to preserve limited resources. Importantly, although COVID-19 diagnoses and deaths decreased during the final measurement wave, food insecurity either remained high or increased during this period. These findings suggest that the rise in COVID-19 cases and affiliated behavioral responses may have catalyzed increases in food insecurity that may persist even after the pandemic subsides. It is also important to note that food insecurity often rises quickly following acute adverse events and is slow to subside (Clay et al., 2018).

One aim of the current research was to identify factors which predicted food insecurity during the pandemic for Blackfeet community members. In the present research, female Blackfeet adults reported greater overall food insecurity compared to male Blackfeet adults, were less likely to report being able to afford balanced meals, were more likely to eat smaller portions, and were more likely to remain hungry relative to Blackfeet male adults in this sample. This initial evidence suggests that women in the Blackfeet community have greater concerns about food insecurity in the context of the COVID-19 pandemic. Although

**Table 3** Estimates from General Linear Mixed Effect Models Predicting Food Insecurity

| | Food Insecurity | | | Replenish | | | Balanced Meal | | | Skip Meal | | | Smaller Portion | | | Remain Hungry | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *B* | *SE* | *95% CI* | *B* | *SE* | *95% CI* | *B* | *SE* | *95% CI* | *B* | *SE* | *95% CI* | *B* | *SE* | *95% CI* | *B* | *SE* | *95% CI* |
| Unconditional Model | | | | | | | | | | | | | | | | | | |
| Linear Time | 1.26*** | .16 | .94 – 1.59 | 1.09 | .20 | .69 – 1.49 | 1.36 | .20 | .97 – 1.75 | .82* | .32 | .19 – 1.46 | .91*** | .14 | .65 – 1.19 | 1.55** | .47 | .63 – 2.48 |
| Quadratic Time | -.13*** | .03 | -.20 – -.08 | - | - | - | - | - | - | - | - | - | - | - | - | -.23* | .09 | -.41 – -.04 |
| Conditional Model | | | | | | | | | | | | | | | | | | |
| Linear Time | 1.26 *** | 0.17 | 0.93 – 1.58 | 1.06 *** | 0.20 | 0.67 – 1.45 | 1.31 *** | 0.18 | 0.97 – 1.66 | 0.92 ** | 0.28 | 0.36 – 1.48 | 1.03 *** | 0.18 | 0.68 – 1.38 | 1.55 *** | 0.46 | 0.64 – 2.46 |
| Quad. Time | -0.14 *** | 0.03 | -0.20 – -0.07 | | | | | | | | | | | | | -0.23 * | 0.09 | -0.41 – -0.05 |
| Age | -0.01 | 0.01 | -0.04 – 0.01 | -0.01 | 0.02 | -0.05 – 0.02 | -0.02 | 0.02 | -0.05 – 0.02 | -0.05 | 0.03 | -0.11 – 0.01 | -0.03 | 0.03 | -0.08 – 0.02 | -0.01 | 0.02 | -0.04 – 0.02 |
| Sex | 0.45 ** | 0.17 | 0.11 – 0.79 | 0.17 | 0.27 | -0.35 – 0.70 | 0.55 * | 0.27 | 0.02 – 1.08 | 0.65 | 0.46 | -0.25 – 1.56 | 1.03 ** | 0.40 | 0.25 – 1.82 | 0.62 ** | 0.24 | 0.15 – 1.08 |
| People in Household | 0.22 *** | 0.06 | 0.11 – 0.34 | 0.29 ** | 0.10 | 0.10 – 0.48 | 0.33 *** | 0.09 | 0.15 – 0.52 | 0.31 * | 0.15 | 0.01 – 0.61 | 0.45 *** | 0.13 | 0.19 – 0.71 | 0.31 *** | 0.08 | 0.15 – 0.47 |
| Random Effects | | | | | | | | | | | | | | | | | | |
| $\sigma^2$ | .65 | | | 3.29 | | | 3.29 | | | 3.29 | | | 3.29 | | | 3.29 | | |
| $\tau_{00}$ | $1.37_{Subject}$ | | | $.91_{Subject}$ | | | $.88_{Subject}$ | | | $6.29_{Subject}$ | | | $.55_{Subject}$ | | | $.04_{Subject}$ | | |
| $\tau_{11}$ | $.15_{Subject.Time}$ | | | $.44_{Subject.Time}$ | | | $.75_{Subject.Time}$ | | | $.03_{Subject.Time}$ | | | $.12_{Subject.Time}$ | | | $.09_{Subject.Time}$ | | |
| $\rho_{01}$ | $-.55_{Subject}$ | | | $-.81_{Subject}$ | | | $-.80_{Subject}$ | | | $-1.00_{Subject}$ | | | $.88_{Subject}$ | | | $1.00_{Subject}$ | | |
| Marginal $R^2$ / Conditional $R^2$ | .250 / .745 | | | .248 / .496 | | | .281 / .637 | | | .207 / .662 | | | .233 / .574 | | | .128 / .336 | | |

*$p$ < .05; **$p$ < .01; ***p < .001

more research is needed to understand the roots of this relationship, it is possible that Blackfeet female adults are more responsible for providing food for others. The CAB also noted the possibility that networks of individuals for which women are responsible for providing for may have increased during the pandemic. Our findings are in line with previous research indicating that due to economic inequality, female-headed households are more likely to experience food insecurity (Jung et al., 2017). Prior work has found that women reduce their dietary intake when they experience food insecurity in order to provide more food resources for others (Johnson et al., 2018). Relatedly, the data indicated that having a greater number of people in the household was associated with higher overall food insecurity as well as greater food insecurity in each domain.

It should be noted that the measure of food insecurity used in the current project was not developed specifically for use by the Blackfeet Community. As summarized in previous work, indigenous communities are likely to have unique food security considerations which affect the four pillars of food security: access, availability, supply, and utilization (Power, 2008). For example, it is possible that seasonal changes in hunting on the reservation and access to wild meat may contribute to seasonal changes in levels of food insecurity. As such, incorporation of indigenous perspectives from community members should inform future development of community-specific measures of food insecurity. The food insecurity measure used in the current work was not developed by the community. However, the CAB did review the measure and found it to be culturally appropriate. Future efforts could add to or revise the measure in order to capture culturally-specific dimensions of food security which may be missing from the more widely used measure of food insecurity.

## 5 Public health implications

The enduring impacts of colonization, genocide, and associated historical trauma are root causes of the challenging socioeconomic conditions and high rates of chronic illnesses observed in these communities. Without acknowledging the context and roots of these deficits, it is possible to perpetuate stereotypes and stigmatization of AIs. Instead, there is a need to shift towards strength-based research, where instead of focusing on shortcomings in AI communities, attention is shifted towards the harnessing of existing capacities and resources within the community which can successfully address persisting inequities and challenges (Hyett et al., 2019).

Overall, the findings from this research provide evidence in support of calls for the development of long-term policies and programs supported and sustained by the federal government, which are focused on the provision of food assistance for AI communities. While these efforts are important and are likely to improve food insecurity, intervention efforts which focus on utilizing existing strengths to improve community health are equally important. These efforts are critical to addressing the socioeconomic inequalities and chronic health conditions observed in AI communities in a culturally appropriate way.

As an example, with the onset of the COVID-19 pandemic, Blackfeet community members rallied together to ensure that the elders in the community had access to fresh food (Mabie, 2021). This program was inspired by a community value and strength, specifically respecting and prioritization of care for Blackfeet elders. Our findings suggest that such programs are of utmost importance to protecting the health of tribal nations such as the Blackfeet community, particularly in the context of a global pandemic. While programs focused on food assistance would surely help reduce food insecurity in the community during these times, federal programs which provide comprehensive unemployment benefits would further ease concerns of community members about being able to provide food for themselves and their families, thereby reducing food insecurity.

While the COVID-19 pandemic negatively affected economic security, food insecurity, and health for a large portion of the global population, the negative implications of the pandemic are amplified for tribal communities such as the Blackfeet community. This is because such communities have very high levels of pre-pandemic poverty, have high incidence of chronic diseases contributing to increased COVID-19 risk, have limited access to health care, and additionally have limited access to fresh food and produce on the reservation because of relative geographic isolation. These existing struggles and systemic barriers linked to colonization and past and current traumas (Gone et al., 2019) are further intensified with the addition of stressors which are specific to the COVID-19 pandemic, including concerns about how the already limited food resources will be further reduced because of the pandemic. Public health initiatives and federally supported programs should work to anticipate increased need in these communities for access to affordable food during crises such as the COVID-19 pandemic. Such efforts will immediately improve access to food for community members during particularly challenging times, and will over time reduce the degree to which sustained high levels of food insecurity contribute to the escalation of existing disparities in health for AI tribal communities. In conclusion, our findings highlight the need for strength-based community-driven interventions, along with federal policies and program, which work to reduce the systemic barriers that AI communities like the Blackfeet community continue to face, which are exacerbated during events such as the COVID-19 pandemic.

**Author's contribution** Neha A. John-Henderson designed the study with community members, implemented study, and wrote the article; Benjamin Oosterhoff conducted statistical analyses and helped with writing the paper. The following authors are community members who were involved in study design, data interpretation, and reviewed the article: Brad Hall, Lester Johnson, Mary Ellen Lafromboise, Melveena Malatare, and Emily Salois.

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**Data availability** The authors have access to all primary data which belongs to the Blackfeet Tribal Community. Authors will share data upon reasonable request and review by the Blackfeet Nation Institutional Review Board.

## Declarations

**Ethical approval** This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving research study participants were approved by the Blackfeet Nation Institutional Review Board. Written informed consent was obtained from all subjects/patients.

**Conflict of interest** The authors have no conflicts of interest to declare.

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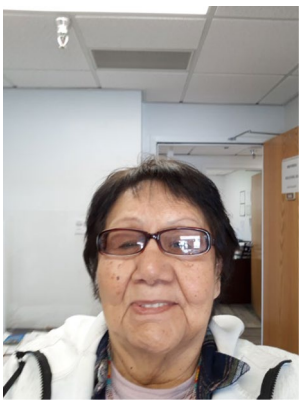

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