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The effect of violent conflict on calorie consumption and dietary quality in Iraq

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Abstract

By combining 2012 Living Standard Measurement Survey cross-sectional survey responses and georeferenced conflict data, this study quantifies the effect of violent conflict on food security and dietary quality in Iraq. Specifically, it estimates the effect of physical insecurity on different food security dimensions, including caloric consumption and household dietary diversity. Because disrespecting war-related foreign national cemeteries is a war crime that discourages nearby fighting, instrumenting conflict intensity by the exogenous variation in distance between these sites and household place of residence addresses potential sources of bias. The instrumental variable analysis confirms the positive (negative) effect of conflict—deriving from state, non-state and one-sided violence (e.g., attacks by the Islamic State)—on per capita caloric consumption (household dietary diversity), which although counterintuitive is unsurprising given Iraq's relatively high-income levels and changes in dietary pattern. Given that the primary driver of conflict's positive effect on calories is increased consumption of carbohydrates and, to a lesser extent, saturated fat, these results suggest that in countries transitioning to Western-style diets, violent conflict may drive the population toward an unhealthier diet, contributing heavily to a growing national prevalence of nutrition-related non-communicable diseases.

KEYWORDS

conflict, food security, instrumental variables, Iraq

JEL CLASSIFICATION

C21, D12, I19, Q12

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1 | INTRODUCTION

In the first two decades of the twenty-first century, the victims of war in the SWANA region¹ numbered over 800,000; 150,000 of them were in Iraq (Uppsala Conflict Data Program, 2021). Over the same period, as most other world regions saw a decreasing trend in food insecurity, SWANA countries registered worsening achievements (World Bank, 2020), with exposure to violence and political instability inevitably disrupting all food security dimensions, from food production to supply stability to household access to healthy diet. In this context, understanding the complex dynamics that underlie this relation is crucial, especially in understudied countries such as Iraq.

Thus, the aim of this study is to identify the effect of conflict exposure on food security in the Iraqi context. In particular, the focus here is on whether physical insecurity leads to greater calorie consumption as a consequence of an increased purchase of cheap carbohydrates. A growing stream of literature demonstrates exposure to violence's negative impact on proxies of food access such as the Household Dietary Diversity Score (HDDS), Food Consumption Score (FCS) and calorie consumption (Lin et al., 2021; Marchesi & Rockmore, 2023; Muriuki et al., 2023). For example, whereas Dabalen and Paul (2014) document the negative relation between measures of self-reported conflict-related victimisation and Ivorian household food security, George et al. (2020) use a fixed effects estimator to illustrate how exposure to Boko Haram violence in Nigeria limits both the variety and portion sizes of food eaten. This latter mirrors the significant drops in both food expenditure and household caloric consumption induced by four decades of war and civil unrest in Afghanistan (D'Souza & Jolliffe, 2013), a negative effect on calorie supply which Hitzhusen and Jeanty (2006) document in 28 other developing nations.

Evidence also abounds of armed conflict's negative effect on other dimensions of food security, such as food utilisation proxied by both short- and long-term child malnutrition (Akresh et al., 2011; Brown, 2018; Koppensteiner & Manacorda, 2016; Oskorouchi, 2019). For instance, Minoiu and Shemyakina (2012) document a causal link between the 2002–2007 civil conflict in Côte d'Ivoire and a half a standard deviation reduction in child height-for-age *z*-scores (stunting), an effect immediately relatable to the negative association documented by Dabalen and Paul (2014). Likewise, Martin-Shields and Stojetz (2019), in their comprehensive review of studies that use robust methodology to establish a causal nexus between conflict and food security, demonstrate that the latter has both a short- and long-term negative effect on anthropometrics. Another stream of literature underscores how conflict lowers food availability by disrupting food production (Adelaja & George, 2019; Fadare et al., 2022; Nillesen, 2016), as illustrated by satellite imagery of a 17% drop in winter wheat production induced by the ongoing war in Ukraine (Deininger et al., 2023).

Unfortunately, as regards the post-2003 effects of the US invasion of Iraq, only a few related studies use nationally representative data, with Acharya et al. (2020) being a rare exception. These authors, by coupling individual-level microdata from the 2011 UNICEF Multiple Indicator Cluster Survey with the Empirical Study on Conflict database, pinpoint an association between an additional population-weighted violent event and a 0.006–0.019 standard deviation lower child height-for-age *z*-score (stunting) driven primarily by maternal stress and child–mother malnutrition. Evidence from a cross-sectional survey of four primary schools in Baghdad further underscores the lower nutritional status of children living in unsafe neighbourhoods as measured by body mass index (BMI; Ghazi et al., 2013, 2014).

As this work suggests, research into conflict's effect on food security mostly employs measures of undernutrition and/or focuses on low-income countries in which conflict-related insecurity is likely to cause undernutrition and calorie scarcity. The contribution of

¹This acronym for South-west Asia and North Africa typically denotes an area extending from Morocco to Afghanistan.

the present study is therefore twofold: first, it tests whether a middle-income context results in the nexus between conflict and nutrition being more complex than a mere drop in food consumption; second, it expands the analysis of conflict exposure's interaction with food security beyond (aggregated) measures of calorie consumption and diet diversity to examine changes in the consumption of specific macronutrients. This shift to a middle-income context broadens the knowledge base by exploring how conflict affects caloric consumption² and dietary diversity when malnutrition is caused more by micronutrient deficiency than by scarcity of available calories (Woertz, 2020). In Iraq, for example, in contrast to settings of extreme poverty, physical insecurity might lead to lower intake of unprocessed foods and more frequent consumption of cheap, easy to store, high calorie products, as particularly evidenced by rates of adult overweight (65%), obesity (30%) and child stunting (12%) (NCD Risk Factor Collaboration, 2017; UNICEF, WHO, & World Bank, 2020). The focus on specific macronutrient consumption thus extends the analysis beyond quantification of conflict's effect on dietary diversity and calorie consumption to detail its relation to the consumption of carbohydrate, fat and saturated fat.

To achieve this, I combine cross-sectional information from the Living Standard Measurement Survey (LSMS) Iraq (2012) with the Uppsala Conflict Data Program Georeferenced Database to estimate the conflict's effect on per capita caloric consumption, household dietary diversity and diet quality, as measured by carbohydrate and total and saturated fat consumption in kilocalories (Kcal). To measure conflict in the period of interest (2011–2012), I include all fatalities stemming from state violence, non-state violence and one-sided violence, where the latter includes all armed attacks against civilians by a state or organised armed group, which for Iraq refers to the violent attacks carried out by the so-called Islamic State (IS) in 2011 and 2012. Because endogeneity in the naïve ordinary least squares (OLS) estimates may stem from non-random measurement error in the count of fatalities (i.e., because of different reporting standards across the country), the conflict intensity values assigned to some groups (e.g., those living in remote areas) may be systematically lower. Moreover, if food insecurity is itself a cause of more violence, the OLS estimates could suffer from reverse causality. To address these potential sources of bias, I employ an instrumental variable (IV) strategy that relies on the prohibition (by both Islamic and international law) of violating mortal remains to construct an exogenous instrument for conflict intensity.

The remainder of the article is organised as follows: Section 2 provides a background on the conflict in Iraq and a theoretical framework; Section 3 describes the data used in the empirical analysis; Section 4 presents the base econometric model, construction of the main variables, the potential sources of bias, and the instrumental variable approach; Section 5 outlines the main results; and Section 6 concludes the paper with a discussion of their implications.

2 | RESEARCH CONTEXT

2.1 | Historical background

2.1.1 | The first Gulf War and the sanctions period

Since the start of the war with Iran in 1980, Iraq has seen no prolonged periods of peace and stability. Following its 1990 invasion of Kuwait, in particular, Iraq entered a decades-long period of

²Because calorie computation is based on food purchase records that may include wasted or bulk purchases stored by households for several weeks (e.g., food rations), food consumption here does not necessarily equal food intake.

violence, economic collapse and deterioration of both its social fabric and the population's living conditions. First, the US-led First Gulf War, despite its short duration (August 1990–February 1991), imposed more damage on the country's economy and infrastructure than the 8-year Iran–Iraq conflict (Tripp, 2010). Subsequently, the UN imposed on Iraq one of the harshest embargos in modern history, one whose sanctions, by initially including food items, not only prevented the import of key agricultural inputs but hindered the global trade in food on which Iraq now became heavily dependent. These sanctions, which disrupted every aspect of Iraqi life (Halliday, 1999; Santisteban, 2005), led to severe food price inflation (Field, 1993), prompting the government's introduction of the still operative Public Distribution System (PDS), a food rationing scheme designed to guarantee sufficient caloric consumption to the entire population.

2.1.2 | The 2003 US invasion of Iraq

In 2003, Iraq's alleged ownership of weapons of mass destruction motivated a US-led coalition to invade the country, further destabilising the insecurity induced by decades of war and sanctions (Ali, 2018). The invasion generated several conditions that paved the way for politicisation of sectarian divisions (Ismael & Ismael, 2015), which later led to the outbreak of civil conflict. One such catalyst was the almost complete dismantling of the pre-2003 state apparatus—translated, for example, into the process of de-Baathification³—which left 400,000 trained military personnel and thousands of civil servants unemployed (Ismael & Ismael, 2015). Another was the Coalition Provisional Authority's (CPA's) imposition of a series of neoliberal reforms, which, combined with the establishment of a confessional quota system (*mohassasat*) for allocating government positions, facilitated and institutionalised sectarian divides (Ismael & Ismael, 2015; Sommer-Houdeville, 2017). Until 2004, the war that followed the Anglo-American invasion saw the fragmented insurgent groups fighting mainly US-led occupation forces. In response, the coalition worked for a progressive 'Iraqization' of the conflict using the newly established Iraqi army to repress the insurgency (Sommer-Houdeville, 2017). This attempted repression led to an increase in direct clashes between the regular army and Iraqi insurgent groups, evolving into an actual civil war by 2005. Over the 2006–2007 period, the level of violence reached a dramatic peak, decreasing consistently after the United States withdrew its troops from Iraq at the end of 2011.

Although the 2011 conflict was categorised as one of minor intensity, the violence continued to affect numerous areas of Iraq. In particular, it affected the central regions including Baghdad and the region bordering Iran, as well as the northern region close to the border with Turkey. Over the 2011–2012 period of interest for this analysis, 2806 people lost their lives through conflict (Uppsala Conflict Data Program, 2021), most as a result of fighting between the Iraqi State and IS, as well as confrontations between Iran or Turkey and Kurdish parties. As regards one-sided violence, IS attacks against civilians—which together with military operations intensified in 2012 after the armed group gained more power—claimed the lives of 1091 Iraqi civilians.

2.2 | Theoretical framework

The generalised climate of violence—from both regular army and guerrilla activities—together with the dismantling of the pre-2003 state apparatus and political economy, heavily affected Iraq's food system. Because the beginning of armed confrontations coincided not only with the end of sanctions but also with structural economic reforms, this effect must be

³A Coalition Provisional Authority policy that removed all public employees affiliated with the Baath Party from their positions.

considered in the light of former shocks. Hence, in the paragraphs below, after explaining how these economic changes relate to the state of Iraqi food security and agricultural production, I present a theoretical framework that justifies how conflict could have driven Iraqis to adopt diets lower in nutritional quality and higher in calorie consumption.

2.2.1 | Liberalisation and the end of sanctions

The changes in food security engendered by conflict need to be understood within the framework of the important economic reforms occurring in Iraq after 2003. In particular, the increased competition induced by CPA food system policies like privatising public agricultural enterprises (Sommer-Houdeville, 2017) and coercively promoting multinational agricultural corporation access into the Iraqi market (Docena, 2004)—which was worsened by international organisations' food provision at subsidised prices (Gibson et al., 2012)—drove many small farmers out of the market. As a result, local production decreased, increasing dependence on imported food. Yet the seemingly positive increased caloric availability from greater food imports did not automatically translate into healthier diets. Rather, it spurred a shift toward a nutrition transitional stage in which a fat- and sugar-rich Western-style diet progressively replaced diverse local seasonal fare (Golzarand et al., 2012). Hence, although changes in dietary patterns usually go hand in hand with economic development—a potential outcome of Iraq's 1980s economic boom—the decade-long sanctions created a situation of food scarcity that delayed the nutritional transition. Such a dietary pattern shift was particularly widespread following the 2003 lifting of sanctions when, as in other middle-income countries in the region, a Western-style diet became more accessible for a larger share of the population. Overweight and obesity therefore increased sharply during the subsequent two decades, with an incidence comparable to that of some high-income countries (NCD Risk Factor Collaboration, 2017).

2.2.2 | Conflict → food supply

To determine the extent to which physical violence and insecurity might have contributed to these important nutritional changes in Iraq, I identify two primary and interrelated channels for this assumed relation; namely, reduced local food production (supply) and difficulties in the capillary distribution of food, especially of more perishable food items. As regards the first, the years after the Iraq invasion saw a decrease in local production because the insecurity and violence made it difficult for Iraqi farmers to work their fields or store their harvests (FAO, 2017), with a share also losing crops to heavy military operations (Picotte & Campbell, 2010). The protracted conflict also deeply affected the country's food distribution system, not only through destruction of physical infrastructure but also via the installation of checkpoints and inaccessible military areas, whose interconnections were made particularly risky and cumbersome by the high level of physical insecurity (Rawaf et al., 2014). Particularly challenging in the context of a progressively less localised food supply and dependence on food imports was access to insecure areas, which reduced local availability of, and accessibility to, more perishable food.

2.2.3 | Conflict → food prices

The shifting dietary patterns in Iraq reflect two well-documented dynamics: First, higher production and transportation costs tend to inflate local food prices, especially for smaller-scale farms. Second, greater availability of imported staples and processed and

semi-processed food encourages the population to replace local fresh food with cheaper imported items of lower nutritional quality (e.g., rich in refined carbohydrates and fat). Such unbalanced diets heavily reliant on refined carbohydrates are documented as leading to high rates of obesity and chronic malnutrition among West Saharan refugees in Algeria (Grijalva-Eternod et al., 2012).

2.2.4 | Potential heterogeneous effects

Although the above theoretical framework attributes higher calorie and less balanced diets to Iraq's insecurity, the effects could nonetheless differ for certain strata of the population. That is, conflict's negative effects might be especially severe for the poorest households, which may have difficulties accessing even the relatively cheaper food items. It would therefore not be unexpected to observe heterogeneous effects of the conflict–food security nexus based on household economic status, especially for the 11% (20%) of Iraqi households living below the food (food and non-food) national poverty line. According to the theoretical assumptions presented above, for the relatively better off (i.e., the great majority of the Iraqi population), exposure to conflict may imply a substitution effect from healthier but more expensive food items to more calorie-dense and fat filled produce, resulting in an ultimately positive average effect on calorie consumption but a decrease in dietary diversity.

3 | DATA

3.1 | Survey data

The analytic dataset comprises household socioeconomic and food purchase information from the LSMS 2012 administered by the Central Organisation for Statistics and Information Technology (COSIT) and the Kurdistan Region Statistics Organisation (KRSO) in collaboration with the World Bank (COSIT, KRSO, & World Bank, 2012). This database provides a rich set of household variables, including demographics, socioeconomic status and food purchases. After first stratifying the sample by *qadha* (district, second administrative division), the researchers randomly selected 215 participant households from each *qadha*, regardless of population. The initial nationally and divisionally representative sample included 25,146 households comprising 176,042 individuals, which, after deletion of implausible and missing values, yielded a final sample of 22,376 households. To compute the consumption of select macronutrients and calories from the LSMS household-level data on quantities of 265 food items purchased in the week before interview, I draw primarily on the Food and Agriculture Organisation's Food Composition Tables for the Near East, which provide conversion factors from quantities to caloric content for various micro- and macronutrients (FAO, 1982). For the 67 food items missing from this database, I use the corresponding nutritional values from the USDA Food Data Central composition tables (US Department of Agriculture, 2018) and the Bahreini Food Composition Tables (FCT) (Musaiger, 2011).

3.2 | Conflict data

The Uppsala Conflict Data Program Georeferenced Event Dataset (UCDP GED) (Sundberg & Melander, 2013) provides georeferenced information on violent events collected from both primary and secondary sources, including but not limited to NGOs, local experts, police and media reports. The database also records violent event characteristics, such as the number of

casualties, identifiers for the parties involved, location, date and the degree of geographic and temporal precision for each event (Croicu & Sundberg, 2016). In this study, I consider only the 96% of violent events identifiable at least at the district level.

3.3 | Population and aid data

Because the Iraqi Statistical Bureau provides no district-level population estimates, I derive per capita conflict intensity by exploiting Gridded Population of the World raster image estimates at 30 arc-second resolution (Center for International Earth Science Information Network [CIESIN], 2018). I then use an Iraqi shapefile of secondary administrative level (OCHA, 2017) to convert these fine-grained data into numeric values aggregated at the district level. For data on international aid, I employ the Iraq AIMS Geocoded Database (Research Release version 1.3.1) of all international development assistance to Iraq from 2003 to 2014 (AidData, 2016).

3.4 | Potential crop yield data

To construct a district level measure of potential crop yield with a 5 arc-minute resolution, I use the raster dataset provided by Galor and Özak (2016), which captures the average potential crop yield measured in calories per hectare per year. The authors provide a Caloric Suitability Index value for each cell that proxies land suitability. To derive the district level data, I convert the raster data into numeric values and again use the second administrative division Iraqi shapefile to associate a potential crop yield value with each district.

4 | MATERIALS AND METHODS

4.1 | Basic regression framework

To quantify the effect of conflict on various dimensions of food security as measured by per capita daily caloric supply, an HDDS and specific measures of diet quality, I estimate the naïve econometric OLS model expressed in Equation 1, where Y is alternatively a food security or a diet quality measure and vector H_i is a control for household characteristics. The main independent variable of interest, $fatalities_{(t-1),i}$, is a continuous population-adjusted indicator of conflict intensity measured at the district level (n) in the one-year period before interview.

$$Y_i = \beta_0 + \beta_1 fatalities_{(t-1),i} + \sum_{k=2}^{15} \beta_k H_i + \sum_{w=16}^{18} \beta_w D_n + e_i \quad (1)$$

One methodological shortcoming of this approach, and a weakness common to other studies using a similar empirical strategy (D'Souza & Jolliffe, 2013; Oskorouchi, 2019), is the inability to control for district fixed effects whose inclusion would overfit the model and result in high multicollinearity. To overcome this weakness, all model specifications control for a vector D_n of district-level controls, and all regression estimates have standard errors corrected at the district level, which both accounts for survey design complexity and allows for heteroscedasticity.

4.2 | Variable descriptors

4.2.1 | Dependent variables

Daily per capita calorie consumption

To compute household-level daily per capita calorie consumption, I merge each food item listed in the LSMS Iraq weekly food records module⁴ with its FAO table counterpart (or USDA/Bahraini FCT counterpart for missing items). In the rare case of an item missing from both food composition tables, I proxy its caloric content and other selected nutritional values by computing the average quantity of interest of similar food items; for example, assigning the LSMS item ‘cherry plum’ the average nutritional content of other plum varieties. I assign the nutritional values to processed food items based on one or more similar products in either the USDA food database (for common snacks such as crisps, chips, cake, biscuits, flavoured juice and ice-cream) or the Bahrain Food Consumption Tables (Musaiger, 2011) (for Middle-Eastern foods such as regional pastries and beverages). Admittedly, because nutritional values for processed food are only approximations, the outcome variable could still be subject to measurement error; however, any such error would only generate attenuation bias.

Another limitation of LSMS Iraq, however, is that it reports no quantities—only monetary values—for food items that are explicitly categorisable but labelled ‘other’ (19 cases). To overcome this issue, I follow San Ahmed and Holloway (2017) and Vu (2008) by first calculating the average price per unit for each food category (fruit, vegetable, meat) in the district of residence and then deriving the missing food quantity by dividing the total purchase value per item by the corresponding food category- and district-specific average price.

To compute total daily caloric consumption at the household level, I multiply the quantity of each food item purchased by its corresponding caloric value from the food consumption table and divide by 7 days. I then further divide this value by the household size in adult equivalency. In this computation, each member weighs the ratio of their daily recommended caloric intake (from WHO, 1985) over that of a medium active male adult aged 18–30. I drop implausible values, defined as households with daily calorie consumption below 500 Kcal per adult equivalent.

Household dietary diversity

To measure diet quality in terms of food group variety, I categorise the LSMS food module items into 21 groups⁵ and assign an HDDS based on the number recorded by a household in the week before interview. Given the research focus and the Iraqi context, instead of the standard HDDS, I use a more disaggregated version to better proxy micronutrient adequacy. Specifically, I employ the categories proposed by Arimond et al. (2010), which are not only more disaggregated than FAO's HDDS but also exclude food categories with limited micronutrient value (cf. FAO Women DDS), including sweets, oils and fats, spices and beverages (FAO, 2013). It should be noted that, following the FAO guidelines, I categorise almost all the processed food items in the Iraq LSMS data as either condiments, or sweets and beverages.⁶

⁴Here, households report not only food obtained through purchase but also rations from the PDS, gifts, self-consumption from own production, and food received as a fee-for-work. If the household did not pay for a specific food item, the respondent is asked to provide an estimate of the price they would have paid at the local market.

⁵Grains, other starchy staples, cooked dry beans and peas, soybeans and soy products, nuts and seeds, milk and yogurt, cheese, organ meat, eggs, small fish eaten whole, large whole fish, shell fish and other seafood, red meat, white meat, insects and other small animals, vitamin A rich vegetables and tubers, vitamin A rich dark green leafy vegetables, vitamin A rich fruits, vitamin C-rich vegetables, vitamin C-rich fruits, other fruits and vegetables.

⁶The LSMS Iraq sample consumes the following process food items: artificially flavoured juice, assorted sweets, biscuits, cake, chewing gum, chips, chocolate, fruit juice, gaseous beverages, ice-cream, jam kahi (local millefeuille), ketchup, klecha (local pastry), mustard, other fruit soft drinks, other sugar products, pizza, sandwich, sauces and flavours, sherbet (local sweet beverage).

The only exceptions are chips, pizza and sandwiches, which, in the computation of the HDDS, I categorise as starchy staples because of their high grain/starch content.

Measures of diet quality

Finally, I construct three specific measures of nutrition quality appropriate for a middle-income country in which diets are increasingly higher in calories and fat—namely, continuous measures of daily kilocalorie consumption from carbohydrate per adult equivalent, from fat, and from saturated fat per adult equivalent.

4.2.2 | Conflict intensity

The main explanatory variable in this study ($fatalities_{(t-1)i}$) is a measure of conflict intensity constructed as the number of per capita war-related fatalities (e.g., as in D'Souza & Jolliffe, 2013; Mansour & Rees, 2012; Oskorouchi, 2019). By exploiting the exact date of interview and district of residence of each LSMS Iraqi household, I assign to the latter the total number of fatalities that occurred in the district of residence in the 365 days prior to the interview. Three reasons underlie this choice of timeframe for conflict variable construction. First, both conflict and food security may follow seasonality, so counting fatalities in a period shorter than 1 year complicates the disentanglement of the conflict effect from that of seasonality. Second, food security and/or diversity measures all qualify as short term (weekly). Lastly, because I cannot adjust the conflict measure for household migration history, only control for the (non)occurrence of migration, which increases as the study period lengthens, measuring conflict over a longer timeframe would increase the non-random measurement error in this variable.

For comparability and to better describe the conflict intensity across districts of different population size, I divide the district-level fatality count by district population in 2010 (per 100,000 inhabitants). If fine-grained information at a level lower than the first administrative unit had been available, population statistics for the conflict period (2011–2012) would obviously have been a better choice; however, despite a small possibility of attenuation bias, such a small temporal mismatch is unlikely to affect the quality of the estimates.⁷ The final measure of conflict must thus be interpreted as the measure in per 100,000 inhabitants of the number of fatalities in the household district of residence during the year prior to the interview.

4.2.3 | Control variables

All models control for a set of variables (H_i) that measure key household socioeconomic characteristics, including dummies for household head gender (1 if female), household head unemployment status (1 if unemployed), and household urban residency (1 if in urban area); and a measure for household head age and education (in years), and household size and dependency ratio.⁸ I also explicitly control for household migration status using a dummy equal to 1 if at least one household member lived in a different residence for at least 6 months. Other regressors measured at the household level include household non-food expenditure, and household

⁷Although the time-constant district area would seem a viable alternative, given Iraqi morphology and its large portions of desert territory with minimal military activity, the conflict effect could be confounded by regional economic development, rainfall level, and other determinants of food security. For example, in the large, mostly desert district of Al Anbar, almost every conflict-related fatality happened close to its few urban areas.

⁸Calculated as the share of children (0–12 years) and seniors (65+) over an individual aged 13–65.

distance in minutes to the nearest paved road, market, food ration distribution centre and hospital. In addition, because conflict intensity and food security indicators may depend on agricultural seasonality (Guardado & Pennings, 2020), all regression models include a categorical variable for season of interview, taking three different values for harvest, lean or sowing season.⁹

For the district level controls (D_n), I construct a poverty headcount ratio for each district and also measure district-level land suitability for agriculture by constructing a population-adjusted Caloric Suitability Index. Given the possible direct correlation between conflict and price levels as an important explanatory variable for food security, I further include a household-level Paasche price index computed by the World Bank with temporal and spatial adjustment. Lastly, because international aid may relieve food insecurity but is also correlated with conflict intensity, I construct a proxy for district-level per capita committed aid computed as the sum monetary value in thousands of US dollars of all international development assistance received by each Iraqi district from 2003 until the interview date divided by district population.¹⁰

4.2.4 | Instrumental variable

The IV approach described below exploits the exogenous variation in the distance between each household place of residence and the closest foreign national war and monumental cemeteries,¹¹ none of which relate to combat after 1990. Given that both international and Islamic law stipulate respect for mortal remains and the sites hosting them, neither regular army nor other fighting groups are likely to wage combat in the vicinity of such locations. This respect is codified in Article 34(1) of the Additional Protocol to the Geneva conventions, which establishes an obligation to respect mortal remains and gravesites, and a *hadith* in which the Prophet Mohammad equates violating a dead body with violence against living human beings (Al-Dawoody, 2017). This aversion to engaging in conflict near to selected sites is confirmed by the 0.21 Pearson correlation coefficient between the variables ‘fatalities in the district of residence’ and ‘household to closest cemetery distance’.

To compile information on these sites, I apply the methodology first used by Otterbach et al. (2021) in studying the association between obesity and supermarket proximity. First, after using the OCHA (2017) shapefile for national borders to construct a georeferenced grid of Iraq at resolution 1/64 degree longitude-latitude, I build a dataset comprising the coordinates of each grid's intersection. Then for each pair of coordinates, I query the Google Places Programming Interface (API) server for the ‘cemetery’ category with no keyword specified. Each query returns a list of at most 10 cemeteries within a radius equal to half the diagonal of the grid rectangles (approximately 1.1 km at the Iraqi latitude) together with cemetery name and geographic coordinates. Although the preliminary dataset lists 518 cemeteries, once I translate Arabic cemetery names into English, delete duplicates and retain only foreign cemeteries built before 1970, the final list comprises a mere 24 unique sites.¹² I can then compute the IV as the Euclidian distance between each household place of residence and the closest war cemetery or memorial site.

⁹Harvest: April–August; Lean: September–October; Sowing: November–March.

¹⁰This computation excludes the 16% of aid projects that were unidentifiable on a district level.

¹¹The term ‘cemetery’ as used here refers to both monumental cemeteries and memorial structures hosting foreign combatants’ mortal remains.

¹²The IV measuring the distance between the closest cemetery and the position of households has 1002 unique values, ranging between 0 and 331 kilometres.

4.3 | Sources of bias

The OLS estimates may suffer from potential biases stemming from systematic measurement errors in the conflict variable, self-selection into treatment and/or, to a lesser extent, reverse causality between conflict and food security. For example, measurement errors in district-level fatality counts might occur if a household migrated during the period of conflict measurement or if different standards were applied in systematically assessing conflict intensity in different parts of the country. The latter is likely because the Uppsala database relies primarily on news agency, non-governmental organisation (NGO) and UN reports that often provide relatively accurate coverage of events in their operational areas while under-reporting the violence in remote or highly insecure areas. Assuming that Iraq's more remote areas generally enjoy lower diet diversity and diet quality, a systematic measurement error due to fatality under-reporting in these areas would only understate the true negative effect of conflict. In fact, these observations would be misassigned to a lower treatment intensity group, ultimately reducing its average observed outcome and thus decreasing the estimated treatment effect.

Self-selection into migration could result from better-off households deciding to move away from most conflict-affected areas, leaving more economically vulnerable households in districts with higher violence intensity. Such migration would result in an overestimation of the coefficient of interest. Given this study's role as one of the first to test the hypothesis of a positive conflict effect on high calorie diets, determining the direction of the migration-related measurement error bias for caloric consumption matters. In addition to the IV approach, two strategies that can at least partially mitigate measurement error-related endogeneity are controlling for each household's migration status and conducting robustness checks that exclude households who migrated in the period of interest for the sample's conflict measure.

Finally, reverse causality could produce a bias in the conflict coefficient if violence and the food security proxies employed as dependent variables are jointly determined; that is, if food (in)security is a cause of lower (higher) conflict levels. According to extant studies, such is the case in certain conflict settings; for example, when deterioration of food security (access and consumption) is deemed responsible for higher levels of violence (Arezki & Bruckner, 2011; Bellemare, 2014; Kelley et al., 2015). Unfortunately, assessing the bias direction for reverse causality in this context is infeasible as it would require speculation on the size and magnitude of the effect of the food security proxies on conflict.

4.4 | Instrumental variable approach

To address these potential sources of bias, I employ an IV approach whose identification strategy exploits the distance between each household place of residence and the closest foreign war cemetery as an exogenous instrument. Previous research employing a similar technique includes the use of distance to border (crossings) to instrument conflict intensity in assessing the impact of the 2014 Israeli offensive on Palestinian food security (Brück et al., 2019) or the link between early life exposure to violence and Afghan child malnourishment (Oskorouchi, 2019). Distance to border and closest police station, respectively, also serve to instrument exposure to violence when measuring its effects on poverty (Merrouche, 2008) or food security (Nnaji et al., 2022). In this current study, the identification strategy relies on both international and Islamic law to capture exogenous variation in the conflict measure.

Because the instrumental variable approach can only estimate local average treatment effects (LATE) when the non-weakness and exclusion restriction assumptions hold, it denotes

the treatment effect for IV compliers only. Specifically, to be valid, this instrument must be highly correlated with the instrumented endogenous variable while having no direct effect on the second-stage outcome variable. Hence, for instrument validity, not only is it key that both international and Islamic edicts discourage conflict in proximity to a graveyard, but the distance to the closest historical cemetery must correlate specifically with conflict measured in the 2011–2012 period. This correspondence is confirmed by a 0.21 Pearson correlation coefficient showing the instrument's positive association with conflict intensity during the period of interest. As Figure 1 shows, the selected cemeteries tend to be located in areas where conflict in the 2011–2012 period was less intense, a reduction evidenced by the first-stage partial F -statistic in all models being well above the threshold value of 10.

Appendix SI: Table A1 reports the first-stage regression results using different control variables. As regards the exclusion restriction for this IV, the cemetery sites' diverse locations—whether close to the capital Baghdad, in rural villages, or even in desert areas—prevent systematic clustering in variable construction based on district-level demographic and socioeconomic characteristics. Were such clustering the case, the better or worse socioeconomics of households living in proximity, by directly affecting their food security, would confound the correlation between the IV and the endogenous conflict measure.

The IV would also be endogenous if constructed using war cemeteries related to modern conflicts, which would capture the endogenous characteristics of the cemetery locations. To overcome this potential problem, the analysis includes only World War I cemeteries for

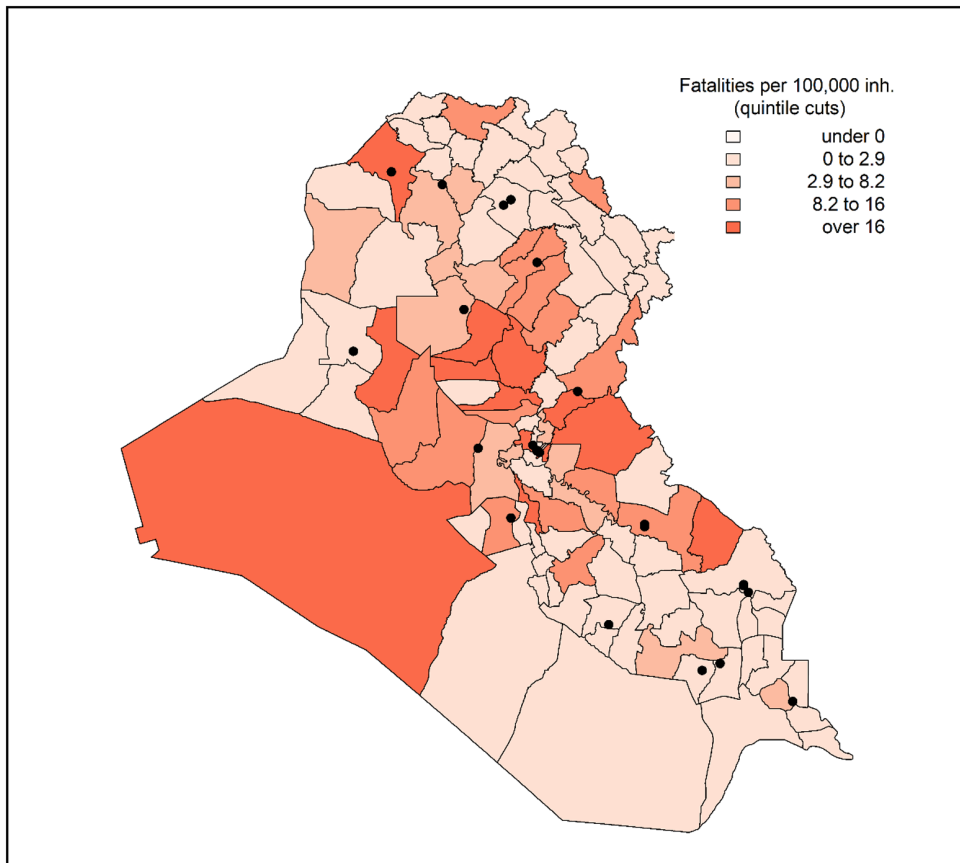


FIGURE 1 Positioning of historical cemeteries and district-level fatalities per 100,000 Iraqi inhabitants: author computation using UCDP GED data. [Colour figure can be viewed at wileyonlinelibrary.com]

foreign forces (British, German, Turkish and Turkmen) and historical cemeteries, while also recognising that migrant households could bias the IV results via measurement errors in the instrumental variable. According to the robustness check reported in Appendix S1: Table A6, however, re-estimating all IV models with the households that migrated in the year before interview excluded (1.57% of the sample) engenders no substantial changes in either the magnitude or the statistical significance of the conflict effect on caloric consumption or diet quality.

The identification strategy could also be invalid if cemeteries were systematically located in areas with low agricultural suitability. In this case, the instrument's coefficient would capture the effect of residing closer to (further away from) an area with limited potential for agricultural production rather than living in proximity to a cemetery. Because living closer to (further away) from an area with high yield potential can directly affect food security, such a mismatch would result in an endogenous instrument. To deal with this source of bias, the regressions use the Caloric Suitability Index to control for potential yield suitability.

5 | RESULTS

5.1 | Summary statistics

After deletion of missing¹³ and implausible values, the final sample includes 22,376 observations, whose descriptive statistics are given in Table 1. At the time of interview, most households in the sample were headed by males (88%), lived in urban areas (73%), and averaged seven family members. These household heads, studied for an average of 6 years, were 68% employed. Between 2003 and 2012, the households typically received average per capita aid worth US\$418 and made a monthly non-food expenditure of US\$115.97. Only 11% of households in the sample fell below the food national poverty line, meaning that the large majority could afford the base 2100 calories an adult requires daily, whereas 20% were below the food and non-food national poverty line. Although households reported purchasing an average 2506 Kcal per day per adult equivalent and an HDDS of nine food categories, the average calorie consumption from carbohydrates alone was 1542 Kcal. In terms of district-level conflict intensity, the average Iraqi household had been affected by two fatalities per 100,000 inhabitants in the year prior to interview, a relatively low level resulting from temporary attenuation of both state and non-state violence during the research period, a situation which reversed shortly after the end of LSMS data collection when IS gained renewed strength.

5.2 | Multivariate analysis

The OLS estimates for the basic model (Equation 1) underscore the association between higher violence intensity and lower dietary quality, as well as an increase in total caloric and carbohydrates Kcal consumption per adult equivalent (see Table 2). On average, one extra fatality per 100,000 inhabitants increases these two measures by 10.5 and 3.7 Kcal, respectively. Conflict is also positively associated with fat and saturated fat Kcal consumption and negatively associated with the HDDS, reducing it by 0.02 food categories.

Although the coefficient signs for all models mirror those in the OLS findings, their magnitude is larger (see Table 3). Specifically, all other factors kept constant, an additional fatality

¹³The analysis excludes observations with at least one missing value in the variable included in my models.

TABLE 1 Descriptive statistics.

Variable	Observations	Mean	SD	Min	Max
Fatalities ^a	23,443	2.13	5.69	0	103.81
Total Kcal ^b	23,442	2506.37	2326.71	500.06	138,336.9
Total Kcal (no outliers)	23,373	2460.99	1980.55	500.06	19,050.19
HDDS	23,443	9.08	1.6	1	13
Kcal carbs ^b	23,442	1542.99	1480.19	66.68	69,880.13
Kcal carbs (no outliers) ^b	23,373	1515.62	1291.84	66.68	14,950.79
Kcal fat ^b	23,442	657.48	831.47	10.48	52,975.77
Kcal fat (no outliers) ^b	23,373	644.23	719.32	10.48	15,173.96
Kcal saturated fat ^b	23,442	194.79	262.7	1.32	22,102.44
Kcal saturated fat (no outliers) ^b	23,373	190.85	216.7	1.32	4797.45
Household size	23,443	6.64	3.32	1	42
Dependency ratio	23,248	0.77	0.72	0	7
Household head unemployed ^c	23,442	0.32	0.47	0	1
Household head edu. (years)	22,713	6.25	5.04	0	19
Household head age (years)	23,443	46.8	13.75	11	102
Household head sex ^c	23,443	0.12	0.32	0	1
Ever migrant household ^c	23,443	0.19	0.31	0	1
Migrated last year ^c	23,443	0.01	0.12	0	1
Urban household ^c	23,443	0.73	0.44	0	1
Paasche Index	23,443	12.59	9.43	0	158
Distance to hospital ^d	23,441	10.8	11.57	−3	240
Distance to ration agent ^d	23,443	4.43	7.08	0	150
Distance to paved road ^d	23,443	9.65	10.62	0	156
Distance to market ^d	23,443	0.83	0.8	0	2
Season of interview (ref: Sowing season)	23,443	0.42	0.49	0	1
Harvest season	23,443	0.33	0.47	0	1
Lean season	23,443	0.25	0.43	0	1
Household below food pov. line ^e	23,443	0.11	0.10	0	1
Caloric Suitability Index ^{e,f}	23,443	0.13	0.12	0	0.72
Aid committed USD/pce ^f	23,443	418.46	840.96	0	10,888.09
Poverty head count	23,443	0.14	0.75	0	29.89

Note: Computations using Iraq 2012 LSMS, UCDP GED, Gridded Population of the World (GPWv4), AidData, and Galor and Özak (2016) data and corrected for survey weights.

^aFatalities per 100,000 inhabitants.

^bKcal per day/adult equivalent.

^cDummy variable.

^dDistance in kilometres.

^eMeasured at district level.

^fMeasured in million kcal.

TABLE 2 Effect of conflict on food security: OLS estimates.

	Model				
	(1)	(2)	(3)	(4)	(5)
	Dependent variable				
	Kcal ^b	HDDS	Kcal Carb ^b	Kcal Fat ^b	Kcal Saturated Fat ^b
Fatalities ^a	10.58*** (3.22)	−0.02*** (−4.19)	3.72* (1.82)	5.54*** (4.33)	1.38*** (3.43)
Controls	Yes	Yes	Yes	Yes	Yes
Observations	22,376	22,377	22,376	22,376	22,376
F-stat (p-value)	***	***	***	***	***
R-squared	0.13	0.13	0.12	0.08	0.07

Note: Results based on Iraq 2012 LSMS, UCDP GED, Gridded Population of the World (GPWv4), AidData, and Galor and Özak (2016) data. *T*-statistics in parentheses corrected for survey design. All models include dummies for sex, unemployment status of household head, urban residency, migration status, and season of interview, and continuous controls for non-food expenditure, household size, dependency ratio, education and age of household head, Paasche index, district-level aid, Caloric Suitability Index and poverty headcount ratio, and distances in minutes to the nearest hospital, ration agent, paved road, market. Full results in Appendix S1: Table A2.

^aFatalities per 100,000 inhabitants.

^bKcal per day/adult equivalent.

p* < 0.1; *p* < 0.05; ****p* < 0.01.

TABLE 3 Effect of conflict on food security: IV estimates.

	Model				
	(1)	(2)	(3)	(4)	(5)
	Dependent variable				
	Kcal ^b	HDDS	Kcal Carb ^b	Kcal Fat ^b	Kcal Saturated Fat ^b
Fatalities ^a	61.28** (2.06)	−0.09*** (−2.59)	44.3** (2.45)	11.90 (0.94)	14.00*** (3.10)
Controls	Yes	Yes	Yes	Yes	Yes
Observations	22,376	22,377	22,376	22,376	22,376
First-stage F-stat	55.95	55.95	55.95	55.95	55.95

Note: Results based on Iraq 2012 LSMS, UCDP GED, Gridded Population of the World (GPWv4), AidData, and Galor and Özak (2016) data. *T*-statistics in parentheses corrected for survey design. All models include dummies for sex, unemployment status of household head, urban residency, migration status, and season of interview, and continuous controls for non-food expenditure, household size, dependency ratio, education and age of household head, Paasche index, district-level aid, Caloric Suitability Index and poverty headcount ratio, and distances in minutes to the nearest hospital, ration agent, paved road, market. Full results in Appendix S1: Table A3.

^aFatalities per 100,000 inhabitants.

^bKcal per day/adult equivalent.

p* < 0.1, *p* < 0.05, ****p* < 0.01.

per 100,000 inhabitants in the year prior to interview increases the caloric consumption by 61.3 Kcal, an outcome partially due to the conflict's positive effect on carbohydrate and saturated fat consumption. Most notable, each additional fatality translates on average into an increase from carbohydrates of 44.3 Kcal and an increase from saturated fat of 14 Kcal. As regards

the HDDS, the IV models show an average conflict-related decrease of 0.09 food categories. Because no other study reports a positive effect of conflict on calorie consumption, comparing these coefficients with other research output is infeasible. However, to truly understand the magnitude of this effect, it is worth considering it relative to an average adult meal of 600 Kcal, which indicates a conflict-induced increase in meal size of 10%. These results confirm the hypotheses outlined in Section 2 that in a situation of physical insecurity, with limited local production and high dependency on foreign products, households cope with the scarcity and unaffordability of more perishable items by reorganising their diets, with a preference for cheaper, easy-to-store and more available food items. The estimated effects thus indicate that vis-à-vis a decrease in dietary diversity, households gravitate toward cheaper more calorie-dense food as evidenced by the conflict's positive effect on carbohydrate and saturated fat consumption (Table 3). This dynamic makes sense in the Iraqi context not only because a minority of the population lives below the poverty line, but because a nutritional transition is underway that will likely accelerate with the increased availability of refined carbohydrates, fat and processed food.

Nevertheless, because 11% of the Iraqi population does live below the food poverty line, the effect of conflict on calorie consumption may be heterogeneous, a hypothesis I verify using the main model in Equation 1 by interacting the conflict variable with a dummy equal to one if the household falls below the national poverty line (zero otherwise). According to the results, although conflict has a negative effect on calorie and macronutrient consumption for poor households, for the non-poor this effect remains positive (see Table 4). Moreover, in line with the extant literature, although conflict negatively affects the HDDS of both poor and non-poor households, this effect is more pronounced for the former. Nonetheless, because this heterogeneous analysis relies on exogenous variation in the distance to the closest cemetery and

TABLE 4 Effect of conflict on food security: IV estimates of interaction with poverty.

	Model				
	(1)	(2)	(3)	(4)	(5)
Dependent variable					
	Kcal ^b	HDDS	Kcal Carb ^b	Kcal Fat ^b	Kcal Saturated Fat ^b
Fatalities ^a	83.89*** (2.74)	−0.06** (−2.36)	57.68*** (3.10)	18.70 (1.45)	16.37*** (3.56)
Fatalities ^a × Poor ^c	−255.26*** (−10.28)	−0.31*** (−8.49)	−151.10*** (−9.78)	−76.85*** (−9.76)	−26.72*** (−12.69)
Controls	Yes	Yes	Yes	Yes	Yes
Observations	22,376	22,377	22,376	22,376	22,376
First-stage <i>F</i> -stat	55.95	55.95	55.95	55.95	55.95

Note: Results based on Iraq 2012 LSMS, UCDP GED, Gridded Population of the World (GPWv4), AidData, and Galor and Özak (2016) data. *T*-statistics in parentheses corrected for survey design. All models include dummies for sex, unemployment status of household head, urban residency, migration status, and season of interview, and continuous controls for non-food expenditure, household size, dependency ratio, education and age of household head, Paasche index, district-level aid, Caloric Suitability Index and poverty headcount ratio, and distances in minutes to the nearest hospital, ration agent, paved road, market. Full results are given in Appendix S1: Table A4.

^aFatalities per 100,000 inhabitants.

^bKcal per day/adult equivalent.

^cDummy variable.

p* < 0.1; *p* < 0.05; ****p* < 0.01.

its interaction with the poverty dummy variable, given poverty's endogeneity, its interaction coefficient must be interpreted with caution.

Two additional sets of regressions check the robustness of the IV results: falsification tests that verify IV exogeneity, and IV model estimations that exclude households with at least one migrating member in the year before the interview. The first robustness check, which uses only the subsample of households who experienced no fatalities in the year prior to interview, alternatively regresses each outcome variable of interest on the IV, together with the full set of control variables. A statistically significant IV effect on any outcome variable would signal that the household to closest war cemetery distance has a direct effect on food security and diet quality, a violation of the exclusion restriction. In fact, as Appendix S1: Table A5 shows, this variable has no statistically significant impact on any of the outcome variables, with the magnitude of the IV coefficients always statistically irrelevant. The second check, running the IV models with migrant households excluded, tests for the potential presence of non-random measurement errors due to household migration history (see Appendix S1: Table A6). These results confirm the main estimates from Table 3, with the conflict coefficients remaining virtually unchanged both in magnitude and statistical significance.

As an additional validation of the identification strategy, I check for result sensitivity using two alternative measures of conflict exposure: number of violent events in the year prior to interview and number of fatalities during the 2 years prior to interview, both expressed in per 100,000 inhabitants. When I use the number of conflict events as the main explanatory variable, the coefficients are larger in magnitude but nonetheless consistent with those in the original estimates (see Appendix S1: Table A7). That is, once the coefficients are divided by the average 7.5 fatalities caused by each event, they conform better to those derived using the previous measure. For the regressions using conflict in the 2 years prior to interview, the results remain significant and with the expected sign, although the magnitude decreases, possibly because the longer timeframe increases the incidence of non-random measurement error (see Appendix S1: Table A8). The results also hold when the regressions exclude households that may have purchased food in bulk because, for example, they receive large food rations (identified here as households with a daily caloric consumption above 6 standard deviations; see Appendix S1: Table A10).

6 | DISCUSSION AND CONCLUSIONS

To contribute to the growing stream of literature on the conflict-food security nexus, I assess the impact of war-related fatalities on calorie consumption and diet diversity in the case of Iraq, which, unlike most previously studied contexts, is a middle-income country transitioning to diets high in calories and fat. In particular, I examine the hypothesis that under these socioeconomic conditions, conflict intensity can negatively affect nutrition by decreasing dietary diversity while increasing overall caloric consumption, especially from carbohydrates. The quasi-experimental method used to address endogeneity empirically confirms these assumptions, documenting that households living in conflict-affected areas not only exhibit lower dietary diversity but also increase their calorie purchases by 61 Kcal for each per capita fatality exposure. Admittedly, assigning nutritional values to the processed and ultra-processed foods in the household purchase record is not straightforward and requires a certain degree of approximation. Thus, my estimates may suffer from an uncertain attenuation bias.

These results thus partially confirm the external validity of previous findings in the dietary diversity literature for low-income countries. For example, Dabalén and Paul (2014), George et al. (2020), and Tranchant et al. (2021) all document a negative effect of conflict on dietary quality, while D'Souza and Jolliffe (2013) and Tranchant et al. (2021) show a negative impact of war exposure on calorie intake. My results provide additional support for the hypothesis

that in war-affected middle-income countries in which diets are transitioning toward refined carbohydrates, fat, processed food, and high calorie consumption, the relation between conflict and food security may be more complex than a simple drop in food consumption. In these contexts, households tend to increase their caloric consumption by purchasing cheap, easily storable products while having more difficulty accessing a diversified diet. I further validated this trend in an additional analysis of income-based heterogeneous effects, which confirms that households living below the poverty line retain the negative effect observed in low-income countries where large portions of the population cannot meet their basic needs. Conversely, the positive effect on calories and macronutrients persists for relatively richer households. This shift toward a less diversified, calorie-dense diet, my analysis demonstrates, is due partially to the current level of physical insecurity, a link that neither national nor international public health authorities should underestimate in the face of high rates of adult overweight and obesity and a recent increase in non-communicable diseases (Hussain & Lafta, 2019; NCD Risk Factor Collaboration, 2017).

Additional barriers also exist, however, to Iraqi households' access to a diversified, nutritious and balanced diet. For example, Iraq's limited food sovereignty and consequent heavy dependence on food imports make it more difficult for its war-impacted communities to access high quality foodstuffs, an obstacle overcome in other contexts by sustaining locally produced and smaller scale agriculture (Ecker, 2018; Jones et al., 2014). To attain such relief, the Iraqi government might consider gradually redesigning its PDS by better targeting beneficiaries, replacing certain staples with fresh and/or micronutrient rich foods—particularly traditional comestibles—and promoting their consumption. As Muhialdin et al. (2021) qualitatively illustrate, traditional Iraqi foodstuffs, being mostly plant based, nutrition rich and easily storable, served as an important source of calories for households coping with food scarcity during the siege of Mosul.

Admittedly, the extreme deterioration of Iraq's infrastructure, agricultural land and food storage and distribution systems by over 30 years of conflict, foreign occupation, and sanctions makes meeting these goals in the currently insecure context extremely difficult. Yet given the rising obesity and overweight in the country, together with the increase in non-communicable diseases (NCD Risk Factor Collaboration, 2017), both national and international actors should work toward removing dietary hurdles, not only via a reduction in violence but also through policies that favour local agricultural and a healthier food rationing system. If no timely action is taken, an obesity epidemic like those in other middle-income countries will soon add to Iraq's already extensive woes.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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