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Original article

Geographical Fast-food Restaurant Density, Workplace Eating Behaviors, and Obesity Among Firefighters

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A B S T R A C T

Background: Obesity rates in the general population are influenced by the local food environment. However, no epidemiological studies have examined how the food environment near the workplace may influence obesity outcomes, especially for occupational groups like firefighters who have high obesity prevalence. This article investigates the direct and indirect pathways between geographical fast-food restaurant density (GFFRD) and obesity among 227 professional firefighters.
Methods: We used three clinically assessed obesity measures (body mass index, waist circumference, and body fat percent) as outcome variables and self-reported eating habits as mediating variables collected with a firefighter-specific questionnaire. We employed structural equation modeling (SEM) to explore both direct and indirect pathways, acknowledging the exploratory nature of this analysis given the limited foundational research in occupational fast-food density.
Results: We found a statistically significant but small indirect association between GFFRD and obesity measures, mediated by organizational and individual-level eating behaviors, with potential implications for occupational health at a population level.
Conclusions: The study findings contribute to the evidence on how the food environment near the workplace influences obesity risk through eating behaviors. These insights may inform interventions targeting dietary habits in firefighters and other shift workers to mitigate workplace-related obesity risks.

1. Introduction

Globally, obesity rates have tripled since the mid-1970s [1]. The World Health Organization (WHO) formally declared it a pandemic in 1997 [2]. By 2016, nearly 40% of adults worldwide were overweight and 13% were obese [3]. According to the CDC [4], using 2021 NHANES data, the prevalence of obesity among adults in the US was approximately 42%. The social environment around people's homes can influence obesity by way of the availability of dietary options [5]. The availability of both restaurants and supermarkets is known to influence food consumption decision-making within the neighboring communities.

Consumption of fast food is a well-established risk factor for increased body mass index (BMI), weight gain [6], and obesity [7]. The caloric value and fat content in fast food may significantly affect individuals' overall diet and health [5]. In the modern food industry, one single fast-food meal could represent a full day's worth of calories [8]. High-caloric content (i.e., total kcal intake) is generally

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higher among people who report eating at fast-food restaurants [5]. About 37% of US adults consume fast food [9], and fast food is the source of roughly 14% of the energy consumed by US adults [10].

Fast food outlets are ubiquitous in the United States; they increased in number from about 30,000 in 1970 to over 233,000 by 2004, making fast food one of the most rapidly expanding food sectors in the country [11]. Fast food is becoming increasingly available near Americans' places of work [12]. Research from the United Kingdom found that exposure to fast-food restaurants near the workplace was 125% higher than in the home neighborhood [13]. The workplace should be considered an elemental component in the development of obesity [14–19], particularly considering that many individuals spend most of their awake hours at work [20].

The US has over 1.2 million voluntary and professional firefighters [21]. Caban et al. [22] found that firefighters are the third heaviest occupational group among 41 occupational groups despite the physical demands of firefighting [23,24]. This apparent paradox could suggest that other work-related conditions may influence the development of obesity and weight-related diseases. Among firefighters, shiftwork, sedentary work, eating behaviors, and exercise contribute to work-related obesity [16]. Emergency calls and sleep interruptions are also related to poor eating habits and high-caloric snacking [25]. However, no studies to date have examined the influence of the neighborhood fast-food density surrounding firehouses on obesity in firefighters. Furthermore, 85% of firefighters report sometimes or always eating out in restaurants or fast-food outlets while on duty [17], and firefighters report preferring to stop at a fast-food restaurant for a bite or to bring back food to the workplace rather than preparing a meal at the station [25]. The workplace is a critical intervention site to control and reverse obesity among shift workers [26], in part because for firefighters, the workplace is practically a second home.

Given this evidence and the gaps in the literature, the objectives of this study are a) to investigate if geographical fast-food restaurant density (GFFRD) is associated with obesity among firefighters and, b) whether station- and individual-level eating behaviors are mediators between GFFRD and obesity among firefighters. Our model conceptualizes the relationship between geographical fast-food restaurant density (GFFRD) and obesity among firefighters through both direct and indirect pathways. The model considers how the presence of fast-food outlets near fire stations may influence dietary behaviors and, consequently, obesity risk. One proposed pathway suggests a direct link between fast-food availability and obesity, where greater exposure to fast food increases the likelihood of consuming high-calorie, processed meals, leading to higher body mass index, waist circumference, and body fat percentage. Furthermore, the model also considers an indirect pathway (see Fig. 1), in which GFFRD affects obesity through its impact on eating behaviors at the organizational and individual levels. When fast food is readily available near fire stations, it can shape station-level eating habits, fostering a culture of frequent fast-food consumption. This shared environment influences individual firefighters' dietary patterns, reinforcing unhealthy eating behaviors, such as a higher intake of high-fat, low-nutrient foods and reduced consumption of fruits and vegetables. Over time, these behaviors contribute to an increased risk of obesity.

Our model acknowledges that fast-food availability near firefighters' homes may also influence their eating behaviors, but this aspect was not the focus of the present study. By integrating environmental, organizational, and individual factors, the model highlights the complexity of dietary decision-making in occupational settings and underscores the need for workplace-based interventions aimed at improving eating habits.

While foundational research on neighborhood fast-food density and obesity exists in broader populations [27,28], studies specifically targeting occupational groups like firefighters remain limited. This study builds on existing literature by investigating both direct and indirect pathways, recognizing that firefighters' unique occupational environment may introduce mediating factors, such as station- and individual-level eating behaviors. The use of structural equation modeling (SEM) is well-suited for exploring these pathways as it allows simultaneous examination of complex interrelationships. This analytical approach enriches the evidence base while acknowledging the need for further foundational studies specific to occupational contexts.

2. Methods

2.1. The FORWARD study

We used data collected as part of the Firefighter Obesity Research: Workplace Assessment to Reduce Disease (FORWARD). The FORWARD Study's main objective was to identify occupational and behavioral risk factors for obesity in firefighters [17]. The Institutional Review Board (IRB) at the University of California,

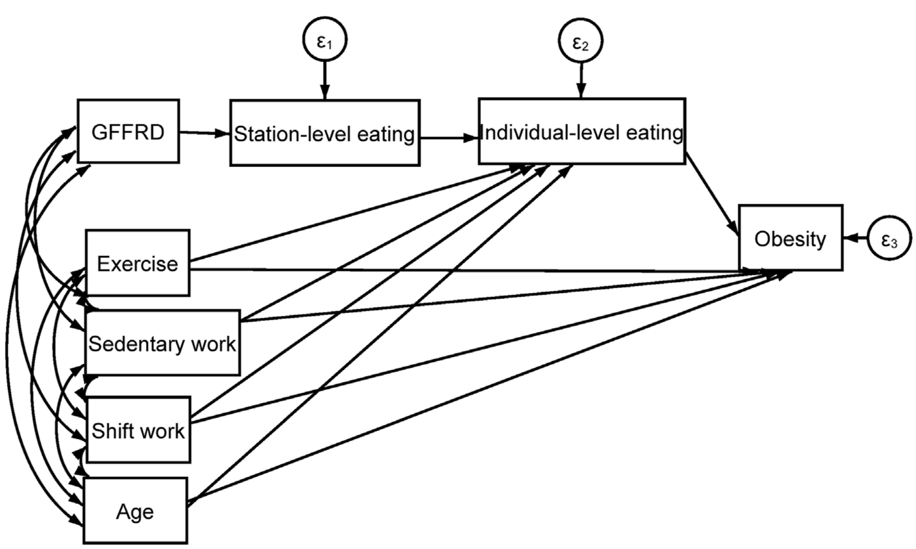

Fig. 1. Path model linking GFFRD and obesity through station- and individual-level eating behaviors. Note that obesity refers to waist circumference, BMI and body fat percent analyzed individually (not aggregate).

Irvine (UCI) approved the study protocols with identification number: HS 2010-7823. Phase I of the CDC/NIOSH-funded FORWARD study (Grant Number: 1R21OH009911) ran between November 2010 and April 2011 in the Center for Occupational and Environmental Health (COEH), where a firefighter-specific questionnaire was developed.

2.2. Geographical fast-food restaurant density (GFFRD)

Available tools like the North American Industry Classification System (NAICS), used for classifying businesses based on the processes used to produce goods or services, is the standard for federal statistical agencies [29]. We utilized NAICS Code 722513 in ReferenceUSA to measure fast-food density [28]. This commercial database has been field validated and used to identify other health-environment risk factors [30].

We used GFFRD data for the years 2011 and 2012, one and two years preceding the data collection of the FORWARD Study (Phase II: from May 2011 to December 2012), to match the time firefighters reported being in their fire stations. A sensitivity analysis allowed us to conclude that a 3-mile radius was the best predictor for obesity measures. This radius ensures that fast-food outlets are within a 10-minute drive, given that firefighters have limited time to prepare meals and instead favor a quick stop at fast-food chains [25]. Other studies have used similar distance radii when studying GFFRD as a risk factor for obesity [27,28,31].

2.3. Obesity measures: Waist circumference, body mass index and, body fat percent

Firefighters participated in a wellness and fitness program (WEFIT) in collaboration with the University's COEH. During their WEFIT visit, an experienced exercise physiologist collected height and weight and recorded the data to the nearest 1/8 of an inch. BMI was calculated by (weight in pounds)/(height in inches)^2 * 703. Weight was measured using a Detecto D1130 mechanical scale and height with a Seca 216 clinical stadiometer. Waist circumference was recorded with a non-stretchable Grafco tape. The FORWARD Study questionnaire was administered during the WEFIT visit with a response rate of 84%.

2.4. Workplace eating behaviors

We used two validated items to assess station-level eating habits [32]: "Estimate the % of firefighters in my station eating more than 5 servings of fruits (1 serving = 1 medium fruit) and vegetables (1 serving = 1/2 cup) each day" and "Estimate the % of firefighters in my station eating foods that are high in cholesterol or fat." These items utilize a multiple-choice percentage estimate of the number of firefighters that consume fruit/vegetables and foods high in fat/cholesterol, i.e., 0%, 20%, 40%, 60%, 80%, 100%.

We assessed individual-eating habits with a four-point Likert scale from 1 = 5-6 servings a day to 4 = never/rarely by asking participants "How many servings of food do you eat (per day) that are high in fiber, such as whole-grain bread, high fiber cereal, fresh fruits or vegetables? (a serving size: 1 slice bread, $^1/_2$ cup vegetables, 1 medium fruit, $^3/_4$ cup cereal)." We used the same response set for a second item "How many servings of food do you eat (per day) that are high in cholesterol or fat such as fatty meat, cheese, fried foods, or eggs? (a serving size: 3 $^1/_2$ oz meat, 1 egg, 1 oz/slice cheese)." For analysis, scores from the individual eating habits variable were combined to form a composite score ranging from 2 to 8, with higher values indicating less healthy eating behaviors. This composite score captures both low consumption of fruits and vegetables and high consumption of cholesterol- and fat-rich foods.

The station-level and individual-level items have been used and validated in previous studies with firefighters [33]. Finney and DiStefano [34] have suggested grouping items into single measured variables: station level eating and individual eating behaviors. For the station-level eating behaviors variable, the average of each station was used to reflect the aggregate calculation of the station-level behaviors.

2.5. Other variables

Age is well-established in the literature as a contributing factor in overweight and obesity in the general population [35].

Sedentary work and shift work are known occupational confounders [36–38]. Specifically, in firefighters, a previous study identified sedentary work and shift work as contributors to the development of obesity [16]. Shift work was self-reported as the total number of 24-hour shifts firefighters worked during the past month. Sedentary work was measured with a single item drawn from the MIDUS II study [18,39]. Choi et al. [16] have also reported satisfactory test-retest reliability of this item.

Exercise is often used as part of worksite interventions to prevent and reduce obesity and other CVD risk factors, including diet and weight loss [40,41]. Also, exercise affects individuals' dietary intake and energy balance [42]. Furthermore, exercise coupled with diet yields improved sustained weight loss [43]. Exercise at work was assessed with a single item: "On average during the past year, how many days a week have you done aerobic or cardio exercise."

2.6. Study sample

The inclusion criteria for the FORWARD Study required firefighters to be over 21 years old, seniority of at least one year, participate in their biennial WEFIT screening, and agree to complete the work-specific questionnaire developed by Choi et al. [17]. The questionnaire collected demographics and worksite information (e.g. firehouse number, size of the fire crew), fast-food consumption, and self-reported physical activity data from 365 participants.

After excluding office workers and firefighters who had not worked for at least one year in their current fire station, the final sample was N = 227. Five female firefighters were also excluded; however, the female firefighters' basic information on work and obesity is reported elsewhere [44].

2.7. Statistical analyses

We explored the relationship between GFFRD (3-mile radius) and work-related obesity. Intraclass correlation coefficients (ICC) were calculated to compare the clustering effect of the station level on the outcome of firefighters (BMI, waist circumference, and body fat percent) [45]. We found no station-level clustering effect after examining the ICC and consequently did not perform multilevel data analyses. The ICC for BMI was 0.087, 95% CI [-0.032, 0.206], 0.078, 95% CI [-0.039, 0.198] for waist circumference and 0.068, 95% CI [-0.047, 0.183]. We conducted univariate regression analyses using GFFRD as independent variable and each obesity indicator as the outcome.

We used path analysis to test the association between GFFRD and work-related obesity, including the mediation effect of station- and individual-level eating behaviors. Path analysis is a multivariate method that allows the testing and verification of theoretical causal models and identifies the direct and indirect contribution of independent variables that explain the variability of dependent variables [46]. This is a type of structural equation modeling: a family of multivariate statistical models and essentially an extension of regression models [47]. Path analysis, as part of the SEM framework, was chosen due to its ability to model both direct and indirect effects, which aligns with the exploratory nature of this study [48]. While SEM is often employed in confirmatory contexts, it is equally valuable for identifying potential pathways in areas where theoretical frameworks are still emerging, such as the occupational influences on obesity among firefighters.

2.8. Normality testing

Normality assessment was conducted for all model variables. Univariate normality was assessed using skewness and kurtosis. Some variables, including fast-food density and shiftwork, exhibited skewness exceeding ± 1.0, indicating deviations from normality. Multivariate normality was assessed using Mardia's test, which revealed significant kurtosis (waist circumference model: 15.218, $p < 0.001$; BMI model: 15.628, $p < 0.001$), suggesting that the data violated multivariate normality assumptions. Given these findings, we applied bias-corrected and accelerated (BCa) bootstrapping with 5,000 resamples to obtain robust standard errors and confidence intervals.

2.9. Specification of the path analysis

We elaborated a path diagram using SPSS AMOS 18 to examine the mediating pathway between GFFRD and obesity. Eating behaviors in this study refer to negative eating behaviors, i.e., high fat and cholesterol-rich food and low fruit and vegetable consumption. The model suggests a pathway from a socio-ecological theoretical standpoint and its effect on the individual obesity indicators of firefighters.

Although BMI, waist circumference, and body fat percent are highly correlated, previous studies show that each outcome has a divergent predicting value of cardiovascular disease risk factors, including obesity [44]. Therefore, as shown in Figs. 2–4, outcomes were explored in individual models (not simultaneously) and obtained adjusted direct and indirect effects.

2.10. Model identification

According to the t-rule and the recursive model rule, the model meets the required conditions for identification. The t-rule for structural equations with observed variables states $t \leq {}^{1}/_{2}\,(p + q)*(p + q + 1)$, where t is the number of unknown parameters and $p + q$ is the number of observed variables [49]. The model is over-identified, having 32 parameters (t) and 45 covariances. Although this is a necessary but not sufficient condition, the recursive rule states that all recursive models are identified, this being a sufficient but not necessary condition [49].

2.11. Goodness of fit

Goodness-of-fit measures such as the Comparative Fit Index (CFI), Standardized Root Mean Square Residual (SRMR), and Root Mean Square Error of Approximation (RMSEA) are widely recommended for model evaluation, as they are less influenced by sample size than traditional chi-square-based indices [50]. While fit indices such as the Goodness of Fit Index (GFI) and Adjusted Goodness of Fit Index (AGFI) were historically used, they are more sensitive to sample size and are not emphasized in modern SEM applications. We primarily assessed model fit using CFI ($\geq$0.90), SRMR ($\leq$0.08), and RMSEA ($\leq$0.08), following Hu & Bentler's [50] recommended cutoff criteria (see Table 3). RMSEA was further interpreted with its 90% confidence interval, which provides additional insight into model fit uncertainty [51].

3. Results

3.1. Descriptive results

The mean BMI of 227 professional firefighters in this study was 27.64 (SD = 3.07), waist circumference assessed in inches was 37.47 (SD = 3.60), and body fat percent was 18.78 (5.72). The minimum and maximum values of those obesity measures are presented in Table 1.

There were on average 10 fast-food restaurants surrounding each fire station, with a $\pm$5.5 standard deviation.

Additionally, the number of 24-hour shift work during the past month had a mean of 13.08 (SD = 3.13). Sedentary work and exercise were measured on a 4-point Likert scale. Their means were 2.39 (SD = 0.73) and 3.28 (SD = 0.85), respectively. The mean age was 43.04 (SD = 8.48).

3.2. Direct pathway

The univariate analysis presented in Table 2 yielded small negative associations between GFFRD, and waist circumference and

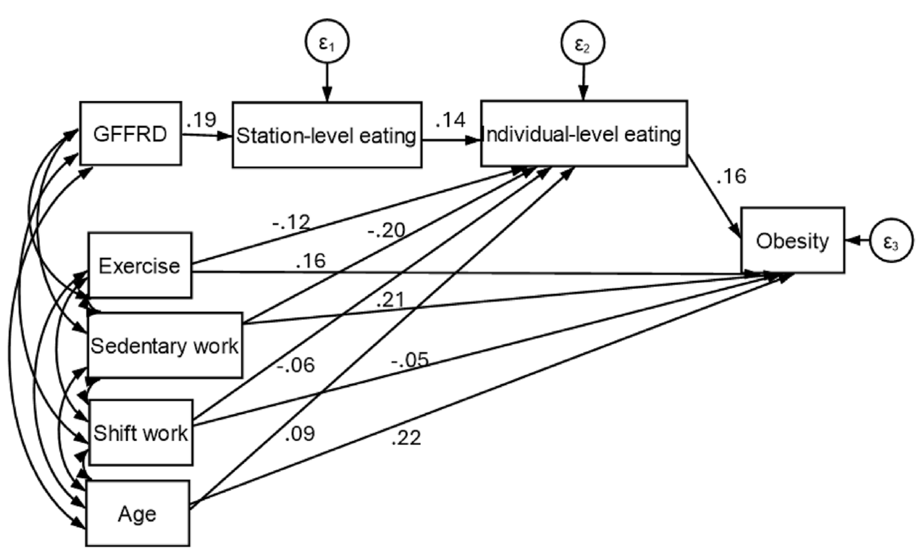

Fig. 2. The results of path analysis from GFFRD to waist circumference. The standardized regression coefficients from GFFRD to waist circumference via station-level eating and individual-level eating are presented.

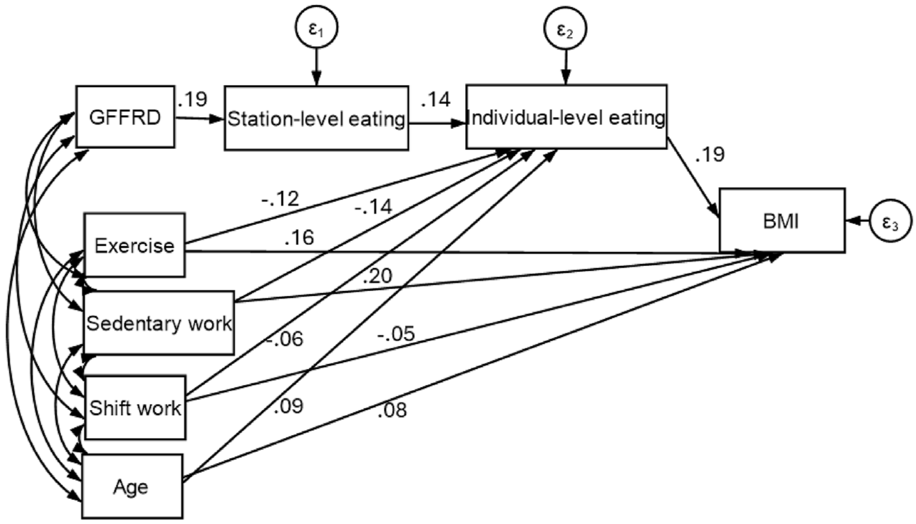

Fig. 3. The results of path analysis from GFFRD to BMI. The standardized regression coefficients from GFFRD to BMI via station-level eating and individual-level eating are presented.

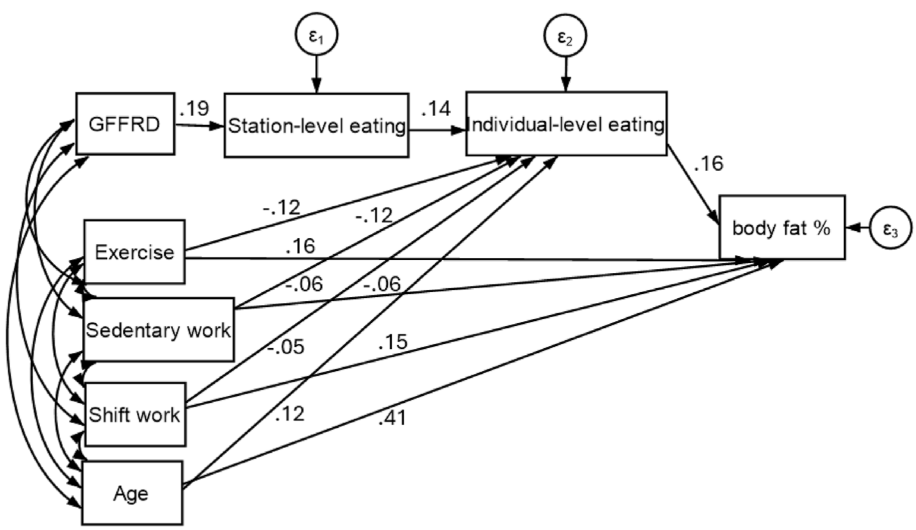

Fig. 4. The results of path analysis from GFFRD to body fat percent. The standardized regression coefficients from GFFRD to body fat percent via station-level eating and individual-level eating are presented.

Table 1
Descriptive statistics of measured variables in the main model

	Mean	SD	Min	Max	Range
Demographics					
Age	43.04	8.48	22	64	
Gender (% male)	100				
Obesity and eating					
Waist circumference	37.47	3.60	30.00	50.38	
BMI	27.64	3.07	21.76	40.30	
Body fat percent	18.78	5.72	6.53	37.04	
Individual eating habits*	4.63	0.87	2	7	2-8
Station-level eating habits*	50.28	0.96	47.50	52.50	0-100
GFFRD (3-mile radius)	10.12	5.5	0	27	

* Individual eating habits scores range from 2 (healthiest) to 8 (unhealthiest), reflecting higher intake of fatty, high-cholesterol foods and lower intake of fruits and vegetables. Station-level scores (0–100) indicate the estimated percentage of firefighters with unhealthy eating behaviors.

BMI were observed (model 1). However, these associations were not statistically significant after including confounders (model 2) and other mediating variables (model 3).

Table 2
Simple linear regression models with each obesity measure as the outcome and the 3-mile radius as the independent variable

	Model 1	95% CI	Model 2	95% CI	Model 3	95% CI
Waist circum.	-0.104	(-.19 – -.02)	-0.037	(-.12 – .05)	-.035	(-.12 – .05)
Body mass index	-0.072	(-.15 – .00)	-0.031	(-.10 – .04)	-.018	(-.09 – .06)
Body fat percent	-0.117	(-.25 – .02)	-0.011	(-.14 – .11)	.009	(-.12 – .13)

Model 1 is crude.
Model 2 is adjusted for age, shift work, sedentary work, and exercise at work.
Model 3 is adjusted for age, shift work, sedentary work, exercise at work, station-level eating habits, and individual-level eating habits.

3.3. Indirect pathway

Although the direct association was not confirmed, all associations in the indirect pathway are statistically significant. GFFRD shows a coefficient of 0.19 in its association with station-level eating. The latter is associated with individual-level eating behaviors; the coefficient for this association was 0.14. Finally, individual-level eating habits are associated with each obesity indicator: waist circumference (0.16), BMI (0.19), and body fat percent (0.16), as shown in Figs. 2–4.

There was an indirect association in the mediating path through negative station-level eating habits and individual-level eating habits. The standardized indirect effects shown in Fig. 5 were small (0.004 for waist circumference, 0.005 for BMI, and 0.004 for body fat percent), which is expected in mediation models where indirect effects result from the multiplication of multiple pathways [52]. Although these effects are numerically small, research suggests that traditional effect size thresholds should not be rigidly applied to indirect effects [53,54]. Additionally, small effects may have substantial population-level implications, particularly in large occupational groups such as firefighters, where even a small individual change could impact the health of 1.2 million firefighters nationwide [55].

All causal pathways in the model were statistically significant, and confounding variables were associated with the outcome measures in the expected direction.

3.4. Model fit

Model fit was assessed using multiple indices recommended for SEM, including CFI, RMSEA, and SRMR. The CFI values indicated acceptable to good model fit, while SRMR values were below the 0.08 threshold, suggesting a reasonable fit to the data. The RMSEA values, along with their 90% confidence intervals, were within the commonly accepted range, further supporting model adequacy. The complete set of fit indices and cutoff criteria are presented in Table 3.

4. Discussion

Our analyses show an indirect association between GFFRD and obesity indicators in professional firefighters. The standardized indirect effects were small (0.004 for waist circumference, 0.005 for BMI, and 0.004 for body fat percent), which is expected in mediation models where indirect effects result from the multiplication of multiple pathways [52]. Nonetheless, small effects may have substantial population-level implications, particularly in large occupational groups such as firefighters, where even a small individual change could impact the health of 1.2 million firefighters nationwide [55]. The study highlights the influence of the food environment near the workplace on obesity outcomes among firefighters, a profession with a high prevalence of obesity, 24-hour shift work, and a distinct occupational culture.

The application of structural equation modeling (SEM) in this study highlights the importance of examining indirect pathways in obesity research. By modeling the mediating role of eating behaviors, this study provides insights into how environmental factors, such as GFFRD, contribute to obesity risk through behavioral mechanisms. This approach underscores the utility of SEM in identifying complex relationships that may not be apparent in traditional regression analyses.

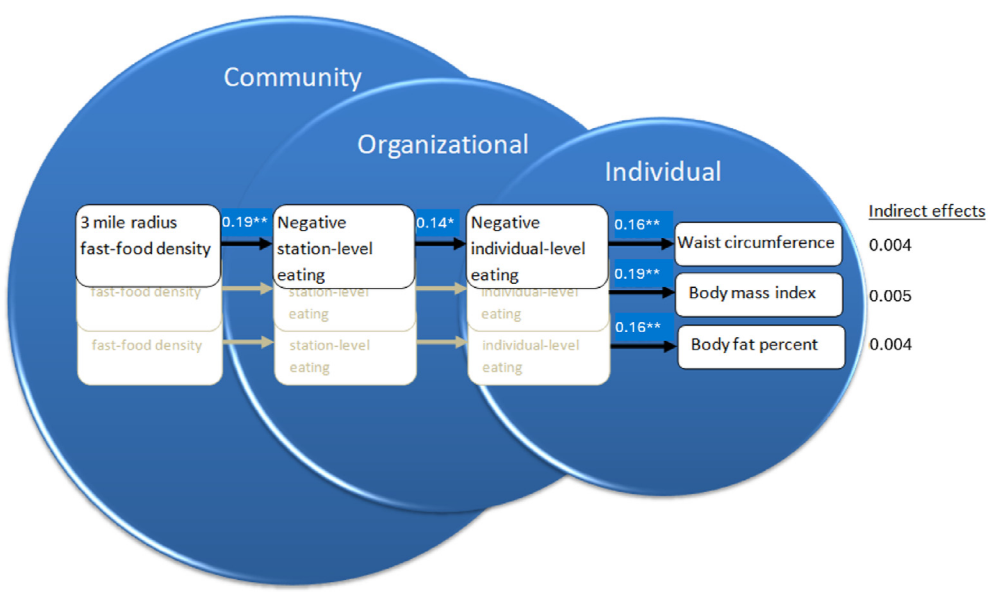

Fig. 5. Multivariate standardized regression coefficients and indirect effects of GFFRD (a 3-mile radius fast-food density) on obesity outcome measures in 227 professional firefighters after controlling for exercise, sedentary work, shift work, and age in each model. The indirect effects were calculated by multiplying all standardized coefficients in the mediating pathway.

Table 3
Cutoff criteria and goodness-of-fit indexes for the path analysis of each model

N = 227	Cut-off criteria	Waist circumference	Body mass index	Body fat percent
Comparative Fit Index – CFI	≥0.95	0.906	0.886	0.924
Root Mean Square Error of Approximation – RMSEA	≤0.05 to 0.08	0.083 (0.082-0.084)*	0.082 (0.078-0.086)*	0.080 (0.067-0.094)*
SRMR	≤0.08	0.0358	0.0357	0.0348

* 95% Confidence Intervals.

For the firefighter population specifically, the findings suggest that interventions targeting eating behaviors at both individual and station levels may mitigate the impact of GFFRD. Given the unique occupational demands of firefighters, including extended shifts and limited meal preparation time, workplace-based health programs should incorporate strategies to improve dietary choices and reduce reliance on fast food. Future research should explore how organizational policies, such as meal planning support or healthy food subsidies, could influence these behaviors.

While the results are exploratory, the use of SEM facilitates a deeper understanding of obesity-related pathways, providing a framework for future studies that could include longitudinal designs or experimental interventions to confirm causal relationships.

This study is, to the best of our knowledge, the first to consider the fast-food environmental surroundings in populations that work 24-hour shifts and have high obesity prevalence. By integrating SEM, this study provides a preliminary exploration of both direct and indirect pathways, integrating foundational research on fast-food density with an occupational perspective. While the observed indirect effects were small, they should not be dismissed as trivial. Although the direct effects were not statistically significant, the mediating role of eating behaviors highlights potential mechanisms that warrant further investigation. This study underscores the importance of foundational research while offering insights into pathways that can inform future interventions. Some studies have explored food availability and quality inside the organization but do not take into consideration the GFFRD surrounding the worksite. Most studies have focused on residence fast-food density [27,28,56–58]. A strength of this study is that we applied a multilayered workplace model that considers the environmental, organizational, and individual factors that interplay in the development of obesity. This may be informative for a wide array of occupational groups who are exposed to shiftwork and the environmental influence of the workplace. This is especially important for firefighters, who essentially live part-time at work (including sleep) and have high prevalence of obesity in the U.S.

4.1. Limitations

While structural equation modeling (SEM) is a powerful tool for exploring complex relationships, its application in this study warrants careful interpretation. The causal pathways presented are based on cross-sectional data, limiting the ability to infer causality. We do not rule out reverse causality, although it is unlikely that the individual and organizational-level eating behaviors of firefighters are such that they influence the environmental conditions surrounding their firehouses.

Additionally, the nascent nature of research on occupational fast-food density necessitates a cautious approach to interpreting indirect pathways. Future foundational studies examining direct effects, particularly longitudinal research, are needed to strengthen the evidence base for applying SEM in this context. The proposed recursive model is theoretically framed within the socio-ecological model. Thus, the causal pathways are explored in a "trickle-down" logic where the outcome is influenced by environmental, organizational, and individual factors. However, future studies may wish to analyze feedback loops in non-recursive models.

Limitations to the study's external validity also exist. Although the sample represents an entire county's fire department, the results are not generalizable to other locations, where obesity rates may differ considerably. The authors recognize the importance of the home environment although this is not explored in our study.

Although the GFFRD measure may not fully capture the exact number of outlets and the quality of the food, e.g. some fast food may be unhealthier than others, it is a useful, informative tool that permits a geographical mapping of the workplace food surroundings (including supermarkets, full-service restaurants, and coffee shops).

Our study was motivated by prior research about obesity [22] and concerning dietary habits [17,25] among firefighters and about the impact of neighborhood food environment and fast-food consumption on weight gain, obesity and other health outcomes [5–7]. Our application of path analysis enabled us to model the complex set of relationships between the firefighters' workplace food environment and obesity outcomes in a way that accounted for eating habits as a potential mediator. Our research was limited by the lack of foundational information about firefighters' on-the-job fast-food consumption. The present study offers useful areas for future scientific inquiry and intervention, and future studies should include foundational research about firefighters' workplace fast-food consumption to provide nuanced information about these workers' behaviors and environments.

The principal merit of this study lies in the theoretical and empirical framework that shows a logical causal pathway where obesity results from worksite and environmental conditions. This pathway is a small but essential part of a complex process in which the workplace is a significant contributor to the development of obesity among firefighters. The implications of this finding offer an additional layer of potential obesity interventions that would be favorable for workplace health programs targeted at reducing work-related obesity.

CRediT authorship contribution statement

Javier Garcia-Rivas: Writing – original draft, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Margaret Whitley:** Writing – review & editing, Validation, Supervision, Methodology. **BongKyoo Choi:** Writing – review & editing, Validation, Supervision, Methodology, Investigation, Funding acquisition.

Declaration of Generative AI and AI-assisted technologies in the writing process

We recognize and endorse the policy regarding the use of generative AI and AI-assisted technologies in scientific writing. During the preparation of this work the authors scarcely used ChatGTP with human oversight and thoroughly reviewed and edited the output for accuracy. AI's role in the writing process is limited to improving readability and language quality. The authors reviewed and edited the content as needed and take full responsibility for the content of the publication. We did not use Generative AI and AI-assisted tools in figures, images, and artwork.

Conflicts of interest

The authors declare the following financial interests/personal relationships that may be considered as potential competing interests: BongKyoo Choi reports financial support was provided by Centers for Disease Control and Prevention. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this article.

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