Chennakesavalu and Gangemi, J Obes Weight Loss Ther 2018, 8:1
DOI: 10.4172/2165-7904.1000366

Journal of
Obesity & Weight loss Therapy

Research Article Open Access

Exploring the Relationship between the Fast Food Environment and Obesity Rates in the US *vs.* Abroad: A Systematic Review

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Abstract

Obesity remains one of the greatest public health concerns in our modern-day society, necessitating an understanding of the underlying contributing factors. This systematic review examines the existing literature to better understand the relationship between the fast food environment and obesity rates within the United States (US) compared to other countries throughout the world. To be included in our review, studies must have been peer-reviewed, published in English, and had to include some measure of analysis of the fast food environment and rates of obesity. Based on the results of our review (n=46 studies), the findings were largely similar between US and non-US studies; in both cases, there were inconsistent associations between the fast food environment and rates of obesity/overweight. However, in terms of socioeconomic status (SES), our findings were consistent across both US and non-US studies; lower SES was associated with unfavourable fast food environments, higher concentrations of fast food restaurants, higher consumption of junk food, and higher obesity rates. Based on the results of our review, we conclude that more longitudinal research must be performed with consistent methodology in order to more clearly understand the role of the fast food environment in the development of obesity.

Keywords: Fast food environments; Obesity rates; Socioeconomic status; Obesity risk factors

Introduction

In modern day society, the prevalence of childhood and adult obesity remains one of the greatest public health concerns, especially in the United States (US). Obesity is officially defined by the World Health Organization as a Body Mass Index (BMI) of 30 and above [1]. An estimated 36.5% of US adults and 17.0% of US youth aged 2-19 are affected by obesity. Both youth and adult obesity rates have increased in the US in recent years [2]. Similar concerns regarding increasing rates of obesity exist in other countries throughout the world, particularly those considered developed [3]. Obesity can lead to the development of a myriad of adverse health conditions in affected individuals; for example, obesity has been linked to serious, complex medical conditions such as diabetes, sleep apnea, and cancer [4]. One of the particular concerns is the link between obesity and the prevalence of abnormal levels of cardio metabolic variables, which may eventually lead to the development of cardiovascular disorders [5]. With the wide range of severe health concerns associated with obesity, an understanding of the factors contributing to the development of obesity is essential.

In recent years, there has been a greater focus on environmental factors potentially contributing to the development of obesity. There has been growing consensus that environmental factors play a prevalent role in determining body weight, leading to a shift in focus from individual to population level issues. The presence of fast food restaurants is one particular environmental factor of interest. An increase in the consumption of fast food has been associated with poorer diet quality and higher energy intake at the individual level [6-8]. However, previously conducted reviews examining the associations between the fast food environment and obesity have largely found inconsistent associations at the population level [9,10]. In addition, no previous study has examined associations between fast food restaurants and rates of obesity across various settings, such as across countries. Building on previously conducted reviews, this review sought to explicitly examine the methodology used in studies and to compare the associations between the fast food environment, socioeconomic factors, and obesity in the US and other countries throughout the world where literature was present to better understand the cross-cultural impact of the fast food environment. To our knowledge, no such review directly comparing study methodology and the associations between the fast food environments and rates of obesity within and outside the US has previously been conducted. This topic of interest has a variety of potential policy and land-use implications and is particularly relevant as increasing attention has been brought to food environments as a potential contributor to the development of obesity [11-18].

Materials and Methods

A review of the existing literature was performed to identify peer-reviewed works studying the relationship between the fast food environment and obesity. Searches for this review were performed in the online databases Pubmed (Medline) and Scopus for studies published between January 1st, 2005 and December 31st, 2015. Based on an examination of previously conducted review articles, the key words included in the online search were "fast food," "fast food outlet," "fast food restaurant," "fast food environment," "quick service restaurant," "concentration of fast food restaurants," "obesity," "overweight," "BMI," "rate of obesity," and "global obesity." Several (Put exact number) duplicate studies from Pubmed (Medline) and Scopus were found in the initial search. To be included in our review, studies must have been published in English. Case studies and expert opinion published works were excluded. Studies that met our inclusion criteria were then further filtered based on their abstract; the abstract must have discussed a measure of the surrounding food environment involving fast food restaurants and a measure of rates of overweight/obesity [19]. Finally, the full papers of studies that passed the abstract criteria were reviewed one more time before inclusion to confirm the presence of the desired inclusion criteria. Screening was performed in accordance with the PRISMA statement.

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Received January 18 2018; **Accepted** January 24, 2018; **Published** February 12, 2018

Citation: Chennakesavalu M, Gangemi A (2018) Exploring the Relationship between the Fast Food Environment and Obesity Rates in the US *vs.* Abroad: A Systematic Review. J Obes Weight Loss Ther 8: 366. doi:10.4172/2165-7904.1000366

Once a study had met all the inclusion criteria, the following data were extracted from the study: 1) Type of Study, 2) Type of Statistical Analysis, 3) Sample Size, Source of Data, 4) Location/Scale of Study (Country, City, Urban/Rural, School, etc.), 5) Fast-Food De nition Utilized, 6) Measure of Fast Food Environment, 7) Other Variables Considered, 8) Health Outcomes Measured, 9) Relationship with Socioeconomic Status, 10) Key Findings.

Results

A er excluding repeats, 59 papers passed the abstract criteria, and 46 papers (12-56) were included in the nal set of data. A owchart of the selection and evaluation process is detailed in (Figure 1). e included studies and the extracted data are presented in (Table 1). A summary of the extracted data is present in (Tables 2 and 3).

Further categorization of included studies

Fast food access studies categorized by country: One of the 46 studies included in the nal review, 34 studies were conducted in the US, three studies were performed in the United Kingdom, three studies were performed in Canada, one study was performed in Taiwan, one study was performed in Australia, one study was performed in China, and one study was performed in Germany. Two studies examined multiple countries simultaneously: One study examined 26 countries at once [20-26], and another study [27-30] examined three countries simultaneously (US, Scotland and Canada). A majority of studies (76%) were performed within the US.

Study designs and statistical analyses utilized by included studies

e vast majority (n=41, 89%) of the included studies were cross-sectional in design; only ve [14,16,21,30] of the included studies were longitudinal. Every included study performed some sort of regression or correlation analysis to study the relationship between the fast food environment and rates of obesity in a certain study population; a large portion (n=25, 54%) of included studies also utilized a multi-level/multivariable/weighted/hierarchical regression analysis.

Populations studied and outcomes measured in included studies

Included studies di ered in terms of the populations they examined. Some studies (n=17, 37%) explicitly stated that they only studied children (under the age of 18). Other studies (n=18, 39%) explicitly stated that they only studied adults (over the age of 18); the adults included in these studies ranged from young adults to

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Name of Article, First Author, Year, Type of Study, Statistical Analysis Used	Sample Size, Source of Data	Location/Scale (Country, City, Urban/Rural, Schools, etc.)	Fast-Food Deýnition	Measures of Fast Food Environment (Density, Proximity, etc…)	Other Variables Considered	Health Outcomes Measured	Relationship between Fast Food Restaurants and Socio-economic Status (SES)	Key Findings
A National Study of the Association Between Food Environments and County-Level Health Outcomes, Ahern, 2011 -Cross-Sectional analysis, linear regression models								

regression models[A]27.01 (Natl.85 Td(CC27004800BF005100n.1 etc.)Tj -10 Td 0 13.865 lSQq 1 0 0 1.1 VcR1m)74.7 (yprdka9ingC27004800BF005100n.1 Td(-Csy18 3.85 Td(CC27

The women's health initiative: The food environment, neighborhood socioeconomic status, BMI, and blood pressure, Dubowitz, 2012 -Cross-Sectional, Multivariate Regression Analysis (22)	N = 60,775 women aged 50 years or older from the Women's Health Initiative Clinical Trial (WHI CT)	-US -various locations throughout the US	- Food outlet data classified based on NAICS	-Calculated the number of fast food restaurants located in a 0.75 mile, 1.5 mile, and 3.0-mile buffer around each resident's address	-Number of supermarkets/ grocery stores	-Body weight, height, and systolic blood pressure were measured by trained professionals in a standardized manner. -Calculated BMI based on these measurements.	-Measured Neighborhood socioeconomic status (NSES)	-Significant negative association between the availability of grocery stores/ supermarkets and BMI, positive association between availability of fast food and BMI, negative association between NSES and BMI. -Significant association between NSES and systolic blood pressure; no such association found for fast food or grocery stores/ supermarkets.
The effect of fast-food availability on obesity: An analysis by gender, race, and residential location, Dunn, 2010 -Cross-Sectional, Instrument Validity Regression, and Ordinary Least Squares Regression (23)	N = an unspecified number of participants age 18-75 from the BRFSS 2004-2006 study.	-US	-Food outlet data obtained from MapQuest search engine; fast food defined as McDonald's, Burger King, Wendy's, and Kentucky Fried Chicken (KFC)	-Determined number of the fast food restaurants in each county, and determined the density as number of fast-food restaurants per 100,000 county residents as reported by the June 2005 Census estimates.	-Accounted for population density, county population, violent crime/ property crime rates and mean travel time to work.	-Self Reported heights and weights from BRFSS survey. -BMI was calculated based on heights and weights.	-Accounted for SES through median county income.	-Fast food availability does not affect weight outcomes in rural counties. -Fast food availability does affect weight outcomes among females and non-Whites in medium-density counties.
Food environment and childhood weight status, Feichtner, 2015 -Cross-Sectional, Multivariable Linear Regression Models (24)	N = 49, 770 pediatric patients age 4-18	-US - Various re-gions of Mas-sachusetts	-Defned food outlets according to NAICS classifcation	-Determined distance to the nearest fast food restaurant in various ranges: <0.5, 0.5-1.0, 1-2, and > 2 miles	-Distance to large/small supermarkets, full-service restaurants, convenience stores, bakeries/coffee shops	-BMI z-score, height and weight measured during patient visits	-Considered race/ethnicity, neighborhood median outcome	-Observed a statistically signifcant ($p< 0.001$) negative relationship between proximity to fast-food restaurants and BMI z-score -Neighborhood median income was cited as an effect modifer: closest proximity to convenience stores and large supermarkets had strong adverse effects in low-income neighborhoods
The association between the geography of fast food outlets and childhood obesity rates in Leeds, UK, Fraser, 2010 -Cross-Sectional Analysis, regression analysis. (25)	N = 33,594 students aged 3-14 years who took part in the TRENDS, Rugby League and Athletic De-velopment Scheme (RADS), Primary Care Trusts (PCT)	-UK -City of Leeds -Geographical units were Output Areas (OA) which consists of about 125 households, and super-output areas, which consist of 4-6 OA's.	-Food outlet data was obtained from Leeds city health and hygiene website and cross checked with online yellow pages.	-Calculated the number of fast food outlets per SOA and performed a density analysis. -Calculated the straight line distance from the child's home address to the nearest FF outlet.	-Accounted for age and gender of students.	-BMI was calculated from the height and weight of each child	-Accounted for SES through a deprivation score.	-Significant association between higher density of fast food outlet and the child being obese. -No significant association between proximity to fast food outlet and being overweight/obese. -Children living in areas of higher deprivation have higher densities of fast food outlets in their SOA.
Food outlet availability, deprivation and obesity in a multi-ethnic sample of pregnant women in Bradford, UK, Fraser, 2012 -Cross-Sectional (26)	N = 1,485 pregnant mothers from 2007-2010 in the Born in Bradford Study	-UK -5 contiguous city wards within the Bradford Metropolitan District Council	-Food outlet details obtained from Bradford Metropolitan District Council list of food outlets, and Bradford Yellow Pages	-Distance to the nearest fast food outlet, number of fast food outlets in a 250 m, 500 m, and 1000 m radius, density of fast food outlets, identified clusters of fast food outlets	-South Asian/ non-South Asian	-Height and weight measured in standardized way as part of the Bradford Study	-Level of deprivation	-Negative relationship between BMI and fast food availability in the South Asian group, no significant association between BMI and access to fast food restaurants. -Significant positive correlations between level of deprivation and the number of food outlets in all categories. -South Asian group had greater access to all food outlets.

A cross sectional study investigating the association between exposure to food outlets and childhood obesity in Leeds, UK,								

A spatial analysis of the association between restaurant density and body mass index in Canadian adults, Hollands, 2013 -Cross-Sectional, Linear Regression Model (32)	N = 1269 Forward Sortation Areas (FSA's)	-Canada	-Fast food defned as outlets where food is ordered and paid for before eating or taking out.	-Calculated number of fast food restaurants per 10,000 persons at the FSA level.	-Number of full-service restaurants, non-chain restaurants	-BMI obtained using self-reported data from 2007-2008 Canada Community Health Survey (CCHS)	-Did not study effects of SES	-Area-level fast food restaurant density was positively associated with area level mean BMI. -Non-Chain restaurants density was negatively associated with area level mean BMI
Association between neighbourhood fast-food and full-service restaurant density and body mass index: A cross-sectional study of Canadian adults, Hollands, 2014 -Cross-Sectional, Ordinary Least Squares Regression (33)	N = 131, 959 individuals from the Canada Community Health Survey (CCHS) 2007-2008 conducted by Statistics Canada	-Canada	-Fast food data obtained from InfoCanada business database; Fast-food restaurants defned as establishments that food is ordered and paid for it is eaten or taken out.	-Density of fast food outlets determined as number of outlets per forward sortation area (FSA), divided by FSA population (per 10,000)	-Metropolitan areas *vs.* non-metropolitan areas, full-service restaurants, other restaurant service	-Individual self-reported height/weight measurements obtained from CCHS 2007-2008 used to calculate BMI; included error-correction factor	-Did not study effect of SES	-Statistically signifcant, positive association between fast food restaurant density and BMI; association found primarily in urban areas -signifcant negative association between full-service restaurants and BMI
Proximity of food retailers to schools and rates of overweight ninth grade students: An ecological study in California, Howard, 2011 -Cross-Sectional Analysis, linear regression analysis (34)	N = 879 public schools participating in FITNESS-GRAM 2007 (physical ft-ness test)	-US -state of California, public high schools	-Food outlet data was obtained from publicly available dataset from Environmental Systems Research Institute (ESRI). Used NAICS classifcation codes.	-Number of fast food outlets within an 800 m network buffer around schools.	-Number of convenience stores, supermarket retailers, ethnic composition of student body, and location of school (urban/ non-urban).	-Determined rate of over-weigh using FITNESS-GRAM, which measured body composi-tion through skinfold, BMI, or bioelectric impedance ana-lyzers. -Overweight standards determined by Cooper Institute of Dallas.	-Accounted for SES through percentage of students rece1E0>Tj/TT2 1 Tf(-)Tj0 - -1.1 Tdn).	urban/schoHodlthlectric h Systems (ESRie1E0ifyicade7losity

The food environment and student weight status, Los Angeles county, 2008-2009, Langellier, 2012 -Cross-Sectional, Multilevel linear regression model (38)	N = 1,694 Los Angeles County schools	-US -Los Angeles County public schools	-Food outlet information purchased from Dun & Bradstreet information service by California Department of Public health (CDPH)	-Created a half-mile buffer around each school, determined whether buffer contained any fast food restaurants.	-Corner Stores within a half mile buffer	-Assessed BMI in California Department of Education (CDE) Physical Fitness Program, measured by trained professionals	-Measured neighborhood socioeconomic status based on median annual family income	-The presence of a fast food restaurant within a half mile of a school was not associated with a statistically significant difference in the prevalence of student overweight. -The presence of a corner store within a half mile of a majority Latino school was significantly associated with an increase in overweight students.
Food access and children's BMI in Toronto, Ontario: assessing how the food environment relates to overweight and obesity, Larsen, 2014 -Cross-Sectional, Logistic Regression (39)	N = 1035 grade 5 and 6 students	-Canada -City of Toronto	-Fast food definition obtained from Toronto Healthy Environments Inspection System (THEIS)	-Distance from participant's home to the neSectioNTj0 Thround >s(-Los Angeles)Tj018 Tw 0 -1.1 Td0hro a half-mile e005100570003>Tj/TT2 1 Tf34				

Obesity and the built environment: Does the density of neighborhood fast-food outlets matter?, Li, 2009 -Cross-Sectional, Multilevel Logistic Model (42)	N = 1,221 randomly sampled adults aged 50-75	-US -Randomly sampled U.S. census block groups in Portland, Oregon's Urban Growth Boundary.	-Commercial business data were purchased via infoUSA, and the data were then compiled using Standard Industrial Classification (SIC) codes.	-Number of fast food restaurants was divided by area to obtain a density measure of fast food outlets; the densities were then standardized, and neighborhoods in upper quartile were classified as high density.	-Measured Residential Density, Land Use mix, eating self-efficacy, physical activity, and fruit/vegetable intake.	-Height and weight were measured in in-person assessments, data used to calculate BMI	-Accounted for median household income, percentage of black/Hispanic residents.	-Increased density of neighborhood fast food outlets was associated with unhealthy lifestyles, poorer psychosocial profiles, and increased obesity risk among adults.
Childhood obesity and community food environments in Alabama's Black Belt region., Li, 2015 -Cross-Sectional, Multilevel regression models (43)	N = 613 children (in Grades Kindergar-ten-5th) living in a county in the Black Belt Region	-US -Black Belt Region in the state of Alabama	-Obtained food outlet information from Yellow Book, did not mention an explicit definition.	-Measured distance from residential address to nearest fast food restaurant. -Determined the probability that the child patronizes a certain store. Calculated a Food Environment Score (FES)	-Included data on convenience stores, supermarkets, and restaurants.	-Both self-reported and measured heights and weights used to calculate BMI.	-Considered percentage of African American, median household income.	

The food environment and adult obesity in US metropolitan areas, Michimi, 2015 -Cross-Sectional, Multilevel logistic regression (47)	N = 300, 933 adults in BRFSS (Behavioral Risk Factor Surveillance System)	-US - 186 MMSA (Metropolitan/ Micropolitan statistical areas) throughout the US	-Concentration of food service workers; North American Industry Classification System (NAICS)	-Location Quotients(LQ's) corresponding to number of paid food service employees in a region.	-LQ's with respect to Supermarkets, Convenience Stores, Full Service-Restaurants, Fast Food Restaurants, and Snack/ Coffee Shops	-BMI of participants in BRFSS data using self-reported measurements - Obesity defined as BMI>30 kg/m^2 - Odds Ratio of obesity with		

Is there a robust relationship between neighbourhood food environment and childhood obesity in the USA?, Shier, 2012 -Longitudinal, Ordinary Least Squares Regression (52)	N = 9,610 children enrolled in a longitudinal study (ECLS-K) from kindergarten to 8th grade	-US -2970 census tracts across 45 states in the US	-Food outlet data classifed based on NAICS	-Calculated the number of fast food outlets per 1000 living in a census tract	-Physical Food Environment Index (PFEI) and Retail Food Environment Index (RFEI). -Whether or not a census tract contains various combinations of supermarkets, convenience stores, and grocery stores, Index of street connectivity	-Height and weighted were measured in a standardized way through the ECLS-K study -Calculated BMI percentiles in 8th grade, and change in BMI percentile from 5th to 8th grade	-Included median household income	-No consistent evidence was found to indicate a positive relationship between fast food availability and BMI or a negative relationship between number of grocery stores and BMI
Body mass index in elementary school children, metropolitan area food prices and food outlet density, Sturm, 2005 -Cross-Sectional, Least-Squares Regression (53)	N = 13,282 children between kindergarten and 3rd grade participating in Early Childhood Longitudinal Study (ECLS)	-US	-Obtained fast food restaurant information from U.S. Census Bureau, classifed data according to NAICS 1997.	-Determined per-capita number of fast food restaurants in the residence zip codes.	-Measured price indices of groceries. -Also used per-capita number of grocery stores, convenience stores, full-service restaurants.	-Heights and weights were measured all at once during examinations. -BMI calculated from measured heights and weights.	-Accounted and controlled for educational level, real family income.	-No signifcant effect of fast food outlet density on BMI. -Lower vegetable prices associated with lower BMI in children
A multi-level analysis showing associations between school neighborhood and child body mass index, Wasserman, 2014 -Cross-Sectional, multilevel correlational analysis (54)	N = 12118 boys and girls and age 4-12, 2008-2009	-US -Kansas City metropolitan area	-Did not mention a specifc defnition for “fast food.”	-Number of fast food restaurants that that fall within a 0.5 mile radius of a school, calculated the density of fast food restaurants.	-Sex, Race/ Ethnicity, density of convenience stores, grocery stores, fness facilities, and parks.	-Standardized Health screenings conducted by medical students, measured height and weight of participants -Calculated BMIp	-Examined effect of school-level SES	-Signifcant positive association between number of fast food restaurants and BMIp in school neighborhoods. - Most obesogenic neighborhoods associated with lower school-level SES
Built environment and obesity by urbanicity in the U.S., Xu, 2015 -Cross-Sectional, Multi-Level Modeling (MLM) (55)	N = 328, 156 from BRFSS 2012	-US -observations from BRFSS in the 48 contiguous states and Washington D.C.	- Fast food as defned in 2012 County Business Patterns (CBP)	- Ratio of fast food to full-service restaurants numbers at the county level, data extracted from 2012 County Business Patterns (CBP)	-Poverty rate, racial-ethnic heterogeneity, walkability, urbanicity	- Obesity Rate (OBR), derived from self-reported data in BRFSS. BMI > 30 kg/m^2 -Physical Inactivity Rate (PIR)	-Did not study effect of SES	-Higher ratio of fast food restaurants to full-service restaurants is associated with obesity most strongly in areas with modern urbanicity. -Signifcant association found between built environment variables and physical inactivity/obesity when controlling for individual and neighborhood characteristics/ attributes.
GIS-based analysis of obesity and the built environment in the US, Xu, 2015 -Cross-Sectional, Geographic Weighted Regression (GWR) (56)	N = 3, 109 counties	-US -Spatial distribution of obesity *vs.* food environment throughout the US	-Food environment data obtained from 5-year U.S. Economic Census	- Food environment represented by a fast-food/ full-service restaurant ratio.	-Street connectivity, Walkability, poverty rate, ethnic heterogeneity	-Obesity rate calculated from Diabetes Interactive Atlases, self-reported measurements	-Poverty rate strongly associated with obesity in most counties	- Ratio of fast-food/full-service restaurants is strongly Td(-Food)Tj0 rogenate between built physical doTd0 -1haTdmu 0 -atial

studies used BMI to measure the outcomes of the population, the included studies were split in terms of how they obtained height and weight measurements. A total of 29 studies (63%) obtained height and weight data of participants in a standardized manner (for example, height and weight measurements were taken during a clinic visit by trained professionals). A total of 17 studies (37%) obtained height and weight data from self-reported measurements.

Fast food access studies categorized by geographic location and scale

A majority of studies included in this review were performed in urban locations or were performed in both urban and rural locations. Only one study was performed solely in a rural location; this study was conducted in rural China [21]. e scale of the included studies varied signi cantly, ranging from studies performed on entire countries [20] to studies examining Metropolitan Statistical Areas (MSA) to studies examining individual cities and neighbourhoods [42-47]. e most commonly used scale in the included studies were the county level (or a similar measure, such as MSA) and the city level.

Characterization of the fast food environment

e included studies also di ered signi cantly in the way the fast food environment was characterized. A majority (n=21, 62%) of the studies performed in the qstudieB (h)4 (0ew were pe])-5 (l (og)-6 (ize)-5 dt)

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food environment and rates of obesity/overweight. Finally, of the three studies performed studying the fast food environment surrounding schools, two (67%) studies found no significant association between the fast food environment and rates of obesity/overweight, while one (33%) study found at least one significant association between the fast food environment and higher rates of obesity/overweight.

Associations found between the fast food environment and SES: US studies

A majority of included studies conducted in the US incorporated various measures of socioeconomic status (SES). In many of the studies, SES measures served as controls to accurately study the fast food environment and its relationship to obesity/overweight rates without confounding variables. However, 21 (62%) studies further examined the relationship between SES measures and the fast food environment. All of these studies demonstrated similar findings: lower SES was associated with a higher density of fast food restaurants and convenience stores, an unfavourable retail environment, poorer food environments, higher consumption of junk foods, and higher obesity rates. Higher SES was associated with a "healthier" food environment and lower obesity rates. In addition, when a significant positive association was found between the fast food environment and rates of obesity/overweight, the association was often strongest in areas with low SES (persistent poverty, higher levels of deprivation, etc.). Examples of such studies include (24,54,57). Interestingly, the SES findings were consistent across

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US studies that examined SES, it was found that areas with lower SES were associated with unfavourable fast food environments, with higher concentrations of fast food restaurants, higher consumption of junk food, and higher obesity rates when compared to areas with higher SES. While there were inconsistent results in the association between the fast food environment and rates of obesity/overweight, lower SES was strongly associated with higher fast food densities and closer proximity to fast food restaurants, especially in urban areas. These findings were consistent across both US and non-US studies. Our findings are in agreement with the review performed by Fleischhacker et al. [59] and several recent studies [60,61] that have affirmed the presence of an unfavourable food environment and higher obesity risks in areas with lower incomes and SES. Several explanations have been posed for this phenomenon, including disproportionate marketing towards children in majority black communities/rural areas/middle-income communities along with other economic factors and social processes [59,62]. Based on the results of our study, the association between low SES and an unfavourable fast food environment is consistently present in both the US and non-US studies. Once again, there were several limitations to our approach. Included studies used a wide range of conditions to define SES, including education, race, personal income, levels of poverty, and median neighbourhood income. As discussed previously, there were also great variations in the measures used to study the fast food environment. Future studies examining SES and the fast food environment must use more comprehensive, uniform methods to define SES and the fast food environment.

Policy Implications in the US

The food environment has come under increasing scrutiny as a potential factor for the development of obesity, and there have been several proposed policy initiatives specifically targeting the fast food environment in the US. Based on the mixed nature of the associations found between the fast food environment and rates of obesity overall in addition to the primarily cross-sectional design of the studies, we find it difficult to justify policy initiatives targeting the fast food environment as a corrective measure to reduce rates of obesity/overweight based on the current literature. More longitudinal studies must be performed with uniform definitions of the fast food environment, study populations, measures of access, and the inclusion of other food outlets in order to more accurately devise policy initiatives that may or may not target the fast food environment. Our conclusions are in agreement with the review performed by Fleischhacker et al. [59].

Relevant to our discussion of policy is the “Los Angeles Fast-Food Ban” introduced in 2007. The ordinance passed by the city of Los Angeles (LA), US is a zoning regulation intending to reduce the prevalence of fast food restaurants in south LA by preventing the expansion or opening of stand-alone fast food restaurants [11]. A study by Sturm and Hattori examined the effects of the so-called fast food ban, and found that there was no significant change in the composition of the food environment, with similar rates of new fast food restaurants in south LA compared to the rest of LA [11]. Overall, the study concluded that the Los Angeles fast-food ban has been ineffective so far, due in large part to the limited focus of the ordinance and the possible limited relationship between the fast food environment and obesity/diet [11].

With the inconsistent associations found between the fast food environment and rates of obesity/overweight in our review along with the limited positive outcomes of initiatives such as the LA fast-food ban, we propose alternative policy measures. While the prevalence of obesity remains high in youth and adult populations in the US, recent research

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