Health Promoting Community Design; Weight Control

Neighborhood Environment and Urban Schoolchildren's Risk for Being Overweight

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Abstract

Purpose. *Child and adolescent obesity is increasingly prevalent and predisposes risk for poor physical and psychosocial health. Physical and social factors in the environment, such as neighborhood disorder, may be associated with childhood obesity. This study examines the association between living in a disordered neighborhood and being overweight among a sample of urban schoolchildren.*

Design. *Baseline interview data, including height, weight, and hip circumference, were obtained from 313 elementary school–aged participants in a community-based epidemiologic study.*

Setting. *The setting was Baltimore, Maryland, a large metropolitan city.*

Subjects. *Subjects were elementary school students ages 8 to 12 years.*

Measures. *To assess neighborhood characteristics, independent evaluators conducted objective environmental assessments using the Neighborhood Inventory for Environmental Typology instrument on the block faces (defined as one side of a city block between two intersections) where the children resided.*

Analysis. *Logistic regression models with generalized estimating equations were used to examine the association between neighborhood disorder and children being overweight.*

Results. *Neighborhood disorder showed a trend toward a statistically significant association with being overweight during childhood (odds ratio [OR], 1.03; confidence interval [CI], .99–1.07; $p = .07$) in the unadjusted model. Gender was significantly associated with being overweight, with female gender increasing the odds of being overweight by 50% in the sample (OR, 1.50; CI, 1.18–1.92; $p < .01$). After controlling for race, age, and comparative time spent on a sport, multivariable analyses revealed that gender (adjusted odds ratio [AOR], 2.42; CI, 1.63–3.59; $p < .01$) and neighborhood disorder (AOR, 1.09; CI, 1.03–1.15; $p < .01$) were associated with being overweight. Further, an examination of interactions revealed girls (AOR, 2.40; CI, 1.65–3.49; $p < .01$) were more likely to be overweight compared with boys (AOR, 2.20; CI, 1.57–3.11; $p < .01$) living in neighborhoods with the same level of neighborhood disorder.*

Conclusion. *Results suggest neighborhood hazards warrant additional consideration for their potential as obesogenic elements affecting gender-based disparities in weight among urban schoolchildren. Future studies in this area should include longitudinal examinations. (Am J Health Promot 2013;27[6]:410–416.)*

Key Words: Youth, Overweight, Gender, Environmental Exposure, Prevention Research.

Manuscript format: research; Research purpose: test of association (odds) cross-sectional; Study design: experimental; Outcome measure: overweight/obesity; Setting: school/community; Health focus: weight control; Strategy: built environment; Target population age: youth; Target population circumstances: race/ethnicity, geographic location, income/education level

INTRODUCTION

The prevalence of obesity among children and adolescents has tripled since the 1970s.[1–3] In the United States alone, 32% of children and adolescents ages 2 to 19 years are overweight.[4] Although obesity has increased significantly throughout the population, sharply higher rates of obesity and being overweight occur among children and adolescents of urban lower socioeconomic status[5,6] and minority groups.[4] Weight increases among children have prompted nationwide programs to prevent obesity and obesity-related illnesses among children, including First Lady Michelle Obama's "Let's Move" initiative aimed at improving food quality in schools, increasing healthy food accessibility, and enhancing parents' nutrition and exercise knowledge. The significant impact that obesity has on the physical and psychosocial health of children[7,8] calls for a change in policy. There is an increased prevalence of insulin resistance, glucose intolerance, advanced growth/early maturity, hypertension, sleep apnea, and weight stigmatization[9–11] associated with obesity and

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being overweight during childhood. Further, these children are at greater risk for ill health persisting into adulthood.[12] Current estimates confirm that obesity is one of the nation's most serious childhood health problems.[2,3,13] As such, there is a need to examine obesity-related risk[14–17] and protective factors (e.g., behavioral, environmental, socioeconomic, and cultural) among urban children.

Pioneering work of urban planners like Jane Jacobs observed that the design of physical spaces can create a repelling or an inviting effect.[18] Using those findings, social scientists undertook empirical studies on neighborhood geography and its contribution to obesity and obesity-related disparities. For example, Franco et al.[19] examined associations between neighborhood income and differential availability of healthy foods. Using a "healthy food availability index" and 159 census tracts, it was found that predominantly African-American, lower-income neighborhoods have lower access to healthy, less energy-dense food options (e.g., fruits, vegetables, low-fat foods) because of the types and locations of stores compared with predominantly white, higher-income neighborhoods.[19] In a similar study by Morland et al.,[20] the authors provided additional evidence that making healthy dietary choices was difficult for people in lower-income communities because of the differential distribution of quality supermarkets and convenience stores by neighborhood wealth and racial segregation.

Other studies, using primarily adult samples, examined neighborhood physical and social surroundings and obesity outcomes. Research using the socioecologic model with adults noted associations between obesity and residential density, land use patterns,[21] poor terrain/sidewalk conditions, fewer community recreational outlets,[22,23] proximity to fast food restaurants,[24,25] and reduced access to supermarkets.[26] Further, indicators of neighborhood quality, safety, disorder, and perceptions of neighborhood conditions as stressful contributed to decreased healthy nutrition seeking and physical activity engagement[27,28] among adults,[29–36] affecting obesity. Yet, there are few analyses of the association between aspects of the built environment and childhood obesity in published peer-reviewed journals. This is especially true for studies including ethnic minority youth.

Existing studies using youth samples have found correlations between the availability of safe places to play,[37,38] carbohydrate-rich dietary intake,[39–41] increased caloric intake, hours spent watching television,[42,43] physical activity,[44,45] and childhood obesity. Molnar et al.[46] showed that an environment (including social disorder and neighborhood safety) can affect children's recreational involvement/physical activity and that unsafe neighborhoods may deprive children of time spent in outdoor play and increase their susceptibility for obesity.[46] Moreover, disadvantaged African-American and Hispanic youth fare worse than their majority white counterparts regarding their neighborhood's features (e.g., abandoned buildings, poor lighting, poorly maintained sidewalks, and fewer green spaces),[47] and this pattern of risk also correlates with gender, with the highest obesity rates found among girls.[48]

Despite these early findings, results do not consistently demonstrate an association between neighborhood safety and disorder and childhood obesity.[49–51] For example, in a study of the effects of neighborhood deprivation on strenuous exercise, Ross[52] found no association between neighborhood disadvantage and walking; however, high levels of walking in low-income neighborhoods are likely due to greater reliance on public transportation.[53] Further, schoolchildren in such neighborhoods are more likely to walk to school.[54] The conflicting results regarding neighborhood effects on childhood obesity prompted literature reviews to identify conceptual gaps and methodologic limitations. The use of cross-sectional study designs and compositional measures derived from U.S. Census data (e.g., aggregated data used to approximate certain neighborhood characteristics) limits conclusions derived from studies using these designs.[17] Additionally, the lack of theoretical foundations and understanding of interdependency among various built and social environmental variables was frequently identified as a limitation of existing studies.[55,56]

In more recent years, a new method called the Neighborhood Inventory for Environmental Typology (NIfETy) was devised to objectively measure physical and social disorder in a neighborhood. The NIfETy evaluates both positive and negative features of the social environment and neighborhood structures, with an emphasis on those that are malleable.[57,58] This study uses the NIfETy method to examine associations between 11 physical and social hazards and being overweight in a sample of urban, primarily African-American, elementary schoolchildren enrolled in an ongoing study.[59] This study also examined the interaction of gender and environmental determinants of being overweight, because evidence shows that these determinants affect girls differently.[3,4]

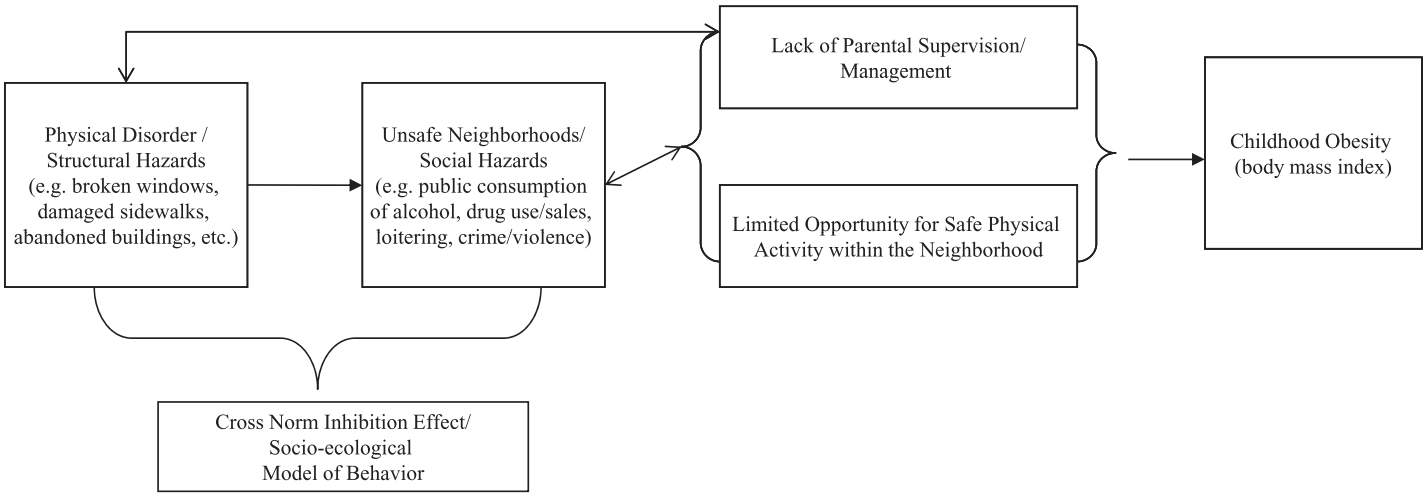
The conceptual model for the current study (Figure) is guided by the socioecologic model of behavior.[60,61] The socioecologic model of behavior holds that multiple contexts and elements in the environment are interrelated. Given that individuals and their behavior are nested within socioenvironmental influences, the socioecologic model of behavior in this conceptual model illustrates that neighborhood physical and social disorder hazards may restrict child residents' range of behavior (e.g., by limiting safe opportunities for physical activity), which in turn increases the risk of obesity and being overweight.

METHODS

Data Sources

Data from the baseline interviews of 313 schoolchildren enrolled in a longitudinal community-epidemiologic study called the Multiple Opportunities to Reach Excellence (MORE) Project were used for this analysis. Within the MORE Project, six schools were selected from the 55 Baltimore Community Statistical Areas; the Community Statistical Areas were ranked into three violence strata based on the number of homicides per 100,000 residents.[59] Within each stratum, the two schools with the largest enrollment of third through fifth grade students were recruited for participation. To be

Figure
Conceptual Model Linking Neighborhood Physical Disorder and Childhood Obesity



eligible for the MORE Project, students had to be ages 8 to 12 years, speak English, and live with an English-speaking parent/guardian. A total of 425 students consented to participate in this study. Most of the non–African-American portion of the sample (n = 49; 11%), self-reported their race as biracial or white. Participating schools were incentivized with honorariums, and students and parents received gift cards worth $5 to $25.

The MORE Project examined the impact of community violence exposure on the emotional, behavioral, and physical health of urban schoolchildren.[59] The assessment protocol included a battery of survey measures administered via computer-assisted interview.[59] Trained research assistants obtained measurements for height (inches), waist (inches), and weight (pounds) while participants were in lightweight clothing and bare feet, with their heads held in a horizontal position and their chins parallel to the floor.

Upon completion of the MORE Project interviews, independent raters made physical disorder observational assessments on the residential block faces of MORE participants, such as deteriorated landscapes (e.g., boarded abandoned buildings, broken windows, graffiti, and trash) and social disorder (e.g., loitering, drug sales, noise, and public drug/alcohol consumption) using the NIfETy Instrument.[57,58] NIfETy assessments were conducted by a pair of trained field raters. The NIfETy includes seven domains: (1) physical layout, (2) dwellings, (3) adult activity, (4) youth activity, (5) physical disorder, (6) social disorder, and (7) violence, alcohol, and other indicators. The NIfETy has good total scale reliability. The internal consistency reliability (ICC) is .84, and the violence, alcohol, and other drug (VAOD) subscale ICC is .71.[57] It has acceptable reliability across raters (ICC, .67–.79). Validity metrics are good as well; NIfETy indicators of VAOD exposure correlated strongly with local crime data.[58] More detailed information regarding the NIfETy instrument has been published.[57,58,62,63] The NIfETy and MORE data were collected during spring and summer 2007. All data collection was approved by the Johns Hopkins Bloomberg School of Public Health Institutional Review Board.

Measures

Outcome. Body mass index (BMI) was calculated according to the Centers for Disease Control and Prevention (CDC) BMI guidelines for children and adolescents.[64]

$$\text{BMI} = \left[\text{weight(lb)}/\text{height}^2\text{(in)}\right] \times 703$$

The resultant BMI value was plotted on a gender-specific growth chart, which reveals a percentile used to assess overweight and risk of obesity between childhood and adolescence.[64] The CDC's BMI-for-age percentile is classified into four categories: underweight (<5th percentile), normal weight (5th to <85th percentile), overweight (85th to <95th percentile), and obese (≥95th percentile). In this study, youth with underweight BMI values (n = 39) were excluded. Overweight and obese values were categorized as a single group. Overweight among children is defined as at or above the 85th percentile of BMI-for-age.

Control Variables. Demographic data, including children's self-reported race (African-American or non–African-American), gender, and age in years were included as control variables. Comparative time spent on a sport was obtained via responses to the question: "How much time do you spend on sport A." Responses were scored as "less than others" (=1), "average" (=2), and "more than average" (=3).

Independent Variables/Environmental Predictors of Being Overweight in Childhood. A total of 21 items were considered for use from the NIfETy.[65–67] Exploratory factor analysis techniques identified 11 items that consistently

loaded together: structures with broken windows, unboarded abandoned buildings, unmaintained property, trash in open spaces, broken bottles, graffiti, noise, people yelling, public alcohol consumption, drug paraphernalia, and discarded alcohol bottles. The presence or absence of these 11 items on each participant's residential block face (Cronbach $\alpha = .806$) was used to create a neighborhood disorder score, which ranged from 0 to 11 (mean, 5.38; SD, 2.89). To address the validity of the neighborhood disorder score, the score was regressed on self-reported neighborhood safety and the violence stratum based on the number of homicides per 100,000 residents. Neighborhood disorder among children living in the highest- and moderate-violence strata was statistically higher than children living in the lowest-violence strata (odds ratio [OR], 4.5; $p < .01$). Neighborhood safety was also associated with the neighborhood disorder score (OR, 1.72; $p < .01$).

Analysis

The analytic sample included 313 children. A total of 425 children were interviewed for the MORE Project; 406 children had valid height and weight data. Additionally, 43 children who were underweight were excluded, and 50 children were missing neighborhood data. The children with missing neighborhood and height/weight data were not statistically different from the children with complete data in terms of age, race, or gender. Logistic regression models were used to measure the association between neighborhood disorder on children's residential block face and overweight status. The data were analyzed using STATA 10.0 (Intercooled STATA 10.0, 2008; StataCorp, College Station, Texas). Generalized estimating equations were used to adjust for correlations among students attending the same school (resulting in six clusters). Male gender was used as the reference. Gender-specific estimates for each unit increase in odds of being overweight were obtained using the lincom command in STATA; the model also included an interaction term comparing girls to boys with the same disorder score. This postestimation technique enabled a test of gender as a modifier of the neighborhood disorder effect on being overweight among the children in the sample. All p values $<.05$ were considered statistically significant.

Table 1
Sample Statistics: Demographics Stratified by Gender*

Variable	Total No. (%) (N = 313)	Male, No. (%)	Female, No. (%)
Total	313	146 (46.6)	167 (53.4)
Normal weight	112 (35.8)	45 (30.8)	67 (40.1)
Overweight	201 (64.2)	101 (69.2)	100 (59.9)
African-American	271 (86.6)	128 (87.7)	143 (85.6)
Non–African-American	42 (13.4)		
Neighborhood disorder	—	5.35 (2.9)	5.41 (2.9)
Mean age, y (SD)	—	10.08 (1.04)	10.06 (1.07)
<AVG	—	26 (17.8)	52 (31.1)
AVG	—	48 (32.9)	45 (26.9)
>AVG	—	72 (49.3)	70 (41.9)

* Reference groups: male gender, African-American race, overweight; comparative time spent on sport (average [AVG]).

RESULTS

Descriptive Statistics

Table 1 presents the sample statistics and the bivariate correlates of being overweight. The sample mean age was 10 years (male age SD ± 1.04 years; female age SD ± 1.07 years). A total of 87% of the sample was African-American (n = 271), which is comparable to the ethnic composition of students in the Baltimore City Public School System.[68]

In the model, 53% of the sample was female (n = 167) and two thirds (n = 201) of the total 313 children had BMIs above normal (BMI-for-age percentile ≥85%) according to the CDC guidelines.[64] Overweight status and neighborhood disorder did not vary by gender (χ^2, $p > .10$).

Logistic Regression Results

Table 2 presents both the independent and adjusted odds for being overweight. In the model of independent effects, neighborhood disorder score showed a trend toward an association with being overweight (OR,

Table 2
Independent and Adjusted Effects of Covariates and Overweight vs. Normal Body Mass Index (BMI)*

	Logistic Regression			
	BMI: Overweight vs. Normal			
Variable	OR (CI)	p	AOR (CI)	p
Female	1.50 (1.18–1.92)	<0.01	2.42 (1.63–3.59)	<0.01
Non–African-American	1.12 (0.68–1.85)	0.65	1.12 (0.64–1.96)	0.69
Neighborhood disorder	1.03 (0.99–1.07)	0.07	1.09 (1.03–1.15)	<0.01
Female × disorder	—	—	2.40 (1.65–3.49)†	<0.01
Female × male	—	—	2.20 (1.57–3.11)‡	<0.01
Age, y	1.01 (0.72–1.42)	0.935	1.00 (0.72–1.39)	0.99
AVG	0.65 (0.41–1.02)	0.06	0.69 (0.43–1.09)	0.11
>AVG	0.81 (0.50–1.30)	0.38	0.84 (0.53–1.35)	0.47

* AOR indicates adjusted odds ratio; OR, odds ratio; AVG, average.
† Adjusted odds for girls being overweight.
‡ Adjusted odds for girls compared with boys with same neighborhood disorder score.

1.03; confidence interval [CI], .99–1.07; $p = .07$). Girls were 1.5 times more likely to be overweight (OR, 1.50; CI, 1.18–1.92; $p < .01$). No statistically significant associations were found between race, age, and overweight status.

The adjusted logistic regression model included race, comparative time spent on a sport, and age, as well as an interaction term comparing girls and boys with the same disorder score. In the adjusted model, the interactions (female × disorder and female × male) were statistically significant (Table 2). Postestimation commands were used in STATA to provide point estimates and standard errors. Among girls, the odds of being overweight increased 2.4 times for each unit increase in disorder on the block (adjusted odds ratio [AOR], 2.42; CI, 1.63–3.59; $p < .01$). A similar but weaker effect was seen among boys, with the odds of being overweight increasing 9% for each unit increase in disorder (AOR, 1.09; 1.03–1.15; $p < .01$). Relative to boys, girls living on disordered blocks were two times more likely to be overweight than their male counterparts when other factors were kept constant (AOR, 2.20; 1.57–3.11; $p < .01$). There were no race- or age-related variations noted in the model.

Subsidiary Analyses

To assess whether socioeconomic status had an impact on study findings, the effect of free and reduced-price lunch, reported by the teachers and participants and used here as a proxy for socioeconomic status, was examined among a subpopulation of youth with available data (n = 170; 54%). Free/reduced-price lunch status was not a significant predictor of being overweight (OR, 1.08; .61–1.92; $p = .79$). However, when free lunch status was added as a covariate to the adjusted model, the OR for neighborhood disorder increased (OR, 1.16; $p < .01$), as did the ORs from the linear combinations of neighborhood disorder and gender.

The proxy for physical activity (comparative time spent on a sport) was assessed as a potential mediator for the association between neighborhood disorder and being overweight. Although the trend (OR, 1.03; $p = .07$) toward an association between neighborhood disorder and risk for being overweight decreased with the addition of the physical activity variable (OR, 1.03; $p = .139$), no significant effect was noted.

DISCUSSION

This study investigated the association between urban neighborhood disorder and the risk of being overweight in childhood. Among urban schoolchildren, gender was associated with an increased likelihood of being overweight. An interaction term comparing girls with boys living in the same level of disorder was also associated with increases in overweight status in childhood, indicating that although urban male and female youth are affected by unhealthy weight status, urban neighborhood hazards may impact school-aged girls more than boys. Lastly, neither race nor comparative time spent on a sport was significantly associated with being overweight, after adjusting for demographic characteristics. The results of this study on children are similar to those in the extant adult literature, suggesting that neighborhood characteristics[14] and physical surroundings encourage obesity, obesity-generating behaviors,[15,16] such as sedentary lifestyle and unhealthy eating habits,[17] and poorer physical health status.[23,27,69,70]

Evidence from this and other studies tends to support the notion that disorder at the neighborhood level may affect obesity by keeping residents indoors. The lack of significant race effects is not surprising given the work of Powell et al.[37] Evidence from their work suggests that the reduced availability of physical activity settings in ethnic minority and socioeconomically disadvantaged communities is the likely culprit for higher weight and lower physical activity among this population. Similarly, the finding of an association between gender and being overweight is consistent with the literature.[1] Between 1999 and 2004, African-American and Hispanic female children and adolescents were significantly more likely to be overweight compared with their white counterparts.[1]

The results of this study should be interpreted in view of its limitations. There are exogenous variables potentially related to obesity and neighborhood disorder that were not available for study, including a dietary intake measure. In addition, we did not quantitatively measure physical activity because of a lack of available metrics. Future studies should use a more robust and empirically validated measure for physical activity. Also, data on parental or familial history of obesity were not available and may have strengthened the study. Lastly, this is a cross-sectional study. Longitudinal prospective studies are needed to evaluate the association of neighborhood characteristics, gender, and weight over time.

CONCLUSION

A major criticism of prior research was the degree to which aggregated individual compositional measures limited the investigation of causal links between specific neighborhood features and health outcomes.[71] The current study used an objective measure of neighborhood features, the NIfETy, which enabled a more direct exploration of environmental triggers for being overweight in childhood. Additionally, this work suggests measures for intervention. Intervention designs may benefit from the inclusion of family, school, and/or community involvement in efforts to increase active-recreational orientation for urban youth, particularly those that are gender specific, given that girls' and boys' obesity risk profiles (defined as the social, cultural, and environmental factors influencing obesity for children) differ. Further, strategies might also include increasing the development of safe neighborhood structures that support gender-specific physical activity. In addition, addressing neighborhood-based obesogenic risks in urban communities (e.g., revitalization projects to improve neighborhood quality and reduce crime) may lead to a more health-promoting environment. Finally, the Child Nutrition Act and campaigns such as the "Let's Move" Initiative must include the importance of neighborhood factors associated with the development and remediation of obesity.

Although this study represents a first exploration, further research is warranted. Obesity and overweight status among urban, ethnic minority children is likely related to neighborhood socioeconomic status, neighborhood disorder, and the availability of safe physical activity settings. Accordingly, efforts to avert, suspend, and reverse this alarming trend may be more effective if culturally and ecologically relevant, long-term, and gender-specific interventions were employed at the individual, family, school, and/or community levels.

SO WHAT? Implications for Health Promotion Practitioners and Researchers

What is already known on this topic?

There is a growing body of research documenting associations between physical and social factors in the environment and increased risk of obesity.

What does this article add?

The current investigation adds to existing literature by providing preliminary evidence, via objective neighborhood assessment, that links the interaction between living in a distressed neighborhood (e.g., crime, violence, substance sales/use) and gender to the overweight status of urban youth.

What are the implications for health promotion practice and research?

The use of tools like the NIfETy instrument can expand health promotion and research efforts by providing appropriate methodology for taking the impact of ecologic settings (e.g., neighborhood-level disadvantage) into account when studying obesity in childhood.

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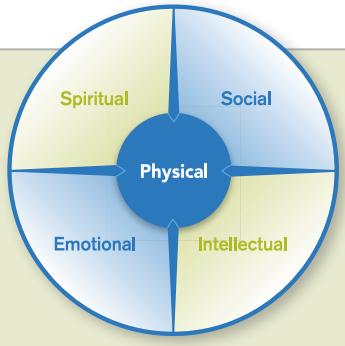

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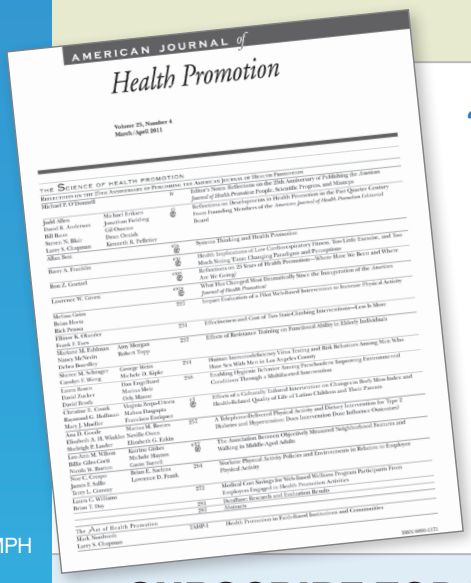
(O'Donnell, American Journal of Health Promotion, 2009, 24,1,iv)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