Research Article

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Furthering the Understanding of the Relationship between Early Learning Environments and Obesity: Next Steps in Preventing Childhood Obesity

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Abstract

Despite efforts and policies to increase physical activity and improve the health of children, childhood obesity remains a prevailing issue with long-term health consequences. The role of early childhood education environments has been shown to be both protective as well as a contributor to obesity. Therefore, the current study aimed to examine the relationship between preschool attendance and obesity. Participants included 4,385 children entering kindergarten in 2014, 2015, and 2016 whose parents submitted a health status survey. A multinomial regression determined that children were at a decreased risk of obesity if they attended a center-based or home-based program compared to children who stayed at home. The number of hours of attendance in a preschool setting was not significantly associated with childhood obesity. Results also revealed that children belonging to a racial minority group, with the exception of Asian/Pacific Islanders, were more likely to be obese as compared to children identified as white. Children living in poverty were also more likely to be obese relative to children not in poverty. Implications for prevention and intervention strategies to address these findings are discussed.

Keywords: Childhood obesity, Early childhood education, Racial disparities, Poverty, Kindergarten, At-risk populations, Public health

Abbreviations: AIC: Akaike Information Criteria; BMI: Body Mass Index; CI: Confidence Interval; FFNs: Family, Friends or Neighbours; NHES: National Household Education Surveys; NICRP: Nevada Institute for Children's Research and Policy; OR: Odds Ratio; PASW: Predictive Analytics Software Statistics; WIC: Women Infants and Children

Introduction

The Centers for Diseases and Prevention (CDC) [1] have estimated that over 12 million children in the United States, ages 2-19 years old, are obese. While the national prevalence of childhood obesity was thought to have plateaued in recent years, it has increased to impact 18.5% of youth as of 2016 [2]. Equally alarming are the health problems associated with childhood obesity. The CDC [3] has attributed an array of physical health problems to children who are obese, including hypertension, type II diabetes, coronary heart disease, stroke, sleep apnea, respiratory disease, and some cancers; childhood obesity can also take a debilitating toll on a child's mental health causing feelings of shame, self-blame, and low self-esteem [4]. Consequently, obesity contributes to approximately 112,000 preventable deaths each year [5]. Decreasing the prevalence of obesity has become a top priority to preserve the mental and physical welfare of our children.

Many medical providers believe the most effective opportunities for obesity prevention lie in early childhood [6]. Past investigations have demonstrated that establishing a well-balanced diet early in life is essential for good health later in life and children who are overweight during their preschool years are more likely to continue to be overweight or become obese as they get older [7]. Since children use this time to develop eating patterns and behaviors that will carry into adulthood, it is important to assess for associations that influence eating behaviors in order to develop effective obesity prevention strategies.

A socioecological framework was developed by Story, Kaphingst, Robinson-O'Brien, and Glanz [8] that illustrates the complexity of diet and behavior choices. The framework proposes that children make these choices based largely on their individual cognitive, lifestyle, and knowledge factors. However, those variables are largely shaped by the child's social environment, which accounts for role modelling and the development of social norms, as well as the child's physical environment that controls his/her access to food and opportunities for physical activity at home and elsewhere. Lastly, the framework identifies additional influences within children's macro-environment, which accounts for legislation and policies, agricultural activity, and urban living, that regulate their social and physical settings.

Potential risk factors that may predispose children to obesity can also be accounted for when studying the moderators from the socioecological framework. For example, cultural attitudes that heavier children are healthier, which are sometimes held among Latino and Black populations, put these ethnic groups at a higher risk for obesity [9,10]. Socioeconomic disparities among minority groups also account for this predisposition. For instance, being of low-income is a risk factor for childhood obesity across all ethnicities since income regulates children's access to healthy foods as well as their options for physical activity [11]. In addition, families with lower incomes may have added stressors that take precedence over ensuring children attain a well-balanced diet and/or an appropriate amount of daily physical activity [12].

Many obesity prevention strategies have incorporated the concepts outlined by the socioecological framework as well as the resulting risk factors, yet the prevalence of obesity continues to rise. Therefore, more successful interventions to decrease such rates may include identifying potential protective influences against obesity and utilizing them as platforms to build more effective strategies. One area to explore is the influence of early childhood care settings on preschool-aged children. Since the 1950's there has been a drastic shift in the percentage of children who are spending time in non-parental child care settings [13]. Results from the 2005 National Household Education Surveys (NHES) Early Childhood Program Participation Survey revealed that approximately 60% of children under five spend almost 30 hours per week in some form of childcare setting [14]. With more children spending time in non-parental care settings than ever before, it is important to understand how preschool environments relate to obesity rates.

Impacts of early care setting on obesity in children

Some research studies have identified early childhood programs as a protective factor against obesity. For example, Koleilat et al. [15] sought to examine the impact of preschool attendance on three and four year old children and ascertained that children who attended more than four days per week of preschool or nursery school had lower rates of obesity than those who did not attend as often. However, these results may not be applicable to all children as 68% of the sample used Head Start programs, which are only available to low-income families. Additionally, only children who participated in the Special Supplemental Nutrition Program for Women Infants and Children (WIC) in Los Angeles County were invited to participate and nearly 96% of the 556 children sampled were Hispanic.

Frisvold and Lumeng [16] specifically examined differences in Body Mass Index (BMI) for children attending a full day versus a half day Head Start program. Researchers gathered BMI scores for 1532 children attending full-day (327 attendees) and half-day (1205 attendees) programs at the beginning and ending of each school year from 2001-2002 to 2005-2006. By the end of each year, results indicate that there was a greater decline in obesity for children in the full day program, on average by 5%, while the half-day attendees observed an average decline of 1%.

In addition to the studies conducted in primarily low-income populations, other studies have found preschool attendance to be associated with a decrease in childhood obesity when looking at a broader sample of children. For example, Flores and Lin [17] found associations in children who attended a center-based care (including early-learning centers, nursery schools, and preschools)

on a regular basis were three times less likely to be severely obese in kindergarten. Likewise, Lumeng, Gannon, Appugliese, Cabral, and Zuckerman [18] utilized data from a longitudinal survey that began in 1997, the Panel Study of Income Dynamics Child Development Supplement, to understand the relationship between the amount of time spent in center-based care (defined as "family day care provider," Head Start program, prekindergarten program, preschool, or child care center) and the prospect of becoming overweight at a later age. From the sample of 1244 children, Lumeng and colleagues contend that children who attended up to 15 hours per week of center-based care from age three to five years old had a decreased risk of being overweight at age six years to 12 years old; however, this protective factor was eliminated for children who attended more than 15 hours of center-based care.

The findings of Frisvold and Lumeng [16], Flores and Lin [17], and Lumeng et al. [18] suggest that, while the type of preschools attended may influence the rates of children considered obese, the amount of time spent in preschool settings could also influence such rates. Understanding these relationships may help explain why some investigations conflict with those previously discussed. For example, in 2010, McGrady, Mitchell, Theodore, Serison, and Holtzapple [6] utilized a kindergarten-readiness database to obtain height and weight measurements for 2,414 kindergarteners and calculated their BMI scores. They maintain that attending public preschool put kindergarteners at a higher risk of being overweight and obese. A more recent study, conducted by Isong, Richmond, Kawachi, & Avendano [19], evaluated over 10,000 nationally representative data points on children followed from age nine months through kindergarten and found no consistent relationship between center care and obesity. Finally, a review article examining 17 studies on childcare type and weight outcomes provided no clearer answers with study findings showing various relationships - four studies indicated no correlations between preschool type and obesity while ten others showed mixed findings [20]. Only four of the studies reviewed found directional relationships including both positive and inverse relationships. Given the mixed results of previous findings, the purpose of this study was to provide additional research evaluating the association of preschool attendance and obesity in kindergartners, by specifically examining the impact of type of childcare and hours of care on obesity.

Methods

Study design

This study utilized existing data collected from the Nevada Kindergarten Health Survey (NKHS), a health assessment conducted by the Nevada Institute for Children's Research and Policy (NICRP) in conjunction with the Nevada Division of Behavioral and Mental Health, all 17 school districts in Nevada, as well as many community partners working to improve children's health outcomes. The NKHS has been disseminated at the beginning of each school year since fall of 2008. Kindergarten teachers are asked to distribute the survey to the parents of children who have entered kindergarten across the state of Nevada. The NKHS is a one-page survey, that contains approximately 30 questions related to the health and well-being of the child entering kindergarten. The survey is available in English and Spanish. The overarching goal of the assessment is to quantify the health status of children as they enter the public school system in Nevada, identify specific areas for improvement to help increase academic success, and provide local information to policymakers to guide decisions that impact children's health. Once parents complete the survey, they can either turn it in to their child's kindergarten teacher or mail the survey directly to the NICRP. Completion of this survey is completely voluntary and does not require the inclusion of any identifying information. This study received approval from the Institutional Review Board.

Data utilized in this study were collected from parents of children entering kindergarten in Nevada during fall of 2014, 2015, and 2016. The average state wide response rate for each of the three years is 28.3%. From this data set (n = 18,596), 7,036 (37%) included BMI data and 4,385 surveys contained complete data for all study variables. Chi square analyses were run to evaluate the difference between response groups. In the original data set (n = 18,596) significant differences were found between those that did and did not have BMI data. Respondents that did not have BMI data were more likely to have a lower income, more likely to have their child stay at home the year before kindergarten, and more likely to be Hispanic. In comparing the sample that had BMI data (n = 7,036) with the analytic sample (n = 4,385), no significant differences were found on the variables utilized in the study.

Study variables

BMI category was used as the dependent variable in this study. The BMI categories utilized in this study

(healthy weight, overweight, and obese) were established based on the Centers for Disease Control and Prevention (n.d.) BMI charts [23]. The independent variables included preschool attendance type, number of hours per week attending preschool, race, and poverty as the independent variables. The BMI categories of healthy weight, overweight, or obese was assigned based on the child's BMI score which was calculated from age, weight, height, and gender information collected on the survey [21]. Because these variables are all self-reported by the individual completing the survey, several strict inclusion guidelines were implemented on each variable used to calculate BMI to increase validity. First, the child's age had to be between 4 and 6 years, as it is unlikely kindergartners would be outside of this age range. Second, the child's height had to be below the 95% interval for their age and gender [22]. Finally, the weight of the child had to be less than 200 pounds. We did not use growth charts to set guidelines for weight. However, there were a few reports of children with a weight over 200 pounds and the research team determined that this extremity would be highly unlikely and excluded these cases.

Preschool type was measured by asking parents to indicate which preschool type their child had attended within the last 12 months prior to the start of kindergarten. Parents could select None, Family/Friends/Neighbor Care, Home-based Preschool, School District Preschool, University Preschool, Head Start, or Other Facility. For the purpose of this study, the categories of none and Family/Friends/Neighbor Care were collapsed into one category indicating no formal care. In addition, the University Preschool category was not large enough to remain independent and was combined with Other Facility/Center as it is a private childcare center. Hours of preschool attendance was measured by asking parents to select the average number of hours per week that their child attended preschool. The options given were none, 5-10 hours, 11-15 hours, 16-20 hours, 21-30 hours, 31-40 hours, or 40 or more hours. However, since past research has suggested that preschool attendance might only serve as a protective factor for children attending up to 15 hours per week [15,16], the responses were regrouped into three categories: none, less than 15 hours, and more than 15 hours. The poverty variable was calculated based on two variables from the survey, number of adults and children living in the household, and annual household income. Since income was initially measured utilizing categories, the average from each category was assigned in order to determine if the family either met or did not meet the 2017 poverty guidelines

for the 48 Contiguous States and the District of Columbia [24]. Finally the race of the child, which was reported by the individual completing the survey, resulted in the following categories for analysis: African American/Black, Asian/Pacific Islander, Caucasian/White, Hispanic/Latino, and Other.

Statistics

All analyses were conducted utilizing IBM SPSS version 24 [25]. A multinomial regression was used to examine which independent variables were associated with each weight category for children entering kindergarten. The initial model included BMI category as the dependent variable with healthy weight as the reference group, and the following independent variables: preschool attendance (no attendance as the reference), hours of preschool attendance (zero hours as the reference), race (Caucasian as the reference), and poverty (Above poverty as the reference). Potential multicollinearity was examined using the Variance Inflation Factor (VIF); all VIFs were under three, indicating that multicollinearilty was highly unlikely [26].

Backwards elimination was used to obtain a model that contained only variables significant at the .05 level. Only one variable, number of hours of preschool attendance per week, was not a significantly associated with weight and therefore not included in the final model. Additionally, an examination of the classification table indicated that all children in the overweight categories were being classified as healthy weight. Given that the model could not differentiate between these two groups, the final model included only two BMI categories of healthy weight and obese, with healthy weight remaining as the reference group. In the final model, the classification table provided a higher rate of reclassification (72.2% versus 62.9% in Model 1) and an examination of Akaike information criteria (AIC) confirmed that the final model (AIC = 246.49) had a better fit to the data than the first model (Model 1 AIC = 668.10). Additionally, the distribution of the values within each variable, and the overall results, remained consistent in the final model.

Results

Descriptive statistics are reported for the sample of 4,385 kindergarten students by weight status in Table 1. The final model included preschool type ($\chi^2(4) = 30.52$, P <.01), poverty ($\chi^2(1) = 18.82$, P <.01), and race ($\chi^2(4) = 74.57$, P <.01) which were significant contributors of obesity (Table 2).

Table 1: Sociodemographic characteristics of the sample population by weight status (n=4,385).

		Total %	Healthy Weight %	Overweight %	Obese %
		100	62.6	13	24.5
Gender	Male	50.5	61	10.7	28.3
	Female	49.5	64.2	15.1	20.7
Race	African American	2.9	46.5	11	42.5
	Asian / Pacific Islander	4.1	59.1	16	24.9
	Caucasian	58.6	68.9	12.5	18.6
	Hispanic / Latino	17.2	48.9	14.7	36.5
	Other	17.6	58.4	12.1	29.5
Income	At or Below Federal Poverty	22.8	51.8	12.4	35.8
	Above Federal Poverty	77.2	65.8	13	21.2
County	Clark County	44.1	62.1	12.4	25.5
	Washoe County	29.1	64.2	13.2	22.6
	Rural County	26.8	61.7	13.3	25
Preschool Type	None/Friends, Family, Neighborhood Care	29.7	57.6	12.7	29.7
	Home-Based	5.1	73.8	11.6	14.7
	School District Pre-School	23.4	58.8	13	28.2
	Head Start	5.7	51.8	13.1	35.1
	Other Facility/Center	36.1	69.3	13.2	17.6
Preschool Hours	Zero	29.7	57.6	12.7	29.7
	15 Hoursor Less	33.4	66.1	12.1	21.9
	More than 15 Hours	36.9	63.5	13.8	22.8

Table 2: Logistic regression analysis examining factors associated with obesity at kindergarten entry.

	B	Wald	Exp(B)	95% Confidence Interval (Lower Bound – Upper Bound)
Attendance Type (Reference: Stayed at home or Family Friends or Neighbor)				
Other Center/Facility	-0.46	22.24**	0.63	0.52 - 0.77
Home Based/Family Child Care	-0.62	9.22*	0.54	0.36 - 0.80
School District Preschool	-0.1	1.1	0.9	0.75 - 1.09
Head Start	0.08	0.29	1.09	0.80 – 1.48
Race (Reference: Caucasian)				
African American	0.99	24.88**	2.71	1.82 - 4.00
Asian Pacific Islander	0.34	3.27	1.4	0.97 - 2.02
Hispanic	0.75	54.45**	2.1	1.73 – 2.57
Other	0.5	25.33**	1.65	1.36 - 2.00
Poverty (Reference: Above Federal Poverty)				
At or Below Federal Poverty	0.39	19.06**	1.48	1.24 - 1.80

Note: Healthy weight is the reference category. *p < .01. **p < .001.

Relative to children who stayed home or with family, friends, or neighbors, children who attended a center or facility, or attended home-based preschool were less likely to be obese and more likely to be in the healthy weight category. No significant associations were found for children who attended a school district preschool or Head Start program. With regard to race, relative to children who were identified as Caucasian/White, children who were identified as African American/Black, Hispanic/Latino(a), and Other races were more likely to be obese than a healthy weight. However, significant results were not found for children identified as Asian/Pacific Islander. Finally, children who met the federal guidelines for poverty were more likely to be obese than a healthy weight relative to children who did not meet the poverty guidelines.

Discussion and Conclusion

Previous studies examining the relationship between type and amount of preschool attendance and childhood obesity have resulted in mixed outcomes [20]. The purpose of the current study was to contribute to the existing body of literature to help determine if preschool attendance, or lack thereof, is associated with obesity based on type and hours of attendance in a state wide sample of children entering kindergarten. Overall, this study found that children who attended center based preschool, outside of head start or district preschool, or home based preschool were less likely to be obese. In addition, our findings do not support data indicating a certain number of hours may serve as a protective factor. Finally, this study also supports existing research which indicates that poverty status and race are significantly associated with obesity [9-12].

This study examined several different early learning settings to determine if some settings were better associated with a healthy weight. Relative to children who stayed home or were with family, friends, or neighbors (FFNs), children who attended center based care or attended home-based care were less likely to be obese. However, school district preschool and Head Start programs were not found to be associated with weight status. With regards to hours of attendance in a care setting, this finding is contrary to some of the existing research [15,18,31], which has indicated that number of hours is both a protective [15,18] and a risk factor [31]. A lack of consistency in findings could be due to the variety of factors assessed in each study along with varying definitions of hours and types of care [20].

Children who were identified as African American/Black, Hispanic/Latino (a), and Other races were all more likely to be obese than a healthy weight relative to children who were identified as Caucasian/White. These findings are consistent with prior studies that have demonstrated that there is a relationship between race and obesity in early childhood [27,28,29]. Additionally, children who met the federal guidelines for poverty were more likely to be obese relative to children who did not meet the poverty guidelines, which is consistent with other studies further elucidating the persistent and pervasive health inequities among minority and low income communities and the need to develop programs and interventions to address the increasing prevalence of obesity.

Research conducted by Weden et al. [29], indicated that that reducing racial disparities in early childhood obesity could occur by promoting policies and practices and increase breastfeeding within the first 7 months, as well as reducing the need for parents to rely on care provided by relatives or in homes. Additionally, addressing generational trauma could be another method to reduce childhood obesity, especially in African American and Native American populations. In a study condcuted by Jones et al. [30], childhood obesity was presistent in these two racial groups despite other socio-economic factors which was not found in other racial groups. Increases in obesity in this population are often attributed to parental education, decreased access to healthy food, and safe physical activity [11], however, a higher income alone may not enough to overcome the physical and mental health impacts from experiences of racism and discrimination [30].

There are a few limitations of this study that should be considered. First, the data presented are correlational in nature and therefore cannot be used to determine causal relationships. Second, all information regarding children were gathered from self-report surveys voluntarily completed by parents of children entering kindergarten so there may be something inherently different about those that returned the survey compare to those that did not. Furthermore, information provided on the survey may be inaccurate due to recall bias or acquiescing to the response thought to be more desirable. Additionally, surveys containing information to calculate BMI represent approximately 30 percent of surveys returned each year and compared to all surveys returned, there are slightly less data available for African American and Hispanic children, and children from lower income households. This may limit the generalizability of the findings.

This study contributes to the current literature by further exploring the complex nature of the contributors to obesity in early childhood while addressing some limitations of other studies such as the inclusion of time spent in preschool environments and specific types of preschools attended in a sample that is racially and economically diverse. Reducing childhood obesity will take significant investments in prevention and intervention programs that target both family dynamics as well as early care and educational environments [31]. Results from the current study suggest that some types of early learning experiences, such as center based care and home based care, might serve as a protective factor for obesity regardless of the number of hours in care. In order to advance our understanding of the relationship between obesity and early learning environments, future research should include a closer examination of specific elements of early learning environments, such as nutrition education provided to children and families, nutritional value of available food in family and early learning environments, as well as aspects of active play and physical activity. It was hypothesized in previous studies that preschool attendance could be protective due to nutrition and physical activity guidelines set by the facility, especially in more regulated care such as Head Start facilities, as well as nutrition education that would be sent home with parents [15]. It would be beneficial for future research to capture specific nutrition and physical activity information about programs children attend in order to better understand the relationship between hours of attendance and obesity. With a growing number of states implementing quality rating improvement systems, many of which track information related to nutrition and physical activity, a more detailed examination of factors that influence this relationship may be more feasible. These additional components will increase confidence in specifically what manner early learning settings impact obesity in young children which can more accurately guide prevention and intervention efforts [20].

Declarations

Ethics approval and consent to participate

All research done in this study was in accordance with the International Review Board ethics guide under the state of Nevada.

Consent for publication

Authors consent to publish this article upon agreement of the final material.

Availability of data and material

All data and material and available for review upon request

Competing interests

The contents of this manuscript have not been copyrighted or published previously and are not now under consideration for publication elsewhere. The contents of this manuscript will not be copyrighted, submitted, or published elsewhere, while acceptance by the Journal is under consideration. Accordingly, there are no directly related manuscripts or abstracts, published or unpublished, by any authors of this paper.

Authors' contributions

All authors of this research paper have directly participated in the design, execution, or analysis of this study and all authors of this paper have contributed to, read and approved the final version submitted.

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