Key Assignment 1

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RES 2700: Statistics

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Abstract

Childhood obesity and the consequences of its development, including the presentation of adult cardiovascular disease, present a considerable burden to the healthcare system and a considerable danger to the well being and mortality to those afflicted by its development.

Behaviorally-focused educational interventions present a potential opportunity to reduce the incidence of childhood obesity. Researchers have identified associations between levels of parental stress, parental education, and the development of childhood obesity. This study seeks to further investigate the relationships between parental stress, parental education, and childhood obesity.

Keywords: childhood obesity, cardiovascular disease, educational interventions, parental stress, parental education

Preventable lifestyle-based diseases represent one of the most opportune points of impact within modern allopathic healthcare. Among the most prevalent of this class of diseases is cardiovascular disease, the consequences of which have been estimated to result in over 50% of all global non-communicative disease deaths worldwide (Ajala et al., 2017). Attempting to discover what drives the development of cardiovascular diseases as well as what can be utilized to reduce the impact of these diseases has understandably developed into an important area of ongoing research (McPhee et al., 2020). One of the most prominent subsets of this research comes in the form of investigations into the relationship between childhood obesity and the development of cardiovascular disease, which is expected to contribute to 100,000 additional cases of adult coronary heart disease by 2035 in the United States alone (McPhee et al., 2020).

Childhood obesity has been a topic of focus for cardiovascular disease researchers since observing increasing rates of childhood obesity in the 1970s, and decades of research have resulted in the discovery of profound impacts on a range of topics relating to childhood health, developmental outcomes, and the generation of adult cardiovascular disease (Franks et al., 2010; Kumar & Kelly, 2017; McPhee et al., 2020; Muthuri et al., 2016; Shankardass et al., 2014; Umer et al., 2017). Childhood has been recognized as a crucial developmental period in which cognitive biosocial programming and development often leads to the creation of health-focused habits which are carried into adulthood (Shankardass et al., 2014). Researchers have found that the issues that develop as a result of childhood obesity are often carried into adulthood, with one-third of obese preschool children and one-half of obese school-aged children aging into adults with obesity challenges (Cullinan & Cawley, 2017). Adult obesity has been recognized as a key contributing factor to the development of type 2 diabetes, various types of cancer, nonalcoholic fatty liver disease, obstructive sleep apnea, and a range of cardiovascular diseases

including hypertension, dyslipidemia, and atherosclerosis, leading to an increased mortality rate and contributing a considerable burden to healthcare systems and the economies which support them (Cullinan & Cawley, 2017; Jang et al., 2019; Kumar & Kelly, 2017; McPhee et al., 2020).

The growing widespread recognition of the impact childhood obesity has on the expression of cardiovascular disease in adulthood has led researchers to seek a more complete understanding of which particular facets might offer the greatest opportunities to create impactful change (Turer et al., 2018). In an editorial, Turer et al. (2018) discussed the relationships between obesity, hypertension, and dyslipidemia in children and concluded that practitioner unfamiliarity with evolving childhood dyslipidemia and hypertension guidelines and complex diagnostic testing thresholds has led to potential underidentification of these issues within the childhood population. As an example, Turer et al. (2018) disclosed the complexities practitioners face with diagnosing childhood hypertension, which requires hypertension be detected at three independent visits, a process which is challenged by children's continual growth and development requiring the practitioner to reference a threshold that is percentile-based and evaluates the child's height and weight at the time of each data collection point.

Consequently, obesity has been identified as the easiest of the three cardiovascular disease risk factors to identify while also the most difficult to longitudinally improve (Turer et al., 2018). However, the social and emotional impacts that childhood obesity presents can continually thwart the identification and improvement of childhood obesity, with healthcare practitioners experiencing a dearth of training on how to properly navigate the shame and judgment often felt or encountered in emotionally-charged conversations around unhealthy weight with parents (Turer et al., 2018). Finally, well-educated parents with obesity have

demonstrated a decreased propensity for objectively gauging their child's obesity, a finding researchers posit being driven by a social desirability bias (Cullinan & Cawley, 2017).

Despite these identification challenges, researchers have discovered the existence of strong associations between childhood obesity, hypertension, and glucose intolerance and an increased probability of premature death, with a doubling of premature death from endogenous causes existing between the lowest and highest BMI quartiles of children studied (Bjerregaard et al., 2020; Franks et al., 2010; McPhee et al., 2020; Umer et al., 2017). As the evidence to confirm the existence of these relationships has grown so too has the recognition for the development of parental capacity for identification and acceptance of childhood obesity as a critical prerequisite to implementation of efficacious interventions (Cullinan & Cawley, 2017). One such group of interventions focuses on stemming the growth of childhood obesity through family-based educational initiatives designed to promote health-forward behavioral habits (Kumar & Kelly, 2017; McPhee et al., 2020; Shankardass et al., 2014).

Kumar & Kelly (2017) stated that family-based behavioral lifestyle interventions which focus on improving dietary habits and increasing physical activity serve as a foundation component of reducing the growth of childhood obesity, though research into these interventions has provided mixed results. Further studies have demonstrated that multifaceted, behaviorally-focused, family-based educational interventions help to reduce parental stress and efficaciously reduce childhood obesity rates (McPhee et al., 2020; Shankardass et al., 2014), However, in a literature review spanning 22 years of research, Kumar & Kelly (2017) shared evidence which suggested that these interventions only resulted in a moderate effect on weight loss, with lower efficacy rates present in children with high obesity levels.

Given the existing uncertainty on the efficacy of educational interventions and the steep impact of childhood obesity and adult cardiovascular disease on wellbeing, mortality, and socioeconomic cost, developing a deeper understanding of what is driving the continued global increase of childhood obesity rates presents a continued importance for researchers seeking to reduce this uncertainty and improve the efficacy of educational initiatives to reduce the incidence of childhood obesity (Bjerregaard et al., 2020; McPhee et al., 2020; Muthuri et al., 2016), Ongoing research efforts have presented two predominant themes which influence the development of childhood obesity in the form of parental education and parental stress, with these themes further often complicated by parental socioeconomic status (Assari, 2018; Cullinan & Cawley, 2017; Jang et al., 2019; Kumar & Kelly, 2017; Lamerz et al., 2005; Muthuri et al., 2016; Shankardass et al., 2014).

Ongoing research efforts have uncovered a myriad of relationships between parental education and childhood obesity rates (Cullinan & Cawley, 2017; Lamerz et al., 2005; Muthuri et al., 2016)**.** Parental gender and socioeconomic status (SES) has been discovered as thematic factors which alter childhood obesity rates, with a stronger relationship demonstrated between maternal obesity rates and childhood obesity as compared to paternal obesity rates and paternal education displaying a more profound impact on lowering rates of childhood obesity than material education levels in countries with high levels of socioeconomic status (Lamerz et al., 2005; Muthuri et al., 2016). Additionally, Muthuri et al. (2016) found that lower rates of material education are related to higher levels of childhood obesity in lower socioeconomic status countries. This is further complicated by parental obesity levels; Cullinan and Cawley (2017) discovered that amongst high education levels non-obese parents are more likely to recognize and accept their children's obesity levels. However, well-educated obese parents are

over 45% more likely to misidentify their child's obesity level as compared to obese parents with lower education levels (Cullinan & Cawley, 2017). This evidence lends support to the theory that parental SES can play a significant role in the levels of parental stress experience and the impact this stress has on the development of childhood obesity (Assari, 2018; Lamerz et al., 2005).

Evidence of a positive relationship exists between both parental general stress and parental role stress and the rates of obesity in children under 10 years of age, with body mass index measurements taken at age 10 being linked to an increased propensity for higher than average increases in body mass index trailing through adolescence (Jang et al., 2019; Shankardass et al., 2014). A further relationship was discovered in a cross-sectional study that links parental obesity and the manner in which it influences the link between parental stress and childhood obesity development, with parental stress in obese parents possessing links to childhood obesity development that is not present in parents of normal weight (Jang et al., 2019). Finally, relationships have been demonstrated between parental stress levels and both childhood eating behaviors and the development of childhood obesity (Kumar & Kelly, 2017).

The American Heart Association (AHA) researchers' purpose for this study was to examine the relationships which exist between levels of parental education and stress, comparing childhood weight differences to an identified median of an ideal weight range, known as d_{MEAN}, as an outcome variable for childhood obesity. Researchers then stratified participants by years of education into four strata, low (less than 12), average (12 to 14 years), moderately high (15 to 16 years) and very high (greater than 16 years), with participants who engaged in more than four years of undergraduate study being included with the moderately high strata to maintain operational consistency. Parental stress was examined utilizing Cohen et al.'s (1994) Perceived

Stress Scale (PSS), which measures perceived general stress on a 10-item survey which utilizes Likert-type subjective rating scale ranging from 0 to 4 (Cohen et al., 1994).

Methods

Participants

Descriptive demographic statistics for parental stress, parental education levels, gender, and ethnicity are located in tables 1a - 1d, respectively. Means and standard deviations for dMEAN and participant age are presented in table 1e. Several outliers were found to exist within the dMEAN and participant age data sets. Exploratory data analysis conducted with SPSS revealed one data outlier above the expected participant age range, participant 331, with an age of 19.67, while also revealing four participants to have ages below the expected range. These participants, subjects 314, 344, 184, and 36 had ages of 8.03, 7.63, 7.11, and 7.80. Analysis revealed that participant 118 served as an outlier for the independent dMEAN variable for both parental education and parental stress, with an above-expectation dMEAN score of 16.07. while participant 333 was revealed to have a below-expectation score of -3.42.

Table 1a. Parental Stress

	Frequency	Percent
Low (0-12)	93	23.3
Mod (13 - 25)	226	56.6
High (26 - 40)	80	20.1
Total	399	100

Table 1b. Parental Education Levels

	Frequency	Percent
Low (<12y)	139	34.8
Avg (12-14y)	118	29.6
Mod High (15-16y)	79	19.8

Very High (>16y)	63	15.8
Total	399	100

Table 1c. Gender

	Frequency	Percent
Female	185	46.4
Male	211	52.9
Transgender/ Non-Conf.	3	0.8
Total	399	100

Table 1d. Ethnicity

	Frequency	Percent
Asian/Pac.Is.	57	14.3
Lat./Hisp.	61	15.3
Eur./Cauc.	221	55.4
African/Carribean	51	12.8
Native American	9	2.3
Total	399	100

Table 1e. dMEAN and Participant Age

	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance
dMEAN	399.00	19.48	-3.42	16.07	5.74	3.21	10.32
Age	399.00	12.56	7.11	19.67	13.75	2.11	4.44

Hypothesis

The hypotheses under examination include:

Parental Stress and dMEAN

H_o: No effect is present between parental stress and childhood dMEAN scores.

H_a: An effect is present between parental stress and childhood dMEAN scores.

Parental Education and dMEAN

H_o: No effect is present between parental education and childhood dMEAN scores.

H_a: An effect is present between parental education and childhood dMEAN scores.

Interaction Effects Between Parental Stress, Parental Education, and dMEAN

H_o: No interaction effect is present between parental stress, parental education, and dMEAN scores.

H_a: An interaction effect is present between parental stress, parental education, and dMEAN scores.

The hypotheses' relationships will be examined utilizing a factorial ANOVA at the 95% confidence interval, $\alpha = .05$.

Results

The purpose of this study was to explore the potential relationships between parental education, parental stress, and measures of childhood obesity rates. Data analysis conducted via Shapiro-Wilk and Levene's Test for Equality of Variances failed to reject both null hypotheses ($p = .643$), leading to the factorial ANOVA test being conducted in alignment with assumptions of normality and homogeneity of variances (see tables 2a and 2b), with independence of observations confirmed.

Table 2a. Parental Stress

	STRESS.o	Kolmogorov-Smirnova			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.

D.MEAN	Low (0-12)	0.082	93	0.158	0.983	93	0.278
	Mod (13 - 25)	0.043	226	.200*	0.994	226	0.503
	High (26 - 40)	0.064	80	.200*	0.984	80	0.431

Table 2b. Parental Education

	EDUC.o	Kolmogorov-Smirnova			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
D.MEAN	Low (<12y)	0.047	139	.200*	0.993	139	0.675
	Avg (12-14y)	0.061	118	.200*	0.982	118	0.113
	Mod High (15-16y)	0.069	79	.200*	0.987	79	0.605
	Very High (>16y)	0.076	63	.200*	0.988	63	0.802

The factorial ANOVA was conducted at the 95% confidence level, $\alpha = .05$ and failed to reject the null hypothesis for interactions between parental education and dMEAN ($F = .69$, $p = .556$) as well as for any potential interaction effects between parental stress and parental education ($F = 1.497$, $p = .178$). However, analysis rejected the null hypothesis between parental stress and dMEAN scores at the .05 level ($F = 14.23$, $p = .000$). A Tukey post-hoc analysis revealed significant differences between low stress ($M = 4.62$, $SD = 3.33$) and both moderate stress ($M = 5.68$, $SD = 2.89$), and high stress ($M = 7.19$, $SD = 3.42$), as well as between moderate stress and high stress.

Discussion

While existing research has suggested a connection between both parental education and stress and childhood obesity rates, an analysis of the study's results only revealed a significant relationship between parental stress and childhood obesity levels, as measured by the difference

between the child's weight and their ideal mean weight, referred to as dMEAN. This statistical significance helps to confirm the findings of Kumar and Kelly (2017), who uncovered relationships between parental stress levels and both childhood eating behaviors and the development of childhood obesity. These relationships were further refined by Jang et al. (2019), who discovered links between parental stress and childhood obesity rates in parents with obesity but not parents with normal weights.

Despite the suggestions of the literature reviewed, the factorial ANOVA failed to reject the null hypothesis for a main effect parental education and dMEAN and for an interaction effect between parental stress and parental education. While these results are somewhat unexpected when considering the majority of ongoing research efforts, it should be noted that recent research has uncovered linkages between subcomponents of parental socioeconomic levels and childhood obesity rates that were not explicitly examined in this study, the exclusion of which potentially skewing results toward a lack of statistical significance (Cullinan & Cawley, 2017; Lamerz et al., 2005; Muthuri et al., 2016).

One such relationship potentially exists between parental education levels and parental obesity levels, as Cullinan and Cawley (2017) identified a relationship between parents who are both obese and highly educated and their capacity to accurately identify their children's obesity levels. Another socioeconomic component that was excluded from this study was parental gender, with Lamerz et al. (2005) identifying a stronger linkage between paternal obesity and education rates and the reduction of childhood obesity levels than maternal education and obesity rates. In light of the gap between the lack of significance regarding parental education levels in this study's results and the results of recent research as a whole, an important potential consideration for ongoing research efforts would be to conduct deeper and more granular

investigations into the specific socioeconomic factors which most profoundly influence the development of childhood obesity.

An additional opportunity for future researchers to exploit exists in the outcome measure utilized to determine the impacts of both parental stress and education on childhood obesity rates. The current study's reliance on dMEAN as an outcome measurement is limited by the relative bluntness and imprecision of a measurement such as body weight, which can be significantly impacted by factors which include bone structure, body fat, and lean muscle mass (Bosy-Westphal & Müller, 2021). Given that the core purpose of the study is to further the field's understanding of how to most efficiently reduce the incidence of childhood obesity and the later development of cardiovascular disease, future researchers might consider utilizing other outcome measures that can provide more nuanced insights into the overall cardiovascular condition of the participants as compared to body weight, including lean body mass composition, resting heart rate, assorted physical fitness standards, and various biomarkers.

Finally, this study's confirmation of the significant role that parental stress has on the development of childhood obesity rates presents future researchers a guiding light into which potential future research directions can carry the most value. One of the most interesting and potentially valuable directions exists with examining which direct interventions on parental stress levels most significantly impact the reduction of childhood obesity rates. With research into stress management and reduction expanding at a rapid pace over the past several decades, it is important to identify the most impactful stress management methodologies on childhood obesity levels, as it is these research efforts which will come to influence both public and private stress management offerings and carry the greatest capacity to reduce childhood obesity levels at large.

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