Original Report:
Obesity

Association of the Family Nutrition and Physical Activity Screening Tool with Weight Status, Percent Body Fat, and Acanthosis Nigricans in Children from a Low Socioeconomic, Urban Community

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Objective: To examine the association of the Family Nutrition and Physical Activity (FNPA) screening tool with weight status, percent body fat, and acanthosis nigricans (AN) in 6- to 13-year-old children from a low socioeconomic, urban community.

Methods: Children (N=415) from four elementary schools located around Flint, Michigan were assessed for body mass index, percent body fat, and AN. The FNPA screening tool was completed by parents. Mann-Whitney U tests were used to assess differences in FNPA score by sex and presence of AN. Logistic regression was used to evaluate the association of the FNPA (tertiles) with weight status and AN.

Results: Children with AN (13.7%) had a significantly lower FNPA score (56.3 $\pm$ 7.1) compared with children without AN (61.0 $\pm$ 7.1; P<.05). Children with FNPA scores in the lowest tertile (high-risk) had odds ratios of 1.74 (95% CI =1.05 – 2.91) and 2.77 (95% CI =1.22 – 6.27) compared with children with FNPA scores in the highest tertile (low-risk) for being overfat and having AN, respectively.

Conclusion: Although the FNPA screening tool did not predict risk for being overweight or obese, it was significantly associated with an increased odds of children at risk for being overfat or having AN. *Ethn Dis*. 2015;25(4):399-404; doi:10.18865/ed.25.4.399

Keywords: Obesity, Familial Environment, Youth, Elementary School

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Introduction

Overweight and obesity among youth continues to be a significant public health problem despite some evidence that prevalence is leveling off.[1] In the United States, 32% of youth are overweight or obese.[1] Among the many complications of childhood and adolescent overweight and obesity are health disparities related to insulin resistance such as impaired glucose tolerance and increased risk of type 2 diabetes.[2] Acanthosis nigricans (AN) is a hyperpigmented, papillomatous, velvety, cutaneous thickening that can occur on any part of the body: axilla, sides of the neck, the groin, antecubital and popliteal surfaces, umbilical area, and even mucosal surfaces.[3,4] It is also a manifestation of insulin resistance linked to childhood obesity. Given the amount of evidence highlighting the medical complications of both pediatric obesity and childhood insulin resistance,[5] it is imperative that the prevention of overweight and obesity start during childhood since obesity and many of its insulin resistance associations, like AN,[6] track from childhood into adulthood.[7,8]

Although diet and physical activity are two major risk factors related to obesity, children and adolescents are unique in that much of their diet and physical activity behaviors are shaped directly by their parents or indirectly through the home environment provided to them.[9,10] Thus, it is important that health professionals are able to evaluate the family environmental and behavioral factors related to obesity risk in youth. These familial traits and behaviors could be intervention targets for modification in order to prevent the development of obesity in youth; therefore, the family and home environment is an ideal setting for obesity prevention among children and adolescents.

The Family Nutrition and Physical Activity (FNPA) screening tool was developed[11] to assess family environmental and behavioral factors (eg, family meals together, TV in bedroom, parental modeling of physical activity) that influence children's risk for becoming overweight. Studies evaluating the validity of the FNPA screening tool have shown it to be significantly associated with baseline prevalence of

overweight,[11,12] and one-year change in BMI.[13] However, these previous studies involved participants that were primarily Caucasian from socioeconomically healthy communities, and, with the exception of the study by Yee et al,[12] have not examined the association with other health consequences. Additional research examining the utility of the FNPA screening tool in varied and diverse settings and populations as well as other health outcomes is warranted. Therefore, the purpose of this study was to examine the association of the FNPA screening tool with risk of being overweight, percent body fat, and AN in 6- to 13-year old children from a low socioeconomic, urban community.

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Methods

Participants

The participants of our study were children from four elementary schools located in and around Flint, Michigan. A total of 554 surveys were sent home to the parents of the participants, with 542 returned (return rate of 97.8%). Of the 542 returned, 54 surveys were removed due to one or more questions not being answered. More surveys (n=73) were removed due to the participant not having all measurements completed. The final number of respondents for our study was 415 children (204 boys, 211 girls; aged 6-13 years). Approximately 49% of the sample were Caucasian and 42% were Black. Informed consent and assent were obtained from the parents and their children, respectively. The study protocol was approved by the Michigan State University Institutional Review Board.

Anthropometry and Acanthosis Nigricans

Stature and body mass were measured according to standard procedures.[14] Body mass index (BMI) was calculated using the following equation: BMI = body mass (kg)/stature (m^2). Body fatness was measured using a foot-to-foot bioelectric impedance device (Tanita Corporation, Tokyo, Japan). Percentiles for height, body mass, and BMI were determined using SAS growth chart programs available from the Centers for Disease Control (CDC). The International Obesity Task Force (IOTF) reference standards[15] were used to classify overweight and obese. Classification of fatness (normal fat vs overfat) was determined using FITNESSGRAM standards, which are age and sex specific.[16,17]

The assessment of AN in the participants was conducted by an experienced pediatrician. The assessment was based on close nuchal inspection using Burke's scale, since this area shows the highest agreement and least interrater variability in observational studies.[18,19] The back of the neck was examined for the presence of AN and, if present, the severity of AN was determined on a 1-4 scale in increasing severity, with 1 representing AN that is present on close visual inspection, but is not visible to the casual observer and is not measurable, and 4 representing severe AN that is extending anteriorly >6 inches.

Family Nutrition and Physical Activity Screening Tool

A recent, revised version of the FNPA was used for this study. Compared with previous versions that consisted of 21 items and 10 items, this version consists of 20 items that assess family environmental and behavioral factors that influence children's risk for becoming overweight. These 20 items are designed to capture 10 factors identified in an American Dietetic Association Evidence Analysis[17] that showed there were 10 factors associated with children's risk of becoming overweight. These 10 factors include: 1) Breakfast consumption and family meals together; 2) Modeling of healthy nutrition; 3) Consumption of nutrition dense foods; 4) Consumption of high calorie beverages; 5) Use of restriction and reward; 6) Parents modeling physical activity; 7) Child's physical activity behavior; 8) Screen time watched; 9) Television use in the bedroom; and 10) Sleep schedule. The development of the FNPA Screening Tool has previously been described.[11] The FNPA was sent home to the parents via participants. Instructions asked parents to complete the survey with responses that were most representative of their

Table 1. Descriptive characteristics by sex and total sample

	Males (n=204)	Females (n=211)	Total (N=415)
Age, yrs	9.2 (1.6)	9.1 (1.6)	9.1 (1.6)
Height, cm	135.9 (11.2)	135.5 (12.6)	135.7 (11.9)
Weight, kg	36.5 (14.2)	37.0 (16.4)	36.7 (15.3)
BMI, kg/m^2	19.2 (4.6)	19.5 (5.5)	19.3 (5.1)
BMI percentile	69.7 (27.1)	66.4 (28.7)	68.0 (27.9)
% Overweight	14.7	16.1	15.4
% Obese	23.0	19.4	21.2
Percent body fat	23.6 (9.9)	25.8 (9.2)[a]	24.7 (9.6)
% Overfat	56.9	56.9	56.9
FNPA Score	59.7 (7.3)	60.9 (7.2)	60.3 (7.3)

Values are mean (SD).
a. Significant difference between males and females (P<.05).

familial practices and home behaviors. Parents returned the surveys with their children. In our study, a total FNPA score was created from summing the score of each of the 20 items. Each item was scored on a four-point scale, and five items were reverse coded. FNPA scores ranged from 20-80, with lower scores indicating an adverse, obesogenic family environment and higher scores representing more favorable family environment and behaviors.

Statistical Analysis

Data were evaluated using PASW version 18.0 (Chicago, IL, USA). Descriptive statistics were calculated for all continuous variables. Mann Whitney U tests were used to assess differences by sex and presence of AN (AN vs non-AN). Pearson correlation coefficients were conducted to examine the associations among the FNPA score, BMI, BMI percentile, and percent body fat. Logistic regression, controlling for age, sex, and ethnicity, was used to evaluate the association of FNPA score tertiles (low, middle, and high tertiles) with weight status (normal weight, overweight, obese), fatness status (normal fat vs overfat), and the presence of AN. Tertiles were used to determine cut points for FNPA group analysis since cut points do not currently exist for the FNPA. Odds ratios and 95% confidence intervals were determined from the logistic regression analyses. Statistical significance was set as P<.05.

Table 2. Descriptive characteristics by presence of acanthosis nigricans (AN)

	AN Present (n=57)	AN Not Present (n=358)
Age, yrs	9.8 (1.5)[a]	9.0 (1.6)
Height, cm	144.1 (11.2)[a]	134.4 (11.5)
Weight, kg	59.6 (20.4)[a]	33.1 (10.5)
BMI, kg/m^2	28.0 (6.3)[a]	17.9 (3.1)
BMI percentile	97.6 (3.0)[a]	63.3 (27.2)
% Overweight	10.5[a]	16.2
% Obese	87.7[a]	10.6
Percent body fat	40.4 (8.6)[a]	22.2 (7.0)
% Overfat	100.0[a]	50.0
FNPA Score	56.3 (7.1)[a]	61.0 (7.1)

Values are mean (SD).
a. Significant difference between presence of AN and AN not present.

Results

Descriptive and Correlation Results

Based on IOTF reference standards, 15.4% of the sample was overweight and another 21.2% was obese. Table 1 provides the descriptive characteristics of the sample by sex. The mean BMI percentile for males approximated the 70th percentile and the mean BMI percentile for females approximated the 66th percentile. Females had a significantly higher percent body fat compared with males (P<.05). Table 2 provides the descriptive characteristics of the sample by presence of AN. Acanthosis nigricans was detected in 57 (13.7%) of the 415 children. Children with AN had significantly higher BMI and BMI percentile compared with children without AN (P<.05) and had a higher percent body fat (P<.05) and lower FNPA score (P<.05). The negative correlations between the FNPA score with BMI, BMI percentile, and percent body fat (-.33, -.17, -.29, respectively) were statistically significant (P<.05).

Logistic Regression Results

Further evaluation of the association between the FNPA and weight status, fatness status, and AN were evaluated using logistic regression. To compare with the results from the previous studies using the FNPA,[11,12] the FNPA score was divided into tertiles to test for differences in weight status, fatness status, and AN between children with low scores vs children with moderate scores or high scores. Table 3 shows the odds of being overweight/

obese and overfat by tertile of FNPA score controlling for age, sex, and ethnicity. No significant association was found between the FNPA score and weight status; however, with regard to percent body fat, children with FNPA scores in the lowest tertile had an OR of 1.74 (95% CI = 1.05-2.91; *P*=.03) compared with children in the highest tertile for being overfat. Lower FNPA scores indicate a higher risk/adverse family and home environment for overweight/obesity. Table 4 shows the odds of having AN by tertile of FNPA controlling for age and sex. Children with FNPA scores in the lowest tertile had an OR of 2.77 (95% CI = 1.22-6.27; *P*=.02) compared with children with FNPA scores in the highest tertile for having AN.

Table 3. Odds ratio and adjusted odds ratio of being overweight/obese or overfat by tertile of FNPA score in children

	Odds Ratio	95% CI	Adjusted Odds Ratio[a]	95% CI
FNPA (Low Tertile)				
Overweight/obese	2.06	1.25-3.41	1.66	0.98-2.82
Overfat	1.86	1.15-3.00	1.74	1.05-2.91
FNPA (Middle Tertile)				
Overweight/Obese	1.90	1.06-3.19	1.79	0.98-3.02
Overfat	1.10	0.70-1.79	1.09	0.67-1.76
FNPA (High Tertile)	1.00	Referent	1.00	Referent

a. Controlling for age, sex, and ethnicity

Discussion

This study shows the association of the FNPA screening tool for assessing familial behavior and the home environment with risk of overweight, overfatness, and AN in children from a low socioeconomic, racially diverse population. The major findings of this study were that the FNPA screening tool was associated with a child's risk for being overfat as well as having AN.

Logistic regression results from the study by Ihmels et al[11] showed that children with FNPA scores in the lowest tertile had an OR of 1.7 compared with children with scores in the highest tertile for being "at risk for overweight" (now known as overweight) or "overweight" (now known as obese); however, the OR values were no longer significant once parental BMI was included in the analyses. We found similar results in that children with FNPA scores in the lower tertile had an OR of 2.14 compared with children with scores in the highest tertile for being overweight or obese. However, results did not remain significant when ethnicity was included in the model. These results, in addition to those from the Ihmels study[11] suggest that both parental BMI and ethnicity need to be strongly considered when examining results from the FNPA. Further, when ethnicity was included in the logistic regression analyses for FNPA and overfat and AN, the OR value decreased from 2.0 to 1.74 for overfat and from 3.44 to 2.77 for AN, yet both associations remained significant. The inclusion of ethnicity in the model is unique to this evaluation of the FNPA since the populations from the previous studies were predominantly Caucasian. This decrease in the OR was expected since obesity rates and the incidence of AN are greater among Blacks. Post-hoc analysis showed this was also true in our sample. This result suggests that the FNPA screening tool can be used as an assessment to determine a child's risk for being overfat as well as having AN in low socioeconomic, racially diverse populations.

A difference between other studies using the FNPA and our study was the populations sampled. When comparing our samples with those of the other two studies using the FNPA, our sample size was smaller (415 vs 854), but more racially diverse, and lower income than the Ihmels study. Additionally, our study included 1st through 6th graders while Ihmels included 1st graders only. The percentage of Black children in our study was significantly greater than that of

Table 4. Odds ratio and adjusted odds ratio of having acanthosis nigricans (AN) by tertile of FNPA score in children

	Odds Ratio	95% CI	Adjusted Odds Ratio[a]	95% CI
FNPA (Low Tertile)				
Have AN	3.86	1.81-8.21	2.77	1.22-6.27
FNPA (Middle Tertile)				
Have AN	1.80	0.79-4.13	1.64	0.68-3.95
FNPA (High Tertile)	1.00	Referent	1.00	Referent

a. Controlling for age, sex, and ethnicity

the Ihmels study (42.2% vs 15.3%). The Yee et al study[12] consisted of 119 fifth grade children from a variable socioeconomic, primarily Caucasian population from the mid-Michigan area. The differences in our sample from those of the previous studies allowed us to explore the utility of the FNPA among a diverse population across ages, income, and race.

The correlation between the FNPA score and BMI was greater in our study compared with that of the Ihmels study (-.33 vs -.17), but was lower than that found in the study by Yee et al (-.42 vs -.33). Correlations between the FNPA score, and BMI percentile, and percent body fat were also lower in our study compared with those of our previous study. When comparing the prevalence of overweight and obese in children by median split, there was a greater prevalence of overweight and obese in children with a low FNPA score compared with children with a high score (42.3% vs 30.9%). Yee et al also compared the prevalence of overweight and obese in children by median split in their sample and also found a greater prevalence of overweight and obese in children in the higher FNPA group compared with the lower FNPA group (43.1% vs 14.9%). This difference was smaller in magnitude compared with that found in this study and could be explained by the higher overweight and obesity prevalence found among our participants.

There are few screening tools that examine familial behaviors and home environments in relation to risk of being overweight or obese. Bryant et al[20] examined the validity and reliability of an instrument called the Healthy Home Survey. Similar to the FNPA, the Healthy Home Survey was designed to measure multiple physical and social factors within the home that may relate to healthy weight behaviors in children. Specific domains assessed by the telephone-administered Healthy Home Survey include food availability, eating environment and policies, physical activity environment, physical activity policies, media environment, and media policies. Many of these domains are similar to those assessed by the FNPA. However, to our knowledge, no studies using the Healthy Home Survey to date have examined its association with assessing risk for overweight in children. This highlights the unique aspect of using the FNPA screening tool to determine how multiple family environmental and behavioral factors are related to a child's risk for being overweight.

The major findings of this study were that the FNPA screening tool was associated with a child's risk for being overfat as well as having AN.

Another instrument, Family Eating and Activity Habits Questionnaire, assesses the eating patterns of a family as well as family policies regarding dietary behaviors.[21] Results found that total score on the questionnaire was significantly related to a child's weight status. However, the Family Eating and Activity Habits Questionnaire was designed to assess family and home environmental changes related to weight loss in an obese child while the FNPA's aims to assess a child's risk for becoming overweight. Also, the FNPA assesses other factors related to obesity risk such as screen time, sleep behavior, and family schedule and policies that the Family Eating and Activity Habits Questionnaire does not capture. This makes the FNPA screening tool the only instrument developed to specifically examine multiple factors related to the family and home environment and how they influence a child's risk of becoming overweight/obese.

A strength of our study was that it is the first study utilizing the FNPA to sample from a low socioeconomic, urban community with a population that was approximately 50% African American, who are known to be at increased risk for health disparities. Another strength is that the presence and severity of AN was determined by an experienced pediatrician. A limitation of our study was the cross-sectional design. Further longitudinal studies, similar to Ihmels et al that predicted BMI change over one year using the FNPA, are needed to determine the utility of the FNPA over time. A limitation with the current version of the FNPA is that there are no other published data using this version. Thus, direct comparisons of mean FNPA scores from our study and previously published studies using the FNPA cannot be made, but scores can be indirectly compared.

Conclusion

The FNPA screening tool identified children who were overfat and had AN in a group of low socioeconomic, diverse children. However, further study is warranted to examine the utility of the FNPA in other settings with other racial groups, in addition to African Americans, who are known to be at risk for obesity and other health disparities (eg, Hispanic/Latino). Clinicians and other health professionals can use the FNPA screening tool to quickly estimate a child's risk for becoming overfat or developing AN by assessing their familial behaviors and home environment. Based on how a family responds to the FNPA, individualized interventions could be designed to modify specific behaviors and constructs of the home environment that could reduce a child's risk for becoming overfat or developing AN. Future research is needed to examine the utility of the FNPA in other populations, determining risk for other health outcomes, and for lengthier follow-up periods.

Acknowledgements

The authors wish to thank the Crim Fitness Foundation, Sharla Gillespie, Darijan Suton, Michelle Witham, RJ Gibbs, MSU Kinesiology graduate and undergraduate research assistants, and the students, teachers, families, and schools that participated in the CrimFit Youth Project.

Conflict of Interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

Author Contributions

Research concept and design: Yee, Pfeiffer, Carlson, Sharman, Lamb, Eisenmann. Acquisition of data: Yee, Pfeiffer, Carlson, Sharman, Lamb, Eisenmann. Data analysis and interpretation: Yee, Turek, Bakhoya. Manuscript draft: Yee, Pfeiffer, Turek, Bakhoya, Carlson, Sharman, Lamb, Eisenmann. Statistical expertise: Yee, Turek, Bakhoya. Supervision: Yee

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