Published in final edited form as:

J Fam Psychol. 2013 February ; 27(1): 106–116. doi:10.1037/a0031428.

Direct and Indirect Effects of a Family-Based Intervention in Early Adolescence on Parent-Youth Relationship Quality, Late Adolescent Health, and Early Adult Obesity

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Abstract

We explored family processes in adolescence that may influence the likelihood of obesity in early adulthood using a randomized trial of a family-based intervention (the Family CheckUp, or FCU). The FCU has been shown to reduce escalations in antisocial behavior and depression in adolescence by supporting positive family management practices, but no research has examined the mechanisms by which the FCU could influence health-related attitudes and behaviors linked to obesity. Participants were 998 adolescents ($n = 526$ male; $n = 423$ European American; M age 12.21 yrs) and their families, recruited in 6th grade from 3 middle schools in the Pacific Northwest. We used structural equation modeling (SEM) and an Intent-To-Treat (ITT) design to evaluate the direct and indirect effects of the FCU on parent–youth relationship quality (ages 12–15), healthy lifestyle behaviors, eating attitudes, depressive symptoms (all measured at age 17), and obesity (age 22). We found that the FCU led to greater parent–youth relationship quality, which predicted enhanced health-related behaviors, reduced maladaptive eating attitudes, and reduced depression. In turn, reduced maladaptive eating attitudes predicted reduced odds of obesity. The indirect effect of the FCU on obesity by way of parent–youth relationship quality and eating attitudes was significant. Our findings illustrate how family processes may influence adolescent health and suggest that family functioning may be an additional factor to consider when developing intervention programs for obesity.

Keywords

obesity; adolescence; parent–youth relationship quality; family-based prevention and intervention; depression

Obesity is one of the most serious problems facing youth today. More than 1 in 3 children in the United States are either overweight or obese (Ogden, Carroll, Curtin, Lamb, & Flegal, 2010). Obesity is associated with numerous adverse medical and psychological consequences, such as impaired glucose tolerance, cardiovascular disease, and nonalcoholic fatty liver disease, as well as low health-related quality of life, low self-esteem, and stigmatization (Lavine & Schwimmer, 2004; Nowicka et al., 2009; Puhl & Latner, 2007;

Schwimmer, Burwinkle, & Varni, 2003; Sinha et al., 2002). Obesity has been shown to be exceptionally resistant to treatment in adolescence, and even the most intensive programs have shown only modest results (Waters et al., 2011; Whitlock, O'Connor, Williams, Beil, & Lutz, 2010). Thus, developing effective prevention programs, particularly for adolescents, remains a vital research goal.

In the prevention and treatment of obesity, involvement of parents has been linked to a greater degree of success (Kitzmann & Beech, 2006; Kitzman-Ulrich et al., 2010; Young, Northern, Lister, Drummond, & O'Brien, 2007). Although the field of obesity research has traditionally focused on parenting behaviors related to physical activity and nutrition (Davison & Birch, 2001), Rhee et al. (2006) noted that a warm and supportive parenting style may have a greater impact on childhood and adolescent obesity. Indeed, variables related to family functioning (e.g., parental acceptance and support) have been linked to successful treatment outcomes in clinical studies (Stein, Epstein, Raynor, Kilanowski, & Paluch, 2005; White et al., 2004). Likewise, epidemiological research has found that family factors, such as parent–youth relationship quality, are important to controlling adolescent weight (Mellin, Neumark-Sztainer, Story, Ireland, & Resnick, 2002). More recently, Sleddens et al. (2011), in a comprehensive review, found that parenting style (e.g., “authoritative” vs. “authoritarian”; see Maccoby & Martin, 1983) had an impact on obesity-inducing behaviors, such as eating attitudes and physical activity. Despite this evidence suggesting that families play an important role in the prevention of obesity, few programs address aspects of parenting outside of diet and physical activity (Gerards, Sleddens, Dagnelie, De Vries, & Kremers, 2011). Obesity prevention and intervention research that targets broader aspects of parenting such as parent–youth relationship quality would provide insight into how family dynamics can influence adolescent behavior and, in turn, health-related outcomes. Such research could also inform prevention and treatment of obesity (Kitzman-Ulrich et al., 2010) and benefit the field of family-based prevention and intervention by documenting the “mechanisms of action” (p. 83) in family-based programs, which thus far have not been adequately explored (Liddle, 2004).

From a theoretical perspective, improved parent–youth relationship quality can influence the likelihood of obesity by helping youths to cope more effectively with the stresses of adolescence and opening them to positive parental influence related to a healthy lifestyle, a healthy body image, and a healthy relationship with food (Mellin et al., 2002; Nowicka, Pietrobelli, & Flodmark, 2007; Rhee, 2008; van der Horst et al., 2007), all of which have been linked to obesity. For example, obesity has been linked to a poor diet (Ebbeling et al., 2004; Prentice & Jebb, 2003; Viner & Cole, 2006), insufficient sleep (Knutson & Van Cauter, 2008; Lumeng et al., 2007), and lack of exercise and/or excessive time spent in sedentary activities (e.g., watching television, playing video games, etc.; Robinson, 1999; Salbe et al., 2002; Viner & Cole, 2006; for review, see Davis et al., 2007). Obesity has also been related to unhealthy eating attitudes and behaviors, such as excessive dieting, radical weight-control behaviors, obsession with food and/or body image, and binge eating (Field et al., 2003; Stice, Presnell, Shaw, & Rohde, 2005; Tanofsky-Kraff et al., 2006).

In addition to lifestyle behaviors and eating attitudes, parent–youth relationship quality could also influence obesity via its impact on adolescent depression. Positive parent–youth relationships have been linked with lower levels of depressive symptoms (Fanti, Henrich, Brookmeyer, & Kuperminc, 2008; Garber, Robinson, & Valentiner, 1997), and many community and clinical studies have linked depression in early adolescence to obesity (BeLue, Francis, & Colaco, 2009; Merikangas, Mendola, Pastor, Reuben, & Cleary, 2012; Stice et al., 2005).

This Study

Our objective was to use a randomized trial of a family-based intervention (the Family Check-Up or FCU; Dishion & Kavanagh, 2003) to explore family processes in adolescence that can influence the likelihood of obesity in early adulthood. Unlike family-based programs that focus on obesity and weight loss, the FCU does not include components specifically related to health or health-related behaviors; rather, the FCU was developed to address adolescent behavioral problems and focuses on broader aspects of parenting, such as monitoring, involvement, and communication. The FCU includes an initial interview, a family assessment, and a feedback session that emphasizes motivation to improve parenting (e.g., knowledge of child's whereabouts and activities, involvement in child's activities, more effective communication strategies, etc.). Randomized trials have demonstrated the effectiveness of the FCU for reducing levels of family conflict, substance use, antisocial and high-risk behavior, and depression (Connell & Dishion, 2008; Dishion, Nelson, & Kavanagh, 2003; Van Ryzin & Dishion, 2012; Van Ryzin, Stormshak, & Dishion, 2012). The FCU has also been shown to promote more positive parent–youth relationships (Caruthers, Van Ryzin, & Dishion, in press).

However, no research to date has examined the impact of the FCU on adolescent or early-adult health or health-related behaviors. We were interested in whether the FCU, by improving parent–youth relationship quality during early adolescence, would have indirect effects on adolescent health that would carry forward into early adulthood and decrease the likelihood of obesity. We were particularly interested in parent–youth relationship quality across ages 12–15, an inherently stressful time during which youth go through a number of significant changes, including puberty, multiple school transitions (i.e., into middle school, into high school), and changes in the parent–youth relationship as youth are given increased behavioral autonomy; families that can navigate these changes and maintain a positive relationship will see a number of benefits in terms of youth adjustment and mental health (Allen & Land, 1999). Thus, we hypothesized that the FCU would have a direct, positive effect on the trajectory of parent–youth relationship quality from age 12 to 15, and that this change would, in turn, have a positive impact on healthy lifestyle behaviors, eating attitudes, and depressive symptoms at age 17. We also hypothesized that each of these factors at age 17 would have a significant impact on the likelihood of obesity in early adulthood (age 22; see Figure 1).

Method

Participants

Participants were 998 adolescents and their families, recruited in sixth grade from three public middle schools in an ethnically diverse metropolitan community in the Pacific Northwest. All students were given information and consent forms to take home to parents, and 90% agreed to participate, suggesting that we did not obtain a biased sub-population from these schools. Parents were told that the intervention program was designed to address adolescent antisocial behavior by improving parenting practices. All participating parents and youth provided signed consent forms, and all study procedures were approved by the relevant institutional review board (IRB). The sample comprised 526 males (52.7%) and 472 females (47.3%). Average age was 12.21 years ($SD = .37$). By youth self-report, there were 423 European American participants (42.4%), 291 African Americans (29.2%), 68 Latinos (6.8%), 52 Asian Americans (5.2%), and 164 (16.4%) of other ethnicities (including biracial). Biological fathers were present in 585 families (58.6%). Annual family income ranged from less than \$5,000 to more than \$90,000 (median: \$30,000–\$40,000). Youths were randomly assigned at the individual level to either control ($n = 498$ youths) or

intervention ($n = 500$) conditions in sixth grade. Approximately 80% of youths were retained across the span of the study (see Figure 2).

Intervention Protocol

The FCU is part of an ecological approach to family intervention (Dishion & Stormshak, 2007) that was originally articulated as a model for adolescents who are at high risk for problem behavior. The goal of the FCU was to improve parental attention to adolescent antisocial behavior and to bring about change in parental monitoring and communication; the FCU included no explicit components related to nutrition, physical activity, or health. The FCU is adaptive in that services are tailored to family needs and circumstances. In recent years, adaptive interventions have been increasingly emphasized as a way to obtain maximum leverage from available resources (Collins, Murphy, & Bierman, 2004). Contrary to traditional intervention strategies in which all participants receive identical services, an adaptive intervention framework specifies that individuals have different needs, and that differing intervention programs and dosages that are responsive to those needs will result in more positive outcomes. The core feature of an adaptive intervention framework is that specific intervention approaches are determined individually based on decision rules in order to adapt the intervention to individual needs. Advantages include decreased likelihood of negative effects of intervention components that are not appropriate for a given individual, less waste of limited resources, and potentially increased compliance with intervention (Collins et al., 2004).

The first level of the FCU, a universal intervention, involved the establishment of a family resource center (FRC) in each of the participating middle schools. The services available at the FRC included brief consultations with parents and feedback to parents about their student's behavior at school. The second level of the program, the FCU itself, was delivered in three brief sessions that consisted of an initial interview, an assessment session, and a feedback session. During the initial interview, a therapist explored parent concerns and encouraged the parents to participate in a family assessment. During the assessment session, the family was videotaped in the home while engaging in a variety of tasks. In the feedback session, the therapist used motivational interviewing strategies (Miller & Rollnick, 2002) to summarize the results of the assessment. An essential objective of the feedback session was to explore whether additional specialized services (i.e., the third level of the program) could be provided to support parents in changing family management practices. These services included interventions consistent with the *Everyday Parenting* curriculum (Dishion, Stormshak, & Kavanagh, 2011), which provides intensive exposure to family management practices, such as positive behavior support, monitoring, communication, and limit setting. Although all families in the intervention group ($N = 498$) could receive the FCU, participation was voluntary and in this study included only 115 families (23% of the intervention group); nearly all of these families (88 of 115) also elected to receive at least one follow-up session following the FCU. The vast majority ($> 99\%$) of the FCU and follow-up sessions occurred during the 7th and 8th grades. Overall, the participating families had an average of 8.9 hours of contact with the intervention staff during this time period ($SD = 9.42$). Students from participating families who left the targeted schools were offered these services if they remained in the same county. The control group received typical school-based services (e.g., access to a guidance counselor or school psychologist).

Measures

In the spring semester, from the 6th through 9th grades (ages 12–15), and again in the 11th grade (age 17), all students were surveyed in the schools. Most students were assessed with a core set of measures, but at baseline (age 12), a subsample ($N = 140$) were given more

intensive assessment (see Analysis Plan); this subsample was equally distributed among intervention and control conditions. When participants were 22, they were surveyed by mail.

Parent–youth relationship quality—Youth reports of their relationship with parents in sixth through ninth grades (ages 12–15) were measured using a subscale of the Community Action for Successful Youth (CASY; Metzler, Biglan, Ary, & Li, 1998). We averaged across six items that reflected the degree to which parents and youth shared activities, mutual regard, and positive affect (e.g., “My parents trusted my judgment,” “I really enjoy being with my parents,” “There was a feeling of togetherness in our family”). Responses ranged from 1 (*never or almost never*) to 5 (*always or almost always*). Scale reliability ranged from $\alpha = .89$ to $.90$. Metzler and colleagues (1998) provide evidence of stability and convergent and discriminant validity using measures of antisocial behavior, association with deviant peers, and substance use.

Healthy behaviors—At age 17, youths were surveyed about whether they had regularly exhibited a variety of behaviors in the previous 3 months (e.g., prosociality, concern for family and friends, etc.) using the Positive Behaviors List (GLST; Oregon Social Learning Center, 1997). Youth responded with yes (1) or no (0). We selected three behaviors from the list that corresponded to obesity: eating a balanced meal, getting 8 hours of sleep, and getting regular exercise. These three indicators were significantly correlated (r 's between $.22$ and $.44$, $p < .001$; see Table 1) and were combined into a latent measure of healthy behavior (see Figure 1).

Eating attitudes—This construct was measured with the Eating Attitudes Test (EAT; Garner & Garfinkel, 1979) at age 17 for the full sample and at age 12 for the subsample. The EAT is used to assess the attitudes and behaviors characteristic of eating disorders, such as excessive dieting, binge eating, purging, and obsession with food or body image. In this study, we used the shortened EAT (26 items; Garner, Olmstead, Bahr, & Garfinkel, 1982; $\alpha = .87$ at age 12, $\alpha = .88$ at age 17). Higher scores indicate higher levels of unhealthy eating attitudes.

Depressive symptoms—For youth age 17, this construct was measured using the Brief Symptom Inventory (BSI; Derogatis & Melisaratos, 1983). The BSI consists of 53 items that measure a wide range of psychiatric symptomatology. Patients rate the severity of symptoms on a scale ranging from 0 (*not at all*) to 4 (*very much*). Each of the 53 items loads onto 9-symptom dimensions: somatization, obsessive–compulsive ideation, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychoticism. In this study, the subscale for depression was used (six items; $\alpha = .86$). For the subsample at age 12, this construct was measured by using the Children's Depression Inventory (CDI; Kovacs, 1985). The CDI is a commonly used self-report measure of childhood depression comprising 27 items ($\alpha = .86$).

Obesity—At age 12 (subsample only) and age 22, participants were asked for their height and weight, and from this information we calculated BMI by using the standard formula: weight in pounds / (height in inches $\times$ height in inches) $\times 703$. At age 22, we created a dichotomous measure of obesity (0 = no, 1 = yes) in which a BMI of 30 or greater indicated obesity. This variable was dichotomized to enable us to explicitly examine the impact of family and behavioral factors on the likelihood of obesity; if we had used BMI itself, we would in effect be examining weight changes in all individuals, including those who are normal weight, which was not our goal. At age 22, 21.9% of individuals ($N=173$ out of 789) were found to be obese.

As underreporting of weight in obese individuals and overestimating of height may underestimate BMI, we chose to perform a sensitivity analysis with a lower cut-off for self-reported obesity (i.e., 28.5 instead of 30), a procedure tested previously (Viner & Cole, 2005). The rationale for this analysis will be provided in the Analysis Plan.

Socio-economic status (SES)—SES was measured using a combination of parental employment status, parental education, family housing status, family income, and financial aid status; when data were available for both parents, the highest level among the two parents was chosen. We controlled for SES along all paths in the model.

Analysis Plan

Our hypothesized model is presented in Figure 1. In this type of model, factors such as parent–youth relationship quality and depressive symptoms may be construed as “mediators” of program effects. In general, requirements for mediation include a significant direct effect of the predictor (i.e., intervention condition) on a presumed mediator (i.e., change in parent–youth relationship quality) and on the distal outcome (i.e., obesity), a significant direct effect of the mediator on the outcome, and a significant indirect effect of the predictor on the outcome by means of the mediator (Judd, Kenny, & McClelland, 2001; MacKinnon & Dwyer, 1993). However, such an approach may have low statistical power and an unacceptably high Type I error rate, and thus MacKinnon and colleagues (2002) have advocated for the consideration of other approaches that focus solely on the joint significance (i.e., indirect effect) of the path between the predictor and the outcome via the mediator. In the absence of a direct effect of the predictor on the outcome, MacKinnon et al. (2002) refer to purported mediators as “intervening variables” rather than as mediators per se. Thus, in this study, if we were to find direct effects of the intervention on obesity, we would evaluate parent–youth relationship quality, healthy behaviors, eating attitudes, and depressive symptoms as mediators; if direct effects were not present, we would evaluate these constructs as intervening variables, or variables that are affected by the intervention that can, in turn, promote beneficial outcomes and thus are theoretically and clinically meaningful even in the absence of a statistically significant direct effect (Sandler, Schoenfelder, Wolchik, & MacKinnon, 2011).

We note that all variables at age 17 and 22 in Figure 1 were regressed on both the intercept and the slope of the growth curve, as well as on the intervention condition (not shown in Figure 1 to aid readability). We also note that the model shown in Figure 1 does not contain baseline controls at age 12, as we did not possess the appropriate data; such data could have been used to control for bias created by any preexisting differences between the intervention and control groups. Given that we used random assignment across a large sample, preexisting group differences should not exist; however, as a precautionary measure, we examined intervention vs. control group differences among a subsample ($N = 140$) that was more intensively assessed at baseline (age 12); for this group, we possessed data from the Eating Attitudes Test (EAT), the Children’s Depression Inventory (CDI), and body-mass index (BMI).

We fit the model to the data using structural equation modeling with Mplus (Muthén & Muthén, 2006). We used maximum likelihood analysis, which can provide unbiased estimates in the presence of missing data if the data are Missing at Random (MAR). We did have a degree of missing data (see Table 1), but when comparing those that left the study by age 22 to those that were retained, we found no significant differences in terms of intervention condition, $\chi^2(1) = .12$, ns ; teacher-reported risk status at baseline (age 12), $\chi^2(1) = 2.55$, ns ; baseline level of parent–youth relationship quality, $F(1,987) = 2.46$, ns ; and baseline weight status, $F(1,380) = .22$, ns .

Mplus does not provide standard indices of fit for models with dichotomous outcomes, so none are reported for models that contain our measure of obesity at age 22. Paths predicting obesity are expressed as odds ratios, with ratios less than one predicting a decrease in the likelihood of obesity, and ratios greater than one predicting the opposite. For models without the dichotomous measure of obesity, standard measures of fit are reported, including chi-square (χ^2), comparative fit index (CFI), Tucker-Lewis index (TLI), and root mean square error of approximation (RMSEA). CFI values greater than .95, TLI values greater than .90, RMSEA values less than .05, and a ratio of $\chi^2/df < 3.0$ typically indicate good fit (Hu & Bentler, 1999).

After fitting the model and reporting the results, we conducted a sensitivity analysis to address the possible underestimation of the obesity due to the self-report nature of our data. In this analysis, we redefined obesity according to a cutoff of 28.5 instead of 30, as data from a large epidemiological study suggested that obese individuals may underestimate their true BMI by a mean of 1.5 kg/m² (Gordon-Larsen, Aida, Nelson, & Popkin, 2004; Spencer, Appleby, Davey, & Key, 2002). If the results using the revised cutoff did not vary from our initial results, we could conclude that underestimation of BMI did not introduce significant bias.

We also conducted a sensitivity analysis to examine whether any links between the growth curve slope and the measures of healthy behaviors, eating attitudes, and depressive symptoms were due to the proximity of these measures (age 17) with the last wave of the growth curve (age 15). We re-specified the growth model to place the intercept at age 15; if the results did not vary, we could conclude that the links were not due to proximity.

Since gender and ethnicity (i.e., European-American vs. non-European-American) have been linked to both obesity and other aspects of the model, such as eating attitudes (Wang & Beydoun, 2007; Wildes, Emery, & Simons, 2001), we examined gender and ethnicity as moderators using a likelihood ratio difference test. Specifically, we fit a model in which paths were estimated freely to a model in which paths were constrained to be equal across groups; if the freely estimated model demonstrated significantly better fit, we concluded that significant differences existed in one or more model paths, and explored the paths individually to determine which differed. We conducted this test twice – once for gender, and once for ethnicity.

Results

Among our subsample at baseline (age 12), we found no group differences in terms of the EAT, $F(1, 136) = .09$, *ns*; the BMI, $F(1, 138) = 2.59$, *ns*; or the CDI, $F(1, 139) = .15$, *ns*. Those in the subsample were evenly distributed among the intervention and the control groups, $\chi^2(1) = .05$, *ns*, suggesting that preexisting group differences were unlikely to bias our results.

Means, standard deviations, and intercorrelations for all variables in the model can be found in Table 1. The intervention condition was not significantly correlated with obesity at age 22, suggesting no direct effects of the intervention.

We initially fit only the latent growth curve for parent–youth relationship quality in order to unambiguously specify its parameters. The model fit the data well, $\chi^2(5) = 12.96$, $p < .05$; $\chi^2/df = 2.59$; CFI = .99; TLI = .99; RMSEA = .040 (.013|.067), and demonstrated a positive intercept (value = 3.57, $p < .001$) and a negative slope (value = $-.11$, $p < .001$) indicating that, on average, the families in our sample were declining in relationship quality across ages 12–15. The intercept and slope were significantly and negatively correlated ($r = -.34$, $p < .001$).

We then inserted the intervention condition as a predictor of the intercept and slope. The model fit the data well, $\chi^2(8) = 14.25$, ns ; CFI = .99; TLI = .99; RMSEA = .028 (.000|.051). The intervention condition predicted the slope ($\beta = .16$, $p < .05$; $R^2 = .03$) but not the intercept ($\beta = -.06$, ns). Thus, intervention families did not differ from the control group in terms of initial status, but did experience a less severe decline in relationship quality across ages 12–15.

Next, we fit the full model containing obesity at age 22 (no fit indices provided). Model coefficients can be found in Table 2. As in our reduced model, the intervention condition predicted a significantly less severe decline in parent–youth relationship quality across ages 12–15; in turn, a less severe decline in relationship quality predicted higher levels of healthy behaviors and lower levels of maladaptive eating attitudes and depressive symptoms. Only maladaptive eating attitudes were linked to the likelihood of obesity at age 22, with greater levels of maladaptive attitudes predicting an increased likelihood of obesity; healthy behaviors and depressive symptoms were not significant predictors (intervention condition and growth curve intercept/slope were also nonsignificant predictors, OR = .95–1.31). The indirect effect of the intervention on obesity via parent–youth relationship quality and maladaptive eating attitudes was significant. SES was a significant predictor of increased maladaptive eating attitudes ($\beta = .07$, $p < .05$) and reduced likelihood of obesity (OR = .60, $p < .001$) but did not predict the intercept or slope, healthy behaviors, depressive symptoms, or treatment group membership.

We next calculated obesity at age 22 based upon a cutoff of 28.5 instead of 30 in order to test the sensitivity of our results to underestimation of BMI. The results did not vary from those in Table 2, so we concluded that they were not substantially biased by underreporting. Finally, we re-specified the growth curve as described above and found several differences. First, the correlation between intercept and slope changed from $r = -.33$, $p < .001$, to $r = .54$, $p < .001$, indicating that intercept and slope were highly collinear in the re-specified model. Despite this, the key effects in the model were only slightly attenuated; specifically, the effect of change in parent–youth relationship quality on eating attitudes was reduced from $\beta = -.18$, $p < .01$, to $\beta = -.14$, $p = .05$, and the indirect effect was reduced from OR = .98, $p < .05$, to OR = .99, $p < .10$. Thus, we concluded that these links were not simply an artifact of their temporal proximity.

Finally, we examined group differences by gender and ethnicity (European-American vs. non-EA). An omnibus test of all model paths suggested that there were significant differences by gender, $\chi^2(29) = 71.16$, $p < .001$. The model paths predicting obesity were not different for boys and girls, but there were significant differences in the following paths: from intervention condition to parent–youth relationship quality (boys $\beta = .22$, girls $\beta = .50$, $\chi^2(1) = 7.90$, $p < .01$); from parent–youth relationship quality to healthy behaviors (boys $\beta = -.09$, girls $\beta = .42$, $\chi^2(1) = 4.59$, $p < .05$); from parent–youth relationship quality to maladaptive eating attitudes (boys $\beta = -.19$, girls $\beta = -.40$, $\chi^2(1) = 44.77$, $p < .001$); and from parent–youth relationship quality to depressive symptoms (boys $\beta = -.09$, girls $\beta = -.46$, $\chi^2(1) = 8.95$, $p < .01$). There were no significant differences by ethnicity, $\chi^2(29) = 23.40$, ns .

Discussion

A number of family-based interventions have been developed in an attempt to reduce obesity in childhood and adolescence (Epstein, Valoski, Wing, & McCurley, 1994; Kitzmann et al., 2010; Savoye et al., 2007), and these programs generally involve efforts to enhance parental oversight of adolescent diet and physical activity. This study reports on the effects of the Family Check-Up (FCU), a family-based intervention targeting adolescents

that does not contain specific nutrition or physical activity components but rather focuses on more general aspects of parenting, such as monitoring, communication, and trust. We found that the FCU helped slow the decline in parent–youth relationship quality across ages 12–15, which in turn improved adolescent health-related behaviors and reduced maladaptive eating attitudes and depressive symptoms at age 17. Lower levels of maladaptive eating attitudes, in turn, reduced the likelihood of obesity in early adulthood. Although the indirect effect of the FCU on obesity by means of parent–youth relationship quality and maladaptive eating attitudes was significant, we contend that the most significant contribution of this study is the insight gained into the links between family processes and adolescent and early-adult health-related behaviors and outcomes; this insight can contribute valuable guidance to future research and developmental efforts related to obesity prevention and intervention programs for adolescents. By linking parent–youth relationship quality with healthy behaviors, eating attitudes, and depression, our results support emerging research attesting to the central role of the family in promoting adolescent health and health-related behaviors. As stated by Rhee (2008), “The socioemotional environment created in the home through specific parenting styles and attitudes toward food and sedentary behaviors can assist in the development of a healthier approach toward weight-related domains with presumably lifelong impacts” (p. 13). Although we did not find links between healthy behaviors, depressive symptoms, and obesity, our results suggest that parent–youth relationship quality can affect a number of aspects of adolescent health. In addition, the ethnic and socio-economic diversity of our sample suggests that our results are highly generalizable.

Our finding that maladaptive eating attitudes were significantly linked to the likelihood of obesity at age 22 underscores their central role in the study of obesity. Other research has revealed similar findings. For example, disordered eating in childhood and early adolescence, mostly binge eating disorder (BED), has been linked to later obesity (Puder & Munsch, 2010). In a prospective study of disordered eating, children aged 6–12 years who experienced loss-of-control eating, a specific form of BED, gained an additional 2.4 kg of weight per year over 4.5 years when compared to children without BED (Tanofsky-Kraff et al., 2009). Excessive dieting has also been shown to play a role in the likelihood of obesity (Stice et al., 2005).

Our results failed to demonstrate that depressive symptoms in youth were related to later obesity, even though previous research has linked overweight status with negative mood scores in younger children (Tanofsky-Kraff, Faden, Yanovski, Wilfley, & Yanovski, 2005). Our findings are echoed by later research in which maladaptive eating attitudes, but not depression, predicted overweight status (Tanofsky-Kraff et al., 2006). Because little of the previous research linking depression and obesity controlled for maladaptive eating attitudes, it may be that these attitudes are a stronger predictor, or that they mediate the effects of depression on obesity.

Our test for gender differences revealed that intervention effects on parent–youth relationship quality were stronger for the girls in our sample. Adolescent daughters engage in significantly more conflict with parents than do sons (McGue, Elkins, Walden, & Iacono, 2005), so the FCU may have been more effective at reducing the negative effects of this conflict on relationship quality. Additionally, we found that the effects of improved parent–youth relationship quality on healthy behaviors, eating attitudes, and depressive symptoms were also stronger for girls. Researchers have hypothesized that a greater frequency of stressful events in adolescence may explain the higher degrees of depression experienced by girls (Hankin, Mermelstein, & Roesch, 2007; Hyde, Mezulis, & Abramson, 2008), and closer parent–youth relationships may be able to reduce or ameliorate the impact of these stressful events. Stress may also play a role in eating attitudes; physical changes during puberty can lead to increased body dissatisfaction in girls, which in turn can lead to the

development of eating problems (Stice, 2002), and improved parent–youth relationships may also be able to reduce the impact of this type of stress and reduce disordered eating in girls. The limited research on gender differences in healthy behaviors does not allow us to draw firm conclusions about this aspect of our results.

From a clinical perspective, our results suggest that family-centered interventions such as the FCU can have a positive impact on family processes, which may in turn impact adolescent health in a manner that is carried forward into adulthood, even if the program does not include components related to nutrition or physical activity. This is especially promising as targeting obesity in adolescents through traditional means (focusing on obesity-related behaviors) continues to produce very modest results (Danielsson et al., 2012). As noted by Gerards and colleagues (2011), few obesity prevention and intervention programs address broader aspects of parenting, and our findings can spur the development of new programs by suggesting specific mechanisms by which the family can influence adolescent and early-adult health. One particularly promising aspect of our results is the application of motivational interviewing techniques (Miller & Rollnick, 2002), which have traditionally been used to treat substance use disorders, to family-based prevention and intervention. This feature of the FCU is particularly salient given that parental involvement is perceived as a significant challenge in the treatment and management of obesity (van Gerwen, Franc, Rosman, Le Vaillant, & Pelletier-Fleury, 2009). Another noteworthy facet of our results is the idea that family-based programs designed to treat obesity may have significant impacts on multiple aspects of adolescent health; beyond reducing the likelihood of obesity, for example, family-based programs may also impact rates of physical activity, depression, and, given previous research on the FCU, may also impact levels of antisocial behavior and substance use. As a result, such programs could be useful in a variety of settings and could be attractive to a wide range of government and youth-focused organizations. Finally, when attempting to modify existing obesity prevention and intervention programs, we believe that clinicians could take either of two approaches. First, given that the FCU is brief, self-contained, and possesses well-defined procedures for training and supervision, clinicians could easily integrate the FCU into existing programs that emphasize traditional topics, such as nutrition and physical activity. On the other hand, the FCU could easily be expanded to include educational components related to health, and the application of motivational interviewing to these components may make them even more efficacious. Future research and program development in this area could have a significant impact on the field of obesity prevention.

Several limitations should temper the interpretation of this study's results. First, the FCU was not directly linked to early-adulthood obesity (see Table 1), so we cannot refer to factors such as parent–youth relationship quality and eating attitudes as mediators; instead, since the joint significance (i.e., indirect effect) of the FCU on obesity was statistically significant, parent–youth relationship quality and eating attitudes can be considered to be intervening variables, or variables that are influenced by a predictor and, in turn, influence a distal outcome (MacKinnon et al., 2002). Since typical tests of mediation possess low statistical power and can demonstrate a high Type I error rate (MacKinnon et al., 2002), the concept of “intervening variables” enables researchers to study program processes across extended timeframes and add to our understanding of developmental theory and clinical practice in the absence of high degrees of statistical power (Sandler et al., 2011). Second, we did not possess appropriate control variables at baseline across the entire sample, nor did we possess data on relevant factors such as parental obesity; thus, any preexisting differences between the intervention and control group could have biased the results, which would limit our ability to draw firm conclusions about the effects of parent–youth relationship quality and late adolescent health behaviors and attitudes on the likelihood of obesity in early adulthood. For example, FCU effects could have resulted in weight loss or weight

stabilization during childhood or adolescence such that obese children at baseline became non-obese by age 22, whereas obese children in the control condition remained obese. However, since we used random assignment on a large sample, such group differences should be minimal, and our analysis of a subsample revealed no differences in eating attitudes, depressive symptoms, or BMI. Finally, our measures of height and weight at age 22 were self-reported, which can be a source of bias (Spencer et al, 2002). However, the use of self-reported weight and heights is common in large epidemiological studies (e.g., the National Longitudinal Study of Adolescent Health; Resnick et al., 1997). More recently, a large, widely cited European study also chose to use self-reports when reporting prevalence of obesity in youth (Janssen et al., 2005). In addition, numerous studies have confirmed to the accuracy and validity of self-report measures in epidemiological studies (Bolton-Smith, Woodward, Tunnstall-Pedoe, & Morrison, 2002; Brener, McManus, Galuska, Lowry, & Wechsler, 2003; Goodman, Hinden, & Khandelwal, 2000; Spencer, Appleby, Davey, & Key, 2002; Strauss, 1999). To be conservative, however, we tested the possibility of underreporting weight and/or overreporting height (which would underestimate true BMI) by conducting a sensitivity analysis; this analysis replicated our original results, suggested that underreporting of BMI did not create a substantial degree of bias.

In sum, this study extends current research by demonstrating that the FCU can have salutary effects on family processes, which in turn may influence health-related outcomes in adolescence and early adulthood. Most importantly, our findings suggest ways in which family processes may play a role in the likelihood of obesity. Future research can explore the impact of other aspects of family functioning on adolescent health, which would provide important direction for the development of effective health-related prevention and intervention models.

Acknowledgments

This project was supported by grants DA07031 and DA13773 from the National Institute on Drug Abuse to Thomas J. Dishion. Support for the first author provided by grant T32 MH20012 from the National Institute of Mental Health to Elizabeth A. Stormshak. Support for the second author provided by a grant from the Swedish Society of Medical Research. We acknowledge the contribution of the Project Alliance staff, Portland public schools, and the participating youths and families. We acknowledge Cheryl Mikkola for editorial assistance.

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Figure 1. Hypothesized model. Latent variable for healthy behaviors (age 17) includes healthy eating, sleeping, and exercise behaviors. All variables at age 17 were regressed on the growth curve intercept (not shown). Obesity at age 22 was regressed on growth curve intercept, slope, and intervention condition (not shown). Obesity refers to the likelihood of developing obesity.

Figure 2. Participant flow through study recruitment, randomization to Family Check-Up, and follow-up.

Table 1

Correlations and Sample Descriptives

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1. Intervention condition	—											
2. Positive family rels (age 12)	-.04	—										
3. Positive family rels (age 13)	.01	.47***	—									
4. Positive family rels (age 14)	.02	.40***	.54***	—								
5. Positive family rels (age 15)	.05	.35***	.45***	.57***	—							
6. Balanced meal (age 17)	-.04	.07	.06	.12**	.11**	—						
7. Sufficient sleep (age 17)	-.05	-.01	.01	.08*	.07	.44***	—					
8. Regular exercise (age 17)	.00	.09*	.07	.09*	.12**	.33***	.22***	—				
9. Eating attitudes (age 17)	.04	.01	-.01	-.06	-.09*	-.13**	-.09*	-.07*	—			
10. Depressive symp (age 17)	-.03	-.08*	-.10*	-.18***	-.16***	-.18***	-.13**	-.21***	.30***	—		
11. Obesity (age 22)	.00	-.02	-.03	-.04	-.03	-.07	-.04	-.05	.14***	.02	—	
12. Socio-Economic Status	-.06	.03	-.03	.00	.03	.01	-.04	.08*	.07	.03	-.11**	—
<i>N</i>	993	989	855	829	819	788	790	792	792	792	789	730
<i>M</i>	1.50	3.58	3.45	3.34	3.27	.70	.65	.70	.30	58.20	.22	.00
<i>SD</i>	-	1.02	.99	1.01	.99	-	-	-	.25	4.63	-	.72

* $p < .05$

** $p < .01$

*** $p < .001$.

Table 2**Model Coefficients (standardized betas)**

Factor loadings (β) for healthy behaviors (age 17)		
Sleep	.56	
Meals	.76	
Exercise	.44	
Model paths (paths predicting obesity are Odds Ratios)		
		95% C.I.
Intervention $\rightarrow$ slope	.16**	-.20 to -.12
Slope $\rightarrow$ healthy behaviors	.19**	.05 to .34
Slope $\rightarrow$ eating attitudes	-.18**	-.30 to -.06
Slope $\rightarrow$ depressive symptoms	-.20**	-.32 to -.08
Healthy behaviors $\rightarrow$ obesity	.49	.21 to 1.13
Eating attitudes $\rightarrow$ obesity	4.07***	2.03 to 8.14
Depressive symptoms $\rightarrow$ obesity	.98	.94 to 1.03
Intervention $\rightarrow$ slope $\rightarrow$ healthy behaviors $\rightarrow$ obesity	.99	.99 to 1.03
Intervention $\rightarrow$ slope $\rightarrow$ eating attitudes $\rightarrow$ obesity	.98*	.96 to .99
Intervention $\rightarrow$ slope $\rightarrow$ depressive symp $\rightarrow$ obesity	1.01	.99 to 1.02
Intervention $\rightarrow$ Healthy behaviors	.09	.00 to .17
Intervention $\rightarrow$ Eating attitudes	-.06	-.13 to .01
Intervention $\rightarrow$ Depressive symptoms	.01	-.06 to .08

*
 $p < .05$

**
 $p < .01$

 $p < .001$.