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Social and cognitive predictors of fruit and vegetable intake among adolescents: The context of changes in body weight

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Abstract

Two studies investigated differences in the relationships between adolescents' fruit and vegetable intake (FVI) and the predictors specified in the Health Action Process Approach and Social-Cognitive Theory. Retrospective (Study 1; *N* = 502) and prospective (Study 2; *N* = 668) designs were applied. Among adolescents with overweight/obesity, intention was cross-sectionally associated with FVI (Study 1); no social or cognitive predictors explained FVI at 14-month follow-up (Study 2). The planning – FVI and self-efficacy – FVI relationships were stronger among adolescents who reduced their body weight to normal, compared to effects observed among those who maintained their body weight (Studies 1 and 2).

Keywords

adolescence, BMI, fruit and vegetable intake, self-efficacy, intention, planning, nutrition

Introduction

Obesogenic behaviors among adolescents include poor nutrition habits, such as low fruit and vegetable intake (FVI). Thus a majority of obesity prevention and treatment interventions

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for children and adolescents address behavior modification, such as changes in diet (van Cauwenberghe et al., 2010). Obesity interventions that target dietary change are more successful in reducing body mass index (BMI) than programs without nutrition components (Safron et al., 2011). Healthy weight management guidelines for adolescents suggest that an increase of FVI is an essential dietary strategy in obesity prevention and treatment (Neumark-Sztainer et al., 2008).

Social Cognitive Theory (SCT; Bandura, 1997) is frequently used to develop obesity prevention interventions for adolescents (Zenzen and Kridli, 2009). SCT assumes that self-efficacy and goal intentions are the most powerful determinants of successful behavior change (Bandura, 1997). Self-efficacy refers to optimistic beliefs about the ability to engage in a target behavior despite environmental or personal barriers (Bandura, 1997; Neumark-Sztainer et al., 2003). Similar assumptions about the role of self-efficacy and intentions can be found in the Health Action Process Approach (HAPA; Schwarzer, 2008). The HAPA suggests that intentions are more likely to be translated into action when people make plans, describing when, where, and how they will act. It also suggests that besides self-efficacy and intention, planning is a proximal predictor of behavior (Schwarzer, 2008; Schwarzer et al., 2007). Other approaches, such as the extended theory of planned behavior, also indicate that intentions and planning are crucial determinants of behavior (Sniehotta, 2009). According to SCT and the theory of planned behavior, other individual variables (eg, taste preferences) or socio-environmental variables are hypothesized to operate indirectly (Conner et al., 2011; Neumark-Sztainer et al., 2003). The HAPA- and SCT-based cognitions, such as self-efficacy or intention, were used in 90 percent of studies explaining nutrition change in adolescence (Contento et al., 2002). Although research investigating associations between FVI, intention, and planning often controlled for co-occurring BMI, the moderating role of *changes* in obesity/overweight status in analyses of cognitions-behavior relationships drew much less attention.

Developmental theories suggest that evaluations of body shape and body weight are among the most important elements of the self in adolescence (Harter, 1999). Research confirmed that children and adolescents actively assess their body size, identify overweight/obesity, are conscious of the consequences of excessive body weight, recognize behaviors leading to excessive body weight, and are aware of pressures to change behaviors in case of overweight/obesity (Rees et al., 2011). In sum, aspects of the self, that refer to physical changes and body weight changes may indeed shape young people's beliefs and behaviors.

SCT suggests that past experiences of successful or unsuccessful regulation of one's own behavior would directly influence such cognitions as self-efficacy and goal intentions (Bandura, 1997). Past experiences may have an indirect influence on perceived opportunities, such as perceived availability of healthy foods and support for healthy eating (Bandura, 1997). It may be expected that SCT- and the HAPA-based predictors may operate differently, depending on overweight/obesity status (and changes in overweight status) as indicators of past experiences with regard to weight regulation. In line with SCT, it may be assumed that compared to those who are able to maintain normal weight, individuals who are overweight, obese or those who recently became overweight have different experiences with attempts to self-regulate one's own food intake (ie, a failure to eat healthy, non-fattening foods, such as fruits and vegetables). It may be assumed that the dissimilarities in these past experiences may not only result in different mean levels of cognitions, but also in different patterns of relations between cognitions and subsequent behavior.

Successful interventions targeting the prevention of weight-gain in normal wieght adolescents as well as weight-loss treatments for overweight/obese adolescents are urgently needed (Lobstein et al., 2004). Overweight prevention usually targets adolescents below the overweight/obesity threshold, whereas

treatment is addressed to those above this threshold. Both prevention and treatment of overweight often apply the same theoretical framework, such as SCT (cf. Contento et al., 2002). However, systematic reviews indicated that interventions using the same theoretical framework might in fact target different variables in overweight prevention (eg, adolescents' efficacy) as compared to those targeted in obesity treatment (eg, home accessibility, parental support, and reinforcement; cf. Cislak et al., 2011; van Cauwenberghe et al., 2010).

The decision about which variables should be addressed in interventions must be based on research positively informing the content of the respective prevention or treatment program (Dombrowski et al., 2007). Before testing if particular techniques are effective in the prevention or treatment of excess weight, research should establish which social and cognitive variables might be good predictors of weight-related behaviors among adolescents with normal body weight (ie, for prevention), and those above the obesity/overweight threshold (ie, for treatment).

So far, there is a lack of systematic research clarifying if social and cognitive variables operate differently among adolescents with normal body weight, compared to those who are or become overweight or obese. Recent studies indicated that adolescents' overweight status moderated the associations between parental behaviors and adolescents' eating behaviors (Elfhag et al., 2010). In addition to studying the predictor-behavior relations in the previously outlined groups, identifying social and cognitive variables associated with FVI in adolescents who are successful in reducing their body weight to normal, may provide relevant insights into the mechanisms promoting successful weight management. To fill this void, we aimed at exploring differences in the relationships between SCT- and the HAPA-based variables, and FVI among adolescents who are potential candidates for overweight/obesity prevention (ie, currently maintaining normal weight), among those who qualify for obesity treatment and finally, among those who were successful in reducing their body weight to normal.

The present studies

Our studies aimed at evaluating relations between the SCT- and the HAPA-based variables and FVI among three groups of adolescents: (1) those who were able to maintain body weight within normal range (below 85. percentile of BMI) within at least one year, (2) those who maintained overweight/obesity or becoming overweight/obese within one year, and (3) those who were able to reduce their body weight (from BMI above 85. percentile at first measurement to below 85. percentile at the second measurement) within one year. In particular, we investigated whether the interplay between nutrition intention, planning, self-efficacy, and FVI would differ across these three groups of adolescents.

The 85. percentile of BMI, adjusted for age and sex, was selected as the cut-off score. This cut-off is considered an internationally accepted threshold for overweight recommended by the International Obesity Taskforce (Cole et al., 2000). Although with limitations, the 85. percentile of age- and sex-adjusted BMI is widely applied in practice and research on overweight and obesity in adolescence and considered the best choice, as it is related to body fatness (Wang, 2004) and increased risk of cardiometabolic morbidity and related mortality (Reilly and Kelly, 2011).

Two studies were designed to investigate the assumed relationships between SCT- and the HAPA-based variables and FVI. Study 1 aimed at providing preliminary tests of the relationships between predictors and FVI across the three groups of adolescents. This approach allowed us to identify indirect and direct predictors that operate differently in the three groups. Using a longitudinal design, Study 2 aimed at confirming if SCT- and the HAPA-based variables, identified as direct predictors of behavior in Study 1, would predict FVI differently in the three groups of adolescents. In both studies, hypothesized models assumed

direct relationships between the FVI and self-efficacy, planning, and intentions. In Study 1, the hypothesized model also assumed indirect effects of four cognitive and environmental variables, tested in previous SCT-based research (Neumark-Sztainer et al., 2003). In Study 2, the hypothesized model accounted for direct effects of baseline behavior. The studies were approved at the Institutional Review Board at the Warsaw School of Social Sciences and Humanities.

Study 1: Associations between social and cognitive predictors and FVI among adolescents with three BMI trajectories

Study 1 focused on cross-sectional relations between social and cognitive predictors of FVI among three groups of adolescents: (1) maintaining their BMI below 85. percentile for at least one year, (2) those who either increased their weight or maintained weight above 85. percentile within 1 year, and (3) those who successfully reduced their body weight from above 85. percentile to below this threshold within 1 year. The assumed associations between the predictors reflect the relations formulated in earlier research on SCT-based predictors of FVI among adolescents (Neumark-Szteiner et al., 2003). The associations between self-efficacy, intention, planning, and FVI were specified in line with the HAPA (Schwarzer, 2008). It was hypothesized that the relationships between SCT- and the HAPA-based cognitions (intention, self-efficacy, and planning) and FVI would differ across the three groups.

Method

Procedure

Data were collected in autumn 2009 in a sample of adolescents from rural (35%) and urban (65%) areas in northern Poland. Measurements were conducted during routine medical check-ups at four pediatrician's or family doctor's offices (37%) and at four school nurse offices (63%). Pediatricians and school nurses informed potential respondents and their parents about the study's aims and procedures, and asked adolescents and their parents to provide informed consent. Additionally, parents provided consent for retrieving body weight and height data from adolescents' medical records. Respondents received no compensation. Among invited, 66 percent provided parental and adolescents' informed consents and filled in the questionnaires. At Time 1 (T1), the questionnaires were filled out in the presence of the trained experimenter; pediatric nurses assessed body weight and height (with clothing, without shoes). Results of previous measurement of body weight and height (Time 0, T0) were retrieved from the participants' medical records by a pediatric nurse, pediatrician or family doctor. Medical records indicated that T0 body weight and height was measured at one to five years earlier ($M = 2.17$, SD = 1.17, in 88% of cases measurement was taken 1–3 years earlier). On average, participants were 12.71 years old (SD = 1.47) at T0.

Participants

Data from 502 adolescents (51% girls) were collected. They were 12–18 years old at T1 ($M = 14.93$, $SD = 1.31$) with BMI above the fifth percentile. We excluded 15 cases of BMI-for-age below 5, indicating underweight and a possibility of eating disorders. Reference values of BMI, adjusted for age and gender (AnthroPlus Software, World Health Organization; WHO, 2009) were used to define the cutoff of 85. BMI percentile. A half of participants (57.8%, $N = 310$) had normal body weight at T1 and T0 (below 85. percentile for their age and gender), 21.5% ($N = 108$) had BMI indicating obesity or overweight at T1 (above 85. percentile, adjusted for age and gender), and either normal BMI or overweight/obesity at T0, whereas 20.7% ($N = 104$) had BMI above 85. percentile at T0 but their body weight was within normal range at T1.

Table 1. Measures and descriptive statistics in Studies 1 and 2.

Variable	Item example[a]	Items	Response scale	Study 1		Study 2	
				M (*SD*)	α	*M* (*SD*)	α[b]
Intention to eat healthy diet (Neumark-Sztainer et al., 2003)	Within the next three months I intend to eat five portions of fruits and vegetables every day	2	definitely not (1) to exactly true (7)	5.15 (0.62)	.52	5.61 (1.44)	.46
Nutrition self-efficacy (Neumark-Sztainer et al., 2003)	How sure are you that you could eat healthy foods when you are with your friends	6	definitely not (1) to exactly true (4)	2.73 (0.68)	.79	2.66 (0.60)	.66
Nutrition planning (Schwarzer et al., 2008)	I have made detailed plan about when to eat fruits and vegetables	4	definitely not (1) to exactly true (4)	2.40 (0.95).	.86	2.39 (0.82)	.86
Taste preferences (Neumark-Sztainer et al., 2003)	Most vegetables taste bad	3	definitely not (1) to exactly true (4)	2.91 (0.63)	.65	-	-
Fruits/vegetables home availability (Neumark-Sztainer et al., 2003)	Fruits and vegetables are available in my house	2	definitely not (1) to exactly true (4)	3.26 (0.51)	.41	-	-
Mother support for healthy eating (Neumark-Sztainer et al., 2003)	My mother cares about eating healthy food	2	definitely not (1) to exactly true (4)	2.14 (0.62	.66	-	-
Health/nutrition attitudes (Neumark-Sztainer et al., 2003)	How much do you care about eating healthy foods?	5	Not at all (1) to very much (4)	2.41 (0.55)	67	-	-
Fruit and vegetable intake (Cox et al., 1997)	Please let us know which of the suggestions you used during last 24h: Eat a bowlful of salad, have fruit as dessert, etc.	9	free response format (number of portions)	2.69 (2.27).	.75	2.59 (0.18)[1] 2.69 (1.16)[2]	.71[1], .81[2]

Notes: a) all items have been translated to Polish using Brislin (1970) translation model; Polish version is available from the corresponding author; b) *r* values were provided for 2-item scales; 1 – T1 measurement, Study2, 2 – Time 2 measurement, Study 2.

Mean BMI for adolescents with normal body weight across the measurement points was 18.45 (SD = 1.98) at T0 and 19.53 (SD = 1.91) at T1, $F(1, 289) = 143.30$, $p < .001$, $\eta = .22$. Among adolescents with overweight/obesity at both measurement points, mean BMI at T0 was 24.00 (SD = 3.92) and 26.26 (SD = 3.45) at T1, $F(1, 107) = 59.76$, $p < .001$, $\eta = .36$. Among those who reduced their weight from T0 to T1, the average BMI was 22.67 at T0 (SD = 1.54) and 21.61 at T1 (SD = 1.56), $F(1, 103) = 61.57$, $p < .001$, $\eta = .37$.

Measures of social and cognitive variables and FVI are presented in Table 1.

Data analysis

Missing data were imputed using the expectation maximization algorithm for SPSS (Enders, 2001). Data were analyzed using SPSS version 19 and AMOS 19 for path analyses (IBM Corporation, Chicago, IL). The path model included eight observed variables, representing mean item responses. In the hypothesized model, support for healthy eating, food availability, and taste preferences were specified as predictors of attitudes, self-efficacy, and intention. Self-efficacy was specified as the predictor of intention and planning, whereas intention was assumed to predict planning. Self-efficacy, intention, and planning were specified as direct predictors of FVI (see Figure 1).

The analyses were conducted for a three-group model. Evaluation of model-data fit was based on Tucker-Lewis Index (TLI), Comparative Fit Index (CFI), Normed Fit Index (NFI), Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Residual (SRMR), and χ^2. The following values indicate an acceptable fit: TLI, CFI, values above .90, SRMR and RMSEA values of .05 or less (Byrne, 2009). The kurtosis for taste and FVI was above 2, indicating a significant non-normality, thus SEM analyses were performed with bootstrapping (1000 samples, with Boolen-Stein *p* index) to aid adjustment of data non-normality (Byrne, 2009).

Results

Preliminary correlation analysis for the total sample indicated that all study variables were significantly and positively correlated, with *r*s

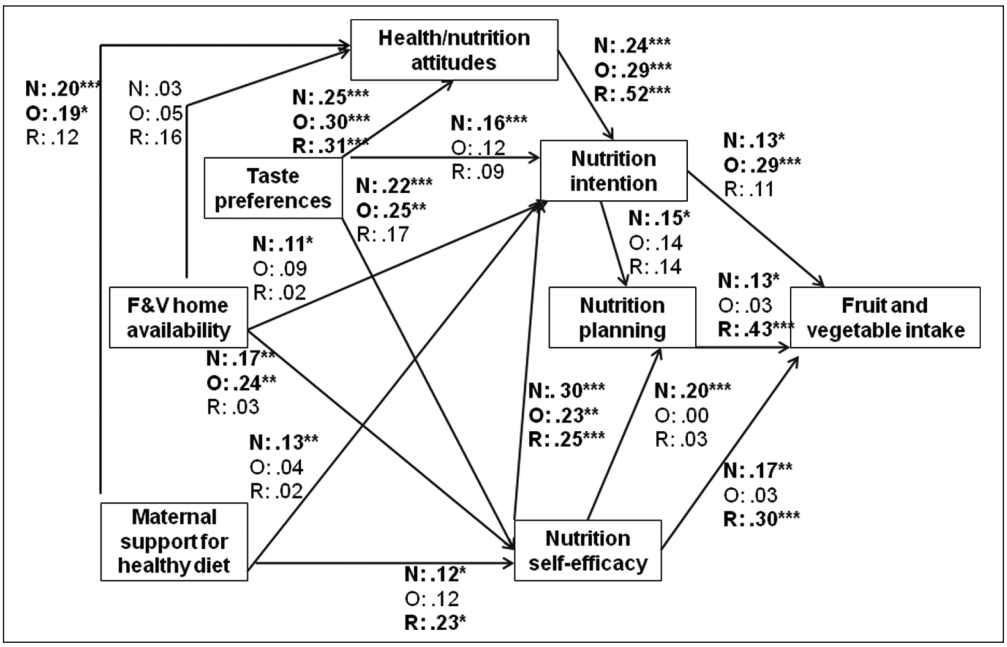

Figure 1. Results of path analysis (standardized solution) for a three-group model (Study 1). Social and cognitive predictors of fruit and vegetable intake among adolescents with: (1) normal body weight from T0 to T1, (2) those who became overweight/obese at T1 or were overweight/obese from T0 to T1 and (3) those who were overweight or obese at T0 but reduced their body weight to normal (T1).

Figure note: * $p < .05$, ** $p < .01$, *** $p < .001$. N – the group of adolescents who maintained *normal* body weight across the measurement points; O – the group of adolescents who maintained *overweight/obesity* or became overweight/obese from T0 to T1; R – the group of adolescents who *reduced* their BMI from overweight/obesity to normal. Significant effects are marked in bold.

Table 2. Study 1 and 2: Comparison of paths in the final model. Relations between self-efficacy, planning, intention, and FVI.

Paths in the model	*Z* values for pairwise comparisons for three groups of adolescents:					
	With normal BMI versus with BMI>85		With normal BMI versus with reduced BMI		With BMI >85 versus with reduced BMI	
	Study 1	Study 2	Study 1	Study 2	Study 1	Study 2
Self-efficacy→ FVI	1.26	.08	2.17*	2.60**	2.43**	2.13*
Plans→FVI	0.79	0.97	2.97***	3.15***	3.01*	1.99*
Intention→ FVI	2.13**	0.01	1.57	1.63	3.08***	1.37
Self-efficacy→ planning	1.63	0.94	1.31	0.17	0.18	0.53
Self-efficacy→ intention	0.67	2.58**	0.34	0.46	0.30	1.46
Intention→ planning	0.04	0.06	0.11	0.62	0.06	0.48

Notes: BMI, body mass index; FVI, fruit and vegetable intake.
*$p < .05$, ** $p < .01$, ***$p < .001$.

ranging from .10 ($p = .020$) to .46, ($p < .001$). After controlling for age and gender, the three groups did not differ in FVI, $F(1, 497) = 1.80$, $p = .167$, $\eta^2 = .01$, planning, $F(2, 497) = 1.46$, $p = .234$, $\eta^2 = .01$, self-efficacy, $F(2, 497) = 2.09$, $p = .125$, $\eta^2 = .01$, or intention, $F(2, 497) = 1.19$, $p = .306$, $\eta^2 = .01$. Across study variables, no significant differences were found for participants recruited at schools compared to those recruited at a pediatrician or family doctor's offices (all *p*s > .29).

Path analysis was conducted for the hypothesized three-group model, with (1) adolescents maintaining normal body weight from T0 to T1, (2) those who were overweight/obese at T1 (maintained overweight from T0 to T1 or gained weight from T0 to T1 and became overweigh/obese), and (3) those who reduced their weight from T0 to T1 (were above 85. percentile at T0 but below 85. percentile at T1). The hypothesized model fit well with the data, with χ^2 (40) = 91.08, $p < .001$, Bollen-Stein $p = .009$, CFI = .95, TLI = .87, NFI = 0.91, SRMR = .05, RMSEA = .03 (90% CI = 0.02 – 0.03). Analyses indicated the equality of intercepts, means, covariances, and residuals (for all χ^2_{diff}, *p*s > .10) across the study groups.

In the next step we evaluated the nested model, assuming that the paths from self-efficacy to behavior, from planning to behavior, and from intention to behavior are equal across the groups. Analyses indicated that the nested model should be rejected, $\Delta\chi^2$ (6) = 20.78, $p = .002$, ΔNFI = .02. Thus, the hypothesized model with respective paths assumed to be different across the groups may be accepted.

Finally, pairwise comparisons for the paths included in the hypothesized model (*Z* values, critical ratios) were conducted (Table 2). Associations between self-efficacy and FVI and those between planning and FVI were significantly stronger among those who were able to reduce their weight from obesity/overweight at T0 to normal at T1, when compared to the relationships found among adolescents in two other groups. By contrast, the relationships between intention and FVI were significantly weaker among those who were able to reduce their weight than among adolescents from the two other groups.

The standardized solution for the three groups is presented in Figure 1. Among adolescents who maintained normal body weight from T0 to T1 all hypothesized associations were significant, except for the relationship between availability of fruit and vegetable at home and adolescents' attitudes (Figure 1). The variables included in the model explained 10 percent of variance of FVI among those who maintained normal body weight. Intention was the only

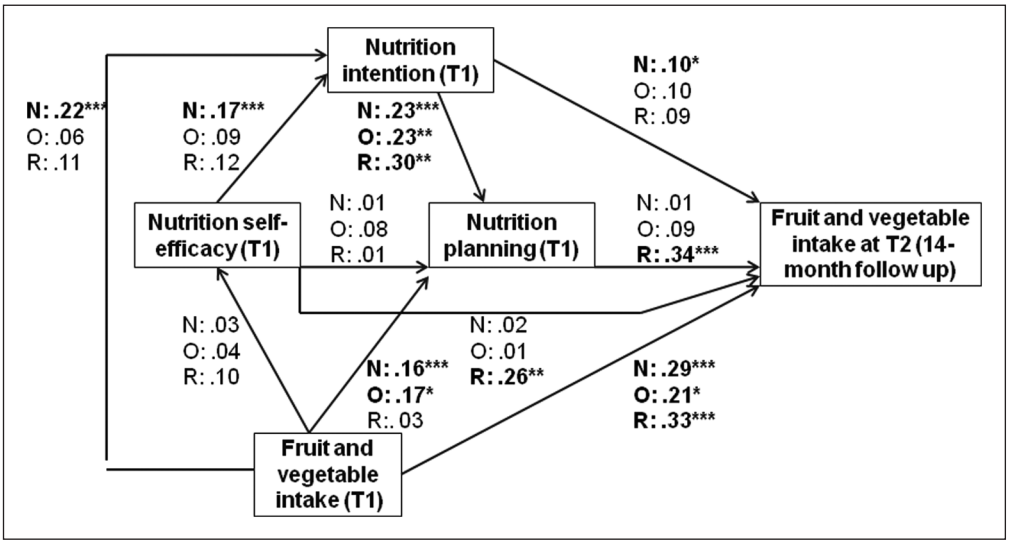

Figure 2. Results of path analysis (standardized solution) for a three-group model (Study 2). Social and cognitive predictors fruit and vegetable intake among adolescents with: (1) normal body weight from T1 to 14-month follow-up (T2), (2) those who became overweight/obese at T2 or were overweight/obese from T1 to T2 and (3) those who were overweight or obese at T1 but reduced their body weight to normal (T2).
Figure note: * $p < .05$, ** $p < .01$, *** $p < .001$. N – the group of adolescents who maintained *normal* body weight across the measurement points; O – the group of adolescents who maintained *overweight/obesity* or became overweight/obese at T2; R – the group of adolescents for *reduced* their BMI from overweight/obesity to normal. Significant effects are marked in bold.

significant direct predictor of FVI within the group of adolescents who were above BMI-for-age 85. percentile at T1 (Figure 1). A total of 9 percent of FVI was explained in the group of those who were overweight or became overweight from T0 to T1. FVI was significantly associated with planning and self-efficacy among adolescents who reduced their BMI from above 85. percentile at T0 to below 85. percentile at T1 (Figure 1). Overall, 27 percent of variance of FVI was explained in this group of adolescents.

Study 2: Longitudinal associations between social and cognitive predictors and FVI at 14-month follow-up among adolescents with three BMI trajectories

Using a longitudinal design, Study 2 investigated the role of self-efficacy, planning, and intention in predicting FVI at 14-month follow-up. Similarly to Study 1, we tested if the relationships between these variables and nutrition behavior would differ across the groups of adolescents with three BMI trajectories. Further, Study 2 focused solely on the cognitions that were identified as direct predictors of FVI in Study 1. In particular, we hypothesized that the effects of self-efficacy and planning would be negligible among adolescents who were overweight, but significant among those who were successful in spontaneous reduction of their BMI.

Methods

Procedures

Data were collected from November 2007 until January 2010 in a rural (35%) and urban (65%) area of southern, central, and eastern Poland. At Time 1 (T1), potential participants

received information about the study aims and the procedures, and provided informed consent. Pediatric nurses measured body weight and height. FVI, body weight, and height were measured again at Time 2 (T2), 13–15 months after T1 (M = 14.3, SD = 1.03). Parental consent was obtained prior to the data collection.

Participants

A total of 913 adolescents took part at T1; seven cases with BMI below the 5. percentile were excluded from analyses, 238 (26.1%) dropped out at T2, and 668 provided their data at both measurement points. The majority were girls (57.2%, N = 358) ages between13–18 years old (M = 16.21, SD = 0.92) at T1. Overall, 69 percent (N = 461) had normal body weight at T1 and T2 (below 85. percentile for their age and gender), 18.6 percent (N = 124) had BMI indicating obesity or overweight at T2 (above 85. percentile, adjusted for age and gender), whereas 12.3 percent (N = 82) had BMI above 85. percentile at T1, but had normal body weight at T2. Mean BMI for adolescents with normal body weight across the measurement points was 20.46 (SD = 1.80) at T1 and 20.48 (SD = 1.86) at T2, $F(1, 460) = 0.27$, $p = .578$, $\eta^2 = .001$. Among adolescents with overweight at T2 mean BMI at T1 was 26.42 (SD= 3.65) and 27.18 (SD = 3.68) at T2, $F(1, 123) = 24.30$, $p < .001$, $\eta^2 = .165$. Those who reduced their weight from T1 to T2 had the average T1 BMI of 24.87 (SD = 1.84) and 23.78 (SD = 2.44) at T2, $F(1, 81) = 38.41$, $p < 001$, $\eta^2 = .322$. Measures of social and cognitive variables and FVI are presented in Table 1.

Data analysis was analyzed with SPSS version 19 and AMOS 19 (IBM Incorporation, Chicago, IL). Missing data were imputed using the Expectation Maximization (EM) algorithm for SPSS (Enders, 2001). The hypothesized model included five observed variables, representing mean item responses. In the hypothesized model, FVI, self-efficacy, planning, and intention were specified as direct predictors of FVI at the 14-month follow-up. Self-efficacy was assumed to predict intention and planning. Intention was specified as the predictor of planning (see Figure 2).

The analyses of the three-group model were conducted with bootstrapping (Byrne, 2009). Evaluation of model-data fit was based on the same indices as in Study 1. The kurtosis for all variables was below 2, indicating normal distribution.

Results

Preliminary analysis indicated that dropouts and completers did not differ in terms of planning, self-efficacy, intention, and FVI (all Fs < 1). Correlation analyses for the total sample indicated significant associations between FVI at T1 and FVI at T2 ($r = .31$, $p < .001$). FVI at T1 was related to intention at T1 ($r = .13$, $p < .001$), T1 planning ($r = .18$, $p < .001$) and T1 self-efficacy ($r = .08$, $p = .036$), whereas T2 FVI was related to T1 intention ($r = .15$, $p < .001$) and T1 planning ($r = .12$, $p = .003$), but unrelated to T1 self-efficacy ($r = .06$, $p = .136$). Intention was related to planning ($r = .28$, $p < .001$) and self-efficacy ($r = .23$, $p < .001$). Self-efficacy and planning were also associated ($r = .20$, $p < .001$). The three groups of adolescents did not differ in FVI at T1, $F(2, 663) = 1.70$, $p = .183$, $\eta^2 = .01$, FVI at T2, $F(2, 663) = 1.92$, $p = .147$, $\eta^2 = .01$, planning, $F(2, 663) = 2.72$, $p = .067$, $\eta^2 = .01$, self-efficacy, $F(2, 663) = 0.24$, $p = .783$, $\eta^2 = .001$, and intention, $F(1, 663) = 0.84$, $p = .434$, $\eta^2 = .001$.

Path analysis was conducted for the hypothesized three-group model. The hypothesized model fit the data well, with $\chi^2 (12) = 31.87$, $p < .03$, Bollen-Stein $p = .03$, CFI = .91, TLI = .90, SRMR = .01, RMSEA = .05 (90% CI = 0.03 – 0.06). Analyses indicated the assumption of the equality of intercepts, means, and residuals (for all χ^2_{diff}, ps > .10) across the study groups should not be rejected.

We evaluated the nested model that assumed that the paths from self-efficacy to behavior, from planning to behavior, from intention to

behavior, and from FVI at T1 to FVI at T2 are equal across the groups. Analyses indicated that the nested model should be rejected, $\Delta\chi^2$ (8) = 22.47, p = .001, ΔNFI = .05. Thus, the hypothesized model with respective paths assumed to be different across the groups may be accepted.

In the final step we conducted pairwise comparisons for the paths included in the hypothesized model (Z values, critical ratios; Table 2). As in Study 1, associations between self-efficacy and FVI and those between planning and FVI were significantly stronger among those who were able to reduce their weight from obesity/overweight at T1 to normal at T2, compared to relationships among adolescents from the two other groups. The relationship between intention (T1) and FVI (T2) was significantly stronger among those who reduced their weight, when compared to those who became overweight or maintained overweight across two measurement points.

The standardized solution for the three groups is presented in Figure 2. Among adolescents who maintained normal body weight from T1 to T2 only intention (T1) and FVI at T1 predicted FVI at 14-month follow-up. The variables included in the model explained 13 percent of variance of FVI (T2) among adolescents who maintained BMI below 85. percentile. Within the group of adolescents who were above BMI 85. percentile at T2, only behavior at T1 was predictive of FVI at 14-month follow-up (Figure 2); only 9 percent of variance of FVI at T2 was explained in this group of adolescents. Finally, FVI at T2 was significantly predicted by planning, self-efficacy, and FVI at T1 among individuals who reduced their BMI from above 85. percentile at T1 to below 85. percentile at T2. The predictors explained 23 percent of variance of FVI (T2).

Discussion

Results of Study 1 and 2 indicated differences in the relationships between FVI and the HAPA- and SCT-based social and cognitive variables. These differences depend on the changes in adolescents' body weight. Data obtained from adolescents who were able to maintain normal body weight throughout at least one year indicated that self-efficacy, planning, and intention were directly related to FVI reported at the same measurement point (Study 1), whereas a strong intention predicted FVI at 14-month follow-up (Study 2). Thus, the results obtained for adolescents with normal BMI partially support SCT (Bandura, 1997), and the HAPA (Schwarzer, 2008), emphasizing direct effects of intention. By contrast, among adolescents who became overweight/obese or maintained overweight/obesity cognitions assumed to predict FVI directly turned out to be unrelated to FVI (Study 2), except for cross-sectional relations between intention and FVI (Study 1).

Most importantly, the associations between analyzed cognitions and FVI are distinct among adolescents who successfully changed their overweight/obese status to normal body weight. Within this group, the associations between FVI and planning as well as the associations between FVI and self-efficacy were significantly stronger than among adolescents from the two other groups. The same pattern was observed in both studies, testing cross-sectional and longitudinal relationships. Among adolescents who were able to maintain BMI-for-age below the 85. percentile, the patterns of associations between social and cognitive predictors were in line with SCT (Bandura, 1997), the HAPA (Schwarzer, 2008), earlier studies on FVI among adolescents (Neumark-Sztainer et al., 2003), and meta-analyses of effects of predictors on behavior (Guillaumie et al., 2010). Stronger relations between the cognitive predictors and FVI mean that more variance of behavior is explained by the variables included in the analysis. As self-efficacy and planning are cognitions closely associated with FVI, these variables may be chosen as targets for obesity treatment interventions, in particular among those who have recently become overweight, or as a target for prevention for regaining weight for those who recently succeeded in the reduction of their BMI to normal. This selection of variables may be not

appropriate, however, for those who struggle to maintain/reduce their body weight for years, experience relapses in attempts to change their diet, and deal with unsuccessful self-regulation of own nutrition. It may be assumed that such experiences may occur more often among the group of adolescents who maintained excessive body weight or became overweight across the period of over 14 months, than among the two other study groups. The results suggest that the variables accounted for in both studies are weak predictors of FVI in the subgroup of adolescents struggling with BMI increasing above overweight threshold or long-term overweight maintenance, thus they may be not ideal target of the treatment intervention for these individuals. Future research needs to identify the social and cognitive variables that may be strong predictors of nutrition behaviors in this group.

It is often assumed that forming plans predict behavior change in people who already intend to adopt a behavior (Schwarzer, 2008). On average, respondents of Study 1 and Study 2 declared that they intend to eat at least five portions of fruit and vegetables a day, and the means were equal across the groups of adolescents with the three body weight trajectories, thus planning could emerge as a significant predictor of FVI.

Our studies have several limitations. First, experimental research is needed to test if the effects observed in Studies 1 and 2 may be of causal character. This research set out to provide a basis for such experimental studies by identifying factors that are worth targeting in different groups of adolescents. Second, the samples were of a convenience character which could affect the findings. Third, the amount of explained variance in FVI was rather low. On the one hand, the differences in explained variance further emphasize the assumed differences in the use of planning and self-efficacy as the group that was able to reduce their BMI had almost triple amount of explained variance in both studies. Fourth, the psychometric properties of the Polish language versions of the applied measures have not been evaluated in earlier research, but back translation method was used (Brislin, 1970). Intentions constitute a relevant moderator of planning-behavior relationship; future research needs to investigate the role of the potential moderators, such as the strength and stability of intentions. Future studies should test for the role of explicitly measured mastery experiences with changes in body weight. Finally, future studies need to account for effects of the role of positive emotions (Turner et al., 2010) and satisfaction with body weight change (Baldwin et al., 2009), which may help to explain food intake in adolescence.

Our research may have some implications for obesity prevention and treatment programs targeting adolescents. Training adolescents how to make nutrition plans and bolstering their self-efficacy beliefs may be an effective tool in changing FVI. Forming nutrition plans emerged as an effective tool in changing body weight among overweight or obese adults (Luszczynska and Haynes, 2009). Thus, future obesity prevention provided to adolescents who already have some achievements in reducing their BMI to normal may account for planning and self-efficacy in order to facilitate nutrition changes. Further research is needed in order to explain which variables should be targeted in treatment programs for adolescents who are overweight/obesity for a longer time and are unsuccessful in BMI reduction.

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