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Adolescent girls' eating disordered behaviors and family communication over a four-time period: Latent Growth Modeling (LGM) analysis

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The relationship between adolescent girls' eating disordered behaviors and communication with their parents was investigated in a prospective study over a four year time period using Latent Growth Modeling(LGM) analysis. The sample consisted of 109 adolescent girls varying in the extent of disordered eating behaviors and attitudes and their parents. Assessment instruments completed by the adolescent included the Eating Disorder Risk Inventory(EDRI) and the adolescent form of the Parent-Adolescent Communication Scale(PAC). Their parents completed the parent form of the PAC. Three kinds of results were noteworthy. First, the mean growth curves demonstrated that the adolescents' disordered eating symptoms, in general, tended to decrease as time passed. Second, a linear model was the best fit for all variables except for the adolescent form of the communication with their mothers(ACOMM), of which the quadratic model best captured the observed data. Third, the multivariate analyses suggested that girls with high EDRI scores at the first year were likely to have low communication scores with their parents at the same time period, from the perspectives of both the girls and their parents. The relationships among latent factors showed that over the years, girls with increasingly disordered eating were likely to indicate a decrease in the perceived quality of communication with their mothers and that girls who had high eating disorder symptoms at the first year tended to perceive increased positive communication with their fathers at later years, and vice versa. There were no significant relationships among latent factors between the EDRI and the parent form of the PAC scores. Based on these results, it is concluded that adolescent girls' disordered eating is significantly associated with a change in perceived communication with their mothers and fathers, but this relationship is significant only in the perception of the girls, and not in the perception of their mothers and fathers.

Keywords : LGM analysis, adolescence, eating disorder, family communication

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Many studies have been carried out to explore the family factors that may be related to or predispose to adolescent eating disorders(Calam & Waller, 1998; Casper & Troiani, 2001; Emanuelli et al., 2004; Fornari et al., 1999; Johnson & Flach, 1985; Keel, Heatherton, Hamden, & Hornig, 1997; Kog & Vandereycken, 1989; Leon, Fulkerson, Perry, & Dube, 1994; Scionti, 2001; Thelen & Cormier, 1995; Thienemann, & Steiner, 1993; VanFurth et al., 1996; Wallin & Hansson, 1999; Wisotsky et al., 2003; Wonderlich & Swift, 1990). It is known that these family factors cover both a genetic and an environmental component. For instance, recent studies have indicated a possible genetic factor in the development of eating disorders(Bulik, Sullivan, & Kendler, 1998; Kendler et al., 1991; Lilenfeld et al., 1998). As demonstrated by recent twin and adoption studies, the heritability is estimated to be 55% for bulimia nervosa(Kendler et al., 1991) and 50% for binge eating(Bulik et al.1998). Family studies also indicate that the first- and second-degree relatives of patients with eating disorders have an increased risk of eating disorders and the subthreshold forms(Kassett et al., 1989; Lilenfeld et al. 1998; Strober, Morrell, Burroughs, Salkin, & Jacobs, 1985). There is another line of evidence that indicates how parents' thoughts and attitudes on weight and dieting can affect their children's own attitudes(Keel et al., 1997; Pike & Rodin, 1991;

Thelen & Cormier, 1995). It was found that the daughters' body weight, desire to be thinner, and dieting were positively correlated with their mothers' and fathers' reported encouragement of daughters to control weight(Thelen & Cormier, 1995) and the parents'general weight concerns(Keel et al., 1997). In this manner, it appears evident that family members can have a significant influence on the initiation or maintenance of eating disturbances through certain routes, either through a biological or a psychological route or both.

Studies demonstrating the perception of family relationships have suggested, as possible risk factors for eating disorders, family cohesion and adaptability(Humphrey, 1989; Leon et al., 1994; Wisotsky et al., 2003), communication patterns within the family(VanFurth et al., 1996), and overall family satisfaction(Leon et al., 1999). It was found that the families of bulimic or anorexic youth have lower cohesion and lower adaptability(Leon, Lucas, Colligan, Ferdinand, & Kamp, 1985; Waller, Slade, & Calam, 1990; Wisotsky et al., 2003), and deficiencies in mutual understanding, nurturance, and support(Humphrey, 1986) than their non-eating-disordered counterparts. Studies in the general adolescent population also reveal that less satisfying family relationships were found in the views of adolescent girls and mothers in higher eating disorder risk groups

compared with comparison groups (Calam & Waller, 1998; Emanuelli et al., 2004; Pike & Rodin, 1991). These studies report lower cohesion, lower parent-adolescent communication processes, and less overall family satisfaction in high-risk adolescent girls compared to the control group. Most of these studies demonstrated that adolescent disordered eating was associated with dysfunctional family patterns, but only a few studies indicated that family functioning was a predictor variable for teenage eating problems (Calam & Waller, 1998; Wisotsky et al., 2003).

In addition to dysfunctional family dynamics, perceptual differences among family members about family functioning have been reported in the literature on adolescent eating disorders. Most of these studies suggest a disagreement among daughters, mothers, and fathers, particularly emphasizing the difference between daughters' perspective and that of their parents (Attie and Brooks-Gunn, 1989; Leon et al., 1994; Rowa, Kerig, & Geller, 2001; Wallin and Hansson, 1999; Woodside et al., 1995). The research indicates that the adolescents' perspectives on family functioning reflect a relatively accurate view of the family dynamics, which is expressed in a more negative way than those of their mothers and fathers (Waller et al., 1990). In particular, it is reported that daughters with some types of eating disorders tend to disagree with their parents about family

functioning (Emanuelli et al., 2004; Wallin & Hansson, 1999). Only a few studies, on the other hand, revealed a convergence of the family members' points of view (Emanuelli et al., 2004; Humphrey, 1986, 1989; Pike & Rodin, 1991).

Limitations of past research

From the past research carried out thus far, it is evident that many studies contributed to evidence suggesting the existence of at least a moderate relationship between family dynamics and adolescent eating problems. However, there are several major limitations. Most of all, with several exceptions, the majority of investigations were cross-sectional, indicating a limitation in not being able to infer a causal relationship between two variables. Although causal inferences are still questionable with longitudinal designs, some causal inferences may be at least somewhat more plausible in suitable longitudinal designs as compared to cross-sectional designs. In fact, prospective studies dealing with family environment and eating disturbances in adolescents are few compared to those investigating other risk factors for this problem (Calam & Waller, 1998; Cervera et al., 2003; Killen et al., 1996; Leon, Fulkerson, Perry, & Early-Zald, 1995; Leon, Fulkerson, Perry, Keel, & Klump, 1999). Regarding methodology, most studies-- that is,

a few longitudinal studies as well as cross-sectional studies--simply used ANOVA, MANOVA, multiple regression and so forth, which are said to be an application of the general linear model(GLM). A few longitudinal studies in the past related to the issue of family functioning(Attie & Brooks-Gunn, 1989; Calam & Waller, 1998; Goller, 1994) were conducted with two-time points, only examining time-point snapshots of the process. The progressive change of the problems has also not been researched as yet. The present study, in this regard, is designed to make up for the weaknesses of past studies by comprehensively examining the issue of family dynamics across 4-time points. To our knowledge, no study has thus far been conducted on how change in adolescent eating disturbances is associated with change in communication with the parents.

As stated above, there are some inconsistent findings regarding agreement/disagreement in the perspectives of family dynamics between daughters and their parents. Even though some studies indicated agreement across family members in their perceptions of family functioning(Emanuelli et al., 2004; Humphrey, 1986, 1989; Pike & Rodin, 1991), most studies suggested disagreement across family members. Many of these studies demonstrated that the daughters' perceptions were most sensitively reflecting the families'interactional styles (Emanuelli et al., 2004; Leon et al., 1994; Rowa

et al., 2001; Woodside et al., 1995). There is one example, however, whose results demonstrated the accuracy of maternal ratings instead of daughters' ratings in the family relationships(Attie & Brooks-Gunn, 1989). A prospective study conducted by Attie and Brooks-Gunn showed that daughters' perceptions of family relationships were not associated with self-reported eating problems, whereas maternal ratings of the family relationships predicted the daughters' eating problems. In this manner, it cannot be said as yet as to what factors induce the discrepant results across studies and whose report among family members is most closely related to the daughters'disordered eating behaviors. This study, therefore, was designed to resolve the inconsistent findings of past studies by comparing the perspectives of family communication patterns across family members and finding that whose perception is most closely associated with the daughters' disordered eating behaviors.

Besides these limitations, studies have rarely been carried out systematically regarding the role that fathers play in the family dynamics and their children's problem eating behaviors. Only one study(Goller, 1994) included the fathers as the informants in the two-year prospective study, which failed to evidence the differences in paternal report of family functioning among subjects with different

eating-risk group status. Goller's study(1994), however, has a limitation in that it only covers two time periods with a one-year interval. In addition to the shortage of longitudinal investigations, past research dealing with the father-daughter relationship mostly targeted adults aged twenty or later, as discussed in the previous section. This results in the loss of some important information on the relationship with fathers in the critical period when daughters begin their disordered eating. Hence, the present study attempts to eliminate this cohort effect and overcome some of the limitations of past studies by focusing on pubertal adolescents and their relationships with their parents, over a longer time frame.

Research questions

Therefore, the present study investigated how the changes in perceptions of the quality of parent-adolescent communication over time from the perspective of daughters, mothers, and fathers are related to the changes in problem eating behaviors in adolescent girls. More specifically, the research questions were as following: (1) How do the growth curves of eating-risk symptom scores and of parent-adolescent communication scores of daughters, mothers, and fathers change over time? (2) How are the growth curves in family communication of adolescents, mothers, and

fathers associated with the growth curves in problematic eating behaviors in adolescent girls over the four years? (3) Are there any differences in the perspectives across different family members (daughters, mothers, and fathers) across time in terms of changes of these variables?

METHODS

Participants

The family data for this study are a part of the longitudinal data collected from 1990 through 1993 by Leon and her colleagues(1993, 1995, 1999). The total sample was drawn from a pool of approximately 2,000, 7th through 10th grade, adolescents attending school in a predominantly Caucasian, middle class, suburban, Midwestern school district. Beginning in 1990, these adolescents participated in a four year prospective study of the development of eating disorders. Subjects were categorized as high risk for eating disorders, moderate risk, or comparison group based on their scores on the 21-item Eating Disorder Risk Index(EDRI). The high-risk group consisted of individuals with EDRI scores of 7-15; moderate-risk, 2-6; and comparison 0. For the family study, adolescents who scored high on this risk index over at least a 2-year period were recruited(Leon et al., 1994). The

remaining subjects for the family study were selected through a stratified randomized design. Among the families of 181 adolescents who participated in the first year, the families of 109 adolescent girls together with their mothers and fathers took part in the present study. Due to high attrition rates over the course of a longitudinal study, some families dropped out and adolescent boys were excluded in the present study. The grades in school at the first time of collecting data were 7th(32%), 8th(37%), and 9th(31%), respectively. The majority of subjects were White(96%) and only a small percentage was composed of other ethnicities. Fifty-six percent of the fathers and 41% of the mothers were engaged in executive, administrative, or professional occupations. More than 90% of the subjects lived together with their biological mothers and 74% among them lived together with both their biological mothers and fathers.

Measures

The Parent-Adolescent Communication Scale(PAC; Olson et al., 1985) is a 20-item self-report instrument that assesses parents' and adolescents' perceptions and experiences of communication with each other. Three different forms are used for the adolescents and the parents: parent form, adolescent and mother form, and adolescent and father form. The

items assess processes such as openness between generations, emotional tone of communication, and communication problems. Sample items for this scale are 'I am sometimes afraid to ask my mother for what I want' and 'It is very easy for me to express all my true feelings to my mother.' Individual items are scored on a 5-point scale. High scores indicate more positive communication between a parent and adolescent. Cronbach alpha reliability was .88 in this sample, indicating high internal consistency reliability.

The Eating Disorders Risk Index(EDRI; Leon et al., 1993) consists of 21 items assessed by self-report questionnaire. The 21 items include scores above the 85th percentile on the Eating Disorder Inventory(EDI; Garner et al., 1983) Drive for Thinness and Bulimia subscales, endorsement of menstrual irregularities in females, weight fluctuations of at least eight pounds, bingeing and purging behaviors, strict dieting, and a BMI less than 17 or greater than 30. Leon et al.(1995) reported an alpha reliability of .75 for Year 1 and a two to four week concordance ratio of 96.8.

The Eating Disorders Checklist(EDC; American Psychiatric Association, 1987) is a 24-item survey developed to assess DSM-III-R criteria for eating disorders. The checklist was designed to assess specific DSM-III-R

diagnostic criteria for anorexia nervosa, bulimia nervosa, and subthreshold forms of these disorders and past and current history of diagnosed eating disorders. Items relating to the diagnoses of anorexia nervosa and bulimia nervosa consisted of weight fluctuations, weight gains and losses, dieting, menstrual history, self-induced vomiting, laxative or enema use, bingeing, diet pill use, negative emotions associated with bingeing, and methods used to counteract food consumed during a binge. All item response categories were dichotomous (yes/no). Cronbach's alpha was .78 in this sample.

Procedures

For the purpose of soliciting the participation of family members in the interview, a project staff member telephoned the subjects selected for the family study. Subjects' parents were initially informed of the investigation by letter and subsequently contacted in order to schedule an appointment with the family. A standard script was used by the schedulers. Parents were informed that this procedure was a continuation of the study of nutrition, health, and psychological processes in which the student had already participated. They were informed that their involvement in the study would consist of brief questionnaires about family processes. They were asked to

consent to their children's participation and were told that their adolescent child would be asked to complete the family questionnaires. Either one or two graduate research assistants, depending on the size of the family, visited the subjects' homes. Written consent was obtained from each subject and parent prior to their participation. The parents and subject independently completed the FACES-III, PAC, Family Satisfaction Scale, and a form with the Revised Restraint scale embedded in it. If the stepparent had contact with the subject within the previous two years, he or she was also asked to complete the various assessment instruments. Each parent and adolescent was tracked across four time points and independently completed the same questionnaires that were used at the first year.

Statistical analyses

Even though there are several statistical methods available in analyzing

individual trajectories over time, two distinct frameworks are representative: Hierarchical Linear Modeling (HLM) and Latent Growth Modeling (LGM) in Structural Equation Modeling (SEM) framework. As HLM has been developed and used for nested designs and the present study is not a nested design, the present study employs the LGM. This is the first reason to use LGM method for the analysis of the

present data. The second reason to employ LGM method is that the present data met the assumptions required using LGM. Maximum likelihood estimation of the parameters in LGM assumes that the variables have a multivariate normal distribution in the population. In the present study, the assumption of a normal distribution is met for the four PAC scores and the log transformed EDRI score. LGM also requires a minimum of three time points for proper estimation and time-structured data so that all subjects are observed on the same set of occasions. The present data, in this regard, satisfies this assumption in that it has been collected over four time periods with all subjects being equally spaced. In addition, LGM methodology may make up for the limitations of previous studies. As stated above, most methodologies previous studies used were an application of GLM, of which systematic relations are evaluated pooling across individuals, and the only source of random variation is in the residual(Curran & Hussong, 2003). Latent growth modeling (LGM) or latent trajectory modeling(LTM) within a SEM framework, in this regard, resolves this problem, emphasizing individual patterns of trajectories of behavior over time while avoiding the implication that that such trajectories must include systematic increases or decreases(i.e., growth) to be estimated. For these reasons, LGM is regarded as the best statistical method

over other techniques considering the characteristics of data and research questions.

Proposed and formalized by Meredith and Tisak(1990), SEM-based latent curve modeling has been widely applied in the social sciences. LGM is a "highly structured type"(Curran, 2000, p. 19) of SEM, drawing on many advantages of SEM. Using SEM is advantageous in that it is also possible to investigate the associations between observed and latent variables, enabling us to test a variety of hypotheses. Similar to SEM, LGM focuses on the unobserved, latent factors, not the observed repeated measures over time. More importantly, LGM is based on the premise that we can estimate the underlying latent growth curve or growth components and their relationships given the observed repeated measures over time. In LGM, the passage of time is parameterized via the factor loadings that relate the repeated measures to the latent factors(Meredith & Tisak, 1990). It is through varying the fixed and freely estimated factor loadings that we may define different forms of growth. In LGM, there are two levels of analysis: Level 1 is modeling individual change and Level 2 is modeling interindividual differences in change. Covariance Structure Modeling(CSM) framework in LGM is used in the analysis of Level 2, in which the means, variances, and covariances of the population are estimated, through the process of finding the closest estimates to the

observed data set (Willet & Sayer, 1994). In LGM, it is allowed to test diverse covariance structures by adding, changing, and removing the elements of their components (Λ , Ψ , and Θ_ε), which is a major strength compared to the traditional approaches.

The analyses were carried out in several steps. First, mean growth curves for the EDRI and adolescent- and parent-forms of PAC scores were conducted to figure out overall changes of these variables over the years. Second, to test simple effects for the change of disordered eating symptoms and parent-adolescent communication, univariate analyses were conducted, in which linear and quadratic models were tested with both the homogeneous measurement error model and the heterogeneous measurement error model. Heterogeneous and pair-wise correlated measurement error model was also tested assuming that the errors of one year are correlated with the errors of another year. The purpose of univariate analyses is to evaluate whether a linear or quadratic function of the growth curves fits better for the eating risk symptoms, and parent-daughter communication scores from the perspective of the fathers, mothers, and adolescent. The log transformed EDRI scores were used for the univariate analyses due to a non-normal distribution of the original EDRI scores. For the parent version of the PAC scores, separate

analyses were conducted for mothers and fathers. Finally, multivariate analyses were carried out, combining two univariate latent curve models simultaneously. Conceptually, the multivariate growth model is simply the estimation of more than two univariate growth models. This part of analyses is the most important of all since unlike univariate analysis, in the multivariate analysis, the focus is on finding relation between growth factors of the two constructs. That is, we allow covariances among the factors across constructs and allow constraining nonsignificant values in Ψ matrices or fixing elements in Θ . For the multivariate analyses, four sets of modeling (EDRI x ACOMM, EDRI x ACOMF, EDRI x MCOMM, and EDRI x FCOMM) were carried out. For the multivariate analyses, both raw scores and log transformed scores of EDRI were used, of which better fitting scores were selected and presented. In the present study, all analyses were conducted with LISREL 8.7 (Jöreskog & Sörbom, 2004).

RESULTS

Treating missing variables

To compute the total PAC scores, any missing score was substituted with the individual mean value unless the number of missing score was more than five out of

twenty. The same was applied to the 21 EDRI scores. This mean substitution method is advantageous over other types of deletion methods in that it does not lose information by replacing the missing item with an appropriate individual mean score.

Due to the high attrition rate, it is very common to find missing data points in longitudinal studies. As is the case for the non-normal distribution of the data, these missing data may constitute a serious problem in SEM analyses. In the present data, there are missing scores, as is relatively common in longitudinal studies. Given the pattern of missing cases, however, there seems to be no systematic evidence that adolescents with lower scores or higher scores of EDRI are more likely to have missing data. The four PAC scores also do not show any evidence of non-ignorable missing variables. The Full Information Maximum Likelihood(FIML) method adopts an approach of fitting a likelihood to each individual score in the data matrix. These likelihoods are weighted and summed over all cases and finally result in parameter estimates and standard errors. Rather than the traditional approach to calculating chi-square, FIML estimates two models, the saturated model and the fitted model. The saturated model is a model in which the number of parameters is equal to the number of statistics for the data. The degrees of freedom in the saturated model,

thus, equal zero. The difference between the log-likelihoods of these two models is used to derive the chi-square. Although both methods are currently used in many studies, FIML appears to be the best method for treating missing cases in most SEM analyses (Allison, 2003). Hence, to solve the problem of the missing data, FIML estimation is used for the present data analysis

Evaluation of the data for normality and homogeneity

As stated above, CSM assumes that the data are normally distributed in a maximum likelihood estimation of the parameters. Therefore, we tested hypotheses of skewness and kurtosis of the present data sets and most variables show normal distributions with a p-value range of greater than .05. The four EDRI variables, however, manifest significantly positive skewness and kurtosis, which may cause problems in interpreting the results. After log transformation, the EDRI variables exhibited an improvement in the skewness and kurtosis. For the statistical modeling and univariate analyses of the present study, these log transformed EDRI scores were used. For the multivariate analyses, both raw scores and log transformed scores of EDRI were used, of which better fitting scores were selected and presented.

Mean growth curves

The shapes of the growth curves for the variables (EDRI, four PAC scores) were explored before conducting the modeling processes. The overall mean growth trajectories for the EDRI and PAC scores are presented in Figures 1 and 2. As indicated in Figure 1, the mean of EDRI scores decreased in the second and third years, and stabilized in the final year. This finding illustrates that the adolescents' disordered eating symptoms, in general, tended to decrease as time passed. The four mean trajectories of PAC scores indicate an overall linear shape with minor changes each year. From Figure 2, only the mean change of ACOMM scores

manifested a somewhat different shape from the other communication scores. It is notable that mothers report the highest communication score with the daughters, which implies that the mothers' perspective is colored most favorably in terms of their relationship with their daughters.

On the contrary, adolescents' perspective of the relationship with their fathers showed the least satisfying view, as manifested by the lowest mean levels across all four years. Like mothers, fathers tended to perceive that they were communicating better with their daughters than the daughters did.

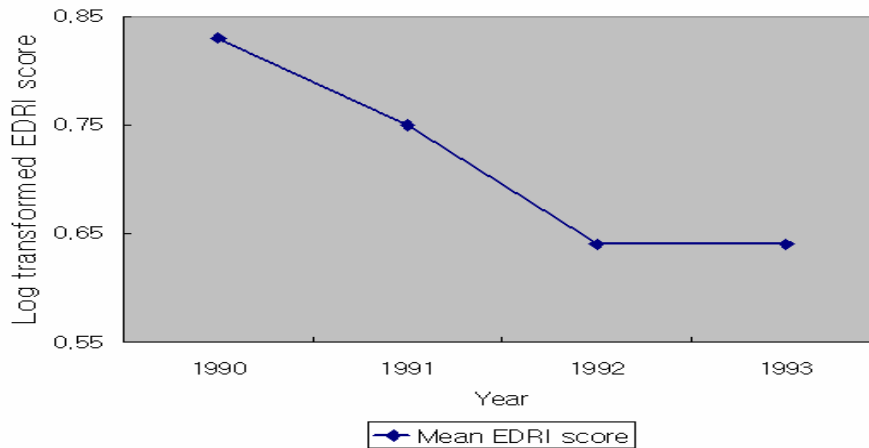


Figure 1. Mean growth curve of EDRI scores over four time points.

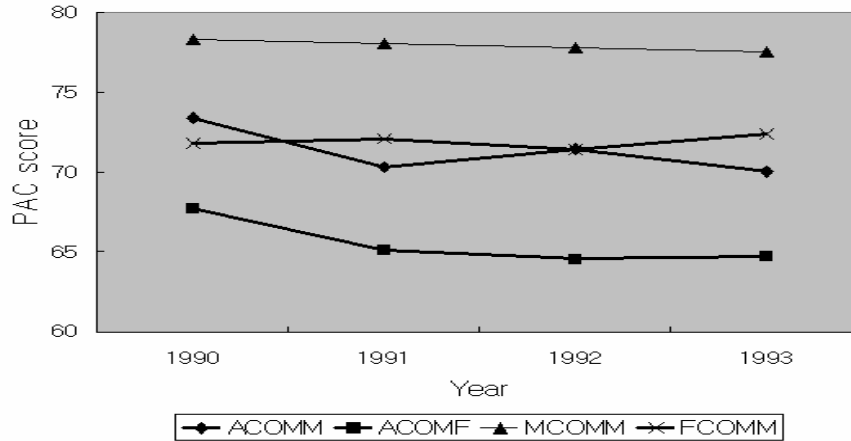


Figure 2. Mean growth curves of four PAC scores over four time points.

ACOMM = Adolescents' communication with mothers; ACOMF = Adolescents' communication with fathers; MCOMM = Mothers' communication with daughters; FCOMM = Fathers' communication with daughters.

Univariate LGM analyses

For the EDRI and each version of the PAC scores, the best-fitting model was selected based on fit indexes such as chi-square test and root mean square error of approximation(RMSEA). For the EDRI scores and all PAC scores(ACOMF, MCOMM, and FCOMM), except for the ACOMM scores, the linear model with heterogeneous measurement errors was the best-fitting. For the ACOMM scores, the quadratic model with homogeneous measurement errors was the best. The parameter estimates and fit indices of the best

-fitting models for these variables are indicated in Table 1. As can be seen in Table 1, in general, the model fittings for the EDRI and ACOMM scores did not seem very promising. For the EDRI scores, the linear model with heterogeneous measurement errors indicated the best fit among the five hypothesized models with a p-value(.087) of greater than .05 and RMSEA(.092) of less than .10. Although these values do not demonstrate an outstanding fit, it gives a reasonably good fit. For the ACOMM scores, the best fitting model is a quadratic model with homogeneous measurement errors(p-value = .11 and RMSEA

Table 1. Parameter Estimates and Fit Indices of the Best Univariate Models for the EDRI and PAC scores

Parameters	EDRI	ACOMM	ACOMF	MCOMM	FCOMM
α	.80**	72.36**	65.95**	77.93**	71.93**
β_L	-.05**	-2.01	-.43	-.20	-.17
β_Q		.45			
ψ_{11}	.53**	121.09**	133.36**	66.14**	114.58**
ψ_{21}	-.02	5.55	-5.94	3.89	-6.82
ψ_{22}	.02**	43.15	10.60**	1.67	7.32**
ψ_{31}		-8.46			
ψ_{32}		-11.74			
ψ_{33}		5.18*			
θ_{11}^e	.20**	43.97**	68.18**	26.83**	15.91**
θ_{22}^e	.15**	43.97**	19.45**	52.74**	12.40**
θ_{33}^e	.10**	43.97**	52.89**	31.35	28.50**
θ_{44}^e	.12**	43.97**	36.73**	41.15	15.47*
χ^2	9.62	7.44	3.02	6.14	3.30
df	5	4	5	5	5
P-value of χ^2	.087	.11	.70	.29	.65
RMSEA	.092	.089	.0	.046	.0

Note. α = mean intercept; β_L = mean linear slope, β_Q = mean quadratic factor; ψ = variance-covariance elements of growth components; θ = measurement error; EDRI = Eating Disorders Risk Index; ACOMM = Adolescent's report of communication with mother; ACOMF = Adolescent's report of communication with father; MCOMM = Mothers' report of communication with the daughter; FCOMM = Fathers' report of communication with the daughter. α

*p < .10. **p < .05.

= .089). Compared to the EDRI and ACOMM scores, model fits for the ACOMF, MCOMM, and FCOMM seemed far better. For the ACOMF scores, a linear model with heterogeneous measurement errors ($\chi^2 = 3.02$, p-value = .0) was considered the best-fitting model. MCOMM (mothers' report of communication with daughters) scores, as with ACOMF, showed a very close fit to the linear models. Both of the quadratic models were invalid because of the problematic non-positive Ψ matrices. Among linear models, a linear model with heterogeneous measurement errors ($\chi^2 = 6.14$, RMSEA = .046) manifested the best fit for the MCOMM scores. For the FCOMM variable, overall model fits were the best compared to other variables, illustrating that all five models are close to the observed data and thus, retainable with all RMSEA values less than .10. A linear model with heterogeneous measurement errors was selected over other models ($\chi^2 = 3.30$, RMSEA = .0) for the FCOMM scores, which was the same as EDRI, ACOMF, and MCOMM scores. As is shown in Table 1, there was a significant intercept effect for all variables, but there was no slope effect except for the EDRI. Also, almost all the variance estimates of each growth component were statistically significant, illustrating that there is evidence of interindividual heterogeneity at both the initial

time point and in the growth component.

Multivariate LGM analyses

For the multivariate analyses, both raw scores and log transformed scores of EDRI were used, of which the better-fitting model was presented. For the EDRI scores and adolescent version of the PAC scores (ACOMM and ACOMF), raw EDRI scores were better-fitting, on the other hand, for the EDRI and parent version of the PAC (MCOMM and FCOMM), log transformed EDRI scores were selected. For the analyses, basically the best-fitting univariate models of each construct were combined. In addition to this basic modeling, there were different models depending on fixing nonsignificant Ψ s to zero. For the multivariate analysis of EDRI x ACOMF, each variance-covariance of Ψ (Ψ_{11} , Ψ_{21} , Ψ_{22} , Ψ_{33} , Ψ_{43} , Ψ_{44}) was fixed to the values in the univariate analyses because the original model was not retainable ($p < .05$). In general, the fits of the multivariate analyses were good, with outstanding fits for the EDRI x MCOMM and the EDRI x FCOMM. As shown in Table 2, the mean estimates of the intercept and the slope of EDRI scores and the intercept of the PAC scores were significant; however, the mean slope of the PAC scores was not. This indicated that the linear change of

Table 2.. Parameter Estimates and Fit Indices of the Best-fitting Models for Multivariate Analyses

Parameters	EDRI x ACOMM	EDRI x ACOMF	EDRI x MCOMM	EDRI x FCOMM
α_1	2.14**	2.05**	.79**	.74**
β_{11}	-.11	-.11	-.05**	-.07**
α_2	72.40**	66.00**	77.97**	71.88**
β_{12}	-2.19*	-.44	-.23	-.15
β_{22}	.45			
ψ_{11}	5.82**	5.36**	.52**	.49**
ψ_{21}	—	.03	-.02	-.04*
ψ_{22}	.28**	.29**	.02**	.02*
ψ_{31}	-10.38**	-9.52**	-1.62**	-1.54*
ψ_{32}	—	—	—	—
ψ_{33}	124.55**	133.36**	73.10**	115.28**
ψ_{41}	2.05	2.43**	—	.30
ψ_{42}	-1.15**	—	—	—
ψ_{43}	—	-5.94	—	-6.69
ψ_{44}	51.06**	10.60**	3.29**	7.27**
ψ_{51}	—	—	—	—
ψ_{52}	—	—	—	—
ψ_{53}	-5.89**	—	—	—
ψ_{54}	-13.92*	—	—	—
ψ_{55}	5.75**	—	—	—
θ_{11}^e	3.35**	3.05**	.21**	.21**
θ_{11}^e	1.85**	1.91**	.15**	.14**
θ_{33}^e	1.10**	1.20**	.10**	.09**
θ_{44}^e	1.71**	1.73**	.12**	.13**

θ_{55}^e	42.76**	62.23**	19.82**	15.86**
θ_{66}^e	42.76**	21.75**	54.15**	12.41**
θ_{77}^e	42.76**	52.40**	32.29**	28.45**
θ_{88}^e	42.76**	37.58**	36.89**	15.66*
χ^2	31.48	42.56	24.70	27.82
df	24	30	26	24
P-value of χ^2	.14	.064	.54	.27
RMSEA	.053	.063	.0	.043

Note. α_1 = Mean intercept for the EDRI score; β_{11} = Mean slope for the EDRI score; α_2 = Mean intercept for the ACOMM score; β_{12} = Mean slope for the ACOMM score; β_{22} = Mean quadratic factor for the ACOMM score; Ψ = variance-covariance elements of growth components; Θ = measurement error.
 *p < .10. **p < .05.

communication scores was not statistically significant. Overall, the variances of the latent factors were significant, implying that there was a significant individual variability in these latent components. Regarding the most interesting question, the relationships among latent factors across constructs, there were significant relationships between Ψ s from the adolescents' perspective. As demonstrated in Table 2, the intercepts of EDRI and communication scores (ACOMM and ACOMF) were significant and negative. It suggests that girls with high EDRI scores at the first year were also likely to have low communication scores with their parents in the

first year. In addition, the slopes of EDRI and ACOMM were significantly and negatively related as manifested by significant Ψ_{42} (= -1.15), indicating that individuals with increasing slopes of the EDRI were likely to have decreasing slopes of the ACOMM. The significant and positive Ψ_{41} (= 2.43) suggests that the intercept of EDRI and the slope of ACOMF were highly associated. This implies that girls who had high eating disorder symptoms in the first year tended to have a more increasing communication with their fathers in later years, and vice versa. Whereas girls' perception demonstrated some significant relationship between the change of their EDRI

scores and the communication with their parents, the mothers' and fathers' perspectives did not indicate these relationships. As demonstrated Table 2, there were no significant relationships among the latent factors except for the ψ_{31} s. Therefore, it is concluded that there were some differences between the daughters' and their parents' perceptions of the changes of these two variables.

DISCUSSION

Growth trajectories of the EDRI and the PAC scores

The first research question was: How do the growth curves of eating-risk symptom scores and of parent-adolescent communication scores of daughters, mothers, and fathers change over time? The findings showed that a linear model with heterogeneous measurement errors was the best-fitting model for the EDRI, ACOMF, MCOMM, and FCOMM scores. This indicates that over the four years of evaluation, these scores manifested a decreasing linear trend with substantially different measurement errors. This implies that positive quality of communication with their fathers as perceived by adolescent girls as well as their disordered eating symptoms had a tendency to linearly

decrease as time passed; and so did the mothers' and fathers' perceived communication with their daughters. Reflecting on the growth curves drawn in Figures 1 and 2, these results appear to be consistent with the data. The finding that the quadratic model with homogeneous measurement errors was the best-fitting model for the ACOMM scores also seems to precisely describe the data, considering its growth curve which gradually decreased for three years and then stabilized. The finding regarding the linear growth trajectories of the adolescent girls' eating disorder symptoms and the communication among family members is new in that, to our knowledge, no study has systematically investigated these issues in a prospective study. This finding, however, needs to be interpreted with caution since there was a range in the age or the grade of the girls at a single time period. Because 7th through 9th graders were analyzed together as Year 1 in this study, further studies distinguishing each cohort are required to clarify the shape of the change of these constructs.

Relationships between EDRI and PAC scores

For the second research question (i.e., How are the growth curves in family communication of adolescents, mothers, and fathers associated with the growth curves in problematic eating

behaviors in adolescent girls over the four years?), the covariances of Ψ matrices in Table 2 address this question. As indicated in Table 2, all the covariances between the intercepts of the EDRI and the PAC scores manifested a significant and negative relationship between the two constructs. This suggests that high scores on disordered eating symptoms of girls at the first year were associated with low scores on communication between girls and their mothers and fathers at the same time point. This finding is consistent with those of previous studies, which found a negative association between various kinds of EDs and family communication patterns (Calam & Waller, 1998; Emanuelli et al., 2004; Goller, 1994; Humphrey, 1986, 1989; Leon et al., 1994; Moreno, Selby, Aved, & Besse, 2000). In addition, as can be seen in Table 2, the intercept of ACOMM scores was significantly and negatively related to the slope and the quadratic factors of the same score. This might reflect "regression towards the mean" in which individuals with high scores at an initial time have a tendency to have lower scores at a later time and vice versa. In the present study, however, this doesn't seem to be the case in that the ACOMM score is the only variable to exhibit this phenomenon; no other constructs showed the significant relationship between intercept and slope.

Regarding the covariances between growth factors across constructs, as shown in Table 2, the covariance of the slopes of the EDRI and the ACOMM reached statistical significance. In other words, the change of adolescent girls' eating disorder symptoms was highly and negatively associated with the change in their perception of their communication with their mothers. This finding can be interpreted in a similar context to Goller's and Leon et al.'s previous investigations conducted with the same data sets as the present study, in which moderate- to high- risk female adolescents perceived less closeness within the family and poorer communication with both parents compared to the comparison group. In the current study, the change of girls' perception of the communication with their fathers, however, was not significantly related to the change in their problem eating behaviors. Instead, the change in their perception of the communication with their fathers was highly associated with their eating disorder symptoms at the first year, as indicated by Table 2. This suggests that girls who reported a large number of disordered eating symptoms at the first year were likely to have more highly increasing positive communication with their fathers at later years, and vice versa. This finding is significant and new in that we can infer that the perception of the communication with their fathers significantly improved from

the perspective of the girls who had high scores on the EDRI scale in the first year. These findings are consistent with the previous studies in the sense that these studies found some associations between father-daughter relationships and the daughters' disordered eating problems (Botta & Dumlaio, 2002; Iniewicz, Jozefik, Namyslowska, & Ulasinska, 2002; McCarthy, 1998; Rowa et al., 2001; Thelen & Cormier, 1995; Woodside et al., 1995). These past studies, however, simply found a correlation between two variables, father-daughter relationships and the daughters' eating problems, without investigating the causality. But the present study is different and significant compared to these past studies, in that it systematically examined the change of the fathers' role after the beginning of their daughters' eating problems and thus, made it possible to infer a possible causal relationship between these variables. After awareness of their daughters' eating problems, the fathers may have become more nurturing and paid more attention to their daughters. But at the current stage, it is premature to draw this conclusion. Further research is required to replicate and clarify the mechanism of the predictive relationship between the girls' eating problems and the father-daughter relationship.

While the change in the adolescents' perspective on the communication with their

parents had a significant relationship with the change of their eating problems, the mothers' and fathers' perspectives of the communication with their daughters did not appear to affect the change in their daughters' eating disorder symptoms. This finding may also be understood as consistent with the findings of Leon's cross-sectional and Goller's two year longitudinal evaluations that did not find significant differences in the parents' perspectives on family communication across different risk groups according to their daughters' EDRI scores.

Multiple perspectives among family members

In sum, there seems to be a distinction among family members in terms of their perception of their communication or relationships with their daughters, which addresses the third research question. From the findings of the present study, it may be inferred that the daughters' perspective is most closely associated with their disordered eating behavior compared to those of their parents. In this regard, the present study adds another line of evidence to past studies that found a lack of agreement or consistency among family members in the perception of their interactions with each other (Emanuelli et al., 2004; Leon et al., 1994; Rowa et al., 2001; Waller et al., 1990; Wallin & Hansson, 1999; Woodside et al.,

1995). This finding is not surprising in that the majority of studies, regardless of the type of sample assessed (clinical versus non-clinical), have consistently found that the adolescents' view of the family environment is more negative compared to that of their fathers and mothers. This finding, however, appears to be inconsistent with Attie and Brooks-Gunn's (1989) and Calam and Waller's (1998) longitudinal studies: these studies found that maternal reports of family dynamics had a predictive power in the development of their daughters' problem eating behaviors, but the daughters' report did not.

In contrast to the present study, Attie and Brooks-Gunn's (1989) and Calam and Waller's (1998) studies were analyzed using methodology such as correlations and multiple regressions to compare and contrast two time points; therefore, their results may have been different from those of the present study. The present study examined the topic in a more comprehensive way. Further longitudinal studies may clarify the concordance/discordance among different family members and possible mechanisms. The present study is also significant because it found that the adolescent girls' perception of the communication with their fathers significantly changed after the initial time period. However, from the current results, it is not clear as yet whether the girls' eating disorder symptoms

predict an increasing positive communication with their fathers, or the initial lack of positive communication between fathers and daughters predisposes the girls to develop eating disturbances. Further research is needed to clarify these issues.

Limitations and future directions

Despite many implications and strengths of the present study stated above, there are some methodological limitations in this study that need to be addressed. These are the problems of non-positive Ψ matrices, small sample size, and violation of the assumption of multivariate normality. As possible causes of non-positive definite matrices, Wothke (1993) suggested the following: too little information provided by the data, outliers and nonnormalities, too many parameters, empirical underidentification, and model misspecification. Reflecting on the characteristics of the present data, the first three (too little information, outliers and nonnormalities, and too many parameters) are likely to explain why some outputs contained non-positive Ψ matrices. Also, the EDRI scores had a problem of some degree of nonnormality and thus, the log transformation method was adopted for normalizing the distribution. For the multivariate analysis, both the raw EDRI scores and the log transformed EDRI scores

were used and the better model was selected. For this reason, the results need to be carefully interpreted even though the reported results seemed to be the "best" models in the hypothesized population.

Here are some suggestions for future research. There is a need for additional family studies with larger sample sizes to eliminate the limitations of the present study. Most of all, the failure to use a Cohort Sequential Design (CSD) likely lost some important information in the present study and also leads us to the difficulty in generalizing results of the present study to the general adolescent populations. Further longitudinal studies using CSD might provide somewhat different results from those of the present study, in that those using the CSD will produce a more differentiated analysis based on each distinct cohort. Also, more prospective studies with larger samples will avoid the problems associated with small sample size, such as non-positive definite matrices and non-convergence of the data analysis.

In addition to this methodological improvement, further research is required for conceptual clarification. The present study found that the slope of the girls' eating disorder symptoms and the slope of the girls' perceived communication with their mothers were highly correlated. But it is not clear as yet as to

which variable predicts or predisposes toward the other variable. Likewise, the intercept of the girls' eating disorder symptoms and the slope of the girls' perceived communication with their fathers were significantly associated. Even if we can infer that there is increasingly positive communication between fathers and daughters after the disordered eating problems started, one still needs to investigate the causality between adolescent girls' disordered eating behaviors and the father-daughter communication patterns. Moreover, additional family studies based on clinical eating disorder populations are worth investigating in order to track the change of overall family functioning as the patients recover or get worse in the course of their illness.

One of the important findings of this study was disagreements among family members in the perceptions of family communication and the girls' eating disorder symptoms, particularly between the adolescents themselves and their parents, which has been demonstrated by many previous studies. Considering this point, it will be important to conduct studies with samples of adolescents with eating disorder problems, their siblings and parents, to better identify the similarities and differences among them. This type of larger-scale study will contribute to the body of knowledge by comparing multiple informants' perceptions of the same phenomenon.

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청소년기 여학생들의 섭식장애행동과 가족간 의사소통에 관한 4년 종단연구: 잠재성장모형 분석을 통하여

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이 논문에서는 청소년 여학생들의 섭식장애 행동과 그들 부모와의 의사소통간의 상관관계가 4년에 걸친 종단연구를 통해 평가되었다. 방법론으로는 잠재 성장모형이 사용되었다. 연구 피험자로는 미네소타 교외의 학교구역에서 추출된, 각기 다른 정도의 식이장애 행동과 태도를 보이는 109명의 청소년 여학생들과 그들의 부모들이 선택되었다. 여학생들에 대한 측정도구들로는 섭식장애 위험 척도(Eating Disorder Risk Index)와 부모-자녀간 의사소통 척도(Parent-Adolescent Communication)가 사용되었다. 부모들에게는 부모 판 척도가 사용되었다. 크게 두 가지 결과가 주목할 만하다. 첫째, 이질적 측정 오류의 직선 모형이 섭식장애 위험 척도와 모든 부모-자녀간 의사소통 척도 들에 가장 잘 부합하는 모형으로 드러났다. 단, 청소년들이 보고한 어머니와의 의사소통 변수에 있어서는, 동질적 측정 오류의 이차방정식 모형이 가장 잘 일치하는 모형이었다. 둘째, 다변량 분석 결과에 의하면, 섭식장애 위험 척도와 각각의 부모-자녀간 의사소통 점수간의 절편들이 유의미한, 부적 상관관계를 보였다. 이 결과는, 여학생과 부모 양측의 관점에서 볼 때, 첫째 년도에 높은 섭식장애 문제를 가졌던 아이들은 같은 시기에 자신의 부모와 의사소통이 잘 되지 않았을 확률이 높다는 것을 제시한다. 성장곡선에서 섭식장애 위험 척도와 청소년 판 어머니와의 의사소통 척도 간의 기울기가 유의미한, 부적 상관관계를 보인다는 것은, 수 해에 걸쳐 섭식문제가 증가한 여학생들은 그들의 관점에서 본 어머니와의 의사소통이 상대적으로 점차 감소하는 경향이 있다는 것을 보여준다. 섭식장애 위험 척도 점수의 절편이 청소년의 관점에서 본 아버지와의 의사소통 변수의 기울기와 통계학적으로 유의미한 관계가 있다는 것은, 첫 해에 많은 섭식장애를 가지고 있던 여학생들이 이후에 아버지와의 의사소통이 증가하는 것으로 인지하는 경향이 있다는 것과 그 역으로도 작용한다는 것을 나타낸다. 섭식장애 위험 척도 점수와 부모 판 부모-자녀간 의사소통 점수들 사이의 잠재 요인들 간에는 어떤 유의미한 상관관계도 발견되지 않았다. 이 결과들에 근거하여, 다음과 같은 결론을 얻을 수 있다. 청소년 여학생들의 섭식장애는 그들이 인지한 부모와의 의사소통 변화와 유의미하게 관련되어 있다. 그러나, 이 관련은 단지 여학생들의 관에서만 유의미하고, 부모는 자녀가 인지하는 이 상관관계를 인식하지 못하고 있다.

주제어 : LGM 분석, 청소년기, 섭식장애, 가족관계