Structural Equation Modeling of Risk Factors for the Development of Eating Disorder Symptoms in Female Athletes

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Risk factors for the development of eating disorder symptoms in female college athletes were studied using structural equation modeling. Three risk factors: social influence for thinness, athletic performance anxiety, and self-appraisal of athletic achievement, were selected for study. The association of these risk factors and eating disorder symptoms was hypothesized to be mediated by overconcern with body size and shape. The study sample was 98 women recruited from eight sports teams at a major university. Structural equation modeling analysis supported the hypothesized model and cross-validation of the model showed the findings to be stable. The results of this correlational study suggested that eating disorder symptoms in college athletes are significantly influenced by the interaction of sociocultural pressure for thinness, athletic performance anxiety, and negative self-appraisal of athletic achievement. If these risk factors lead to overconcern with body size and shape, then the emergence of an eating disorder is more probable. © 1995 by John Wiley & Sons, Inc.

Recent etiological models of anorexia and bulimia nervosa have emphasized the importance of overconcern with body size, fear of fatness, and body image disturbances as central underlying psychopathological features of the eating disorders (Schlundt & Johnson, 1990; Slade, 1988; Rosen, 1992; Thompson, 1990; Williamson, 1990). Others (e.g., Levine & Smolak, 1992; Striegel-Moore, Silberstein, & Rodin, 1986) have noted that
preoccupation with weight and dieting is so pervasive among young women that it has become normative. Therefore if excessive concern about weight were the sole determinant of eating disorders, we might expect most young women to be afflicted by significant problems related to eating, weight, and body shape.

Based on this formulation, researchers in this area have proposed a number of additional “risk factors” for the development of eating disorders (Stiegel-Moore et al., 1986). Psychosocial variables that have received considerable attention as potential risk factors are: social pressure for thinness (Brownell, 1991), teasing about appearance (Rosen, 1992; Thompson, 1992), low self-esteem (Shatford & Evans, 1986), negative affect/stress (Shatford & Evans, 1986), and negative self-evaluation of achievement (Stiegel-Moore, 1993).

This study was designed to evaluate a psychosocial model of the eating disorders using structural equation modeling. The study sample was composed of female student athletes from a major university. Female athletes were selected for study because they are considered to be an “at risk” population due to psychosocial pressure to maintain a thin body shape in certain sports, for example, gymnastics and swimming (Brownell, Rodin, & Wilmore, 1992; Striegel-Moore et al., 1986).

The psychosocial model tested in this study postulated that overconcern with body size and shape was a mediating variable for three risk factors determining the symptoms of anorexia and bulimia nervosa in college female athletes. The three risk factors of the model were: (a) psychosocial pressure for thinness, (b) anxiety about athletic performance, and (c) negative evaluation about athletic achievement. This psychosocial model was tested with structural equation modeling using the LISREL VII package (Joreskog & Sorbom, 1989).

Figure 1 presents a psychosocial model of the eating disorders for female athletes that was tested in this study. The model has three antecedent risk factors, a mediating variable, and a pathological behavioral consequence. The antecedent risk factors are: perceived influence/pressure to maintain a thin body shape from coaches and teammates (SOC INFL), anxiety concerning athletic performance (PERF ANX), and self-appraisal of athletic achievement (ATH SELF-APP). Overconcern with body size and shape (BODY CONCERN) was hypothesized to be the mediating variable between these risk factors and symptoms of anorexia and bulimia nervosa (ED SYMP).

**METHOD**

**Subjects**

A sample of 98 female college athletes from a major state university (31 swimmers, 7 tennis players, 9 basketball players, 12 volleyball players, 14 gymnasts, 10 track team members, 7 cheerleaders, and 8 members of the dance team) participated in the study. All subjects participated voluntarily. They received feedback on the results of the evaluation and some were referred for further counseling. The mean age of the subjects was 19.6 years (SD = 1.59). Average weight was 63.7 kg (SD = 26.8). Seventy-three percent of the sample was Caucasian, 18% was African-American, and 9% was Hispanic.

**Assessment Methods**

Subjects were tested using questionnaires designed to measure: social influences for thinness, sports competition anxiety, athletic achievement, and concern with body size
and shape. They were also interviewed for evaluation of eating disorder symptoms. Each of these assessment methods is described in more detail below.

**Social Influence**
Social influence for thinness was measured with five items designed specifically for this study. These items assessed the degree to which the subject perceived pressure about body weight or size from coaches and teammates. Coefficient alpha for the five items combined was .69.

**Performance Anxiety**
Sports anxiety was measured using the Sports Competition Anxiety Test (SCAT; Martens, 1977). Scores on the SCAT defined Performance Anxiety in Figure 1.

**Athletic Self-Appraisal**
To measure the subject’s appraisal of her athletic achievement, a five-item scale assessing a positive self-appraisal of athletic achievement was developed. Coefficient alpha for this five-item scale was found to be .84.

**Overconcern with Body Size**
The Body Shape Questionnaire (BSQ; Cooper, Taylor, Cooper, & Fairburn 1987) was selected to measure excessive concern about body size and shape.

**Eating Disorder Symptoms**
The Interview for Diagnosis of Eating Disorders (IDED) was used to assess the presence and severity of eating disorder symptoms (Williamson, 1990). The IDED is a structured interview for diagnosing anorexia and bulimia nervosa using the criteria established by the American Psychiatric Association (1987), DSM-III-R. For the purposes of this study the nine symptom ratings of the IDED anorexia and bulimia nervosa scales were summed to yield a single indicator of eating disorder symptoms to define EATING DISORDER SYMPTOMS in Figure 1. Coefficient alpha for this measure was .87.
Procedures

All subjects had volunteered to participate in a larger psychological evaluation project. The measures used in this experiment were administered in the context of other questionnaires and interviews that surveyed a broader range of psychological and behavioral characteristics.

ESTIMATION PROCEDURES

The psychosocial model in Figure 1 was tested via LISREL VII (Joreskog & Sorbom, 1989) with a correlation matrix as input. For this study, we used the summed-item measures of the constructs to operationalize the model and incorporated random measurement error into the model by fixing the measurement loading of each construct to the square root of its coefficient alpha internal consistency estimate and the error loadings to one minus alpha (Joreskog & Sorbom, 1989).

The model was estimated using the entire sample and the model was cross-validated using splits of the sample. Cross-validating a model entails splitting the sample into two groups, estimating the model with one group, and then re-estimating the model with the other group. The fit and path estimates for the two groups are then compared to determine if the model "held" across the two groups (Cudeck & Browne, 1983). Although a totally random split of the entire sample is recommended, we split the sample such that each group had an approximately equal number of swimmers, tennis players, basketball players, volleyball players, gymnasts, track athletes, and other sports. The split by each sport, however, was random. This approach to splitting the sample was taken because previous research has shown that different sports are associated with different prevalence rates for eating disorder symptoms (Borgen & Corbin, 1986).

RESULTS

Overall Sample

The top portion of Table 1 presents zero-order correlations among the constructs for the entire sample. As the table suggests, a relatively high degree of correlation was found among eating disorder symptoms, concern with body size, and proposed antecedents.

Table 1 also presents the causal model estimates. Several fit indices (reported in the middle of Table 1) and path significance tests (bottom section of Table 1) were used to evaluate the model. The goodness-of-fit index (GFI) and the adjusted-goodness-of-fit index (AGFI) generated by the LISREL package were .967 and .835, respectively. These values suggest good fit (values in the .80 and above range are advocated as acceptable). Two other fit indices that have been viewed as robust to sampling characteristics, the Tucker-Lewis index (TLI) and Bentler’s (1990) comparative fit index (CFI) also suggested good fit.

The lower portion of Table 1 indicates that all standardized structural path estimates were significant in the predicted direction ranging from .23 to .86 (p < .01). Figure 2 summarizes the relationships found among the variables.
Table 1. Correlations among constructs and causal model estimates

<table>
<thead>
<tr>
<th>Correlations Among Constructs</th>
<th>SOC INFL</th>
<th>PERF ANX</th>
<th>ATH SELF-APP</th>
<th>BODY CONCERN</th>
<th>ED SYMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOC INFL</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>PERF ANX</td>
<td>-.114ns</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>ATH SELF-APP</td>
<td>-.219</td>
<td>-.227</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>BODY CONCERN</td>
<td>.360</td>
<td>.299</td>
<td>-.382</td>
<td>-.350</td>
<td>-.738</td>
</tr>
<tr>
<td>ED SYMP</td>
<td>.278</td>
<td>.189</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

Casual Model Estimates

<table>
<thead>
<tr>
<th>Fit Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\chi^2$</td>
</tr>
<tr>
<td>Total sample</td>
</tr>
<tr>
<td>Group 1</td>
</tr>
<tr>
<td>Group 2</td>
</tr>
</tbody>
</table>

Path Estimates

<table>
<thead>
<tr>
<th>Total Sample</th>
<th>Group 1</th>
<th>Group 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOC INFL → BODY CONCERN: $\gamma_{11}$</td>
<td>.450</td>
<td>.550</td>
</tr>
<tr>
<td>PERF ANX → BODY CONCERN: $\gamma_{12}$</td>
<td>.352</td>
<td>.263</td>
</tr>
<tr>
<td>ATH SELF-APP → BODY CONCERN: $\gamma_{13}$</td>
<td>-.234</td>
<td>-.161ns</td>
</tr>
<tr>
<td>BODY CONCERN → ED SYMP: $\beta_{21}$</td>
<td>.864</td>
<td>.868</td>
</tr>
<tr>
<td>SOC INFL → PERF ANX: $\phi_{12}$</td>
<td>-.161ns</td>
<td>.032ns</td>
</tr>
<tr>
<td>SOC INFL → ATH SELF-APP: $\phi_{13}$</td>
<td>-.293</td>
<td>-.353</td>
</tr>
<tr>
<td>PERF ANX → ATH SELF-APP: $\phi_{23}$</td>
<td>-.294</td>
<td>-.281*</td>
</tr>
</tbody>
</table>

Note. "ns" denotes path coefficients that were not significant. All other paths were significant at the .05 level or better with the exception of those marked by (*), which were significant at the .10 level.

Test of the Mediation Hypothesis

The effects of SOC INFL, PERF ANX, and ATH SELF-APP on ED SYMP were modeled as mediated through BODY CONCERN. This mediation hypothesis was tested using a procedure suggested by Baron and Kenny (1986). Evidence for the mediation of eating disorder symptoms by overconcern with body size was supported.

Cross-Validation

Cross-validation estimates are also presented in Table 1 (the split-half samples are referenced as Group 1 and Group 2). The fit statistics showed acceptable levels of fit for both groups, and with the exception of the ATH SELF-APP → BODY CONCERN path ($\gamma_{13}$) in Group 1, all paths were significant and in the predicted direction ($p < .05$). Thus, evidence for cross-validation was found. To offer a more stringent test of cross-validation, multigroup analyses using LISREL VII was performed. Using multigroup analyses, relationships among constructs was found to be invariant across Groups 1 and 2.

DISCUSSION

The results of this study supported the prediction that overconcern with body size was a primary and strong mediator of other risk factors for developing eating disorder symp-
Figure 2. Results of the structural modeling analysis of the psychosocial model of risk factor for developing eating disorder symptoms in female college athletes. The variables in the model were: social influence/pressure for thinness, athletic performance anxiety, appraisal of athletic achievement, concern about body shape and size, and eating disorder symptoms.

toms in female athletes. Risk factors that were mediated by overconcern with body size were: social influence for thinness, anxiety about athletic performance, and negative appraisal of athletic achievement. It is important to note that these risk factors were not strongly predictive of eating disorder symptoms without mediation through overconcern with body size. The stability of this model was demonstrated via cross-validation of the model on split-halves of the sample.

The finding that eating disorder symptoms were strongly associated with overconcern with body size is consistent with several prospective (Attie & Brooks-Gunn, 1989) and cross-sectional (Fabian & Thompson, 1989; Leon, Fulkerson, Perry, & Cudeck, 1993) studies that have found body dissatisfaction to be predictive of eating disorder symptoms in nonclinical samples of young women and adolescent girls. These and other studies have found a history of teasing about body size (Thompson, 1991), negative self-appraisal of achievement (Levine & Smolak, 1992), and negative affect (Fabian & Thompson, 1989; Leon et al., 1993) to also be predictive of eating disorder symptoms. Of the investigations of risk factors for eating disorder, this was the first to use structural modeling analysis to test the hypothesis that overconcern with body size mediated the influences of social pressure for thinness, negative emotionality, and negative appraisal of achievement. Confirmation of this hypothesis provides support for recent theories of the eating disorders which postulated that body image disturbance and body dysphoria are primary determinants of anorexia and bulimia nervosa (Rosen, 1992; Slade, 1988; Thompson, 1992; Williamson, 1990).

In summary, a psychosocial model of risk factors for developing eating disorder symptoms in female college athletes was validated in this investigation. The model suggested that social pressure for thinness from coaches and peers, combined with anxiety about athletic performance and negative self-appraisal of athletic achievement was associated with increased concern about body size and shape. Excessive concern about body size mediated these antecedent risk factors and eating disorder symptoms. From this model, we can conclude that eating disorders in collegiate athletes are multidetermined and are not simply a function of the emphasis on thinness in some women's sports, or the personality characteristics of some young women. More likely, several risk factors must occur during the same time period to cause overconcern with body size and shape,
which in turn leads to pathological eating, dieting, and purgative habits, as suggested by Levine and Smolak (1992).

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REFERENCES
