Title
Changes in Body Weight, Body Composition, and Eating Attitudes in High School Wrestlers

Running Head
Changes in Body Weight and Body Composition in Wrestlers

Authors
Lenka Humenikova Shriver, PhD, 311 Human Environmental Sciences, Department of Nutritional Sciences, Oklahoma State University, Stillwater, OK 74078; Phone: (405) 744-8285; Fax: (405) 744-1357; Email: lenka.humenikova@okstate.edu

Nancy Mulhollen Betts, PhD, RD, 301 Human Environmental Sciences, Department of Nutritional Sciences, Oklahoma State University, Stillwater, OK 74078; Phone: (405) 744-5040; Fax: (405) 744-1357; Email: nancy.betts@okstate.edu

Mark Edward Payton, PhD, 301B Math Sciences Building, Department of Statistics, Oklahoma State University, Stillwater, OK 74078; Phone: (405) 744-5684; Fax: (405) 744-3533; Email: mark.payton@okstate.edu

Corresponding Author
Lenka Humenikova Shriver, PhD, 311 Human Environmental Sciences, Department of Nutritional Sciences, Oklahoma State University, Stillwater, OK 74078; Phone: (405) 744-8285; Fax: (405) 744-1357; Email: lenka.humenikova@okstate.edu
Abstract

**Background:** Many wrestlers engage in chronic dieting and rapid “weight-cutting” throughout the year to compete at a category below their natural weight. Such weight management practices have a negative influence on the health and nutritional status, thus the National Wrestling Coaches Association has implemented a new weight management program for high school wrestlers in 2006.

**Purpose of the study:** The purpose of this study was to determine whether seasonal changes in weight, body fat, and eating attitudes occur among high school wrestlers after the implementation of the new weight management rule.

**Methods:** Fifteen high school wrestlers participated in the study. Wrestlers’ weight, body composition and eating attitudes were measured during pre-season, in-season and off-season. Body fat was assessed using Dual Energy X-ray Absorptiometry. Attitudes towards dieting, food, and body weight were assessed using the Eating Attitude Test (EAT).

**Results:** No significant changes in body fat were detected from pre-season to off-season. Weight increased from pre-season to in-season (p<0.05) and off-season (p<0.05). While the EAT score did not change significantly from pre-season to off-season, 60% reported “thinking about burning up calories when exercising” during pre-season and only 40% felt that way during the season (p<0.05) and 47% during off-season (p<0.05).

**Conclusions:** The wrestlers experienced a significant weight gain from pre-season to off-season with no significant changes in body fat. The wrestlers’ eating attitudes did not change significantly from pre-season to off-season in this study; however, further research utilizing a large sample of high school wrestlers is warranted to confirm these findings.
INTRODUCTION

Many wrestlers compete at a lower body weight compared to their training weight in order to gain a competitive advantage (Horswill, 1993; Klinzing & Karpowicz, 1986). Thus, drastic weight fluctuations and repeated weigh losses and weight gains are common among wrestlers during the year (Alderman et al., 2004; Oppliger et al., 2003; Kinningham & Gorenflo, 2001). Wrestlers are also known to use extreme techniques to “cut” weight and body fat during season (Horswill, 1993; Davis et al., 2002; Woods et al., 1988). Weight loss is most commonly achieved through dehydration, dieting, and an increase in the amount and/or intensity of training (Oppliger et al., 200; Woods et al., 1988; Steen & Brownwell, 1990). Because wrestlers utilize two or more of these techniques simultaneously, rapid weight loss can be achieved within a short period of time (Ransone et al., 2004). In a study by Nitzke et al. (1992) collegiate wrestlers reported losing 9-11 pounds before a match and their mean weight loss during a 1-week “weight cutting” period was 13 pounds.

Drastic weight fluctuations can adversely affect wrestlers’ athletic performance primarily due to the effects of dehydration (Casa et al., 2005; Hancock & Vasmatzidis, 2003; Armstrong et al., 1997; Sawka & Coyle, 1999; Rankin et al., 1996; Webster et al., 1990). Many wrestlers also engage in starvation, chronic dieting and avoidance of certain foods throughout the year that may compromise their nutritional status. Low-calorie diets and inadequate carbohydrate consumption may not only impair recovery but can also lead to an excessive utilization of protein for energy (Houston et al., 1981; Roemmich & Sinning, 1997).

Some studies also suggest that wrestlers have an increased prevalence of disordered eating compared to other male athletes and non-athletes (Byrne & McLean, 2002; Oppliger et al., 1993). For example, Oppliger et al. (2003) found that as many as 80% of collegiate wrestlers
engage in dieting, more than 50% use fasting and approximately 75% increase their training load in order to lose weight. Another study revealed that wrestlers scored significantly higher on the drive for thinness scale of the Eating Disorder Inventory during season compared to wrestlers in off-season and non-wrestlers (Dale & Landers, 1999).

The potential development of eating disorders and the use of starvation and dieting are of concern especially among adolescent athletes who are vulnerable to the negative influences of inappropriate weight management and may suffer from disrupted growth and development (Woods et al., 1988; Oppliger et al., 1996; Saarni et al., 2006). Thus, the National Wrestling Coaches Association (NWCA) and the National Federation of State High School Associations (NFHS) enforced a new weight management rule designed to minimize the use of “weight cutting,” and to improve the nutritional and health status of high school wrestlers around the country (NWCA, 2008). Under the new weight management program, the minimum wrestling weight for each wrestler is established using body composition and hydration assessment prior to the beginning of the season (NWCA, 2008). Furthermore, wrestlers are not allowed to compete below their minimum wrestling weight and/or lose more than 1.5% of their body weight per week (NCWA, 2008). The purpose of this study was to determine whether substantial changes in body weight, body composition, and eating attitudes occur in a sample of high school wrestlers from pre-season to off-season following the implementation of the new weight management program.

METHODS

This prospective descriptive study was conducted during the 2006-2007 wrestling season (late October through April) in a mid-western state in the U.S. A convenience sample of high
school wrestlers from two schools was utilized in the study. The principals from each school were informed about the nature and the scope of the study and written consent was obtained. Wrestling coaches and/or athletic trainers in each school were familiarized with the research project and a detailed description of study procedures was provided. High school wrestlers with a wide range of wrestling experience were recruited for the study through coaches and/or athletic trainers. Because all wrestlers were under the age of 18, a written informed consent was obtained from at least one parent. Each wrestler was asked for assent prior to data collection. The study was approved by the University Institutional Review Board.

The study was conducted in three phases, including pre-season, in-season, and off-season. One lab visit was scheduled with the wrestlers in each phase. Data were obtained from all the participating wrestlers within 2 weeks during each phase of the study to minimize any effects of the wrestling season on the measurements. Body composition of the wrestlers was determined using a whole body scan performed by the Dual Energy X-ray Absorptiometry (DEXA QDR 4500A, Hologic Inc., Bedford, MA). The DEXA instrument was calibrated, following the manufacturer’s protocol in the morning hours on each data collection day. A spine phantom calibration was used to ensure that the system and software were scanning properly prior to testing. The quality control for body composition measurements was conducted using a step phantom calibration. The coefficient of variation for the whole body scan was <1% during the study. The proportion of fat mass (% of body fat) was determined from the DEXA scan for each wrestler. Subjects were weighed using a digital scale (Seca 664, Hamburg, Germany) and their height was measured using a wall-mounted stadiometer (Harpenden, Holtain, Crymmych, Pembrokeshire, United Kingdom) and standard procedures with head, shoulders, buttocks, and
heels touching a vertical wall behind them (United Department of Health and Human Services, 2006).

The Eating Attitude Test (EAT) was completed by every wrestler during each phase of the study. The EAT is a standardized measure of symptoms and concerns that are characteristics of eating disorders that has been used with wrestler populations in previous studies (Garner et al., 1982; Enns et al., 1987). The questionnaire consists of 26 items that are scored using 6 answer options with the following scores (0=never, 0=rarely, 0=sometimes, 1=often, 2=usually, and 3=always). A score of ≥20 is indicative of symptoms and concerns about eating disorders. The EAT can also be analyzed using three individual subscales (Dieting, Bulimia and Food Preoccupation, and Oral Control) and a score for individual items within each subscale are added (Garner et al., 1982; Garner & Garnfinkel, 1979).

Statistical Analysis

The statistical analysis was conducted using SPSS 16.0 (Windows, Chicago, IL, 2008). Descriptive statistics were used to describe characteristics of the wrestlers who completed all three measurements (pre-season, in-season, and off-season) and to summarize their responses to individual EAT items. Repeated measures Analysis of Variance (ANOVA) procedures were used to assess the effect of season on body weight, body fat, and the overall EAT score. Change in height across the three data collection points was used as a covariate to remove the effect of height on changes in the main outcome variables from the pre-season to in-season and off-season. Pair-wise comparisons using the Least Significant Differences (LSD) post hoc method was utilized when appropriate. Chi-square statistics were used to test for significant associations
between the wrestlers’ responses to individual EAT items and season (0=never/rarely/sometime; 1=often, usually/always). The level of significance for all statistical tests was set at p<0.05.

RESULTS

Out of 24 wrestlers who participated in the study, 15 wrestlers completed all three measurements. The wrestlers were 15.5±0.3 years old and the majority of them were Caucasian (n=10) with 4 Native Americans and 1 African Americans. The subjects’ anthropometric characteristics are presented in Table 1. The wrestlers’ body weight and height increased significantly from pre-season to off-season (Table 1). After adjusting for height, the mean increase in body weight was 3.2 kg from pre-season to off-season. No significant changes in body fat were detected from pre-season to off-season. Body fat was significantly positively correlated with wrestlers’ body weight throughout the study (pre-season r=0.84; season r=0.82; off-season r=0.82; p<0.05).

The wrestlers’ total EAT score was not significantly different between pre-season, in-season, and off-season (p=0.4). One wrestler earned a score of ≥20 during all three seasons (pre-season=25; in-season=21, off-season=29). Wrestlers scored somewhat higher, although not significantly, on the Dieting subscale of the EAT in pre-season compared to in-season and off-season (4.8±1.1 vs. 3.9±1.1 and 3.5±1.1). The Bulimia and Food Preoccupation subscale (0.3±0.2; 0.07±0.1; 0.30±0.2) and the Oral Control subscale (3.2±0.7; 3.5±0.7; 3.1±0.7) scores were similar from pre-season to off-season. Chi-square analysis of individual EAT questions by season did not detect significant difference in the wrestlers’ responses to EAT questions except for one item that was related to “thinking about burning calories when exercising” (Table 2).
DISCUSSION

The purpose of this study was to determine whether changes in weight, body composition and eating attitudes occurred in a sample of high school wrestlers from pre-season to off-season after the initiation of the new weight management program. The results of our study show that the wrestlers did not experience a significant decrease in their body fat from pre-season to in-season. Furthermore, our findings indicate that the wrestlers experienced an increase in body weight from pre-season to off-season. While the small sample size limited the analysis of the eating attitudes, the wrestlers in our study appeared to maintain similar attitudes throughout the year with the exception of one EAT item.

The wrestlers participating in our study increased their body weight during the year and gained, after adjusting for height, 3.2 kg from pre-season to off-season. These results are consistent with previous studies that reported weight gain ranging from 2 to 6 kg among high school and/or collegiate wrestlers from pre- or mid-season to off-season (Steen & Brownell, 1990; Roemmich & Sinning, 1997; Buford et al., 2006). The non-significant changes in body composition were also consistent with previous studies and were expected due to the relatively short period of time between pre-season and off-season (Roemmich & Sinning, 1997; Schmidt et al., 2005; Utter et al., 2002).

Previous research has reported that wrestlers usually reach their lowest weight during the peak season (Roemmich & Sinning, 1997). The wrestlers in our sample, however, did not experience a significant weight loss from pre-season to in-season and in fact gained a small but significant amount of weight from pre-season to in-season. This finding may be explained by the fact that our wrestlers were subjected to the new weight management rule under which their minimum wrestling weight was established prior to the season (NCWA, 2008). As part of the
new rule, wrestlers were not allowed to compete below their minimum wrestling weight and/or lose more than 1.5% of their body weight per week (NCWA, 2008). Thus, our findings suggest that the new weight management program may have contributed to a less frequent use of drastic weight cutting techniques among the wrestlers during the in-season.

The wrestlers’ total EAT score in our study did not change significantly from pre-season to off-season; however the Chi-square analysis of the individual EAT items revealed that a significantly larger number of wrestlers reported “thinking about burning calories when exercising” during pre-season compared to in-season and off-season. In addition to this significant finding, our study identified some interesting trends in the data that should be investigated with a larger sample of high school wrestlers in future studies. For instance, five wrestlers reported “being afraid of overweight” (often to always) in pre-season compared to only two wrestlers who felt that way during in-season and off-season. Because both of these items were part of the Dieting scale of the EAT, it is not surprising that our wrestlers scored somewhat higher on the Dieting subscale during pre-season compared to the rest of the year. Although this difference was not statistically significant, it is likely that the small sample size influenced the statistical significance of the results. Additionally, it is also important to note that two wrestlers who dropped out of the study before the off-season measurements reported that they had an impulse to vomit and actually vomited after meals in pre-season while no wrestlers reported this behavior during in-season or off-season. This trend is consistent with research by Oppliger et al. (1993) who found that 45% of 713 high school wrestlers in Wisconsin met two or more criteria for bulimia nervosa. Given the trends observed in our study, further research on changes in eating attitudes of high school wrestlers are warranted with a large and representative sample in the future.
While our study contributes significantly to the current knowledge related to weight, body fat and eating attitudes among high school wrestlers, it has several limitations that should be addressed in future research. First, our study utilized a relatively small sample size that limits the power of the statistical analysis and generalizability of the results. However, it is important to note that the smaller sample size allowed for the evaluation of the wrestlers’ body composition using DEXA which is currently considered to be the gold standard of body composition assessment (Silva et al., 2006). Second, three wrestlers in pre-season, four wrestlers during season, and seven wrestlers in off-season did not complete all three measurements due to illness and/or injuries. Thus, a follow-up of all subjects participating in the study (n=24) was not possible from pre-season to off-season. Third, because the EAT was not designed to be used as a diagnostic tool for eating disorders, our analysis refers to signs and concerns about eating disorders rather than a diagnosis of eating disorders. Thus, additional research instruments should be used to determine the prevalence of eating disorders among high school wrestlers in future studies.

CONCLUSIONS

The results of our study suggest that the new weight control program implemented by the NWCA and NFHS may have contributed to an increase in the wrestlers’ body weight from pre-season to in-season. Furthermore, the study suggests that the new guidelines may have contributed to the prevention of weight loss in the young wrestlers during a competitive season. While the overall eating attitudes of the wrestlers remained similar during the study, our results identified several trends that should be investigated further in future studies. The fact that 60% of the wrestlers reported “thinking about burning calories when exercising” and one third of them
“felt terrified about being overweight” often to always during the pre-season is of concern. Realistic body image, healthy dietary behaviors, and positive attitude towards eating are expected among adolescents, especially among young athletes whose calorie and nutrient requirements are higher compared to general population. Future research should focus on the assessment of eating attitudes and dietary intakes in a large and representative sample of high school wrestlers in order to detect potential patterns of unhealthy dietary behaviors, attitudes or feelings that wrestlers may experience prior to the beginning of the competitive season and/or throughout the year. Further research is warranted in these areas in order to develop and implement effective nutrition education programs for high school wrestlers that would increase not only their understanding of appropriate weight management, but also improve their overall nutrition knowledge and prevent the development of disordered eating.
References


### Table 1. Demographic and anthropometric characteristics of the sample

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pre-season n=15</th>
<th>In-Season n=15</th>
<th>Off-season n=15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body weight (kg)</td>
<td>mean±SE</td>
<td>mean±SE</td>
<td>mean±SE</td>
</tr>
<tr>
<td></td>
<td>68.7±5.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>69.7±5.1&lt;sup&gt;b&lt;/sup&gt;</td>
<td>70.9±5.1&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>169.2±1.7&lt;sup&gt;a&lt;/sup&gt;</td>
<td>170.2±1.7&lt;sup&gt;b&lt;/sup&gt;</td>
<td>170.5±1.6&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Body fat (%)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>16.8±2.3</td>
<td>16.2±2.0</td>
<td>16.4±2.0</td>
</tr>
<tr>
<td>Total EAT</td>
<td>8.3±1.7</td>
<td>7.3±1.4</td>
<td>8.9±1.9</td>
</tr>
</tbody>
</table>

<sup>1</sup>Statistical significance based on repeated measures ANOVA with height as a covariate; means in a row with superscripts without a common letter differ, p<0.05.

### Table 2. Wrestlers’ responses to the selected items of the Eating Attitude Tests

<table>
<thead>
<tr>
<th>Subscales</th>
<th>Pre-season n=15</th>
<th>Season n=15</th>
<th>Off-season n=15</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dieting</strong></td>
<td># (%)</td>
<td># (%)</td>
<td># (%)</td>
</tr>
<tr>
<td>I am terrified about being overweight</td>
<td>5 (33.3)</td>
<td>2 (13.4)</td>
<td>2 (13.4)</td>
</tr>
<tr>
<td>I particularly avoid foods with a high carbohydrate content</td>
<td>2 (13.4)</td>
<td>1 (6.7)</td>
<td>3 (20.0)</td>
</tr>
<tr>
<td>I think about burning up calories when I exercise*</td>
<td>9 (60.0)</td>
<td>6 (40.0)</td>
<td>7 (46.7)</td>
</tr>
<tr>
<td>Preoccupied with the thought of having fat on my body</td>
<td>2 (13.4)</td>
<td>1 (6.7)</td>
<td>1 (6.7)</td>
</tr>
<tr>
<td>Avoid foods with sugar</td>
<td>3 (20.0)</td>
<td>2 (13.4)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>I engage in dieting behavior</td>
<td>4 (26.6)</td>
<td>4 (26.6)</td>
<td>2 (13.4)</td>
</tr>
<tr>
<td><strong>Bulimia and Food Preoccupation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I have the impulse to vomit after meals</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>I find myself preoccupied with food</td>
<td>1 (6.7)</td>
<td>0 (0.0)</td>
<td>1 (6.0)</td>
</tr>
<tr>
<td>Eating binges with no control</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td><strong>Oral control</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I avoid eating when I am hungry</td>
<td>3 (20.0)</td>
<td>1 (6.7)</td>
<td>1 (6.7)</td>
</tr>
<tr>
<td>Others think I am too thin</td>
<td>5 (33.4)</td>
<td>4 (33.4)</td>
<td>3 (20.0)</td>
</tr>
<tr>
<td>I display self-control around food</td>
<td>10 (66.7)</td>
<td>11 (73.4)</td>
<td>9 (60.0)</td>
</tr>
</tbody>
</table>

<sup>1</sup>Data presented in this table represent responses of the subjects ranging from “often” to “always”

*Chi-square indicates statistical significance at p=0.013