# Weight cycling in adolescent Taekwondo athletes

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Background: Weight reduction cycles are used by weight classed athletes in Taekwondo to make a weight category. Tension, dizziness, headaches, and confusion have been associated with rapid weight loss (RWL). There is a lack of research in weight cycling and its benefits among Taekwondo athletes.

Purpose: To investigate the rate of weight cycling in Junior Taekwondo athletes and its effect on performance.

Methods: Athletes were weighed prior to competition, then again before their first match. Body mass difference in relation to winning was compared.

Results: A significant increase from weigh-in to prematch measurements was consistently found in both genders with no significant difference between them. Winners had a mean body mass gain (1.02 kg) which was non-significantly less than the non-winners (1.09 kg).

Conclusions: *RWL practices do not define which athlete will perform better. Negative effects of weight cycling coupled with RWL has unclear performance benefits which indicates a need for further research.* (JCCA 2011; 55(4):318–324)

KEY WORDS: competitive behaviour, martial arts, Taekwondo, weight loss Information de base : les cycles de perte de poids sont utilisés par les athlètes pratiquant le taekwondo afin de se conformer à une catégorie de poids. La tension, les étourdissements, les maux de tête et la confusion ont été associés à la perte de poids rapide. Il existe peu de recherches concernant le cycle de poids et ses avantages chez les athlètes pratiquant le taekwondo.

Objet : enquêter sur le cycle de poids des athlètes d'âge junior pratiquant le taekwondo et ses conséquences sur leur rendement.

Méthodes : les athlètes étaient pesés avant une compétition, puis encore une fois avant leur premier combat. La différence de poids fut comparée aux victoires remportées.

Résultats : une importante hausse de poids entre la pesée et le début d'un combat fut constatée chez les deux sexes, sans différence significative entre ceux-ci. Les gagants avait une masse corporelle moyenne supérieure de 1,02 kg, alors que cette hausse était de 1,09 kg chez les perdants.

Conclusions : la perte de poids rapide ne peut déterminer quels athlètes performeront le mieux. Les conséquences négatives du cycle de poids, jumelées à la perte de poids rapide doivent être analysées plus amplement avant de déterminer si les athlètes sont avantagés ou non.

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MOTS CLÉS : comportement compétitif, arts martiaux, taekwondo, perte de poids

\*\* Intern, Canadian Memorial Chiropractic College. The research conducted involved human subjects. All procedures conformed to the ethical standards of the IRB located at the Canadian Memorial Chiropractic College. Prior to the commencement of the study ethical approval was granted. Competing interests – None.

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## Introduction

Taekwondo (TKD) is a full contact free-sparring weight classed sport. This form of martial arts originated in Korea and became an Olympic demonstration sport in the summer of 1988 which led to its eventual inclusion into the summer 2000 Olympic Games. It has since gained in popularity and is now practiced worldwide.

Taekwondo competitions are divided by weight classes, as is done in wrestling, judo, and other combat sports. This classification system aims to equalize differences in strength, leverage and agility amongst competitors.<sup>1</sup>Athletes often aim to compete in the weight class below their natural body mass, as it is believed that this will provide a competitive advantage, sparring against smaller and theoretically weaker opponents. In order to achieve this feat, weight classed athletes often use rapid weight loss practices prior to weigh-in which occurs 16-20 hours before competition. After weigh-in occurs, athletes tend to abandon body mass loss practices to replenish nutrients, hydrate and thus, increase weight before the first match. In this study, Taekwondo athletes were weighed at the usual pre-match time 16-20 hours prior to initiation of the competition, then again immediately prior to sparring in order to indirectly measure the rate of weight cycling occurring in adolescent Taekwondo athletes.

The RWL that occurs prior to competition leads to weight cycling a term used to describe RWL following self-induced food limitation and/or dehydration. Both gradual (seasonal) and rapid (weekly) weight reduction cycles are used by TKD athletes, and have been investigated for potential effects on nutrition and performance.<sup>2</sup> Some initial data on pre-competition weight cycling in TKD showed that 53% of the respondents fasted prior to competition.<sup>3</sup> A follow up study<sup>4</sup> comparing the group in the 2005 study (Group A) to the Canadian National team (Group B) found that the National Taekwondo team athletes were more likely to have more years of practice (p = 0.03) and were less likely to fast prior to competition (p = 0.03) as compared to the Group A athletes. Not surprisingly, more than half of the competitors in Group A and eighteen percent of Group B athletes dieted prior to competition in order to make their weight class. This may suggest that the elite athletes (Group B) have been preparing for the competition more systematically.

Current literature reveals controversy regarding weight cycling, RWL and performance. Artioli et al.<sup>1</sup> reported

that rapid reduction of approximately 5% body mass achieved by typical judo athletes, when followed by a 4 hour recovery period, did not impair simulated judo performance or arm power. In contrast, Filare et al. reported that left hand grip values and 30-second jump test output were decreased after seven days of food restriction in judo athletes.<sup>5</sup> All mean micronutrient intakes were below recommended values, while triglyceride levels and free fatty acids were increased.5 Koral and Dosseville found that RWL procedures did not have an effect on short intense efforts (squat jump, countermovement jump, repetitions of Judo movements), but adversely affected prolonged physical performance.<sup>6</sup> There is a need to find out what this translates to for TKD athletes who often compete in many matches over a day of tournament. Varied performance outcomes associated with weight cycling has been a common finding in weight cycling research. Koral and Dosseville suggest that alterations in performance may depend on the type of body mass lost, type of sport undertaken and on the type of dietary restriction the competitor is committed to.<sup>6</sup>

The focus of this study is on adolescent athletes participating in TKD competition. Apart from a lack of knowledge as to how this may affect the health of adolescent athletes, it must not be ignored that the possibility of adolescent athletes developing eating disorders as a consequence of being overly concerned with weight control in weight class sports cannot be ruled out, as most athletes begin weight cycling at impressionable, young ages.<sup>1</sup> What is particularly striking are the methods used to induce RWL which range from nutritional restrictions to extreme physical demands. Specifically, dieting, fasting, fluid restriction, increased physical activity, passive (sauna) and active (sweat suit) dehydration, and even pathogenic methods such as diuretics, laxatives, and selfinduced vomiting are practiced to achieve RWL.<sup>5</sup> These drastic methods for RWL can have severe short term and long term impacts on health, particularly associated with water restriction. Water balance is essential for metabolic processes and temperature regulation to properly cool down the body via sweating. It is no surprise that 60 percent of the subjects reported that during weight loss they felt fatigued, 30 percent perceived that their performance was decreased, 30 percent felt increased tension, 23 percent felt their vigour was reduced, 20 percent felt increased anger and 17 percent felt dizzy.<sup>6</sup> Collegiate

wrestlers undergoing RWL suffered similar symptoms to that of Taekwondo athletes as reported by Alderman et al.,<sup>7</sup> including headaches, dizziness, nausea, and fever sensations. Furthermore, Koral and Dosseville<sup>6</sup> reported an increased perceived effort during physical activity for Taekwondo athletes, even if their overall results and performance were maintained.

Athletes using weight control techniques may believe an advantage will be gained over the opponent competing at his/her natural body mass. There are many warnings against weight cycling and RWL in the literature, and while some aspects of performance have been shown to decline, many studies have not revealed the effects of weight cycling and RWL on performance to be negative. Therefore, it is important to illuminate the potential long term health hazards and exposure of young TKD athletes to dangerous short term effects. It is also suggested that experienced weight cyclers adapt to weight loss procedures and become less affected by negative effects on performance. This may mask declines in performance that could present in less experienced weight cyclers. Considering the lack of consistently negative performance consequences, it can be postulated that athletes may have a misplaced sense of improved strength and performance capabilities when weight cycling for competition. These views may be reinforced if a weight cycling athlete wins a competition, thus increasing the likelihood of using these strategies in the future.

To date, there is a lack of research in the areas of weight cycling and its perceived benefits among Taekwondo athletes. The purpose of this study is to investigate rate of weight cycling utilization in Junior Taekwondo Athletes (14–17 years old) and its effects on performance (winning a medal).

# Methods

The junior athletes (14–17 year-old) were weighed one day prior to the competition (weigh-in) as required for qualification to compete in their specific weight category. Weight scale CAS model DL-100N, serial # 080441216 and CAS Model DL-200N, serial # 080441232 were used to weigh female and male athletes respectively. The scales were calibrated before weighing. Subsequently, athletes were weighed again, utilizing the same weight scales used for initial weigh in, just before their first match (16–20 hours later). This initial body mass and pre-match body mass were recorded on a separate sheets so that the recorder was blinded to the athlete's initial weight.

## Statistical Analysis

Descriptive statistics (proportions, means and standard deviations) were used to summarize the sample of athletes. A two factor repeated measures analysis of variance with time (weigh in versus pre fight weight) and gender was used to analyze the weight measurements. A comparison of winners (medalist) versus non-winners in terms of body mass-gain after official weigh-in was conducted using a two sample t test. Statistical packaged used was "Statistica". Statistical evaluation was carried out by Dave Soave, Research Methodologist.

#### Results

A total of 108 athletes (72 males, 36 females) participated in the study. Mean male body mass weigh-in was 62.7 kg, and pre-match body mass was 63.7 kg indicating a 1 kg body mass gain during the recovery period. Mean female weigh-in was 55.5 kg while mean pre-match body mass was 56.7 kg, indicating a 1.2 kg body mass gain during the recovery period. Body mass gain was significant for both sexes, but not significant across sexes (males did not gain significantly more than females and vice versa) (Table 1).

Table 2 depicts mean body mass differences between weigh-in and pre-match per weight category. The 'lightheavy' weight class had the highest change in body mass amongst males at 1.9 kg, while the bantam and lightmiddle weight classes had the highest change amongst females, both with a mean body mass gain of 1.6 kg. In contrast, females and males in the 'heavy' weight class both lost body mass during recovery period.

Winners had a body mass difference of 1.02 kg after recovery period while non-winners had a slightly larger body mass difference of 1.09 kg. Both body mass changes were significant, however the difference of body mass change between winners and non-winners was not significant (0.11) (P = 0.81) (Table 3).

#### Discussion

The main objective of this study was to determine if pre-competition weight cycling had an effect on overall performance (winning a medal) in Junior TKD athletes. Though there are several studies investigating perform-

	Males	Females	Combined
Ν	n = 72 (66.7%)	n = 36 (33.3%)	n = 108
Weigh-In (kg [SD])	62.7 [13.3]	55.5 [6.5]	60.3 [11.9]
Pre-match (kg [SD])	63.7 [13.0]	56.7 [6.4]	61.4 [11.7]
Age (Year [SD])	16.3 [0.6]	16.1 [0.9]	16.2 [0.7]

Table 1Mean weigh-in and pre-match body mass (kg) by sex

\*SD = Standard Deviation - Statistics derived from "Statistica"

Weight Category	Males N	Body mass Difference from weigh-in to pre- match Mean(SD) kg	Females N	Body mass Difference from weigh-in to pre-match Mean(SD) kg
FIN	4	0.43(1.3)	_	-
FLY	2	1.1(1.8)	1	1.0(-)
BANTAM	3	1.5(1.2)	1	1.6(-)
FEATHER	14	1.6(0.7)	3	1.3(0.2)
LIGHT	11	1.3(1.0)	8	1.4(0.5)
WELTER	10	0.9(0.7)	7	1.4(1.1)
LIGHT MIDDLE	10	0.5(2.2)	5	1.6(0.6)
MIDDLE	7	0.7(0.7)	5	1.1(0.8)
LIGHT HEAVY	5	1.9(1.0)	5	0.7(0.9)
HEAVY	6	-0.2(0.7)	1	-0.2(-)

Table 2Mean body mass changes from weigh-in to pre-match per weight category

\*SD = Standard Deviation – Statistics derived from "Statistica"

ance and weight cycling in TKD and other weight classed combat sports,<sup>1,6,8</sup> current literature reveals controversy in results regarding weight cycling, RWL and performance, indicating a need to tease out this relationship. Our findings suggest that pre-competition weight cycling has no significant effect on overall competitive performance in both male and female weight classes following a 16–20 hour recovery period. Body mass gained during the recovery period between the initial "weigh-in" and secondary "pre-match" measurements is an indirect method of measuring body mass lost during weight cycling. It is assumed that the more body mass lost during the recovery period.

iod.<sup>9</sup> All athletes in this study were allowed about 16–20 hour recovery period between the "weigh-in" and "precompetition" measurements whereby athletes re-fed and rehydrated. In a similar study by Artioli et al.<sup>1</sup> investigating weight cycling amongst judo athletes, subjects who lost body mass proceeded to regain  $51 \pm 13\%$  of their body mass during a 4 hour recovery period between weight-in and performance evaluation. In the present study, as seen in Table 1, both males and females gained less than 0.5% of their body mass back between weight-in and pre-match which is considerably less than the body mass gain values found by Artioli et al.<sup>10</sup> This can be attributed to the fact that the average age of the participants in the present

	Weigh-in	Pre-match	Difference
Winners (kg [SD])	60.13 [11.94]	61.23 [11.77]	1.02 [1.03]
Non-Winners (kg [SD])	61.54 [12.21]	62.55 [11.68]	1.09 [1.11]

Table 3 Body mass changes in Taekwondo athletes: Winners vs. Non-Winners

\*SD = Standard Deviation – Statistics derived from "Statistica"

study is 4 years younger and presumably less experienced at RWL and recovery then the participants used in the Artioli et al.<sup>10</sup>study, which had the average age  $20 \pm 4$  years and were all males. These differences in results could also be due to the sport specific variability between judo and TKD.

All weight categories, with the exception of the 'Heavy' weight class (for both males and females) gained body mass during the recovery period. The weight classes that gained the most body mass differed between male and female groups. The "Light Heavy" group in males and "Bantam" and "Light Middle" groups in females are the groups that gained the most body mass during recovery. This discrepancy between sexes may be due to the differing weight loss methods undertaken by female and male athletes in those groups to re-hydrate and feed during the recovery period. It may also be due to low number of participants in these weight categories. Interestingly, both male and female "Heavy Weight" groups lost the same amount of body mass during the recovery period at 0.2 kg. The athletes in the 'Heavy' weight class do not need to weight cycle, as there are no upper limits for their weight category.

Table 3 depicts the difference in "weigh-in" measurements between *Winners* and *Non-winners* as less than 1% (exactly 0.27%). Because body mass changes due to RWL between winners and non-winners was not significant it may be inferred that RWL cannot solely be a determining factor in winning a TKD match. Instead, it may be postulated that *Winners* are simply more skilled at their craft when compared to *Non-winners*, and RWL is not a factor affecting performance. Body mass gained during the recovery period in non-winners was slightly and non-significantly greater than that gained in winners. Non-winners on average gained 0.7kg or 0.8% more body mass than winners. Weight gained during recovery may have affected performance but this is currently not supported by other research. A study by Koral and Dosseville<sup>6</sup> found that mass loss procedures (gradual weight loss over 3–4 weeks) employed by elite judoists prior to competition had no affect on short duration performance. In this study a 1–2 hour recovery period was allowed after weigh-in and prior to performance evaluation. As mentioned previously, Artioliet al.<sup>1</sup> allowed a 4 hour recovery period for a weight-loss group. In both studies the weight-loss group performance, following recovery, had no effect on overall performance when compared to a control non-weight losing group.

RWL is a technique that is not practiced by TKD athletes alone. Artioli et al.<sup>10</sup> noted that 86% of the judo athletes participating in the study subjected themselves to RWL techniques. A very similar percentage was found in a study by Fleming and Costarelli<sup>8</sup> whereby 87% of the TKD athletes in their study were subjecting themselves to RWL practices.

Rapid weight loss is a potentially dangerous technique to partake in that may have negative effects on athletes. It has been noted in various studies<sup>6,9</sup> that RWL practices can cause increased tension, dizziness, fatigue, increased confusion and loss of vigour. Artioli et al.<sup>1</sup> also mentions that three young athletes in 1997 died due to hyperthermia and dehydration in the USA as a result of RWL practices. Since RWL seems to have no foreseeable benefits on overall performance the incentive for TKD athletes to subject themselves to this potentially harmful practice is not justified. Monitoring dietary habits of athletes in weight classed sports is recommended since most weight class athletes compete 5-10% under their natural body mass and do this up to 10 times a year.<sup>1</sup> It is prudent to assume that larger body mass losses and more frequent dieting could potentially result in negative physiological and performance consequences. Twenty percent of the athletes reported that they had never received advice on healthy eating and appropriate weight loss practices.<sup>8</sup> It is clear that athletes in weight classed sports are not receiving adequate education regarding the potential health risks and negative performance outcomes associated with weight cycling.

A limitation of this study was the failure to record the methods of weight cycling employed by participating athletes, and who provided the information regarding how to weight cycle. The methods of RWL employed could have shed some light into the physiological and psychological states of the competitors. This could have elicited why there were differences in pre-match weight gain between different weight classes, and determined the severity of the RWL practices being conducted in TKD today. Also, different methods of RWL may have manifested in different associated symptoms, and could have affected performance in various ways.

The methods of recovery employed by athletes during the 16–20 hour recovery period are unknown and act as another limitation in this study. What is clear is that most groups (except the 'Heavy' weight class) in the male and female categories gained body mass during recovery. Previous studies<sup>1,6</sup> have shown that implementing a recovery period after RWL methods negates negative effects on overall performance. Additionally, sample sizes in this study were relatively small, thus limiting conclusions from the descriptive statistics. Further research with larger sample sizes should be conducted in the future.

One subject that remains to be explored is the effects of weight cycling on first time competitors. The current study has not explored at what age the athletes began to practice RWL. Artioli et al.<sup>1</sup> and Koral and Dosseville<sup>6</sup> studied experienced martial art athletes with an average age over 20 years old, who have been implementing RWL techniques for many years. Even though the average age of the participants in the present study were younger (on average 16 years of age), these athletes may have been using RWL techniques for some time. Artioli et al.<sup>10</sup> found that on average, male and female judo competitors begin weight cutting for competition at  $12.6 \pm 6$ years of age. As mentioned in the study conducted by Artioli et al.,<sup>1</sup> seasoned competitors have time for their bodies to adapt to the weight cycling practice. This can help athletes overcome some of the negative side effects of RWL. It would also be interesting to study the effects of RWL on athletes that were not allowed a recovery period following weigh-in. Currently this does not follow

real world scenarios since in TKD tournaments, recovery periods of various durations are allowed. However, such a study can potentially demonstrate if RWL itself results in negative effects on performance. The other area to be explored is the effect of RWL on endurance sports versus anaerobic sports.

# Conclusion

RWL is a common practice that many athletes undergo prior to competitions. RWL seems not to have a significant effect on overall performance in young TKD athletes. This may be due to the fact that RWL is followed by a recovery period which may mitigate negative effects associated with RWL.

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