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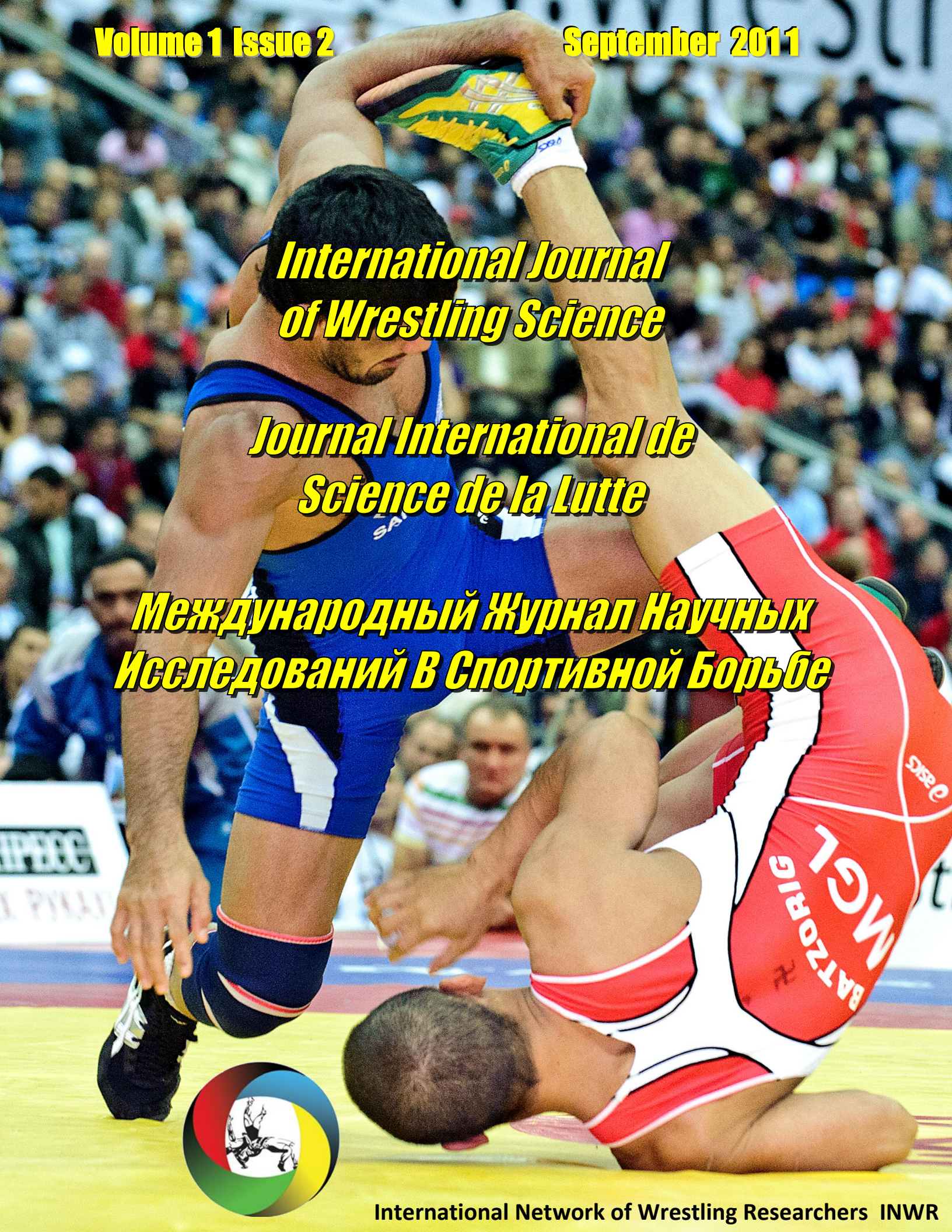

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Editor's Remarks

I want to welcome you to this World Championship edition of the ***International Journal of Wrestling Science.*** The variety of the topics addressed in the articles demonstrates the rich knowledge base that supports our sport of wrestling. It also parallels the growth of our supporting organization-the International Network of Wrestling Researchers (INWR). Our goal is to have a representative from every country affiliated with FILA. I ask for your assistance in this venture. We have been fortunate to assemble an outstanding group of Reviewers to whom we are indebted.

Yours sincerely,

David Curby, EdD, USA

Director INWR

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Cover photo by Tony Rotundo-Sushil Kumar made history when he became the first Indian to win a gold medal at the 2010 World Wrestling Championships in Moscow, 2010.

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THE INFLUENCE OF COMPETITIVE PRESSURES ON THE BODY OF YOUNG WRESTLERS

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ABSTRACT
In preparing young wrestlers (16-17 years of age) the design often follows a relatively well-developed system of training for adult masters of sport. This approach does not take into account that the impact of training, as well as the effects, of competitive loadings, are significantly different between young athletes and adults. Young wrestlers possess particular voltage, circulatory and respiratory systems characteristics in relation to their age and their functional and morphological development (2, 3, 8, 9). The volume of the heart of the young athlete reaches adult levels near 20-21 years of age. Systolic ejection and contractile function, which cause the cost to the heart, are much smaller in male youth than adults (2, 7). These features lead to considerable tension in the circulatory system of young athletes during intense stress (8, 9). Keep in mind that the lung capacity, maximum ventilation, tidal volume, the efficiency of respiration and gas exchange in boys is inferior to the performance of adults. In addition, the transfer of oxygen into the blood and its utilization in the muscles of the young men is slower, since the hemoglobin content per kilogram of body weight is less than adult athletes (10). In general, the youthful body is characterized by a high intensity cardio-respiratory and blood systems during physical stress. So far, no data on the impact of intense competitive activity on the dynamics of individual aspects of preparedness of young wrestlers is available. Our objective was to study the impact of competitive activity on the functional training state in young wrestlers.

METHODS
In a study of young Greco-Roman wrestlers, ages 16-17 years, all candidates for master of sports, we used the following methods:

1. Physical performance (PF) was determined by the PWC $_{170}$ when pedaling on a bicycle ergometer. HR values were recorded during the first 3 minutes in the recovery period.
2. To determine strength endurance a special test was used, which consists in curling the barbell weight of 20 kg in flexion and extension at the elbow joints to exhaustion.
3) Determination of the functional states of the neuromuscular system (NMS) and the central nervous sytem (CNS) were examined, before and after testing the strength endurance, using an electrostimulator ETRANS-2 (Yaroslavl Radioworks, Ltd., Moscow). The excitability of the biceps was determined by the magnitude of the voltage in millivolts. A muscle contraction (submaximal stimulation of muscle strength in response) is determined by the voltage required to lift the forearm to 90° from the starting position while lying on the table.
4) Testing for fine differentiation and reproduction of small muscular efforts reflects the coordination processes in the CNS. It was conducted on a small-sized dosimeter. The subject was standing in the Romberg position (feet together, arms extended forward), the index finger was tested three times with the dosimeter using forces of 100 and then 200 g - first with eyes open and then with eyes closed.
5) A functional test of spatial orientation to assess the perception and reproduction of body position in space was used. This test assesses the functionality of the vestibular apparatus. The athlete slowly rotates standing on a moving platform with eyes closed (2 turn duration of 5 seconds each). After that, without opening his eyes, his right hand indicates the initial position of the body. The errors in these tests characterize as athlete's coordination abilities and higher degree of fatigue of the brain and vestibular apparatus in particular, reducing the ability to differentiate between fine efforts and tto judge the orientation of the body in space (6).

RESULTS
To study the problem young Greco-Roman wrestlers were tested three times in the annual cycle of training: in March (before the special training), immediately after the competition in April, and on the 9th day after the tournament. Test results are shown in table 1.

Table 1 Changes in performance on pre-event athletes and competitive stage and after the competition

Testing Phase	PWC_{170} kgm / kg	Recovery heart Rate (bpm)		Power Test Min.	Muscular response (mV)		Differentiation of muscular effort, T, error			The orientation of the body in space-the degree of the error.	
		1 `	2 `		To load	After loading	To load	After loading	Total error		
March Before Special Training in March n = 16	22,7 ±1,2	115 ± 0,9	104 ± 1,1	2'0" ± 0,18	26,2 ± 0,8	34,2 ± 0,94	241 ± 2,2	212 ± 1,4	453 ± 1,9	35 ± 1,1	12 ± 0,9
April Immediatelt after competition n = 15	11,3 ± 1,7	165 ± 1,2	153 ± 1,5	2'10" ± 0,16	18 ± 1,1	22 ± 0,84	230 ± 2,2	235 ± 1,8	465 ± 2,1	24 ± 1,3	27 ± 0,9
April 9 days after competition n = 14	22 ± 1,5	118 ± 1,7	107 ± 1,3	3'55" ± 0,19	23 ± 1,3	22 ± 1,1	240 ± 1,7	210 ± 1,4	450 ± 1,1	25 ± 1,5	7,5 ± 1,1

Prior to the beginning of the pre-event training the wrestlers were characterized by fairly high performance and adequate response of physiological systems in adapting to the PWC_{170} and from the test of muscular endurance. After the special phase preparation and participation in the tournament these young athletes showed a reduction in the PWC_{170} by half compared with the initial level in February, along with a significant increase in intensity of blood circulation after work on the cycle ergometer. There was deterioration in the ability to determine orientation of the body in space after loading by a factor of two. Consequently, the intense pre-event training and the competitive activity in the tournament, caused a significant reduction in the reserve capacity of the CNS and in particular, the vestibular apparatus. There was a decrease in the capacity of the cardio respiratory system and in the organism as a whole, leading to a pronounced decrease in physical performance. After 7 days of leisure and training, mainly in the aerobic mode, the testing revealed a complete recovery of the sportsmen, as evidenced by the achievement of the initial level of PWC_{170} and phase super compensation after load indicators of CNS and NMS (M-response threshold before and after the test run, reducing errors to test for orientation in space, and improved differentiation of muscle effort). Strength endurance in April compared with the survey in March increased by 1.8 times, the orientation of the body in space after the test has improved to 1.6 times, the differentiation of muscular effort is also greatly improved.

DISCUSSION/CONCLUSIONS

The impact of competitive pressures on the body of young wrestlers qualifications was demonstarted. Programs of pre-event training for adults and young highly skilled fighters are virtually identical. However, its performance in adult athletes contributes to a significant increase in physical performance, improve the lability of the NMS and the functional state of the CNS to a competitive level compared to the preparatory (1). It is believed that the slowly varying features, which include physical performance, are relatively stable. In this regard, monitoring of changes carried out 3 times a year on the program of staged due diligence (5).

In adult, highly qualified wrestlers, these figures are relatively stable at different stages of training, but can significantly decrease in a short span of time, as was found in these young athletes. These young athletes even had marked increases in physical performance prior to participating in competitions. There is no doubt that the marked deterioration in the health and functional status of young athletes when the intense competitive nature of the load to be offset by recovery stages: 10.7 days of active rest and in the subsequent 2-week decrease in intensity in order to stabilize performance. When planning the training process of young wrestlers one needs to start from the concept of compliance rate exposure rhythm recovery. So after a 3-week special pre-event preparation and 2-day tournament you need to plan the recovery phase for the same duration to obtain a training

effect. These specially planned recovery phases should be considered as part of the overall structure of training loads of young wrestlers. In this regard, of great importance is the introduction of recovery microcycles when coaching young wrestler (4). Application of these remedial steps significantly increases the effectiveness of coaching young athletes.

CONCLUSIONS

1. Attention to the age peculiarities of adaptation in wrestlers 16-17 years of age should include the body's response to competitive stress, which causes a significant reduction in functional reserve and physical capacity.
2. In order to avoid overwork with young wrestlers the post competition plan must include a transitional recovery phase lasting 8-10 days, which contributes not only to achieve the initial level of efficiency, but also allows for the supercompensation strength endurance and functional status of the CNS and the NMS.

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ВЛИЯНИЕ СОРЕВНОВАТЕЛЬНЫХ НАГРУЗОК НА ОРГАНИЗМ ЮНЫХ БОРЦОВ

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При подготовке юных борцов 16-17 лет высокой квалификации используется относительно хорошо разработанная система предсоревновательной подготовки взрослых мастеров спорта. Однако не принимается во внимание, что воздействие тренировочных и соревновательных нагрузок на организм взрослых и юных спортсменов имеет существенные различия.

Возрастные ограничения юных борцов связаны со значительным напряжением систем кровообращения и дыхания в связи с возрастными особенностями их функционального и морфологического развития (2, 3, 8, 9). Объём сердца юного спортсмена достигает показателей взрослого лишь к 20-21 году. Систолический выброс, сократительная функция, которые обуславливают экономичность работы сердца, у юношей существенно уступают показателям взрослых (2, 7). Указанные особенности приводят к значительной напряженности системы кровообращения юных спортсменов во время интенсивных нагрузок (8, 9). Следует учитывать, что объем легких, максимальная вентиляция легких, дыхательный объем, эффективность дыхания и газообмена у юношей уступают показателям взрослых. Кроме этого, передача в кровь кислорода и утилизация его в мышцах у юношей медленнее, так как, содержание гемоглобина на килограмм массы тела у них меньше, чем у взрослых спортсменов (10).

В целом для юношеского организма характерна большая напряженность кардиореспираторной системы и системы крови при выполнении физических нагрузок. До настоящего времени отсутствуют данные о влиянии напряженной соревновательной деятельности на динамику отдельных сторон подготовленности юных борцов высших разрядов.

Цель исследования: изучить воздействие соревновательной деятельности на функциональную подготовленность юных борцов.

Методы и организация исследования.

При обследовании юных борцов греко-римского стиля 16-17 лет, кандидатов в мастера спорта и мастеров спорта, использовались следующие методы:

1. Физическая работоспособность (ФР) определялась по PWC_{170} при педалировании на велоэргометре. Значения ЧСС регистрировались во время велоэргометрической нагрузки и в течение первых 3 минут в восстановительном периоде.
2. Для определения силовой выносливости использовался тест, заключающийся в подъеме грифа штанги весом 20 кг при сгибании и разгибании рук в локтевых суставах «до отказа от работы».
3. Определение функционального состояния нервно-мышечной системы (НМС)и ЦНС проводилось до и после тестирования силовой выносливости с помощью электростимулятора «Этранс-2». По величине напряжения тока в милливольтах определялась возбудимость двуглавой мышцы плеча. М-ответ мышечного сокращения (субмаксимальный по силе раздражения мышечный ответ) определялся величиной напряжения тока, необходимого для подъема предплечья на 90^{o} из исходного положения лежа на столе.
4. Тест тонкой дифференциации и воспроизведения малых мышечных усилий отражает координационные процессы в ЦНС. Он проводился на малогабаритном дозиметре. Испытуемый должен был, стоя в позе Ромберга (стопы вместе, руки вытянуты вперед), указательным пальцем трижды воспроизвести на дозиметре усилие в 100, а затем 200 г, сначала с открытыми , а затем с закрытыми глазами.
5. Функциональная проба для оценки восприятия и воспроизведения положения тела в пространстве характеризует пространственную ориентацию. В этом тесте оценивались функциональные возможности вестибулярного анализатора. Спортсмен медленно вращался в положении стоя на подвижной платформе с закрытыми глазами (2 оборота длительностью 5 секунд каждый). После этого он должен был, не открывая глаз, правой рукой воспроизвести начальное положение тела. Величины ошибок в этих тестах характеризуют как координационные способности спортсмена, так и степень утомления высших отделов мозга и вестибулярного анализатора в частности, снижающих способность к тонкой дифференциации усилий и ориентацию тела в пространстве (6).

Результаты исследований.

Для решения поставленной задачи юные борцы греко-римского стиля обследовались трижды в годичном цикле подготовки: в феврале до начала специальной предсоревновательной подготовки, в марте сразу после соревнований и в апреле на 9 день после турнира .

Изменение показателей работоспособности борцов на предсоревновательном и соревновательном этапах и после окончания соревнований

Этап подготовки	PW C_{170} кГм\ кг	Восстановление ЧСС уд\мин		Силовой Тест Мин. с	Мышечный ответ, млвт		Дифференциация мышечных усилий, Г, ошибка			Ориентация тела в пространстве, градус, ошибка.	
		1`	2`		До нагрузки	После нагрузки	До нагрузки	После нагрузки	Суммарная ошибка		
Февраль До соревнований n=16	22,7 ±1,2	115 ± 0,9	104 ± 1,1	2'0'' ± 0,18	26,2 ± 0,8	34,2 ± 0,94	241 ± 2,2	212 ± 1,4	453 ± 1,9	35 ± 1,1	12 ± 0,9
Март В период соревнований n=15	11,3 ±1,7	165 ± 1,2	153 ± 1,5	2'10'' ± 0,16	18 ± 1,1	22 ± 0,84	230 ± 2,2	235 ± 1,8	465 ± 2,1	24 ± 1,3	27 ± 0,9
Апрель После соревнований n=14	22 ±1,5	118 ± 1,7	107 ± 1,3	3'55'' ± 0,19	23 ± 1,3	22 ± 1,1	240 ± 1,7	210 ± 1,4	450 ± 1,1	25 ± 1,5	7,5 ± 1,1

До начала этапа непосредственной предсоревновательной подготовки борцы характеризовались достаточно высокой работоспособностью и адекватной реакцией физиологических систем при адаптации к PWC_{170} и тесту силовой выносливости. После этапа предсоревновательной подготовки и участия в турнире у юных спортсменов выявлено снижение PWC_{170} в два раза по сравнению с исходным уровнем в феврале при существенном повышении напряженности кровообращения после работы на велоэргометре и ухудшение в 2 раза после нагрузки ориентации тела в пространстве. Следовательно, напряженная предсоревновательная и соревновательная деятельность борцов, участников турнира, вызвала значительное снижение резервных возможностей ЦНС и в частности, вестибулярного анализатора,

кардиореспираторной системы и организма в целом, что привело к выраженному снижению физической работоспособности. После 7-дневного активного отдыха и тренировки преимущественно в аэробном режиме тестирование выявило полное восстановление организма спортсменов, о чем свидетельствует достижение исходного уровня PWC_{170} и сверхвосстановление после нагрузки показателей, характеризующих ЦНС и НМА (порога М-ответов до и после выполнения теста, снижение ошибок в тесте на ориентацию в пространстве и дифференциацию мышечных усилий). Силовая выносливость в апреле по сравнению с обследованием в марте возросла в 1,8 раза, ориентация тела в пространстве после выполнения теста улучшилась в 1,6 раза, дифференциация мышечных усилий также значительно улучшилась.

Обсуждение результатов исследования.

Воздействие соревновательных нагрузок на организм юных борцов высокой квалификации изучено недостаточно. Программы предсоревновательной подготовки взрослых и юных высококвалифицированных борцов практически не отличаются. Однако ее выполнение у взрослых спортсменов способствует существенному повышению физической работоспособности, улучшению лабильности НМС и функционального состояния ЦНС на соревновательном этапе по сравнению с подготовительным (1). Считается, что медленно меняющиеся характеристики, к которым относится и физическая работоспособность, относительно устойчивы. В связи с этим контроль за их изменением осуществляется 3 раза в год по программе этапного комплексного обследования (5).

У взрослых высококвалифицированных единоборцев эти показатели относительно устойчивы на разных этапах тренировки и их выраженного снижения в короткий промежуток времени, как это было обнаружено у юных борцов, не происходит. Напротив, перед участием в соревнованиях отмечается повышение физической работоспособности. Не вызывает сомнения, что выраженное ухудшение работоспособности и функционального состояния юных спортсменов при выполнении интенсивных нагрузок соревновательного характера необходимо компенсировать восстановительным этапом: проведение 7-10 дневного активного отдыха и в последующем 2-недельным снижением интенсивности для стабилизации работоспособности. При планировании тренировочного процесса юных борцов нужно исходить из концепции о соответствии ритма воздействия ритму восстановления. Поэтому после 3-недельной специальной предсоревновательной подготовки и 2-дневного турнира необходимо планировать восстановительный этап такой же продолжительности, чтобы получить отставленный тренировочный эффект. Такие специально планируемые этапы восстановления должны рассматриваться как составная часть общей структуры тренировочных нагрузок юных борцов. В этой связи большое значение приобретает введение в тренировку юных борцов спортсменов восстановительных микроциклов (4). Применение восстановительных этапов существенно повысит эффективность тренировки юных спортсменов.

Выводы:

1. К возрастным особенностям адаптации борцов 16-17 лет следует отнести реакцию организма на соревновательные нагрузки, которые вызывают значительное снижение функциональных резервов и физической работоспособности.
2. Во избежание переутомления юных борцов после окончания ответственных соревнований необходимо планировать переходно-восстановительный этап продолжительностью 8-10 дней, что способствует не только достижению исходного уровня работоспособности, но иТаблица 1

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THE MONITORING OF WEIGHT FLUCTUATION AND HYDRATION STATUS IN CADET WRESTLERS (AGES 14-17) DURING A TRAINING CAMP PERIOD LEADING UP TO COMPETITION

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ABSTRACT

This study aims to determine the body weight and hydration levels of wrestlers within the cadet super league and to investigate their affects upon performance. Measurements were recorded four times: on the first day of training, which is 17 days prior to competition, three days out from weigh ins, immediately prior to weigh-in and immediately before the competition. During these study periods, body weight and urine specific gravity (Usg) were measured. Body composition was measured in the first round of testing. Results of these measurements were compared to competition results. Body weight and hydration levels did not change significantly until the third day before weigh in ($P > 0.05$). A significant level of weight loss (% 3.9 ± 2, 7) and an increase in Usg levels (1.024-1.028 g/cm³) were discovered in the last three days before official weigh-ins. However, no significant change in Usg values ($P > 0.05$) were observed between weigh in and the competition, although a significant weight gain ($P < 0.05$) was observed. Consequently, it can be shown that although the rapid weight loss and dehydration observed in cadet wrestlers just prior to weigh-ins was followed by a rapid weight gain between weigh-ins and the competition; there was no improvement in the hydration status.

KEYWORDS: Cadet Wrestlers, Hydration, Urine Specific Gravity, Body Weight

INTRODUCTION

Wrestling is a primarily anaerobic sport characterized by repeated high force and power outputs while attacking and defending during the competition. However, a significant aerobic fitness level is also required in order to maintain performance over the course of a 2 hour competition (9). Most athletes will subject themselves to rapid weight loss methods just before weigh in, in order to compete in the weight categories they, and their coaches, believe are best suited for them. Despite evidence indicating that, rapid weight loss is not a healthy practice. Weight loss prior to competition is typically achieved by restricting fluid and food ingestion, in conjunction with acute dehydration by strenuous exercise in hot environments (e.g., saunas, steam rooms). In addition, wrestlers have been known to wear extra clothes or vapor-impermeable suits during exercise to increase core temperature and stimulate greater perspiration (31). This rapid weight loss in wrestlers may cause dehydration and possibly a decrease in physical performance. Dehydration resulting from rapid weight loss causes changes such as a decrease in blood plasma volume, increased rectal heat, an increased heart rate and a decrease in cardiac output. In addition, the distributions of nourishment / energy resources are affected, the removal of metabolic wastes are slowed down and cellular metabolism changes have also been observed (11). The most striking result of this rapid weight loss was the death of 3 college wrestlers in the USA when they lost 15% of their body weight as a consequence of food restriction and dehydration in 1997 (19). Such practices result in a decrease in body water volume and muscle mass, as these kinds of rapid weight loss methods are carried out by limiting nourishment and fluid in-take. Therefore, it is important to evaluate the body composition of the athlete to determine their physical condition during weight-loss periods (15). As previously described, such rapid weight loss methods have serious implications concerning their health (1).

It is suggested that weight loss per week should not exceed 1.5 % of body weight by Wrestling Weight Certification (WWC) program instituted by the National Collegiate Athletic Association (NCAA) (28, 17). Meanwhile, it is also required to determine the hydration level as well as body weight and body composition for each wrestler at the beginning of the season by NCAA in accordance with weight loss protocols to establish a wrestler's minimal wrestling weight (29, 17). The NCAA's WWC uses urine specific gravity (Usg) as the most practical and effective measurement to determine hydration level during the weight classification period (26, 5). The NCAA accepts 1.020 g/cm³ and smaller values as the limit criteria to demonstrate a euhydrated condition (28, 26, 5). In addition, skin fold methodology is used to determine body fat percentage and establish the minimal weight class using the weight of the wrestler at a minimum of 5 % body fat (17). Although weight loss problems are known in our country, scientific research or data are scarce. Although there is significant research concerning

adults, there is very little, if any concerning the hydration status and weight loss patterns of young elite wrestlers either in our country or abroad (28, 5, 24, 15). Significant relationships have been observed between weight loss before weigh-in and subsequent weight gain before the competition, and the scores achieved in wrestling competition (32, 15).

The aim of this study is to identify the hydration status of cadet wrestlers during the training camp period and to evaluate the changes in their body weight and hydration level prior to the league competition. In addition, a further aim was to investigate the relationships among the changes in the wrestlers' body weight, hydration levels and their scores in league competition.

MATERIALS AND METHODS

This study was conducted with 13 elite cadet wrestlers whose ages range from 14 to 17 (14.7±0.8) from the Corum Wrestling Education Centre who compete in the Turkey Cadet Super League. Subjects were representative of all weight categories (39 - 69 kg), with the exception of heavyweight. The heavyweight wrestlers were excluded because they typically do not have weight loss concerns. This study covers a 17-day period before the league competitions planned by the Turkish Wrestling Federation at the Corum Wrestling Education Centre. Measurements were made on the 17th day before the competition (first measurement), third day before weigh-in (second measurement), immediately preceding the official weigh-in (third measurement) and before the competition (fourth measurement). An ethics committee approval was obtained from the Ethics Committee of Medicine Faculty of Ankara University and an informed consent form was provided to each athlete requiring their signature. All of the researchers involved in the study have signed the Helsinki Declaration.

Measurements and Evaluations

Measurements of Height and Body Weight: Body weight measurements were made using a digital scale (Seca 664, Hamburg, Germany) in bare feet and wearing only shorts. *Determination of Body Fat Percentage***:** Three body sites (abdominal, triceps, subscapular) were measured in mm by using a skin fold caliper (Holtain Ltd.UK). These measurements were converted into body- fat percentage by using the Lohman and Brozek equations (14).
Urine Measurement: Urine samples were taken from all of the athletes during the periods mentioned-before weigh-in (after a 12 hour fast) upon waking up 17 days before the league competition, 3 days before the competition, before weigh-in and just before the competition, the next day. With these samples, urine specific gravity (Usg) was determinated using a refractometer (Atago Digital Urine S.G. UG-α alpha). In addition, color identification was made using 8 different color scales belonging to these samples (4). All subjects were considered to be adequately hydrated based upon a urine Usg less than or equal to 1.020 g/cm³ (28). Meanwhile, ≥4 level in urine color is associated with dehydration level (23).

Evaluation of The Scores: The athletes were assigned their points according to their scores in Cadet Super League competitions in compliance with FILA (International Federation of Associated Wrestling Styles) scoring system.
Classification points at the end of a bout were as follows;
5 points for the winner and 0 for the loser: victory by fall, injury, withdrawal, default, disqualification.
4 points for the winner and 0 for the loser: victory by technical superiority (6 points difference, 5 points hold or 2 holds with 3 points), with the loser scoring no technical points.
4 points for the winner and 1 for the loser: victory by technical superiority (6 points difference, 5 points hold or 2 holds with 3 points during two periods) with loser scoring technical points.
3 points for the winner and 0 point for the loser: when out of three periods, the wrestler wins two periods of 1 to 5 points and the loser scoring no point.
3 points for the winner and 1 point for the loser: when during two periods the bout ends by a victory by points during regular time or by an ordered hold and the loser scoring one or several technical points.

Evaluation of the Data: All measurements (body weight, Usg and color) were compared with the one before and after using the T-test (paired t-test in group). The relationship between variables was analyzed through the Pearson correlation test. The correlation values above 0.65 were judged as strong relation, those around 0.50 as a moderate relation and the below 0.35 were judged as low relation. Statistical significance was accepted as $P < 0.05$.

RESULTS

A description of the subjects is presented in Table 1.

Table 1. Anthropometric Characteristics of the Wrestlers.

N=13	Minimum	Maximum	Mean	Standard deviation (±)
Age	14	16	14.7	0.9
Height (cm)	145,5	177	165.2	9.2
Fat%	5.7	10.5	8.1	1.6
Weight (kg)	41.3	77.3	58.3	11.5

The fluctuations in body weight and Usg in the wrestlers during the four measurement periods are shown in table 2.

Table 2. Body Weight and Urine Density in Wrestlers during the Study

	1st Measurement Before 17 Days	2nd Measurement Before 3 Days	3rd Measurement Before Weigh in	4th Measurement Before Competition
Body weight(kg)	58.3± 11.5∞	58.2±11.2*	56.0±11.4 *∞●	57.4±11.2●
Usg (g/cm³)	1.025	1.024	1.028	1.027

●∞*P<0. 05

There is not a statistically significant difference between the body weight of wrestlers at the beginning of the study (58±11.5 kg) and 3 days before weigh in (58.2 ± 11.2 kg), (P>0.05). However, there was a statistically significant difference between body weight at competition weigh-in (56.0 ±11,4 kg) and 3 days before weigh-ins (58.2 ±11.2 kg), (P< 0.05). The percentage difference was -3.9± 2.7. The difference between the amount of weight change and percentage rate of change (+2.6±1.9 kg), between the 3rd weigh-in (56.0 ± 11.4 kg) and the weigh-in just before the competition (57.4±11.2 kg) was also found to be statistically significant (P<0.05). There was no statistically significant difference was found between urine measurement results (Usg and color) (P> 0.05).

The relationship between the urine color scale and Usg measurement scores of the cadet wrestlers are illustrated in table 3 and the relationship between Usg, changes in body weight and match scores are illustrated in table 4. It was found that the correlation between two measurement methods (urine color and Usg) was strong. No significant relationship was found between changes in Usg and body weight with match scores.

Table 3. The Correlation Between Urine Measurement Methods

	Usg 1	Usg 2	Usg 3	Usg 4
Color 1	0.75**	0.25	0.27	0.46
Color 2	0.59*	0.90**	-0.40	0.52
Color 3	0.19	-0.12	0.70**	0.50
Color 4	0.47	0.38	0.23	0.91**

** Correlation Significance Level P< 0.01

* Correlation Significance Level P< 0.05

Table 4. The Correlation between Match Points, Body Weight Changes, and Urine Specific Gravity Changes

	Competition Points	Weight difference between 3 days before and competition	First weight and weigh in	The difference between first weight and competition
Urine 1	.084	-.028	.135	.395
Urine 2	.492	-.260	.021	.470
Urine 3	-.056	.596*	.602*	.354
Urine 4	.300	.499	.613*	.650*
Competition Points	1.000	.325	.300	.449

* Correlation Significance Level P< 0.05

DISCUSSION

The effects of rapid and excessive weight loss on performance have been the focus of attention of researchers for many years. The potential damages on physiological parameters resulting from weight loss and the changes in body composition during a competition season, have been studied and conflicting results were found (24). There is very little research studying the relationship between weight loss and performance during competition or tournaments (32). The National Wrestling Coaches Association (NWCA) in the USA has stated that a college wrestler may have a minimum body fat level of 5% (33). We have found out that the body fat percentage of the wrestlers were above the value (8.1%±1.6) used by the NWCA (Table1). The studies revealed that most of the wrestlers lost 2 kg in a week and 20 % of them lost 2.7 kg. It has stated that one out of three wrestlers underwent rapid weight loss more than 10 times during the season (2). Another study, Oppliger et al. (20) found that as many as 80% of college wrestlers engage in dieting, with more than 50% use fasting, and approximately 75% increasing their training load to lose weight. The study revealed that there was not a significant change in the body weight of wrestlers between the beginning of the study and 3 days before weigh-in (58.3±11.5 kg- 58.2± 11.2 kg), but there was a significant weight loss in the period between 3 day before weigh in and just before weigh-in (58.2±11.2 kg- 56,0±11,4 kg (- 3.9 %) ($P< 0.05$) (Table 2). In addition, a significant time effect was found for Usg, which was demonstrated by an increase in Usg from baseline after the 3% reduction in body mass. This supports the practical use of Usg to identify hydration status in both athletic and clinical populations (31). In this study, there was an increase in Usg values (1.024 g/cm³ - 1.028 g/cm³) between 3 day before weigh in and just before weigh in, but there was not a significant difference. These results show that wrestlers often lose weight using the food and fluid restriction and using dehydration methods one or two days before competition. Meanwhile, it was found that they demonstrated significant weight gain when the values of their body weight after weigh in and before the competition were examined. Kukidome et al., (15) observed that there was not a significant change between the values one week before weigh-in (74.3 ±9.4 kg) and one month before weigh in (74.5±9.2 kg) in their research on 12 wrestlers (ages 18-22). In contrast, the results obtained from weigh-in for competition (69.1±9.0 kg), an average decrease of 5.4 kg was recorded in comparison to the measurements one month before equating to an approximately 7.3 % weight loss. Kukidome et al., revealed a 3.1 kg increase in body weight on the day of competition. Wroble and Moxley (32) found that college wrestlers gained 1.3 ±1.1kgs between the night of weigh-in and the following morning. Ransome and Hughes (22) reported that 78 male wrestlers (ages 21.3±1.5) weighed 73.93±11.62 kg 24 hours before the competition, 72.53 ±11.66 kg at the moment of weigh-in and 73.65±13.58 kg 24 hours after the competition. Kraemer et al., (13) reported that wrestlers lose 6% of their weight between one week before the tournament and weigh-in. After which, they gain approximately 1.8 % of their weight until the time before the competition (13). An increase of 1.4 kg occurred between the period after weigh in and the competition (56.00±11.4 kg- 57.4±11.2 kg) in accordance with the literature, it is thought that wrestlers lose weight rapidly with the thought of regaining the weight they lost between weigh-in and the competition based on the results.

It is doubtful that if the wrestlers completely regain their body water, electrolyte and glycogen storage despite their regaining of weight. It has been found that there is no change in the level of glycogen in skeleton muscle before weight loss when compared with 17 hour recovery period after losing weight (30, 15). Meanwhile, it is stated that liquid homeostasis can only be renewed in 24 to 48 hours and the muscle glycogen can be replaced in 72 hours (2). Similarly, no significant change can be seen in hydration status (1.028 g/cm³- 1.027 g/cm³) despite a 1.4 kg weight gain occurring during the 14-hour time between post weigh-in and the competition (Table 2). This supports the concept that the hydration status of rapid weight gain after weigh-in cannot be renewed before 24-48 hours. Another study proving weight gain has no effect on hydration level is Buford et al., (2006). In this study, it was observed that although there was a 6.9 % increase in wrestlers' body weight (75.11±3.53 – 80.30 ±2.98 kg) in the 3 weeks following the competition season. No significant change was recorded in hydration levels from the middle of the season to the end (1.024±0.001 g/cm³- 1.022±0.001 g/cm³). The fact that there is no change in hydration level in spite of 7% increase in body weight in 3 weeks makes it ambiguous if this increase is only water or not. On the other hand, it has been found that wrestlers have higher Usg levels even in normal hydration when compared with non- wrestlers. The fact underlying this phenomenon is unknown. However, it is put forward that this may be related rapid weight loss of wrestlers before every competition and weight gain after each one during the season (6). Finn et al. (8) have found that carbohydrate intake (1.5 g/kg) after rapid weight loss in wrestlers and periodical sprint exercise performances have no positive effect on blood-lactate response and psychological well-being of the athletes. In consequence, studies showing that weight gain after rapid weight loss can not completely renew body liquid- glycogen storage and its effects on performance remain ambiguous.

The results of the study are important in that they support the concept that some urine variables as well as the change of body weight can be used as a significant sign of body hydration status. It has been seen in 4 different Usg measurements done to determine hydration status; that wrestlers face a light chronic dehydration and an

increase in the values between 3 days before weigh in and during weigh-in. These values are seen to be above 1.020 g/cm³, which is accepted as euhydration level for the athlete by NCAA (28, 26, 5). Meanwhile, ≥4 level in urine color is associated with dehydration level in other studies about the issue (23, 19). Armstrong et al (4), state that higher urine color than the 3 level can be a sign of dehydration status on a Likert color measure (4, 19). According to this, values found in our study, are rarely above normal limits. Also, Armstrong et al (4) put forward that there is a significant relationship between urine color, specific gravity and osmolality in hydration status in urine indicators studies, and that these methods can be used in sport related field researches. It has been established that there is a high correlation level between Usg and color measurements and that the result supports the literature.

In this study, we have attempted to prove the relationship between body composition and hydration status of cadet wrestlers and their scores in league matches with the positive points gained at the end of the competition. Although there is a meaningful relationship between weight loss and gain before weigh-in and the competition, no meaningful relationship has been found when compared with positive points gained. It is perhaps because the majority of wrestlers are in the same dehydrated state. There are few studies investigating the effect of weight loss before weigh in on the competition. Wroble and Moxley (32) have reported in their research among 260 college wrestlers that winners gain 1.5±1.1 kg while losers gain 1.2±1.0 kg. They have found a significant difference in the weight gain of winners and losers ($P<0.05$). Choma et al (7) have reported that rapid weight loss results in damage in short term memory and breakdown of mental balance as well as a number of physiological effects, and they conclude that this can lead to anxiety before the competition**.** As well as a 6.9 % increase in the wrestlers' body weight (75.11±3.53- 80.30±2.98 kg) in 3 weeks following the completion of the season, a significant increase (28%) was found in isometric leg force (Buford, 2006). Kraemer et al., (13) have diagnosed a significant decrease in the level of lower and upper body isometric force during the 2 day- wrestling-tournament period after 6% body weight loss in one week before the weigh-in. Consequently, they have found out that rapid weight loss before the tournament has a decreasing effect in performance parameters during the 2 days- wrestling tournament (13). Schoffstall et al., (25) have found that there is a decrease in bench press maximum as a result of approximately 1.7% (1.5 kg) weight loss and acute hydration. The laboratory research studying effects of dehydration on performance has proved that body water loss has very little effect on muscle force and ballistic power while it deteriorates aerobic exercise performance (16).

These studies show that weight loss can have negative effects on performance parameters while weight gain before the competition can have positive effects. However, in our study, no such effects of the changes in body weight have been observed on competition performance. Many factors such as skill, ability, experience, wrestling age and physiological condition of the rival at that moment affect the scores in wrestling. These factors mentioned should be taken into account when the performance is evaluated.

Consequently, it has been seen that cadet wrestlers lose weight more than what NCAA suggests (maximum 1.5 % per week), then gain weight rapidly after weigh-in but the weight gained does not have a completely positive effect on the hydration level of the athletes. On the other hand, these changes do not appear to have a direct effect on the matches. Other studies that use more subjects, use control groups, and longer in duration are needed to find out the effects of the rapid changes on match performance completely. Moreover, it should be considered that physiological condition, wrestling age and skill of the rival affect the score of the competition when the performance is evaluated.

PRACTICAL IMPLICATIONS/ADVICE FOR ATHLETES AND COACHES

In wrestlers, rapid weight loss is generally carried out just prior to weigh-in. Since the time between weigh-in and competition is not enough for wrestlers to rehydrate. Wrestlers will often participate in the competitions in a dehydrated state. The process of weight cutting should be monitored by coaches and/or trainers and take place for an extended period of time (1.5 % body weight per week). Otherwise, wrestlers may be at risk of dehydration. Urinary markers, including Usg and urine color, can be used to determine hydration status. In addition, acute weight change can also help to evaluate body water loss during practice. Weight fluctuations can be monitored by weighing before and after all practices. A refractometer may be provided for all teams or urine color chart may be placed on the wall of the locker room for athletes read. All of these methods to assess hydration level in wrestlers are practical, non-invasive and do not require technical skills.

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DETERMINANT FACTORS FOR THE FREQUENCY OF SUCCESSFUL TECHNICAL-TACTICAL COMBINATIONS IN THE STANDING POSITION FROM THE 2009 WOMENS' SENIOR WORLD WRESTLING CHAMPIONSHIPS

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ABSTRACT
Objective. To classify the perfomance of world-class women wrestlers in the frequency and characteristics of their effective Technical-Tactical Combinations (TTC) from the standing position at the highest level of international competition in 2009. *Methods*. All effective TTC were characterized from a sample of 70 wrestlers, the top 10 place-winners in each of the 7 weight categories. Five descriptive variables were used: effectiveness, technical group, and characteristics of its 3 phases. Variables were obtained determining the effectiveness, measured the "success rate" achieved per wrestler, all through factor analysis. Later wrestlers were classified by cluster analysis by Ward's method. *Results*. The most important factor related to winning a medal was the execution of leg attacks, with several possible endings, with almost non-contact set-up, followed by low-risk attacks launched from a close distance. Outstanding wrestlers opted mostly for low risk counterattacks. Most competitors who had good results using throws chose variants with several alternative endings. *Conclusions*. The Characterization Model used and the factors of effective TTC in the standing position provided detailed explanations of the performance characteristics of the best female wrestlers in the Senior World Championships 2009. The design of this research can be applied year after year in both men's and women's freestyle competition.
KEY WORDS: Technical - Tactical Combinations, Rules, Female Wrestling, Factor Analysis, Technique

INTRODUCTION

The International Federation of Associated Wrestling Styles (FILA) has organized World Championships for women's freestyle wrestling since 1987. The growing popularity of women's wrestling, especially in countries where wrestling was already established, led to its inclusion in the official program of the Olympic Games in Athens. This has led many National Federations to promote this modality, and to study talent identification, develop programs and methods for fitness and to assess the adequacy of training and technical-tactical training systems specific to the characteristics of women, all under the requirements of the International Wrestling Rules.

Modifications to the international rules of Olympic wrestling in 2004 had an impact on strategy, technique and tactics of the world's top wrestlers. Several national teams are still trying to adapt, with modest results. In the specialized literature, there are many investigations of factors related to the wrestlers sporting success: technical analysis, as developed by Schultz (1992) and Cipriano (1990), and studies of the relationship between success and physiological and psychological variables (Highload and Bennett, 1979; Roemmlch and Frappier, 1993; Chamakov, 1999, Martínez-Abellán et al, 2010). Much of this research assessed success on a two-level, nominal scales (e.g. "successful" and "unsuccessful") and it did not investiagate the causes of technical/tactical success.

MATERIALS AND METHODS

Using the five variables considered in the characterization of technical-tactical combinations by López González (5), all 193 videos of the matches in the Women's World Wrestling Championship 2009 senior age category recorded by FILA were analyzed. The purpose was to observe each action which received technical points in the standing position from the top ten ranked wrestlers in each weight division. The "Technical-Tactical Combination" concept and their variables and classification criteria are defined as follows.

Technical-Tactical Combination. A wrestling specific literature review showed that technical-tactical actions used by wrestlers to earn points are called by several names. In Russian the term is Приемы, transliterated: priemy (Tumanyan, 1998), Spanish translation: "key." In most English-language documents it is "hold", defined by Shakhmuradov as "the set of actions that achieves the intended result from the attacking, counter-attacking or defensive action" (2008). In Spanish, words were as diverse as "hold", "key", "action" and "technique" (González, S. and Cañedo, I., (1996). For this work, we chose the more contemporary term "Technical-Tactical Combination" (TTC), prepared as part of the theoretical framework of the "FILA's Master Degrees" program: "The combined

technical / tactical is an invariable sequence of three phases: a starting phase, a preparation phase, and a technical phase" (4). Table 1 contains an example of these phases of a TTC.

Variables. The five variables used together characterize all TTC phases and their relationships.

Effectiveness - Success Rate. Effectiveness is defined as obtaining certain technical points for making a technical-tactical combination. Effectiveness characterizes the final phase. To characterize the activity of a wrestler during a match or tournament, the corresponding variable is the success rate, ie, total TTC with which the wrestler received technical points.

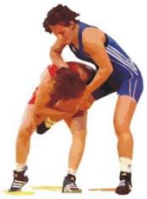
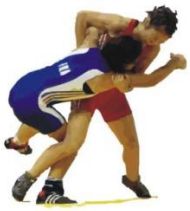
Table 1

TECHNICAL-TACTICAL COMBINATIONS CHARACTERIZATION MODEL
FREESTYLE WRESTLING, STANDING POSITION (López, 2010)

PHASES	1. SETUP Phase (PREPARATION)	2. TECHNICAL Phase (also called "Execution")	3. FINAL Phase
TTC			
VARIABLES (Technical-Táctical Featrures)	**c) SETUP Type (Preparation)** Set of maneuvers to achieve distance and position to attack the opponent, breaking their stability and leading to oversights in their defense.	**b) TECHNICAL GROUP** CTT classification according to the fundamental movements (body Movements) that the wrestler performs to score from a control (grips) determined.	**a) Effectivity** Getting technical points under the rules implementing the refereeing body
		d) Tactical Risk Adverse consequences (i.e. points to the opponent, the opponent in top position) facing the wrestler to make an unsuccessful CTT	
		e) Completion Alternatives (Technical-Tactical Complex) Number of different movements with which the wrestler can continue and complete a TTC to face his first defense of fundamental movement. This feature is not obtained through observation of the sequence, but by the historical record of the different endings achieved in attempts same type of CTT in the same or in other tournaments..	

Technical Group. Each TTC was classified into one of eight groups according to the mechanical properties of the fundamental movement ("body movement ", according to Lafon, (4) that are performed by the wrestler for attaining the desired effect on the opponent's body, based the criteria in Table 2. The push outs of the red zone and purely counter-offensive actions were recorded for particular groups.

Table 2. Technical Groups used in the investigation and its Features

 1. Takedowns The opponent is taken to the mat by means of a push or pull applied to his upper body ,keeping at least one foot in contact with ground as the axis of rotation. Are commonly associated with a go behind..	 2. Single Leg The attacker controls one of the opponent's legs with at least one of his hands. Is a group with a variety of terminations and can be combined with other body movement.	 3. Double Leg The attacker applies some kind of shift while controlling both legs of the opponent. The completion requires more continuity than in the group of attacks on one leg.	 4. Throws The opponent is lifted off the floor and launched into the air, passing over an rotational axis that is located somewhere in the opponent's torso or hips.
 5. Leg-on-leg Are mechanically similar to the takedowns, but the attacker secures a rotational axis using one leg to limit movement of one leg of his opponent. Are takedowns that end in danger position.	 6. Counterattacks We considered separately the TTC facing an opponent's attack and take advantage of conditions created by the defense. We included only those actions that can only be applied in such circumstances.	 7. Blocks Defensive actions, contrary to the attack and without application of technical phase, where the attacker is at a disadvantage as the defensive wrestler score points against him.	 8. Push-outs Category for situations where one of the wrestlers step into the protection zone during the standing position, meriting a technical point for the opponent. Only were considered in that category actions without technical phase.

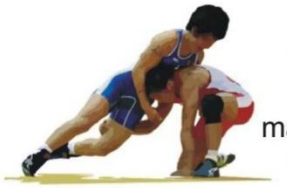
Set-up Type. The maneuvers used in the preparation phase to break the stability of the opponent and cause lapses in its defense were considered within a four group nominal scale with the technical criteria "distance", "position" and "tie-up", as detailed in the table 3. The actions from the clinch position were considered as a particular group because the attacker does not apply any tactical procedure for attaining the grip on the opponent's leg.

Table 3. Four set-up types of the TTC in the standing position and criteria of each.

Set-up Type	 1. Non Contact Set-up	 2. Fast Set-up	 3. Power Set-up	 4. Without Set-up
Distance	Open	Medium	Close	Close
Tie-ups & Contact	Non tie-ups	Secondary Áreas (wrists, elbow, forearm, neck)	Primary Áreas (arms, shoulders, head, torso)	Inside Single leg grab
Level of Stance	All;major times low, medium	Low, medium	Medium, high	Ordered Clinch

Tactical risk. It is defined as the disadvantage to make a TTC ineffective, the tactical risk characterized the technical phase and fundamental body movement itself. It was rated on a four-level scale, from least to greatest known risk, and is illustrated in table 4. Even if they are effective, TTC's could be classified according to the risk associated with implementation.

Table 4. The four types of tactical risk, characteristics, and the consequences for the red wrestler.

	**Low Risk** Offensive wrestler is over her/his opponent, or lose contact, so it is not at a disadvantage.
	**Medium Risk** The fighter is under the rival, in front of it. The opponent must make a technical phase to take this disadvantage and score points.
	**High Risk** The wrestler give his/her back at the opponent, so the rival wins one technical point and define its role clearly offensive..
	**Very High Risk** The wrestler falls in danger position, so the opponent scores two or more technical points and have a big chance for seek win by pin.

Completion alternatives. This concept was uses the number of different execution moves that can effectively end the same type of TTC against defense, and characterizes the technical phase from the point of view of the possibility to overcome the defensive behavior. Earlier, it was found that there was a strong positive correlation (r = 0.828) between the amount of completion alternatives of a TTC and the amount of actual successful attempts (Lopez, 2010). It is the only variable that was not classified by direct observation, but accounting for the end of data collection, the amount of different endings (so-called "variants") observed throughout the complete tournament for the same TTC. According to the number of variants alternative found, the TTC was classified on a 4-level categorical scale ranging from only one ending to more than 7 possible endings (Table 5).

Table 5. Categories of Completion Alternatives variable

Category	*a)*	*b)*	*c)*	*d)*
Criteria	*Only one ending*	*2 to 3 endings*	*4 to 6 endings*	*7 and more endings*

Statistical analysis and software. Using the video analysis program Longomatch version 0.15.7, each TTC was observed and categorized. Subsequently a database of wrestlers from the sample was generated (Table 6), listing all of the frequencies of each technical-tactical criteria. The data were processed by factor analysis to group

the variables according to their importance in the overall success rate of each wrestler. The wrestlers were classified by cluster analysis by Ward's method with Varimax Kaiser rotation components, reducing the variables of each factor considering two criteria: value of more than three frequencies, and higher correlations with the frequency of success. All data and statistical procedures were performed in software SPSS 17.0. Finally, the averages of the frequencies of each variable used in cluster analysis were converted to percentiles to compare the performance of each cluster.

Table 6. Example of the database frequency of each feature of TTC's of wrestlers studied

General and Behaviour Wrestler data					Setup type				Technical Groups								Tactical Risk				Completion alternatives			
Wrestler	Country	Weigth class	Rank	Succes rate	Without setup (Clinch)	Non contact setup	Fast setup	Power setup	Double leg	Single leg	Takedowns	Leg-on-leg	Throws	Counterattacks	Push-outs	Blocks	Low risk	Medium risk	High Risk	Very high risk	Single ending	2-3 endings	4-6 endings	7 and more endings
Stadnyk, M.	AZE	48	1o	13	0	4	3	6	5	5	1	1	0	0	0	1	2	11	0	0	2	3	2	6
Ratkevich, J.	AZE	59	1o	11	1	0	5	5	3	3	0	0	5	0	0	0	1	5	4	1	4	3	1	3
Dugrenier, M.	CAN	67	1o	12	0	10	1	1	5	7	0	0	0	0	0	0	0	12	0	0	0	0	6	6
Qin, X.	CHN	72	1o	11	0	1	6	4	1	6	1	0	0	1	0	2	3	7	1	0	1	0	1	9
Yoshida, S.	JPN	55	1o	22	0	9	11	2	10	10	1	0	0	0	1	0	2	20	0	0	1	5	0	16
Nishimaki, M.	JPN	63	1o	11	0	1	1	9	0	4	4	0	0	0	3	0	7	4	0	0	0	7	0	4
Mattsson, S.	SWE	51	1o	15	0	3	5	7	6	5	0	0	2	0	1	1	2	11	2	0	0	3	5	7

RESULTS

Factor analysis yielded seven components (Table 7), the latter being ruled out to contain a single variable, whose highest value was less than 1 frequency. The remainder account for 75.76% of the total variance.

Table 7. Rotated component matrix.

	Components						
	1	2	3	4	5	6	7
Medium Risk Freq	.965						
7 and more endings Freq	.883						
Single leg attacks Freq	.813						
Double leg attacks Freq	.798						
Non contact setup Freq	.787						
Fast setups Freq	.767						
2-3 endings Freq		.868					
Push outs Freq		.811					
Power setups Freq		.702					
Low Risk Freq		.655					
Takedowns Freq		.611					
Throws Freq			.867				
4-6 endings Freq			.708				
Leg-on-leg attacks Freq				.840			
Blocks Freq				.837			
Counterattacks Freq					.925		
High risk Freq					.668		
Only one ending Freq						.867	
Very high risk Freq							.741
Variance percent	25.598	14.780	11.099	9.645	8.061	7.715	6.271

The component 1 in order of importance was composed of 6 variables: Medium risk, 7 or more completions, Single leg attacks, Double leg attacks, Non-contact setups and Rapid (poor contact) setups, all these features are related to conditions for leg attacks with short time setup and several ending alternatives to address the defense.

Component 2 is characterized by a predominance of characteristics of low-risk attacks with close distance setup, whose variables were 5: 2 to 3 completions, Push outs of the combat area, Power setups, Low risk, and Takedowns.
The third component consisted of two variables: Throws, and 4 to 6 possible endings.
Leg on leg attacks and blockages, which reached low frequencies, are the two variables that were grouped into component 4.
The component 5 links the high risk to the conduct of counterattacks.
The sixth component consists of a variable, TTC's with only one possible ending.
The cluster analysis was performed with nine variables, those that by their correlation with others of the same component had the highest predictive value of the success frequency, resulting as follows: "Medium Tactical Risk", "Power setups", "High Tactical Risk", frequencies "Blocks "and "Counter-attacks" and the 4 levels of "Completion Alternatives". This program determined the solution of 8 groups as appropriate to classify the wrestlers and describe the characteristics of their effective TTC's (Table 8).

Table 8. Top 10 wrestlers in each division at the Senior World 2009 and its classification in 8 groups by cluster analysis. The frequency in each factor is shown in percentiles.

CLUSTER	WRESTLERS	% EFFECTIVE IN DISPUTE MEDAL	Medal contenders	RANK				FACTOR 1 Leg attacks with short time setups and several alternative endings		FACTOR 2 Low risk attacks with close distance setup.		FACTOR 3 TTCs with médium amount of alternative endings	FACTOR 4 Pin (fall) like only one ending	FACTOR 5 Inevitable High Risk (counterattack)		FACTOR 6 TTC's distinctive of specific wrestlers
				Gold	Silver	Bronze	5°	Medium Risk	7 and more endings	Power set-ups	2 or 3 endingss	4 to 6 endings	Blocks	High Risk	Counter attacks	Only one Ending
I	1	100.00%	1	1	0	0	0	100.00%	100.00%	30.01%	98.35%	23.49%	30.31%	21.98%	32.66%	65.55%
II	4	100.00%	4	3	0	1	0	98.93%	89.72%	77.96%	72.47%	94.80%	57.98%	49.14%	45.72%	56.31%
III	8	100.00%	8	1	1	3	3	70.22%	93.09%	39.96%	17.38%	39.32%	80.85%	41.71%	71.78%	37.28%
IV	3	100.00%	3	1	0	2	0	55.47%	66.55%	99.59%	99.84%	40.48%	96.39%	59.06%	32.66%	40.37%
V	11	54.55%	6	1	1	3	1	38.20%	38.71%	86.10%	65.59%	62.87%	44.55%	92.12%	51.91%	77.39%
VI	12	50.00%	6	0	1	2	3	38.03%	48.62%	30.01%	39.22%	27.35%	43.31%	46.65%	67.81%	31.37%
VII	6	50.00%	3	0	0	1	2	70.22%	62.25%	57.74%	37.27%	76.51%	38.81%	44.17%	59.27%	65.55%
VIII	25	44.00%	11	0	4	2	5	27.38%	20.07%	27.08%	42.00%	44.25%	38.46%	31.83%	34.66%	45.93%
SUMA	70	SUMA		7	7	14	14									

DISCUSSION - CONCLUSIONS
Tünnemann has described the growing use of leg attacks and a decrease in the throws by the senior class female wrestlers in the last two Olympic cycles. Podlivayev and Shakmouradov discuss the case of freestyle wrestlers at the international level, that "throws demanding a great deal of time for preparation and are connected with a higher level of risk" (2010, p.168).

However, the characterization model and its variables grouped in this study as determinants of effectivity in standing position provided more detailed explanations of the performance characteristics of the best female wrestlers in the case of the Senior World Championships 2009. The most important factor of effectiveness in this position is closely related to the attainment of medals, characterizing the TTC of six of the seven champions was the execution of single and double leg attacks with several possible endings with setup almost without contact with their opponents, followed by the use of attacks with a close distance setup but low risk, mainly the technical group takedowns. The high tactical risk hardly distinguishes the frequency of actions of these wrestlers, opting mainly for defense and counterattacks of low risk. The wrestlers who were successful using throws chose variants with between 4 and 6 alternative endings.

PRACTICAL IMPLICATIONS / ADVICE FOR ATHLETES AND COACHES
Considering that the sample comprises the elite of women's wrestling under the current rules, the technical and tactical characteristics found are useful for the management of the preparation of aspiring wrestlers to achieve high results at the international level. According to our data, several female wrestling national teams- Cuba, France, Germany and Spain, were distinguished by the preferred use of throws prepared in close distance and high risk, with poor results in comparison with teams like Japan, China, Azerbaiyan and Sweden.

The design of this research can be applied year after year in both freestyle and female wrestling, and its implementation at other levels (continental, national) may provide relevant data on the performance of wrestlers from other countries and less effective teams compared with outstanding world class wrestlers.

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EVALUATION AND REHABILITATION OF FUNCTIONAL ANKLE INSTABILITY IN WRESTLERS

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ABSTRACT
Objectives: The aim of the present study was to evaluate functional deficits after an ankle sprain in collegiate wrestling students and to examine the effectiveness of two different balance rehabilitation programs on balance ability.
Methods: Thirty-three collegiate wrestling students with functional ankle instability were randomly divided into three groups. One subject group (n=10) underwent no specific balance training (control group). The remaining two groups followed an intervention balance program for 4 weeks, 3 times per week, 20 min per time using balance boards. One of the two training groups performed the exercise in a swimming pool- the "pool" group (N=13), and the other at the ground- the "land" group (N=13). Balance ability was assessed before and after the 4 week balance training program. Balance assessment included a stability index recorded on a Biodex Stability System. The functional ability evaluations used the "figure of 8" and "triple jump" tests.
Results: The results showed that in both training groups balance and functional ability of the injured leg were significantly improved after the training period. In the final measurements no statistical significant differences between the injured and healthy limb were found.
Conclusion: The present study indicates that the performance of balance exercises in or out of the water by wrestling athletes with functional ankle instability improves their balance ability.
KEYWORDS*:* Ankle; Balance; Ankle Instability; Ankle Rehabilitation

INTRODUCTION

Wrestling is unique among athletics (Halloran, 2008). It is considered to be one of the most physically demanding sports among high school and college athletics. A wrestler needs to have not only strength and endurance but also technical skill to be successful (Halloran, 2008). However, as expected in a physical contact sport, the athletes are prone to occasional injury. Wrestling injuries account for the second most frequent sports injuries after football (Centers for Disease Control and Prevention, 2006). Lateral ankle sprains are one of the most prevalent injuries in high school, collegiate and recreational sports (Buchanan et al., 2008). According to the United States National Collegiate Athletic Association (NCAA), the most commonly injured body part was the knee at 21% of all reported wrestling injuries, while the ankle was the third most common injury at 9% (Newton et al., 2002). Similarly, many investigators reported that in collegiate wrestling, the ankle joint was one of the most commonly injured regions (Jarrett et al 1998; Agel 2007; Yard et al 2008; Shadgan et al., 2010)

Functional ankle instability (FAI) is a condition that occurs after an ankle sprain in approximately 40% of patients (Freeman, 1965; Bosien et al., 1955). Functional ankle instability has been defined in many ways, including the "disabling loss of reliable static and dynamic support of a joint" (Vaes et al., 1998) and a tendency for the foot to give way" (Freeman 1965b). Experimental studies have demonstrated a correlation between impaired proprioception and FAI. Moreover, deficits have been identified in postural stability control (Fu & Hui-Chan, 2005; Nakagawa & Hoffman, 2004). As a result, many studies have been conducted which report that exercise rehabilitation aimed at retraining proprioceptive deficits associated with FAI, such as using multiaxial platforms or wobble boards, is associated with positive outcome (Baltaci & Kohl, 2003; Mattacola & Dwyer, 2002; Wilkerson & Nitz, 1994).

The wobble board is commonly used in the rehabilitation of FAI and is designed to assist the reeducation of the proprioceptive system by improving mechanoreceptor function and restoring the normal neuromuscular feedback loop (Rozzi, Lephart, Sterner, & Kuligowski, 1999). The wobble board training improves single leg stance ability (Rozzi et al 1999; Gioftsidou et al., 2006) and postural sway (Bernier & Perrin, 1998; Gauffin, Tropp & Odenrick, 1988; Malliou et al. 2004; Malliou et al., 2008, Gioftsidou et al., 2006) On the other hand, the pool can be a safe environment used at the first stage of muscluloskeletal injuries rehabilitation (ACL, MCL) or for the rehabilitation of

chronic musculoskeletal disease, such as knee osteoarthritis and chronic low back pain (Hinman et al 2007). However, the use of a pool environment for functional ankle instability rehabilitation has not been reported. When using the pool environment for lower limb training, subjects try to stand in the water and maintain a stable upright stance over the base of support, while water movement and turbulence play an important role by overloading the postural control systems especially during one leg stance (Melzer et al., 2008). While water-based training is a non-weight bearing condition for the joints, keeping balance is a difficult task due to turbulence which is produced in the water.

The purpose of this study was a) to investigate functional deficits in collegiate wrestling students after an ankle sprain and b) to examine the effectiveness of two different rehabilitation training programs (the first performed on land and the second in a pool environment) on balance ability.

METHODS

Subjects-The participants in this study were 36 collegiate (age: 21.02±1.3 y) wrestlers. All participants had one functionally unstable ankle. To be characterized as functionally unstable, the participants satisfied the following criteria 1) at least one repeated injury or perception of ankle instability or "giving away" in the unstable ankle, 2) no evidence of mechanical instability as assessed by an orthopedic doctor using anterior drawer test, 3) pain free, full weight bearing and normal gait at the time of study. The average time period since the last episode of instability and injury was 2 months. Prior to any testing informed consent was obtained from all participants.Exclusion criteria for the participants included a history of lower extremity surgery or fracture, joint swelling or any systemic disease that might interfere with sensory input.

Equipment and instruments-The balance ability assessment was performed with the Biodex Stability System (Biodex, Inc, Shirley, NY). The Biodex Stability System (BSS) (Biodex, Inc, Shirley, NY) uses a circular platform that is free to move about the anterior-posterior (AP) and medial-lateral (ML) axes simultaneously. In addition to moving about these axes, it is possible to vary the stability of the platform by varying the resistance force applied to the platform. Springs apply this force to the underside of the platform and can be adjusted to preset resistances established by the manufacturer. Rather than measuring the deviation of the COP during static conditions, this device measures the degree of tilt about each axis during dynamic conditions. Thus, the BSS appears to provide more specific information on ankle joint movements (Arnold & Schmitz, 1998; Biodex Stability System, 1998).

Participants Preparation

The subjects stood on the BSS with one leg. They were allowed to flex the support knee to no more than 10° but were required to maintain an upright posture with the supporting leg. Additionally, participants were instructed to keep their hands at their sides and to maintain a comfortable knee angle with the unsupported leg during testing. Once in this position, the stability platform was unlocked to allow motion. The participants were then instructed to adjust the supporting foot position until they found a position at which they could maintain platform stability. This was done to establish the participants' ideal foot positioning for testing. The platform was then locked, and participants were told to maintain the foot position. This position was used for testing.

Testing protocol

The testing protocol consisted of a single 20-second test, while the platform (Figure 1) was set to freely move with the minimal resistance available (level 1). From the magnitude and duration of these deviations, a total stability index (SI) was computed by the system. The subjects performed three 20-sec practice trials and three 20-sec test trials out of which only the best Ii score was further processed.

Fig. 1. The platform of the Biodex stability system

In agreement with previous reports (Pincivero et al. 1995; Johnson et al. 2005; Gioftsidou et al 2006), intraclass correlation coefficient values for two measurements taken in the same day ($p>0.05$, Student's t-test) were 0.75 for the Biodex test.

Procedures for completing the functional assessments

"Figure of 8": the participants were asked to cover the figure of 8 three times (cycle diameter was 4 m.). The time was recorded in seconds (Tropp et al., 1984; Donahoe et al., 1993; Risberg and Ekeland, 1994; Guskiewicz and Perrin 1996). "Triple jump test": from standing position on both legs the participants first jumped onto the healthy leg, then jumped again from and to the healthy leg, and thirdly from the healthy leg to both legs. The same procedure was done on the injured leg. The score was the best jump of the three trials, recorded in meter (Risberg and Ekeland, 1994; Risberg, et al., 1995; Scholl, et al., 1999).

Procedures for the Balance training program

The subjects were randomly assigned to one of the three groups - two training groups and one control group. The control group (N=10) did not participate in any specific training program. Both training groups performed a 20 min training program (45sec exercise and 15sec rest), with 5 different exercises performed a) on a "hard balance board", and b) on "air disk", with 3 repetitions for each exercise (5 exercise X 2 boards X 2 repetitions). The first experimental group, the "land group" (N=13), performed the rehabilitation program on land (Figure 2) and the second experimental group the "pool group" (N=13), performed the same rehabilitation program in a swimming pool (Figure 3) (Detailed in Table 1).

Fig. 2. Balance exercise performed on the ground

Fig. 3. Balance exercise performed in the water

Table 1. Balance training program

Exercises performed on a) "hard balance board", b) on "air disk"
1. Attempt to maintain single –limb stance"
2. Attempt to maintain single-limb stance and try to bend and extend the knee
3. Attempt to maintain single-limb stance and try to move the unsupporting leg in front and back
4. Attempt to maintain single-limb stance and try to catch and return the ball to the trainer
5. Attempt to maintain single-limb stance while the trainer from the back pouss the exerciser

ANOVA (both one way and repeated measures) was used in order to determine possible statistically significant differences among measurements, among the experimental groups and control, and among the injured and non-injured lower limb.

RESULTS

According to the results, no difference ($p>0.05$) in balance ability was found in the control group between baseline testing and re-testing 4 weeks later. In contrast, the 4 week balance training program improved ($p<0.05$) all balance and functional performance indicators in both of the two training groups. However, the rate of the improvement ($p>0.05$) did not vary between the two groups. Finally, no statistically significant differences were found between the injured and healthy limb in the testing after the completion of the training program (Table 2).

Table 2. Balance and functional stability assessments

	Pre Training				Post Training			
	Group "Land"		Group "Pool"		Group "Land"		Group "Pool"	
	Healthy	Injured	Healthy	Injured	Healthy	Injured	Healthy	Injured
SI (°)	3.21±1.8	7.42±2.7 †	3.22±1.2	7.31±2.7 †	3.23±1.5	3.36±1.9 *	3.29±1.5	3.42±1.2 *
Jump	5.39±0.9	4.79±0.7 †	5.42±0.9	4.83±0.9 †	5.33±0.9	5.29±0.8 *	5.35±0.9	5.30±0.8 *
Figure 8	8.81±0.47		8.73±0.54		7.48±0.56*		7.67±0.29*	

† indicates $p<0.05$ between injured and healthy limb balance training,
* indicates $p<0.05$ between "pre" and "post" training.

DISCUSSION AND CONCLUSIONS

The main objectives of this study were to investigate 1) whether a previous ankle sprain influences the collegiate wrestling students balance and functional ability, and b) whether the effectiveness of balance training program is affected by the environment in which it is performed, namely on land or in a swimming pool. It was found that 1) a previous ankle sprain caused functional deficits, and influenced the balance and functional ability of the the collegiate wrestling students, and 2) the balance training program effectiveness was not affected by the program enviroment.

In previous studies, impaired postural control is frequently evident in subjects with both acute and repetitive ankle sprains. Similarly, functional deficits in postural control are consistently recognized in subjects with chronic ankle instability. These postural deficits are most likely secondary to a combination of impaired neuromuscular control and proprioception (Docherty et al., 2006; Wikstrom et al., 2006; Ross and Guskiewicz 2006; Holmes & Delahunt, 2009). As far as postural deficits are concerned, the present study found higher instability scores at the initial measurement, which is in accordance with the results of previous studies which studied subjects with FAI (Docherty et al., 2006; Wikstrom et al., 2006).

Concerning the second objective of our study, it was found that both balance training programs decrease the postural instability of the subjects, which agrees with previous reports (Bernier & Perrin, 1998; Eils & Rosenbaum, 2001; Gauffin, Tropp, & Odenrick, 1988; Rozzi et al., 1999; Ross & Guskiewicz, 2006). Previous reasearch has also shown that wobble board training improves single leg stance ability (Rozzi et al., 1999) and postural sway (Bernier & Perrin, 1998; Gauffin, Tropp, & Odenrick, 1988; Eils & Rosenbaum, 2001) in participants with FAI. Wester et al (1996) showed that patients with FAI who underwent wobble board training experienced significantly fewer recurrent sprains during a follow-up period than those who did not follow a training programme. As far as the exercise equipment is concerned, it is identical to the Bernier & Perrin (1998), and Eils & Rosenbaum (2001) studies, involving modalities such as ankle disks, tilt boards and single-leg standing activities.

The duration of the present study balance training programs was 4 weeks, 3 times per week. Similar period for balance training on individuals with functionally unstable ankles was used by Clark and Burden (2005) and the results of their study showed an increased perception of ankle stability during and after exercise program, consistent with the results of the present study. While Sodermann et al. (2000) found no effect of balance board training on the ankle sprains, with the respect to the duration of the program, the overall results of the present study support the performance of balance exercises by wrestling athletes with functional ankle instability in order to improve their proprioception ability.

Recarding the water-based balance training program, the focus was on adapting the land-based balance exercises to water environment, adding hand movement to create water terbulance, which would contribute to the progressive exercises difficulty with the aim to improve balance ability. The water terbulance during balance exercises challenges balance control in multiple directions, and in adittion, when perturbations are applied by instructors in predictable and unpredictable manners could allow subjects to exercise safely and progress when needed (Melzer et al 2008). Before Melzer et al (2008) research, no study had proposed using a water-based training program that includes perturbations to improve stability.

CONCLUSION

The findings of this study advocate the use of balance exercise programme for rehabilitation of wrestling collegiate athletes with functional ankle instability. The results demonstrated that wrestling collegiate athletes with a previous ankle sprain experienced balance and functional deficits. A balance training program performed on balance boards increased the balance and functional ability of the participants. The performance of balance exercises can take place in either a pool or land environment, with the same positive effect.

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THE EFFECTS OF TWO DIFFERENT DOSAGES OF BCAA SUPPLEMENTATION ON A SERUM INDICATORS OF MUSCLE DAMAGE IN WRESTLERS

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ABSTRACT

Background and Aim: Few studies have been done to examine the effect of different dosages of branched-chain amino acid (BCAA) supplementation on muscle damage indices in wrestlers. The purpose of this research was to compare the effects of two dosages of BCAA on muscle damage indices after heavy resistance exercise in wrestlers. **Methods:** 29 young wrestlers were randomly selected and divided into three groups. All subjects participated in heavy weight resistance exercise (3 sets, 10 repetitions, 80% 1RM). The BCAA was given at doses of 210 and 450 mg·kg $^{-1}$ body weight for supplemental groups 1 and 2 respectively, 30 minutes before and after the exercise test and dextrin was given at a dose of 210 mg.kg $^{-1}$ body weight for the placebo group. To identify enzyme activity (IU/L), venous blood samples were obtained 30 min prior to exercise and at 24 and 48 hrs post exercise. Data were statistically analyzed using ANOVA with repeated measures and the Bonfferoni test ($P \leq 0.05$). **Results:** Based on this study results, creatine kinase (CK), lactate dehydrogenase (LDH), creatine kinase isoenzyme MB (CK_{MB}) activity were significantly increased ($p<0.05$) in all groups. CK, LDH, CK_{MB} indices having the highest activity in the placebo group, but there were no significant differences between all groups. **Conclusion:** These results provide evidence that the use of two different dosages of BCAA did not decrease the muscle damage associated with heavy resistance exercise.

KEY WORDS: BCAA, muscle damage, heavy resistance exercise, CK,CK_{MB}, LDH.

INTRODUCTION

Nutritional supplements frequently contain compounds of mainly carbohydrate, protein (essential and non-essential amino acids), vitamins, minerals and another (1,6,15). Use of dietary supplements is very extensive in sport and few athletes can be found who have never used them while involved in the quest for top performance (12,16,22).

Branched-chain amino acids (BCAA), including leucine, valine and isoleucine are classified as essential amino acids. The human body cannot synthesize these amino acids and must be included in the diet (13,26,29). There is some evidence showing that the consumption of branched amino acids has an anticatabolic effect during and after exercise (2,3,4,27,28). The theory has been proposed that branched amino acid supplementation can increase the healing rate from muscle damage after exercise (8,10,14,18).

One of the consequences of resistance training is injury, pain and delayed onset muscle soreness (DOMS). Muscle damage occurs when the muscle cell structures breakdown (11,13,21). Symptoms of muscle damage are the presence of muscle proteins in the blood, long-term decline in muscle function, including reduction in strength and power, flexibility and muscle dynamic speed (20). Researches measure a serum index of muscle damage, such as creatine kinase (CK), creatine kinase iso enzymes (CK_{MB}) and lactate dehydrogenize (LDH) (18). Creatine kinase enzymes are involved in the phosphate system that is important for energy metabolism in most body cells, especially muscle cells and the brain. The LDH enzyme is found in abundant quantities in the cytoplasm of all tissues and in different concentrations in the conversion of pyruvate to lactate (4,25).

Greer and colleagues (2007) did not see any significant difference between consumption of BCAA and a similar caloric placebo (14). Zebblin et al (2007) in a double blind study found that consuming eight grams of BCAA before light resistance activityhad no effect on the 24 and 48 hour post exercise serumic creatine kinase index (31). A review of research shows that the majority of studies with BCAA supplementation used training programs with endurance exercises. The results obtained from a review are not consistent. Our research question is, can

taking two different doses of BCAA supplementation before and after a session of heavy resistance exercises effect the serumic index of muscle damage (CK-CKMB-LDH) in wrestlers?

METHODS

The study design was semi-experimental. The subjects were trained wrestlers from Mahabad City that volunteered and were assigned according to the criteria and indicators to fitness and had similar groups based on maximum aerobic power, anaerobic power, and one repetition maximum (1RM) in the desired movements. 29 wrestlers were then randomly assigned to one of three groups 1- low dose supplement group, 2- high dose group and 3- a placebo group. The subjects did not practice any sports activity a week before the test and were not using any drugs or supplements and were also healthy according to the medical questionnaires all subjects completed. After completing the consent form, the subjects was forbidden taking from any medication, supplements, or performing any heavy physical activity during the research protocol execution. The caliper was used for measuring the skin fat thickness of subjects.

Method of BCAA Supplementation The BCAA supplement (50 percent leucine, 25 percent iso leucine and 25 percent valine) was prepared to the required amount. Using digital scales (Sartovious models: GM312), the amounts for ingestion of 68 mg/kg for six days before the exercise test and two days after the exercise test, were prepared and were placed in a special plastic. The placebo for this study was Dextrin. Before taking supplements, it use explained to the subjects by the researcher, that they were required to ingest their assigned supplement for six days, three meals daily (before meals). On the performance day, the supplement group with the lower dose consumes 210mg/kg, and the supplement group with a high dose consumes 450 mg/kg and placebo group consumes 210mg/kg supplements, 30 minutes before and after the exercise test.

Heavy Resistance Exercise Protocol To create the muscular stress, a heavy resistance exercise program was used. Multi-joint movements and then single-joint movements were used. Resistance training activities at the 80 percent of 1RM was chosen; in case the subject's have ability to do more than one repetition, the Cochrane formula was used (4). 7 exercises were performed with the three sets of ten repetitions. The rest interval between sets was three minutes; rest between exercises was one minute. The exercises were: leg presses, chest presses, lat pull downs, leg extensions, arm curls, leg curls and abdominal crunches.

Blood Sample Blood sampling was collected at three points- prior to exercise performance, 24 h and 48 h after exercise protocol. The subjects entered the laboratory and sat for five minutes. The laboratory technicians collected 5 ml blood from the anticubital vein. These blood samples were placed for 30 minutes at a laboratory temperature until clotted, then separating by centrifuge (Hettich, Germany) and then the amount of enzymes (CK, CKMB and LDH) were measured via auto analyzer device (COBAS-Mira Plus, Switzerland).

Statistical Analysis Kolmogrov Smirnov test was used for data normality testing. for statistical Analysis, one way analysis of variance with repeated measure ANOVA with between group factor and post hoc Bonferroni tests was used ($p < .05$).

RESULTS

Subject's physiological profiles to separate the three groups are listed in table 1.

Table1. Profile of subjects in three study groups

Variables	Low-dosage BCAA supplement group (N=10)	High-dosage BCAA supplement group (N=10)	Placebo group (N=9)
Age (years)	22.4	22.6	22.6
Weight (kg)	73.4	71.9	74.4
Height (cm)	173.8	174.4	172.2
Fat percent	17.2	17.5	17.2
Vo_2max(ml/kg/min)	42.4	43.05	44.3
Sargent jump (cm)	52.2	51.5	50.8
BMI (kh/m^2)	24.2	23.7	24.5

Research findings show a significant increases in the mean values for group cellular damage serum indexes (CK-LDH-CKMB) within both supplementation groups with low dose, high dose supplements and placebo 24 and 48 hours after the test (table2).

Table 2. Mean and SD measured (international units per liter) in three sampling periods.

Group	Pre activity	24 h after activity	48 h after activity
Supplement 1-CK	172 ±29.1	343 ±78.6	400 ±183.5
Supplement 2-CK	168 ±23.9	634 ±214	468 ±220.2
Placebo-CK	177 ±13.4	762 ±331	582 ±264
Supplement 1-CK_{MB}	19 ±8.2	33 ±8.5	27 ±6.1
Supplement 2-CK_{MB}	5 ±2.2	30 ±5.7	25 ±3.5
Placebo-CK_{MB}	19 ±2.3	38 ±10.1	29 ±8.8
Supplement 1-LDH	250 ±29.6	394 ±60.1	312 ±33.5
Supplement 2-LDH	260 ±37.9	398 ±72.6	354 ±53.8
Placebo-LDH	264 ±36.9	419 ±61.1	345 ±59.8

Results of analysis of variance with repeated measurements within groups showed that time effect in both time periods (24 and 48 hours after the activity) on (CK-LDH-CKMB) values is significant (p=0/001). According to statistical test results, cellular damage indexes in the three groups in LDH (Sig= 0.734), CK (Sig= 0.312) and CKMB (Sig= 0.181) was obtained, which is not significant.

DISCUSSION

Comparison of results between groups in mean and amplitude changes of serum indexes of cell damage (CK-LDH-CKMB), 24 and 48 hours after the exercise performance showed no significant difference between the 3 groups. In other words, different amounts of BCAA did not significantly affect the serum cell injury indexes (CK-LDH-CKMB), 24 and 48 hours after the heavy resistance activity.

Data analysis from this study suggest that taking two different values of BCAA does have an significant effect on LDH enzyme activity compared with similar calories placebo. After studying changes in LDH enzyme activity 24 and 48 hours after exercise protocol, a significant increase in activity of LDH was observed in all three groups.
It seems that serum LDH enzyme concentration increases after muscle cell damage in sports activities. When the muscle cell membrane permeability increases or complete tears occur in muscle cells, enzymes are imported into the blood or lymphatic system (14). LDH enzyme widely distributed in tissues and its high concentration is found in the liver, myocardial, kidney, skeletal muscle, red blood cells and other tissues. Activity of serum LDH and CK enzymes, like other muscle damage goes up after a period of time, and its concentration remains high for a long time(14,30). Ferri and colleagues (2006) after running ten sets of ten repetitive plantar flexion motion (to gastrocnemius and soleus muscle) with 70 percent of 1RM intensity reported significant increased in LDH enzyme rates (10).

The results of these research is consistent with the results from Greer (14), whereas it is inconsistent with Coombes et al (2000) and Koba et al (2007) result (7,18). For justifying factors affecting the activity of serum enzymes we can refer to fitness levels, muscular type, muscle mass, race and age (4,5,17,23). Activity of serum enzymes also depends on gender differences. The estrogen hormone has a protective effect on the muscle cell membrane therefore the increase in serum enzymes is less in women than in men. The research has shown that in resting conditions, CK activity in athletes is higher than non-athletes. So after exercise, a smaller increase is seen in athletes serum CK levels (4,5). Sasaki and colleagues showed resistance exercise significantly increased serum CK for an hour to seven days after the exercise test execution.

The present findings are inconsistent with the findings of Coombes and Koba et all studies (7,18,19). Koba and colleagues showed that taking 10 grams of BCAA supplementation compared with a placebo reduced serum CK and LDH activities (24). This inconsistency probably was due to the type of subjects. Also, in this study used a heavy resistance activity for muscle cell damage. Activities with high and low intensity resistance increased serum CK activity (15). Reasons for why the present findings contradict the previous research, could be the difference in anabolic hormone response to BCAA intake in endurance and resistance activities.

Results related to CKMB isoenzyme activity levels before, and 24 and 48 hours after heavy resistance activity indicates that adding a BCAA supplement to diet and either two dosage does not affect activity of CKMB isoenzymes. Increases in CKMB 24 and 48 hours after heavy resistance activity in both groups of BCAA supplementation was lower than the placebo group but, these differences were not statistically significant. The range of CKMB changes after 24 h using a t-test showed that BCAA supplementation with high dosage and placebo groups were close to significance. It may be that with increasing amounts of BCAA supplementation we could see significant changes. Vigorous physical activities can be potentially damaging to cardiac function. The

relative risk for heart cell damage during intense physical activity can increase after an hour. Cardiac dysfunction caused by exercise, if there is no cardiovascular disease, shows the category of symptoms that is called heart fatigue.

Atashak (2006) concluded that creatine consumption weekly significantly increased the level of CKMB isoenzymes (1). Also Faramarzi and colleagues (9) reported that three sessions of intense periodic soccer activity is associated with significantly increased CKMB isoenzymes, and carbohydrate supplementation significantly reduced CKMB isoenzymes activity compared with a placebo group (9). Muscle cell damage has been studied in human and animal models. Most signs of muscle cell damage were delayed onset muscle soreness (DOMS), which is very dependent on the type and intensity of sporting activity. DOMS is usually emerges eight to 24 hours after cells damage, and usually reaches a peak 24 to 48 hours after exercise. On the other hand, creatine kinase secretion takes 24 hours to reach peak values. Some studies have mentioned that in resistance activities, creatine kinase secretion reaches a maximum after 48 hours.

Generally, from the results of this study we can infer that the effect of consuming a BCAA supplement, particularly with higher doses, have a very poor effect in the prevention of muscle damage as evidenced by increased CK, CK_{MB}, and LDH activity. But much research is needed to actually determine the effect of different dosage of BCAA intake on cellular damage serum indices.

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THE EFFECT OF TAPERING ON SELECTED PLASMA CYTOKINE LEVELS FOLLOWING INCREMENTAL TRAINING IN ELITE MALE WRESTLERS

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ABSTRACT
The aim of this study was to determine the effect of tapering on the concentration of plasma interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNFα) in elite male wrestlers after a period of incrementally increasing training volume. After completing 4 weeks of the incremental training exercise, the subjects were randomly assigned to one of two groups: a control group of wrestlers (n = 10) which continued performing the incremental weekly training volume for one week while a taper group of wrestlers (n = 10) proceeded with a 75% reduction in weekly training volume relative to the control group. Blood samples were collected from all participants at the beginning of the 1st week and at the end of the 4th and 5th weeks. Plasma levels of IL-6 and TNFα were assayed using standard commercial ELISA kits (Quantikine; R & D Systems, Minneapolis, MN). Data were analyzed by using t-test ($P<0.05$). The results showed that after one week of tapering, plasma levels of IL-6 significantly decreased ($P<0.05$). Although the plasma levels of TNFα decreased in the experimental group, it was not statistically significant ($P>0.05$). According to the results, increasing plasma level of IL-6 and TNFα in the wrestlers who continued incremental training might be related to the high volume of training.
KEY WORDS: Tapering, Interleukin-6, Tumor Necrosis Factor–alpha, wrestling

INTRODUCTION

Intense exercise with inadequate recovery can lead to overtraining syndrome, a state where performance and the sense of well being may be compromised for several months (3). Immune suppression is one of the main side effects of overtraining. Acute and chronic exercise influence several markers of immune system function (3). These markers and other biochemical changes which are associated with heavy training have been proposed as potential markers of overtraining. Prolonged periods of heavy training with different intensity and duration cause to temporary depression of several aspects of immune function that usually last 3-24 h after exercise (3,11). Epidemiological studies show that exercise with high volume and intensity causes athletes to be more susceptible to minor infection (16,20). For example, athletes who do intensive and prolonged exercise, are more likely than non-athletes to experience common cold and sore throat symptoms. In athletes this may cause a decline in athletic performance and an inability to sustain heavy training (19). In fact, there is no clinical disorder present in the athlete's immune system, but the total changes in various parts of the immune system cause a decline in the athlete's resistance to infection, especially during the most important competition when athletes should be at peak performance (7). There are different factors that interfere with immune system impairment that are completely unknown, but most physiologists believe that the changes in the immune system related to exercise are associated with changes in plasma cytokines and neuro-hormonal factors such as changes in the amounts of cortisol, catecholamine and growth hormone (17,18). Cytokines are immune system proteins that modulate or influence the immune response. Intense exercise induces increased levels of cytokines in the blood. While most studies have focused on the acute effects of exercise on cytokines, some have investigated the chronic effects in well-trained athletes during tapering periods. The majority studied three cytokines; interleukin-6 (IL-6), TNFα and interleukin-1α (IL-1α) (15). Generally, the concentration of these cytokines in response to exercise such as marathon is unchanged or increased (15). The intensity and type of training affected the cytokine response (22). Gokhale et al. (2007) investigated cytokine response to strenuous exercise in athletes and non-athletes. Their results showed that in both groups, the plasma levels of IL-6 increased, whereas TNFα decreased (8). Gorzi et al. (2006) reported that after ten weeks of endurance training plasma levels of cortisol and TNFα did not show significant decrements (9). Farhangimaleki et al. (2009) studied the effect of two different tapering periods on the concentrations of plasma IL-6, IL-1β and TNF-α, as well as performance in elite male cyclists. The results showed significant reductions in ($p < 0.001$) IL 1β, IL-6 and TNFα concentrations in the taper group relative to the control group at the end of the 3 week tapering period, but not at the end of the 1 week tapering period (1). Despite the high level of research interest in the effects of exercise on immunity, there are only a limited number of studies that have directly examined immunological changes in athletes during the taper phase prior to competition (12). Most of these studies were done in sports such as swimming, cycling and endurance running. There are a few studies investigating the immunological changes in wrestling, specifically in the tapering phase. The primary

purpose of this study was to investigate the effect of tapering (75% reduction in training volume) on the concentration of post-exercise plasma levels of IL-6 and TNFα in elite male wrestlers.

MATERIALS AND METHODS

Twenty Iranian high-level wrestlers (age = 21.8±1.4 years, weight = 71.5 ± 6.9 kg, BF% = 10.6 ± 1.9) volunteered to participate in this study as subjects. After receiving oral and written information about the study plans and procedures, the subjects signed an informed consent form. After completing 4 weeks of incremental training exercise, the subjects were randomly assigned to one of two groups: a control group of wrestlers (n = 10) which continued performing the incrementally increasing training volume for one week while a taper group of wrestlers (n = 10) proceeded with a 75% reduction in weekly training volume relative to the control group.

To create a realistic reduced training scenario, the 20 elite wrestlers were fully trained as if preparing for a competition season. The training status of every subject over the preceding 8 weeks was obtained by questionnaire, training log, and a personal interview. Blood samples were collected from all participants at the beginning of the 1st week, and at the end of 4th and 5th weeks. Plasma levels of IL-6 and TNFα were analyzed using validated ELISA kits (Quantikine; R & D Systems, Minneapolis, MN).

All participants completed a 4-week incremental, high-intensity training period (Table 1). After this four-week progressive training and before the tapering period began, the subjects were randomly divided into two equal groups: an experimental tapering group (75% reduction in training volume) and a control group (continued weekly incremental training).

Table 1. Training programs; values in parentheses denote the number of sessions for each item per week

Mesocycle	Incremental training				Tapering	
Group					control	experimental
Weeks	1	2	3	4	5	
Warm-up(min)	15 (6)	15 (6)	15 (6)	15 (6)	15 (6)	15 (6)
Interval training (min)	20 (3)	-	-	-	-	-
Resistance training (min)	45 (3)	45 (3)	45 (3)	45 (3)	45 (3)	11 (3)
Speed training (m)	160 (2)	190 (2)	210 (2)	240 (2)	270 (2)	60 (2)
Plyometric training (j)	-	30 (3)	36 (3)	42 (3)	48 (3)	10 (3)
Technical training (min)	16 (3)	18 (3)	20 (3)	22 (3)	24 (3)	5 (3)
Wrestling competition (min)	10 (3)	12 (3)	14 (3)	16 (3)	18 (3)	4 (3)
Warm-down	10 (6)	10 (6)	10 (6)	10 (6)	10 (6)	10 (6)

RESULTS

The results are presented as mean values and standard deviation. Independent t-tests were used for comparing any significant difference between groups after week 5 of training. The level of significance was set at $p<0.05$. Descriptive values of cytokines level in three phase of measurement were presented in table 2.

Table 2. Mean ± SD level of IL-6 and TNFα ($pg.ml^{-1}$) in studied groups

Group	**IL-6 ($pg.ml^{-1}$)**			**TNFα ($pg.ml^{-1}$)**		
	wk1	wk4	wk5	wk1	wk4	wk5
Control	4.99 (0.85)	7.84 (0.67)	8.82 (0.72)	3.81 (0.66)	5.33 (0.61)	5.45 (0.54)
Tapering	4.94 (0.66)	7.71 (0.72)	5.85 (0.52)	3.73 (0.55)	5.48 (0.62)	5.25 (0.57)

The result of t-test showed that the IL-6 concentrations between two training groups were significantly different ($P<0.05$). Means at the end of week 4 were 57% greater than those at the beginning the training protocol. After one week of tapering IL-6 concentrations declined 24% in the tapering group.

Plasma TNFα levels between the two training groups showed no significant differences ($p>0.05$). The mean TNFα concentrations at the end of week 4 were 43% more than those at the day before beginning of the training protocol. After one week of tapering TNFα concentrations decline 4.2% in the tapering group.

DISCUSSION/CONCLUSIONS

This study showed that following four weeks of incremental training, post-exercise plasma levels of IL-6 and TNFα increased in elite male wrestlers. This elevation of pro-inflammatory cytokines can be attenuated after one week of tapering. In the tapering group with a 75% reduction in weekly training volume the plasma levels of these cytokines decreased. Continuation of incremental training in the control group lead to increasing the plasma levels of these cytokines. These findings agree with that reported by Nielsen et al. (2003) and Gokhale et al. (2007). Impairment of the immune system is influenced by different factors that are not presently known. The changes in the immune system related to exercise are impressive with changes in plasma cytokines and neuro-hormonal factors observed more than others (17,18). The studies show that high levels of IL-6 and TNFα during training are a part of the acute inflammatory response due to exercise. It is probable that systemic inflammation causes a catabolic state that is in part related to plasma cytokines and glucocorticoids (6,10). Smith (2000) reported that high levels of IL-6 and TNFα is a symptom of high volume of training (21). Elevation of these cytokines may lead to immune suppression. A greater incidence of infection among athletes is probably due to repetitive intense exercise with insufficient recovery.

According to the results of this study, high levels of IL-6 and TNFα in the control group may result from a high volume of training and thereby contribute to a higher rate of infection in athletes. These findings are similar to those reported by Gleeson et al.(2000) and Gokhale et al. (2007) and disagree with those reported by Tsukui et al.(2000). Elevation of these cytokines also prevent protein synthesis due to muscular proteolysis, which finally leads to impairment of performance (2). Following physical exercise, there are decreases in circulatory anabolic factors and increases in catabolic cytokines like IL-6 and TNFα (13). Elevation of these plasma cytokines is related to increased susceptibility to infection (Gleeson et al., 2004).

The release of IL-6 by the contractile muscles may be a sign for the liver to increase glucose output and it may also prevent a glucose concentration decline caused by training. If the training duration is decreased, or the recovery times between training sessions is increased, IL-6 secretion will be decreased (23), because of increasing muscle glycogen stores.

As our findings showed that after one week of tapering plasma levels of IL-6 decreased. This is most likely related to the increasing muscle glycogen during the tapering. Our findings support suggestions that a reduction in training volume prior to competition may reduce the negative effects of overtraining. Increases in the plasma levels of IL-6 and TNFα in wrestlers who continue incremental training seem to be related to a high volume of training and could indicate a greater susceptibility to infection.

PRACTICAL APPLICATIONS

According to the results of this study, a four-week incremental training program used with elite male wrestlers can significantly elevate post exercise plasma levels of IL-6 and TNFα. A tapering approach with a 75% reduction in weekly training volume may reverse these levels, while at the same time improve subsequent performance. The optimal length and amount of the training reduction needs to be refined.

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INFLUENCE OF POWER LOADING ON THE AEROBIC READINESS OF JUDOISTS

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To investigate the influence of power loading on aerobic endurance, judoka carried out a specially developed complex with weights. In a monthly cycle of four weeks, ten exercises were carried out in three different time periods. The primary goal during this period of training was to complete a set of 20 repetitions, for three sets. Time of rest between repetitions and sets was not limited. This monthly cycle has been named volumetric.

Results of research have shown that the offered loading renders essential influence on an organism of sportsmen so the time of performance of all complexes of exercises decreased during the monthly cycle (fig. 1). In the beginning of research the sportsmen carried out this complex in about 91 minutes, and by the end time the performance was reduced to 56 minutes. The performance of the entire complex showed a considerably increase in the volume of work performed, (fig. 2) from 921.5 total repetitions up to 1920 total repetitions by the end of this monthly volumetric cycle.

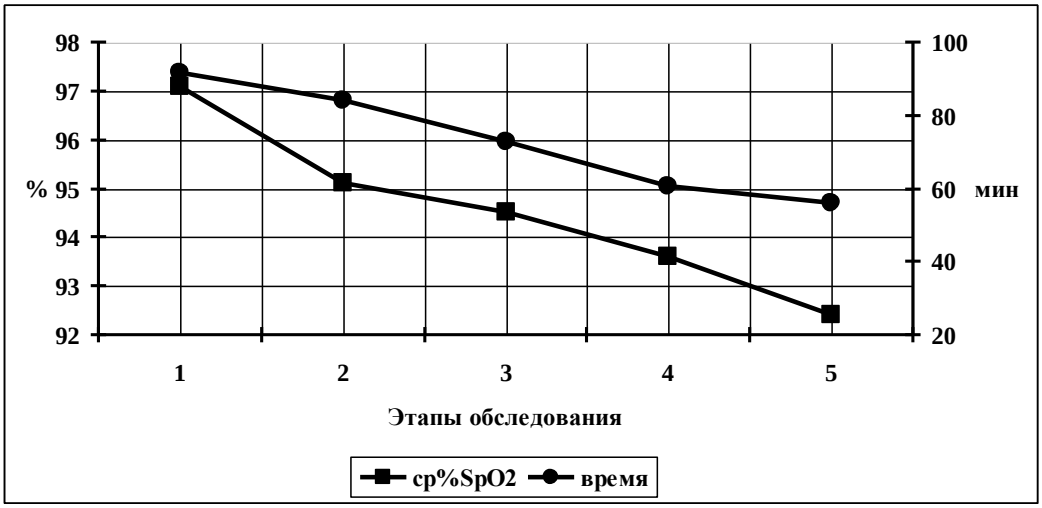

Fig. 1-percent absorption rates of blood oxygen and time of exercise completion

This increase of volume and time performance has led to the fact that athletes perform at work drops in blood oxygen absorption to 92.4 percent absorption rates and increase in heart from 151 beats / min. to 158 beats / min. (Fig 2). Such indicators characterize the aerobic energy supply of the body.

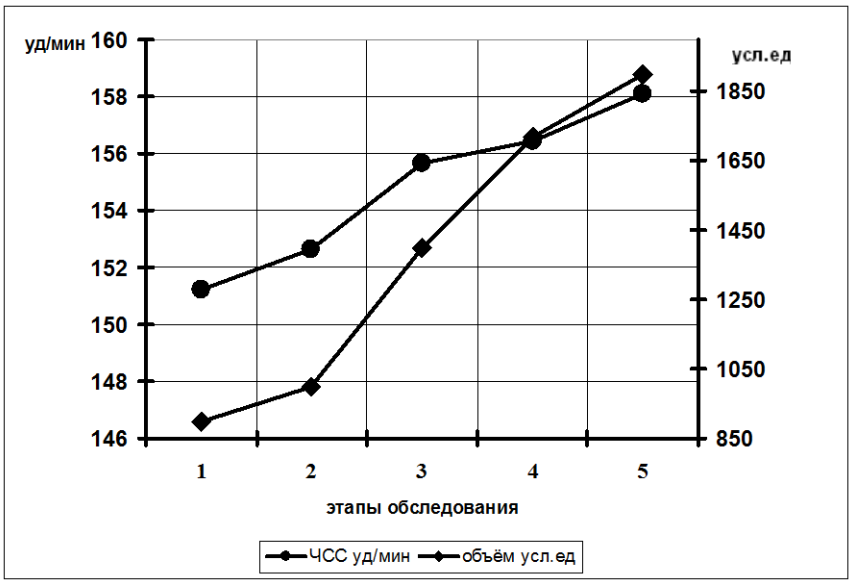

Fig.2-Performance of the work performed (total reps)and heart rate when the speed-power complex in the bulk mesocycle

During the speed-power load tested the performance of respiratory judoka. First of all, it should be noted that the forced vital capacity has not changed and remained at the average for the specialization of fighters [80]. Along with this there have been significant changes in rates of respiratory muscles in Fig. 3 Since the strength of inspiratory muscles (SIM) at the beginning of the experiment was 87%, and at the end of the experiment increased to 99.5%, which significantly improved the breathing of athletes and has provided an additional amount of oxygen in the body's transport system judoka.

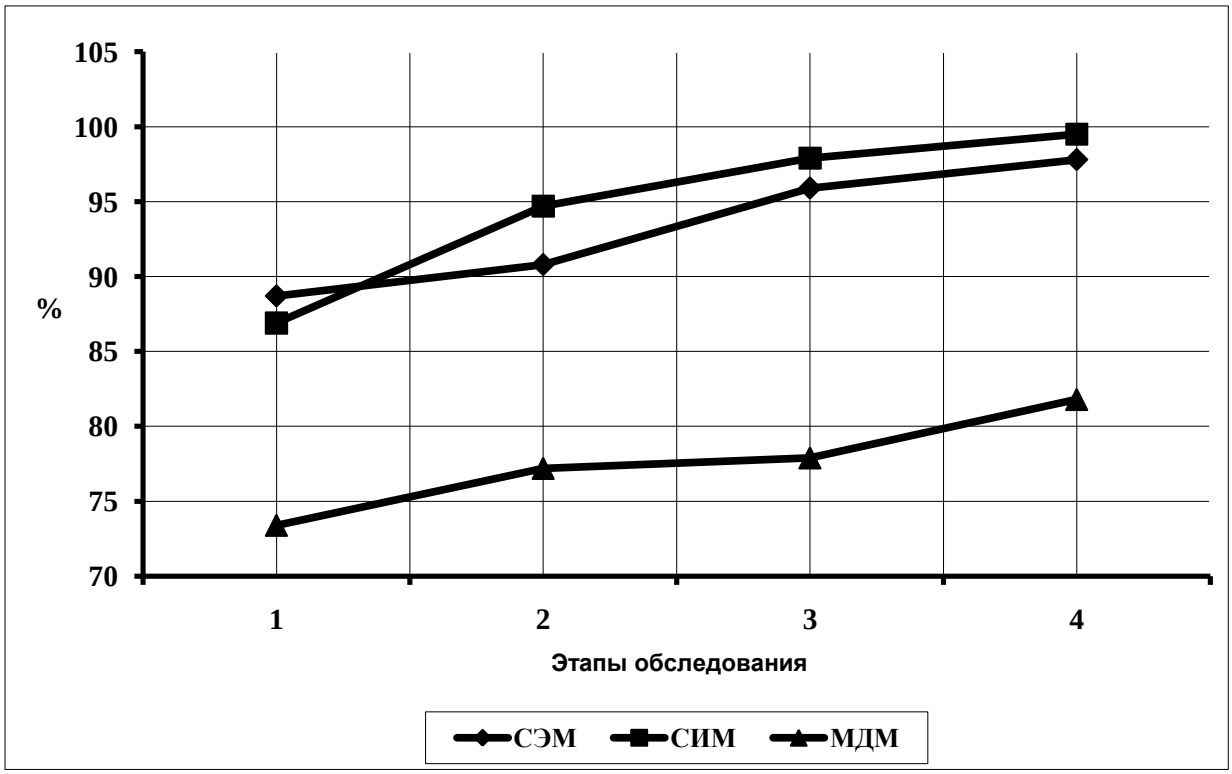

Fig. 3 - Indices of muscle strength of respiratory muscles during speed-power load

The strength of expiratory muscles (SEM) increased from 88.7 to 97.8%, this increase has allowed athletes to increase the recycling of carbon dioxide from the body and greatly improve the oxidation-reduction processes during the performance. Increased muscle strength inhalation and exhalation, respectively, resulting in better general indicator of muscle respiratory muscles (MDM) from 73 to 82%, it describes the positive effects of the application of speed-power load on the respiratory system of judo.

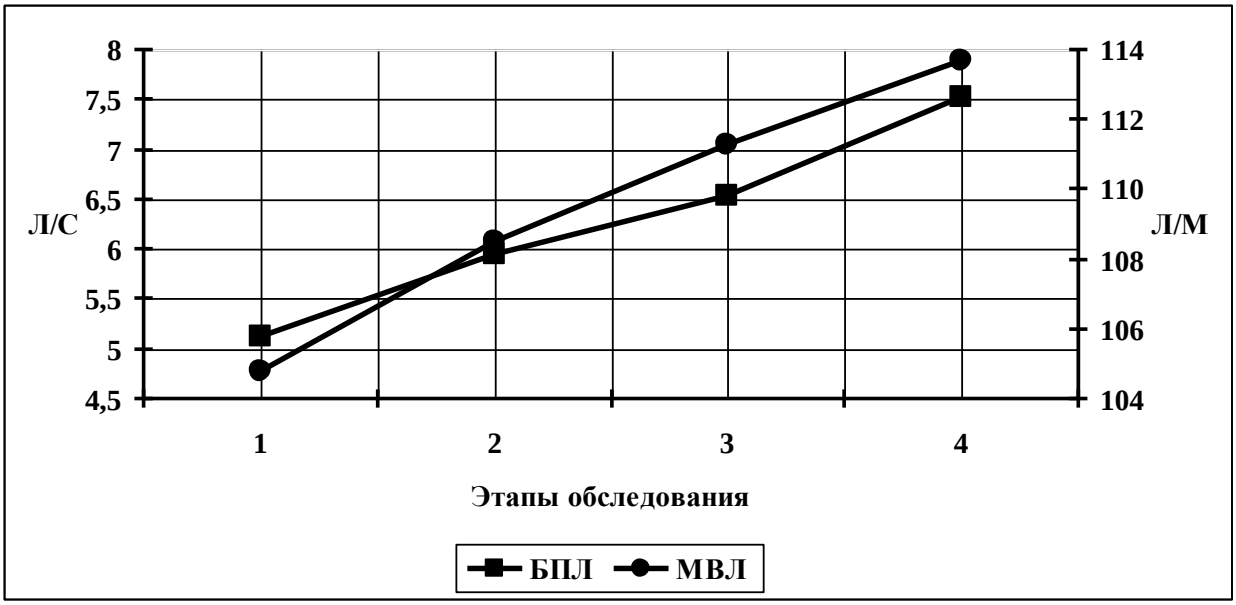

Fig. 4 - bronchial patency rates and maximum ventilation after the speed-power load

Consider the indicators of bronchial patency and maximum ventilation Fig.4. From these data show that bronchial permeability of the lungs (BPL) is gradually increased throughout the experiment with 5.13 l / s to 7.53 l / s at the end of the study. This improvement in bronchial patency demonstrates the positive impact of speed-power load on the aerobic capacity of sportsmen.

The use of speed-power orientation has increased the maximum ventilation (MVL) from 105 to 114 l / m, which also improves performance of external breathing. Thus, we can say that speed and power load increases the strength of respiratory muscles, maximum ventilation and improves bronchial patency lungs, which improves performance of external respiration and aerobic capacity develops judoka.

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ВЛИЯНИЕ СКОРОСТНО-СИЛОВОЙ НАГРУЗКИ НА АЭРОБНУЮ ПОДГОТОВЛЕННОСТЬ ДЗЮДОИСТОВ

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Для определения влияния скоростно-силовой нагрузки на аэробную выносливость, дзюдоисты выполняли специально разработанный комплекс с гирями. В мезоцикле длительностью четыре недели десять предложенных упражнений выполнялись в трёх подходах. Основная задача в этот период тренировки довести количество повторений в одном подходе до 20 раз. Время отдыха между повторениями и подходами не ограничено. Этот мезоцикл был назван объемным.

Результаты исследования показали, что предложенная нагрузка оказывает существенное влияние на организм спортсменов, так время выполнения всего комплекса упражнений уменьшалось на протяжении всего мезоцикла рис. 1. В начале исследования спортсмены выполняли комплекс

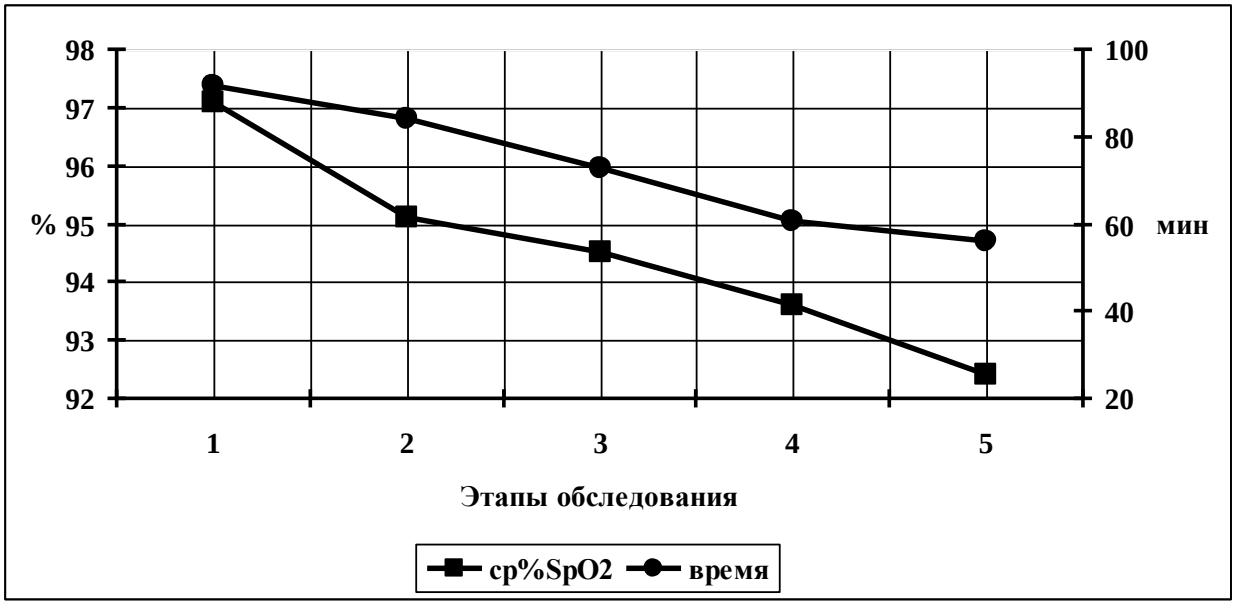

Рис. 1-показатели процентного усвоения кровью кислорода и время выполнения комплекса упражнений в объёмном мезоцикле

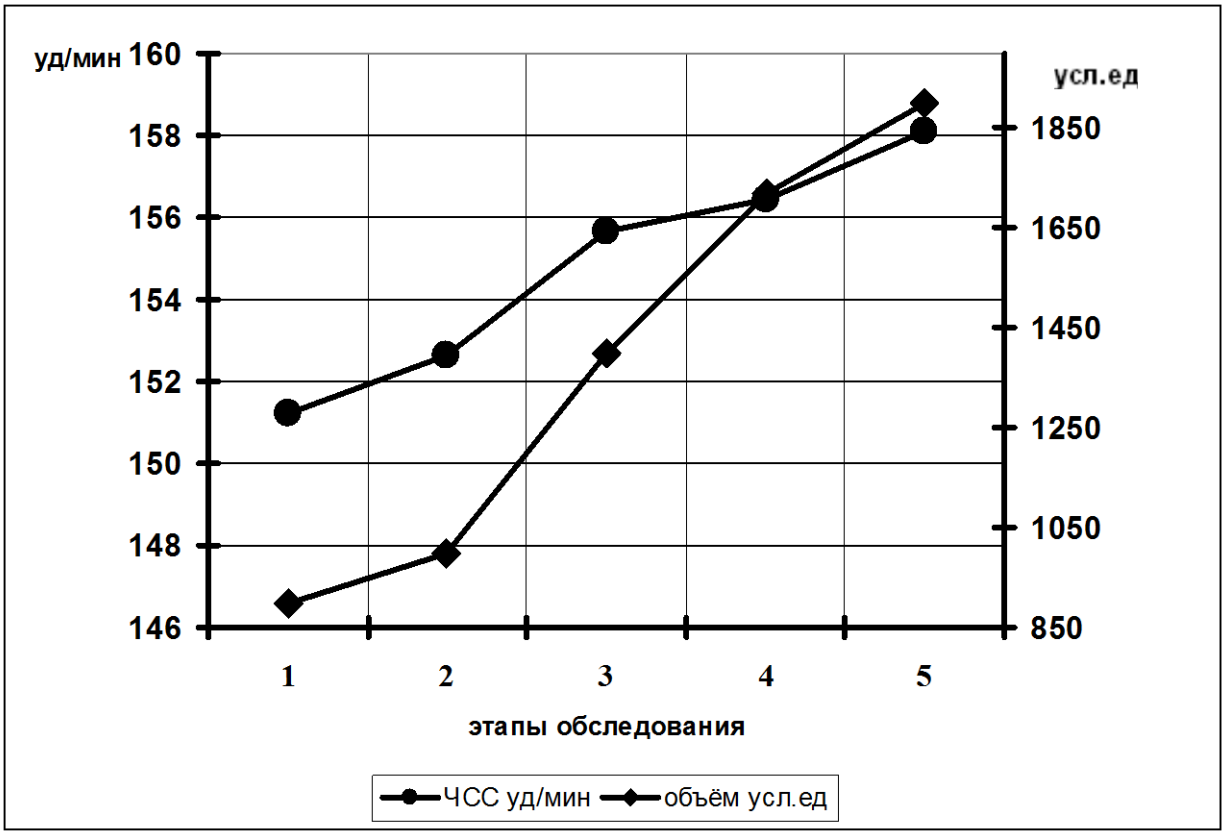

Рис.2- показатели объёма выполненной работы и ЧСС при выполнении скоростно-силового комплекса в объёмном мезоцикле

затрачивая на его выполнение примерно 91 минуту, а в конце время выполнения сократилось до 56 минут. При этом дзюдоисты при выполнении комплекса значительно увеличили объём выполненной работы рис. 2 с 921,5 усл.ед до 1920 усл.ед. в конце мезоцикла объёмной направленности.

Такое увеличение объёма и снижения времени выполнения работы привело к тому, что спортсмены выполняли работу при снижении показателя усвоения кровью кислорода до 92,4 % рис.1 и повышении ЧСС с 151 уд/мин. до 158 уд/мин. рис.2. такие показатели характеризуют аэробное энергообеспечение организма.

В период проведения скоростно-силовой нагрузки проводилось тестирование показателей внешнего дыхания дзюдоистов. В первую очередь, необходимо отметить, что форсированная жизненная ёмкость лёгких практически не изменилась и осталась на уровне средних показателей для специализации борцов[80]. Наряду с этим произошли значительные изменения в показателях дыхательной мускулатуры рис. 3.

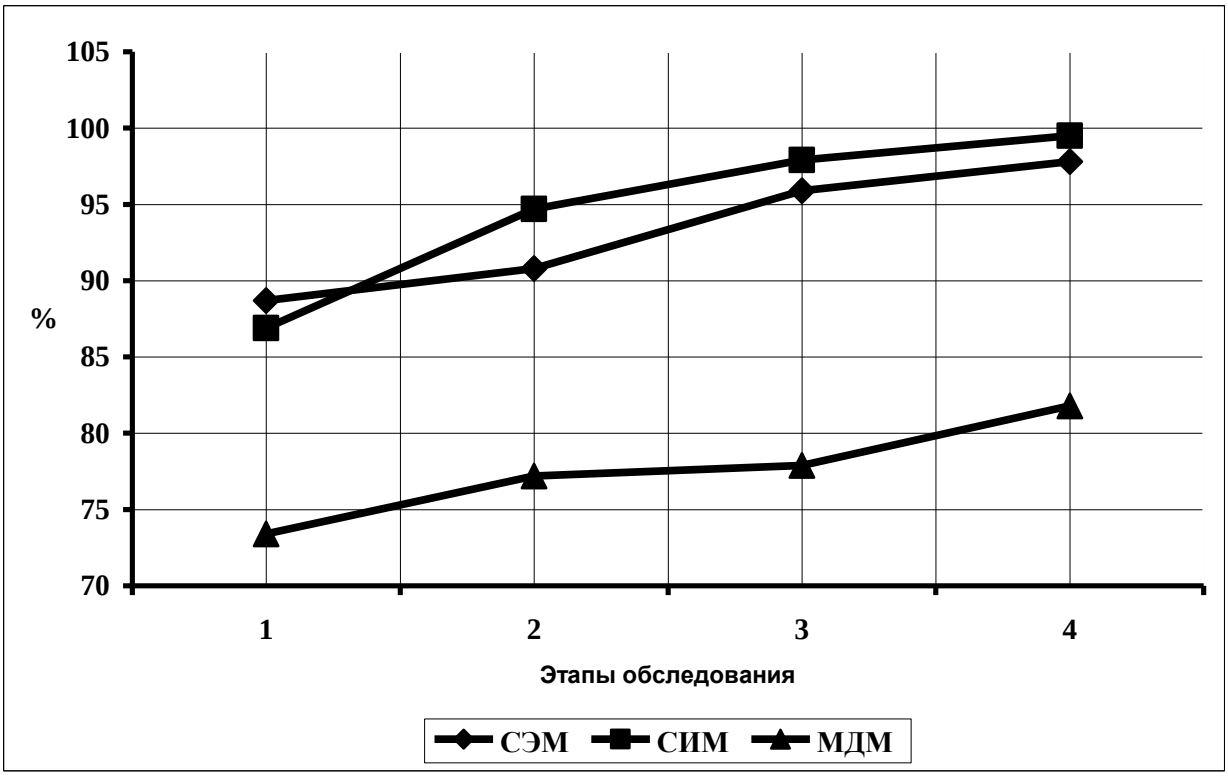

Рис. 3 - показатели силы мышц дыхательной мускулатуры в период скоростно-силовой нагрузки

Так сила инспираторных мышц (СИМ) в начале эксперимента составила 87%, а в конце эксперимента увеличилась до 99,5%, что значительно улучшило вдох спортсменов и обеспечило дополнительное количество кислорода в транспортную систему организма дзюдоистов.

Сила экспираторных мышц (СЭМ) увеличилась с 88,7 до 97,8%, такое увеличение позволило спортсменам повысить утилизацию углекислого газа из организма и значительно улучшить окислительно-восстановительные процессы во время выполнения работы.

Увеличение силы мышц вдоха и выдоха, соответственно привело к улучшению общего показателя мышц дыхательной мускулатуры (МДМ) с 73 до 82%, это характеризует положительное влияние применённых средств скоростно-силовой нагрузки на систему внешнего дыхания дзюдоистов.

Рассмотрим показатели бронхиальной проходимости и максимальной вентиляции лёгких рис.4 . Из полученных данных видно, что бронхиальная

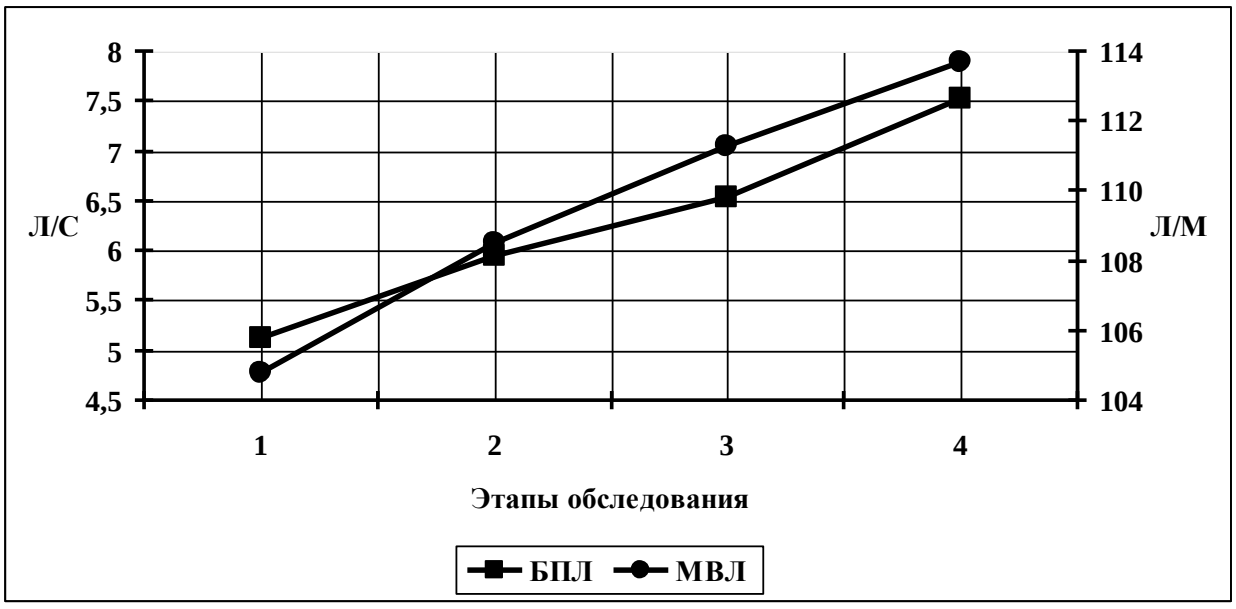

Рис. 4- показатели бронхиальной проходимости и максимальной

вентиляции лёгких после скоростно-силовой нагрузки

проходимость лёгких (БПЛ) постепенно увеличивается на протяжении всего эксперимента с 5,13 л/с до 7,53л/с в конце исследования. Такое улучшение бронхиальной проходимости свидетельствует о положительном влиянии скоростно-силовой нагрузки на аэробные способности организма спортсменов.

Применение средств скоростно-силовой направленности увеличило максимальную вентиляцию лёгких (МВЛ) с 105 до 114 л/м, что также положительно влияет на показатели внешнего дыхания.

Таким образом, можно констатировать, что скоростно-силовая нагрузка увеличивает силу дыхательных мышц, максимальную вентиляцию и улучшает бронхиальную проходимость лёгких, что положительно влияет на показатели внешнего дыхания и развивает аэробную производительность дзюдоистов.

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EFFECT OF EIGHT WEEKS OF WRESTLING AND CIRCUIT FITNESS TRAINING ON APO LIPOPROTEIN A-I AND LYMPHOCYTE ABCA1 GENE EXPRESSION IN WELL-TRAINED WRESTLERS

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ABSTRACT:
Introduction: Atherosclerotic cardiovascular disease is now the leading cause of death in most countries. The ABCA1 gene provides instructions for the production of proteins (ATP-binding transporter protein) whose function is to export phospholipid and cholesterol out of the cells where they are bound to circulating apolipoprotein A1 (apoA1) and removed in the liver. Increased ABCA1 activity could inhibit atherosclerosis. In the present study, ABCA1 gene expression in lymphocytes and the associated effect of exercise were studied. **Method:** Subjects were 16 well-trained wrestlers randomly assigned into experimental and control groups. The experimental group performed 8 weeks of wrestling and circuit fitness training and the control group remained sedentary. Blood samples were collected 48 hours before the first session and 48 hours after the last session (subjects were fasting). After isolating lymphocytes by centrifugation, ABCA1 gene expression in lymphocytes was measured using semi-quantitative-RT-PCR. Data analyzed by SPSS software (version 16). **Results:** a significant increase in lymphocyte ABCA1 gene expression was shown following the 8 weeks of training (experimental $p<0.001$, $t=-9.954$). Plasma HDL-C concentrations and Apo A-I increased ($P<0.001$, $t=4.97$ $P<0.05$, $t=2.67$ respectively) and plasma LDL-C concentration decreased ($P<0.001$, $t=4.35$) in experimental group when compared with the control group. **Discussion and Conclusion:** Anaerobic exercises like wrestling and circuit fitness training can increase ABCA1 gene expression, an effective factor in the prevention of cardiovascular disease.
KEYWORDS: ABCA1, lymphocyte, circuit training

INTRODUCTION:

Coronary artery disease is now the leading cause of death worldwide. An early sign of atherosclerosis is the accumulation of cholesterol-loaded macrophages (foam cells) in the intima of arteries. An elevated plasma level of low-density lipoproteins (LDL) is a risk factor for atherosclerosis, mainly because this lipoproteins deposit cholesterol within cells of the arterial wall. Numerous epidemiological studies have also demonstrated that plasma levels of high-density lipoproteins (HDL), and their major protein constituent apolipoprotein A-I (apoA-I) are inversely correlated with the risk of atherosclerosis [1].Moreover, rising HDL cholesterol inhibits atherogenesis in several genetic animal models [2].

This protective effect of HDL-C against atherosclerosis [3,4] is due to the HDL-C role in Reverse cholesterol transport (RCT). In RCT, HDL-C mediates the removal of excess free cholesterol from peripheral cells to the liver for excretion as bile [5]. In RCT process, the formation and remodeling of HDL-C in plasma require several factors such as ATP-binding cassette transporters, particularly ABCA1 that its action is a key element of the reverse cholesterol transport pathway [6, 7, 8, 9].

ABCA1 is a protein expressed abundantly in liver, macrophages brain and various other tissues [10,11] and facilitates delivery of phospholipids from cell membranes to lipid-poor ApoA-1 with the formation of ApoA-I containing HDL and it is play a pivotal role in plasma HDL formation [10,12,13,14,15]. ABCA1 is essential for the maintenance of plasma HDL-cholesterol levels. It is generally accepted that an increase in liver ABCA1 expression will has a heavily impact on plasma HDL-C formation and protects against atherosclerosis [16,17,18].

ABCA1 is responsible for lipidation of lipid-poor apolipoprotein A–I (ApoA–I) by cellular cholesterol and phospholipid, a rate-limiting step in both high density lipoprotein formation and cholesterol efflux [19,20]. Environmental factors likely contribute significantly to variation in ABCA1 expression and plasma HDL-C in the general population [21,22]. Therefore, in this study, measured ABCA1 expression in human lymphocytes, may partially reflect that in macrophages.

MATERIAL AND METHODS:

Study participants: The subjects were 16 well-trained wrestlers randomly assigned into experimental and control groups. The experimental group performed wrestling and circuit physical fitness training six sessions per week for 8 weeks, and the control group remained sedentary.

Study design: Weight was measured to the nearest 0.1 kg on a digital scale both before and at the end of the research program. Heart rates were monitored during the research program by heart rate monitors device (Polar® model F1). Subjects exercised with an average of 85-90% HR max. Body fat percentages were obtained using skinfoild caliper measures from three sites (22). Participants presented to the laboratory 48 hours before the first training session and 48 hours after the last session at 8 am. This followed an overnight fast and rest without exercise. A 10 cc fasting venous blood sample taken from the brachial vein was obtained. Blood samples were collected in test tubes anticoagulated with EDTA. Peripheral blood mononuclear cells were isolated by lymphocyte density gradient centrifugation (Cedarlane, Laboratories Limited, Burlington, Canada) at 900 g, according to the manufacturer's instructions and the pellet containing the lymphocytes was used for further analyses.

ABCA1 expression and abundance: The lymphocyte was powdered with cold mortar and pestle, and approximately 50 mg was used for the isolation of RNA. Total RNA was extracted by the guanidine thiocyanate method [25] and mRNA purified using an mRNA Isolation Kit (Roche, Germany) according to the manufacturer's instructions. Two-hundred nanograms of mRNA was used for synthesis of first strand cDNA by using oligo (dT) primer in the first-strand synthesis kit (Fermentase, Germany). Relative expression levels of ABCA1 mRNA in the lymphocyte were determined using a semi-quantitative PCR method. The following primers were used to amplify rat ABCA1 and b-actin (as an internal control) cDNA: ABCA1-Forward: 50-CGT CCT CCT TGT CAT CTC TG-30. ABCA1-Reverse: 50-TAA CTT TCT TTC ACT TTC TCG TC-30. b-actin- Forward: 50-TCC TGT GGC ATC CAT GAA ACT-30; b-actin-Reverse: 50-ATC GTG CAC CGC AAA TGC TTC-30. ABCA1 cDNA was amplified yielding a 237-bp product. PCR was formed for 35 cycle of denaturation 94° C for 30 s, annealing of 55.5° C for 30 s and extension at 72°C for 50 s. Reactions were set up using a twofold serial dilution of template cDNA to assess the best dilution of template in PCR. Template cDNA was standardized by amplification of a 315-bp internal control of b-actin, a house keeping gene. All the reactions were repeated a minimum of three times to ensure repeatability. All PCR products were electrophoresed on an agarose gel and bands visualized by ethidium bromide staining and quantitated by computer integrated densiometry (Kodak, CT). Levels of mRNA were expressed as a ratio of signal intensity for the b-actin gene.

Lipoproteins and apolipoprotein A–I: Plasma high-density lipoprotein cholesterol (HDL) was determined by direct immuno method (HDL-C Immuno FS, Pars Azmoun, Tehran, Iran), the intra-assay coefficient of variation and sensitivity of the method were 1.2% and 0.03 mmol/L. The procedure of Friedewald was used to estimate low-density lipoprotein cholesterol (LDL-C). Apolipoprotein A1 was determined by ELISA method (Wuham USCN Sciences Co. LTD, Wuhan, China).

STATISTICS

All results are expressed as means ± SD. All variables were compared by unpaired t-tests. Correlations wwere calculated using the Pearson Product Moment correlation. All statistical analysis was performed by using SPSS (Version 16).

RESULTS

Participant characteristics: The average age of the participants was 17.44±0.92 (mean±SD.) years for control group and 17.33±1.05 for experimental group, BMI was 21.06±3.11kg/m^2 for control group and 22.30±4.21 for experimental group, body fat percentage was 14.28±4.15 for control group and 15.87±5.02 for experimental group. Other lipid-related parameters are shown in table1

Table1. Participant characteristics

Parameter	control	experimental	P value
Age(year)	17.44±0.92	17.33±1.05	P<0.81
BMI(kg/m2)	21.06±3.11	22.30±4.21	P<0.66
Body fat percentage	14.28±4.15	15.87±5.02	P<0.61
HDL-C(mmol/L)	38.10±2.51	40.80±4.49	P<0.11
LDL-C(mmol/L)	74.70±12.15	94±11.4	P<0.002
Apo A-I(mg/dL)	158.23±8.53	159.59±8.37	P<0.73
Lymphocyte(n×1000 /IÙ)	2.70±0.84	2.33±0.49	P<0.75
ABCA1mRNA-lymphocyte(RU)	76.16±6.34	77.25±3.43	P<0.77

RU-relative units.

ABCA1 and reverse cholesterol transport: ABCA1 gene expressions in lymphocytes and plasma lipoprotein (HDL-C, LDL-C) were examined in subjects. Despite a reduction in lymphocyte count in both groups (P< 0.05), the ABCA1 gene expression in lymphocyte was significantly (P< 0.001, t=9.95) higher in the experimental group when compared with the control group (figures 1 and 2).

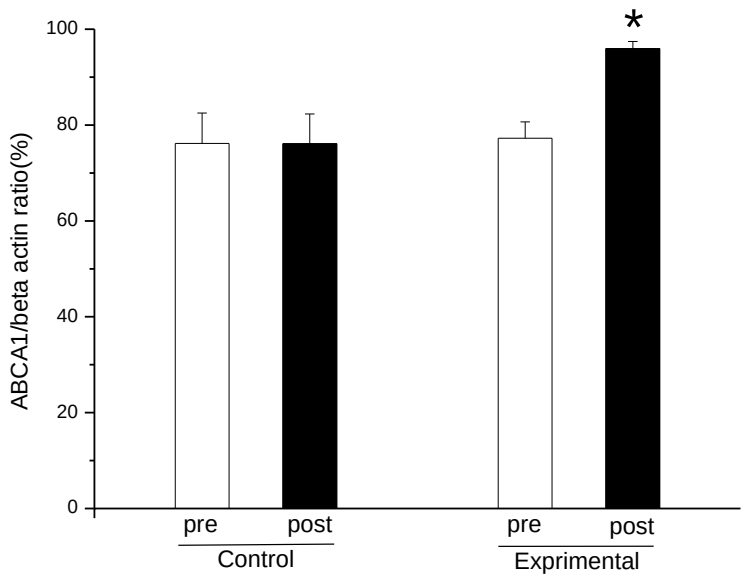
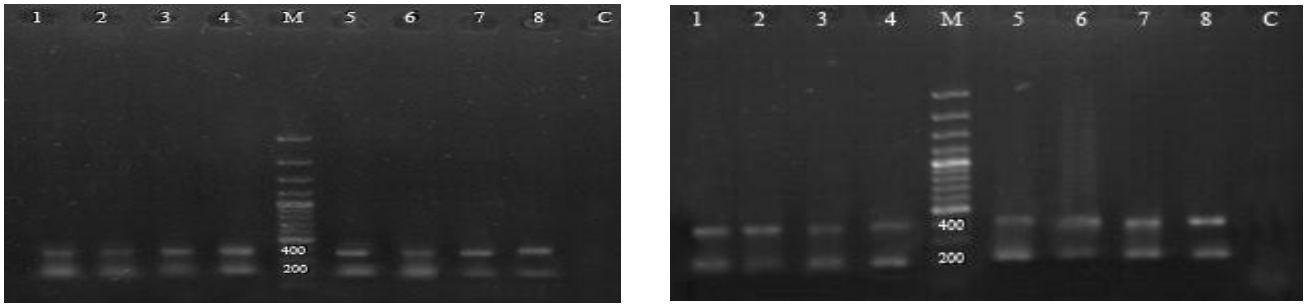


Figure1. Semi-quantitative RT-PCT of lymphocyte ABCA1 mRNA expression in two groups, prior and after research program (mean±SD)



Control Experimental

Figure 2. Semi-quantitative RT-PCT of peripheral blood lymphocytes ABCA1 mRNA expression in control and experimental groups

Plasma HDL-C and Apo A-I concentrations were higher in the experimental group following the 8 weeks of wrestling training (P<0.001, t=4.97 and P<0.001, t=2.67 respectively). There was also a significant decrease in plasma LDL-C concentration in the experimental group compared to control group (P<0.001, t=4.35). (Figure 3)

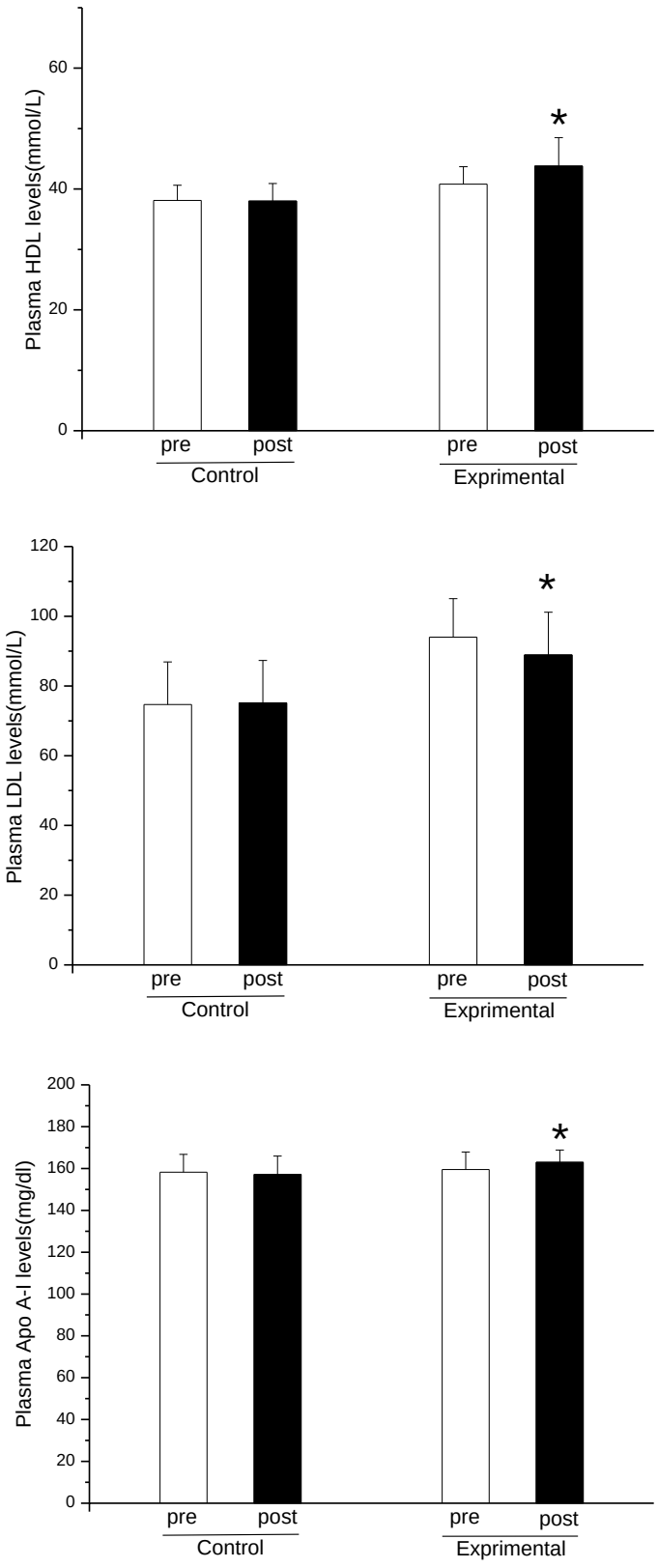


Fig. 3. Plasma HDL-C, LDL-C and apolipoprotein A-I concentrations after 8 weeks of research program in control and experimental group Data expressed as mean±SD.

CONCLUSIONS

A gene expression in white blood cells in response to exercise has been shown by previous studies [23,24,25,26]. The effect of exercise programs (acute and chronic) on reverse cholesterol transport (RCT) and its key elements except ABCA1 has been studied by several investigators, but to our knowledge this is only the third human study to demonstrate that ABCA1 is expressed by peripheral blood lymphocytes due to exercise [20,27]. The main finding of present study was that eight weeks of wrestling exercise with 85-90% of HR max, increased the ABCA1 expression on lymphocytes in well trained wrestlers. Plasma HDL-C and apo A-I levels increased following eight weeks of wrestling and wrestling based training. Furthermore plasma LDL levels decreased significantly following the protocol.

Our findings on ABCA1 expression are partly similar to Ghanbari-niaki et al findings. When they calculated the expression of ABCA1 mRNA in peripheral blood lymphocyte found significant increase in a short time after exercise in all given exercise intensities (40%, 60%, and 80% of one repetition maximum) and was more pronounced in 60% group. In addition plasma HDL concentrations showed a moderate change immediately due to exercise. The result also shows that a higher lymphocyte ABCA1 expression was not accompanied with a significant change in plasma HDL [27].

In Hoang et al study ABCA1 expression was measured in human skeletal muscle biopsies and leukocytes and physical activity (habitual exercise) were assessed using International Physical Activity Questionnaire (IPAQ). The main findings of Hoang et al were that leukocyte ABCA1 expression relates positively with frequency of exercise and muscle ABCA1 expression relates positively with alcohol consumption [20]. Khabazian et al reported that six week of endurance training increased Liver and intestine ABCA1 mRNA expression significantly higher in trained rats compared to control rats [9,18]. In the present study, we investigate lymphocyte ABCA1 gene expression in human and use specific eight weeks training protocol that may be more accurate than questionnaire or acute exercise.

Jurimae et al studied the effect of a circuit resistance protocol (3 circuits, 10 exercise using a work-to-rest ratio of 30 s: 30 s at 70% of 1RM) on HDL-C and other lipid and lipoprotein profiles. They reported results showed that LDL-C, and HDL-C concentrations remained unchanged immediately after exercise, but an elevation in plasma HDL-C observed after 1h of recovery period [28]. There is little doubt that ABCA1 interacts directly with ApoA-I. However, this does not exclude that ABCA1 might also efflux lipids onto ApoA-I at the cell surface. Concerning the substrate specificity, phospholipids rather than cholesterol seem to be transported by ABCA1 [7].

In Olchawa et al study, 25 endurance-trained male athletes (VO2max=53.4±1.2 mL/min per kg) were compared with 33 males enjoying an active lifestyle (VO2max=38.8±1.0mL/min per kg). Plasma concentrations of HDL-C (1.4±0.1 versus 1.7±0.1 mmol/L, $p<0.001$) and ApoA-I (128±3 versus 145±_2 mg/dL $p<0.001$) were higher in athletes compared with active subjects [29]. Both systemic and selective hepatic over expression of ABCA1 in mice results in an increase of HDL-C plasma levels. Vice versa, apoA-I and HDL plasma levels are dramatically reduced in mice with a liver-specific deletion of ABCA1 [17,30]. Hence, hepatic ABCA1 expression is a rate-limiting factor for plasma HDL production [31]. Although ABCA1 in macrophages has little influence on plasma HDL levels, it is a crucial factor in the prevention of excessive cholesterol accumulation in macrophages of the arterial wall and their transformation in foam cells, independently of plasma HDL levels. Regulation of ABCA1 expression in leukocytes may partially reflect that in macrophages [20].

PRACTICAL IMPLICATIONS/ADVICE FOR ATHLETES AND COACHES

Anaerobic exercises such as wrestling can increase plasma HDL and Apo-I, decrease LDL concentrations and also enhance ABCA1 gene expression on lymphocytes so that they are effective factors in the prevention of cardiovascular disease.

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PERCEIVED COACHING BEHAVIORS IN WRESTLING

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ABSTRACT
The purpose of the present study was to determine the internal consistency and the reliability of the scales of Coaching Behavior Assessment System - Perceived Behavior Scale (CBAS-PBS) when using the Greek version (Gr-CBAS-PBS) with athletes and coaches in Greco-Roman wrestling. A secondary purpose was to determine the degree to which athletes' perceptions about their coaches' behaviors correlate with coaches' perceptions about their own behavior. Participants in this study were 105 male Greco-Roman wrestling athletes (*M* = 25.8, *SD* = 5,3 years) and their experience in competitive wrestling was 11.34 (SD = 5.68 years). Additionally, 21 male Greco-Roman wrestling coaches (M = 44.9, SD = 12.8 years) participated in this study and their experience in competitive wrestling was 14.9 (SD = 11.3 years). Analysis of data revealed that GR-CBAS-PBS items have good internal consistency (α = .86). Calculation of intraclass correlations using a 2-way random variable absolute agreement approach generated an average ICC (2,1) of .77 for athletes (ranging from .55 to .98) and of .70 for coaches (ranging from .55 to .91). Additionally, results revealed a strong correlation (r =.81, p>.01) between the coaches' perceptions of their own behaviors and athletes' perceptions of their coaches' behaviors. In conclusion the results of the study revealed moderate to substantial psychometric properties of the scale. Therefore, the scale could be used in the Greek wresting population to categorize perceptions of coaching behaviors.
KEY WORDS: CBAS-PBS, Greco - Roman wrestling, coaching behavior assessment, reliability

INTRODUCTION

The study of coaching behaviors and their effects of athletes has been extensively analyzed by researchers in the fields of sport science and physical education. High performance coaching is characterized by higher levels of commitment, more stable coach-athlete relationships and greater focus of medium to long term planning, monitoring decision making and management skills to facilitate control of performance variables when compared to participation coaching (8).

From a review of coaching behaviour studies, several behaviours have been identified which are related to positive psychosocial outcomes for players. Provision of positive reinforcement, technical instruction, and encouragement have been shown to be significant factors in player valence toward the coach (5, 14) as well as in players' perceived success, competitive preference for challenging activities, and perceptions of enjoyment and effort (1).

Even though several instruments aimed at measuring specific aspects of coaching effectiveness can be found in the literature CBAS (11); the Leadership Scale for Sports (***LSS***) (2), and the Coaching Behavior Questionnaire (CBQ) (19), their use in comprehensively evaluating coaches work remains limited (4). The CBAS is an instrument used in previous studies were systematic observation provided specific guidelines for coaches and coach educators about the coach – athlete environment in youth sport and the pedagogical strategies used in effective coaches (3,15). In addition, a questionnaire form of the CBAS was developed to assess the perceptions of coaches' behaviours (12). Smith and colleagues (1978) developed a player and a coach version of the scale respectively. Each item provided a verbal description of the respective CBAS behavioural dimension, in which players and coaches were asked to specify how frequently coaches exhibit each class of behavior as described in the systematic observation instrument. The three different sources of measurement (observers, players' perceptions, self-perceptions), is an effort for objective reflection of coaching behaviors. Previous studies performed in Greece have provided the adaptation of the CBAS for a Greek population and have provided high reliability readings (interobserver *k*=.79 and intraobserver agreement *k*=.81) when used to assess coaching behavior of youth basketball and handball coaches (16).

In the sport of Greco-Roman wrestling the work of the coach is a complex, multidisciplinary and creative pedagogical activity that includes the improvement of the wrestlers' psychological soundness, will power and the

stimulation of a diversity of tactical thinking on the mat (Kazarian, 2006). These personal characteristics will be exhibited by the wrestler during the wrestling combat that lasts for 6 min (3 x 2 min sessions and 2 x 30sec breaks). The coach starts working on the above elements from the first year of the athletes' involvement and both the personality traits and the pedagogical skills of the coach play an essential role in the training of psychology and will power of the wrestler. According to Kazarian (2010), the coach should among others pay great attention to the following pedagogical aspects: a) equal attitude to all the trainees and never show his positive or negative attitude to this or that trainees, irrespective of their physical, psychological, physiognomic characteristic features, b) study the behavior of each young wrestler like a parent, and educate their character and teach the desired behavior typical to wrestling in each of them, c) frequently encourage the trainees after they have carried out the task assigned by the coach, and d) analyze with the wrestler his own good performance: "Bravo, you performed it correctly. If you go on like that, you will become a great sportsman."

The purpose of the present study was to determine the internal consistency and the reliability of the scales of the Greek version of the CBAS Perceived Behavior Scale (Gr-CBAS-PBS) when used by athletes and coaches of Greco-Roman wrestling. A secondary purpose was to determine the degree to which athletes' perceptions about their coaches' behaviors correlate with coaches' perceptions about their own behavior

METHODS

The participants in this study were 105 male Greco-Roman Wrestling athletes that participated in the Men's National Greco-Roman Championship that took place in Athens in December of 2010.These athletes were members of 63 wrestling clubs in Greece. The athletes ranged in age from 19 to 43 years (*M* = 25.85, *SD* = 5,3 years) and their experience in competitive Wrestling ranged from 2 to 28 years (M = 11.34 SD = 5.68 years). Additionally, 21 male Greco-Roman Wrestling coaches (M = 44.9, SD = 12.8) participated in this study and their experience in competitive Wrestling ranged from 13 to 28 years (M = 14.9, SD = 11.3).

Athletes and coaches were contacted during the Men's National Greco-Roman Championship, in Athens in December of 2010. In total 250 athletes competed in the 3-day tournament and 105 of them completed the 12-item Gr-CBAS-PBS on the first day of the tournament. Finally, 76 of these athletes completed the Gr-CBAS-PBS for a second time 3 days later, during the final day of the tournament. Additionally, out of the 58 coaches that participated in the tournament 37 of them completed the12-item Gr-CBAS_PBS on the first day of the tournament. Finally 21 of these coaches completed the Gr-CBAS-PBS for a second time during the final day of the tournament.

INSTRUMENT

The 12-item CBAS-PBS, the definitional items of which consist of behavioural descriptions derived from the CBAS observer training manual (Smith et al., 1977b). A sample definitional item (mistake-contingent encouragement), derived from the CBAS training manual, is: "Sometimes players goof and make mistakes. Some coaches give their players support and encouragement after they make a mistake. For example they may say, 'That's OK, don't worry about it; you'll get 'em next time.' Other coaches don't give much encouragement after mistakes. Circle how often your coach encouraged you after you made mistakes." Athletes indicated how frequently their coaches engaged in each class of behaviour on a Likert scale ranging from 1 (never) to 7 (almost always).

DATA ANALYSIS

First, the CBAS-PBS' internal consistency was assessed using an item-total test approach. To this end, Cronbach's alpha was calculated. As the CBAS-PBS does not have subscales, the consistency of responses across the entire 12 items was assessed. In addition, an Intraclass Correlation Coefficient (ICC) has been employed to assess the reliability of the scales, separately for coaches and athletes. Coefficients were calculated to assess reliability, based on a one-way analysis of variance, along with 95% confidence intervals (CI), (Chelladurai & Riemer, 1988). Furthermore, correlational measures have been used for the comparison of the scores obtained separately by athletes and coaches.

RESULTS

Participants' responses were analyzed for the purpose of examining the scale's internal consistency. The items were normally distributed for both the test and retest data. The result from the test of internal consistency indicated that the CBAS-PBS items have good internal consistency (α= .86).

Calculation of intraclass correlations using a 2-way random variable absolute agreement approach generated an average ICC(2,1) of .77 for athletes (ranging from .55 to .98) and of .70 for coaches (ranging from .55 to .91). The

above ICC coefficients would suggest that the CBAS-PBS items examined possess acceptable test-retest stability (Vincent, 1999), suggesting that there were moderate to fairly strong positive relations between the responses initially collected and the retest responses for the CBAS-PBS items (Table 1).

Table 1: Test-retest reliability using intraclass correlation coefficients (ICC(2.1)) with 95% confidence intervals (CI)

Behavioral Categories	Athletes	coaches
	R(2,1)	*R(2,1)*
1. Positive Reinforcement	.98	.70
2. Non Reinforcement	.96	.84
3. Mistake-Contingent Encouragement	.94	.76
4. Mistake-Contingent Technical Instruction	.78	.65
5. Punishment	.83	.91
6. Punitive Technical Instruction	.80	.61
7. Ignoring Mistakes	.65	.65
8. Keeping Control	.69	.75
9. General Technical Instruction	.55	.61
10. General Encouragement	.72	.71
11. Organization	.67	.59
12. General Communication	.66	.59
Overall agreement	**.77**	**.70**

In addition, Pearson's correlation was conducted to examine the degree of congruence between coaches' perceptions of their own behaviors and athletes' perceptions of their coaches' behaviors. Results revealed high correlation (r=.81, p>.01) between the two sets of scores (Table 2).

Table 2: Athletes' and Coaches CBAS-PBS descriptive statistics

Behavioral Categories	**Athletes**		**Coaches**	
	M	*SD*	*M*	*SD*
1. Positive Reinforcement	5.55	1.46	5.65	.81
2. Non Reinforcement	2.65	1.38	5.65	.81
3. Mistake-Contingent Encouragement	5.18	1.49	5.42	1.40
4.Mistake-Contingent Technical Instruction	5.84	1.24	6.57	.60
5. Punishment	2.52	1.41	2.82	1.44
6. Punitive Technical Instruction	2.77	1.88	2.57	1.78
7. Ignoring Mistakes	2.57	1.43	2.55	1.14
8. Keeping Control	4.56	1.49	4.82	1.65
9. General Technical Instruction	5.54	1.10	5.72	1.20
10. General Encouragement	5.79	1.17	5.70	1.04
11. Organization	5.33	1.46	5.57	1.22
12. General Communication	5.04	1.38	5.15	1.33

DISCUSSION/CONCLUSIONS

The purpose of the present study was to examine the reliability of the Perceived Behavior Scale (CBAS-PBS) on a sample of Greek wrestling athletes and coaches. The results of the study revealed moderate to substantial psychometric properties of the scale. Therefore, the scale could be used in a Greek wresting population to categorize perceptions of coaching behaviors. In line with the aforementioned findings, Smoll and Smith (2006) using modern structural equation methods suggested that in absence of systematic behavioral measures like CBAS, CBAS-PBS constitutes a measure of acceptable reliability. Moreover, correlations between coaches' and athletes' scores were conducted to examine the degree of concurrence among coaches' and athletes' perceptions of coaching behaviors. Markedly, in contrast with previous research findings (12, 18) participant coaches seem to have an increased awareness of how often they behaved, as indicated by strong correlations between coaches' perceptions of their own behaviors and athletes' perception of their coaches' behaviors. This finding could be interpreted in the light of coaches' age and coaching experience (M age = 44.9, SD=12.8 years and M experience=14.9 years, SD=11.3). It should also noted that most of previous studies that employed CBAS or CBAS-PBS measures used youth coaches and not high performance or elite participants as in the present study. However, due to small sample size, further examination is needed.

Despite measurement issues, a tangible usefulness of the CBAS-PBS is its contribution to coach training since it is a means to increase coaches awareness about their behaviors in training and in matches. Most of the past research in this particular scientific field has shown that coaches are unaware of how often they behaved in various ways, as well as the consequences that their behaviors had on athletes (10). If the aim of a coaching education program is to cause a change in coaching behavior, then it is highly unlikely for these changes to occur without self-awareness.

Moreover, as the model proposed by Smith et al, (1978) suggests, there are limitations when the coaching behavior assessment is only obtained from a third-party (an actual observer), and that it is highly desirable to conduct studies that measure actual behavior, players' perceptions and self perceptions. Studies as such would provide us with data in a holistic approach concerning coaches' training.

PRACTICAL IMPLICATIONS / ADVICE FOR ATHLETES AND COACHES

The use of instruments of proven psychometric properties like the GR-CBAS-PBS would increase coaches' self-awareness, encourage coaches to take their athletes' perspective, acknowledge their feelings, which in turn it will hopefully contribute to the improvement of the coach-athlete relationship, thus resulting in better coach-athlete communication, in increased training quality and coaching guidance and presumably this will lead to the enhancement of athletes' performance.

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FACTORS CONTRIBUTING TO THE SUCCESS OF THE IRANIAN NATIONAL TEAM IN THE SENIOR GRECO ROMAN WRESTLING WORLD CHAMPIONSHIP IN DENMARK 2009: PERCEPTIONS OF COACHES AND ATHLETES

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ABSTRACT
The purpose of this study is to identify the perceived factors that contributed to the success of the Iranian national team in the senior Greco-roman World Championship-2009 in Denmark from the viewpoint of coaches and athletes. To reach this goal, four specific areas, including physical and physiological, psychological, management and facilities were included in a questionnaire developed for this study. Validity was established by a review of 10 wrestling experts and reliability was estimated with a Cronbach alpha coefficient of .89. From an original pool of 250 people, of which there were 150 wrestlers and 100 trainers, a proportional random sample of 60 wrestlers and 40 wrestling coach were selected. Management factors were identified as most important followed by in order of perceived importance by psychological factors, facilities, and physical factors.
KEYWORDS: Success factors, coaches, athletes

INTRODUCTION

Movement is a part of human life and gets motivation from the innate nature and causes him/her to improve his/her health and happiness (10). Physical education and sport are an integral part of education and a means to achieve physical and mental health in young generation (9). Studying the factors of success and obtaining more favorable results in various sport disciplines is an issue that many sports science professionals and researchers are interested. Through the use of scientific research, the results and practical experiences of teams could help in future Olympic, World and Asian competitions in different sport fields (7). Undoubtedly wrestling is the first sport in Iran and is held in high esteem by its people, Wrestling in Iran is viewed as an honorable sport in part because it conveys a symbol of generosity and manliness, and because of the successes-sixty- three percent of Olympic, world and international medals for Iran have come from wrestling. Therefore, in order to obtain international results, preparing experienced instructors and coaches for developing elite wrestlers is very important (2).

Wrestling is a sport by which motivates many in Iran to become a champion (3) and also has a many fans as it belongs to our tradition and culture (5). In the past, all efforts of the federation and the authorities was to strengthen freestyle wrestling, and most resources were directed in that direction. Not enough attention was given to Greco-roman style and the medals were expected from freestyle wrestling, and Greco-roman was actually neglected. The process of preparing the national Greco roman wrestling team and the quality of exercises for Beijing Olympics was poor and also they get bad results (9). Following Beijing, the authorities paid more attention to it and now many experts believe that the national Greco roman wrestling team is in a good position.

According to experts, the national wrestling team members are in the appropriate age range for success in the London Olympics. This is similar to the way Russians have planned in order to pay more attention to youth with the aim of programming for the future (4). The Iranian Greco roman wrestling team not only got good results in the world Championship competitions in Denmark in 2009 but also they were better than the freestyle wrestling national team and got the second place in that tournament. The technical analysis of this competition showed that the team has made great progress in comparison to the past and if they continue on this path can achieve significant results in the next competitions and Olympic Games (4).

Gural (2008), in research dealing with the the effects of high motivation on sport, concluded that it is the person's behavior which makes the difference at the highest level. Motivation is one of the important bases for success. People who pursue goals need a great motivation system. The obvious reality is that becoming successful requires great patience, practice and training. In order to become a champion in a sport, one must practice and train daily and consistently. In this long process motivation has a crucial role.

Rahimi (2008) researched the factors affecting the performance and results of Iran's athletes in the Asian Games (Doha 2006) from the viewpoint of administrators, experts, coaches and athletes, and concluded that 75% of all believe that the operating budget as the most effective factor in obtaining results. 80% listed athletes' salaries during training as an important factor. Shokri (2008) compared the country's elite athletes competing motivation in freestyle and Greco roman wrestling. Results showed that there was not a significant difference among wrestlers regarding motivational aspects such as ability motivation, achievement motivation, failure avoidance motivation and over all motivation. Bhutto (2006) investigated the factors causing failure or success among team sport players in Spain. The winner stated that their success depends on their abilities and efforts, while the losers explained chance and work difficulty as the cause of their failure. The analysis of this approach shows the winners selected the reasons that indicate internal control. Fanaie (2004) studied the relationship between team cohesion with their success among hockey teams in the Premier League. He concluded that the highly cohesive teams were ranked higher at the end of the season. Sajadi (2001) researched the causes of failures among youth national football teams in Asia for twenty years (1998-1978). Results showed that the lack of good special training programs, wasted human resources, inadequate preparation camps, traditional methods, lack of job security among coaches, and neglect of scientific advisers were the main causes of failure. Adam (2000) researched the relations of a team's cohesion and success, and concluded that the team cohesiveness is a very important component of team success. Self belief and belief in team mates are the main reason for the success of the team.

Finally, the major reason for this research was to consider the factors that contributed to the success of the national Greco-roman wrestling senior in Denmark in 2009 in which they reached second place after fifty years of participation. This second place finish was attained in an environment where many countries have spent a great amount of money on their teams. Studying the factors affecting the success is therefore a worthy pursuit and may help authorities, coaches and wrestlers in better planning. Therefore, the intent of this research was to review and determine the effect and extent of psychological factors, facilities, physical and physiological factors and management factors on the success of the team.

METHODOLOGY

This study is descriptive in nature and utilizes data collection in the field. The statistical population in this study is composed of instructors who have A license in Greco roman wrestling in different age groups and athletes from the national Greco roman wrestling teams from the past five years who have been champions in Olympic, World or Asian Games competition. The samples in this study were 40 coaches and 60 athletes. The measuring instrument in this study was a researcher made questionnaire consisting of thirty-nine questions in four domains: physical, physiological, psychological, management and facilities. For validity of the questionnaire the opinions of ten experts were solicited. The reliability of the questionnaire was determined through the Cronbach alpha method and was estimated with an alpha of .895. The questionnaires results were coded and analyzed using SPSS. Data results assessed by using descriptive statistical methods and frequency and percentage were calculated.

RESULTS

Information collected from the questionnaires from coaches and the national wrestler team members was analyzed and indicated that the managerial elements were viewed as the most important factors, while the physical condition of the athletes were the least important factors in the success of the national Greco roman wrestling team. *http://www.powerdevelopmentinc.com/?id=34 Fundamentals of the Theory and Adaptation of Sports Training*, SE Pavlov Russia State Medical University, Moscow Russia State Medical University, Moscow

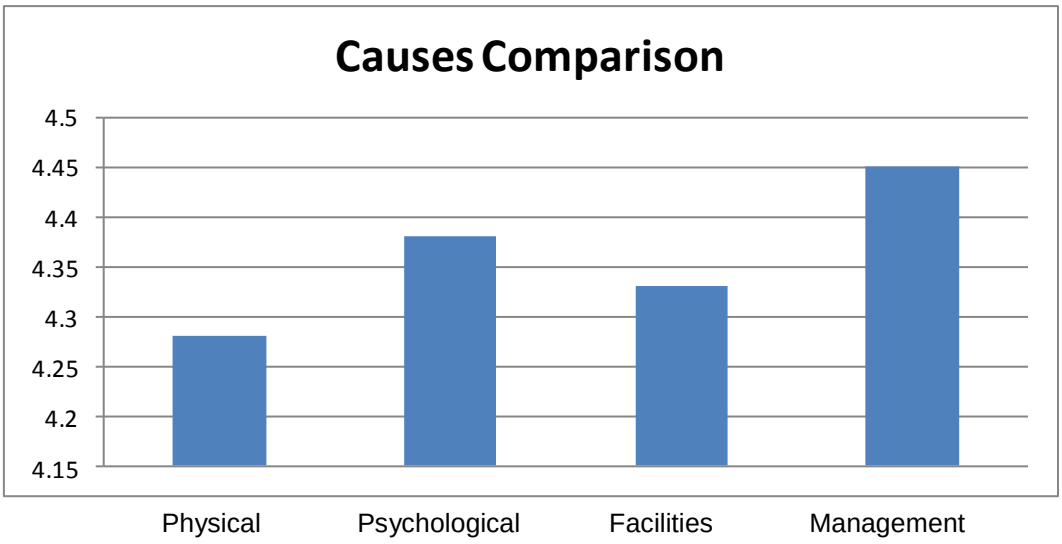

Fig.1. Means of Success Factors from Questionnaire

DISCUSSION/ CONCLUSION

The results of this study indicated that the managerial elements were the most important factors in the success of the Iranian national Greco roman wrestling team in the World Championship in 2009. The results of this study are consistent with the research results of Ramzanynajad (2009), Pezeshki (2004), Fnaie (2004), Sajadi (2001), Adam (2000), Jackson (2001), Rahimi (2008) and Danchez (2008), in all of which the role of management factors of successful athletes teams was significant. Considering the role of administrative factors being identified as the most important factor in this field, the wrestling federation should provide the necessary conditions. Management in general is the ability to influence and to affect the behavior of others. The manager is one who gives motivation, direction, authority and responsibilities to the people under his/her management in the organization and deals with them so well that things get done, problems are solved correctly and the group goals and objectives are achieved.

In this study psychological factors were the second most important factor contributing to the success of Iranian national Greco roman wrestling team. The results of this study are consistent with the findings of Mohammadian (2008), Gural (2008), Butugonzalez (2006), Shokri (2008), Rahmaty (2009), Mac Dunag (2000) and Pezeshki (2005) in all of which the psychological factors played a great role in the success of athletic teams. Considering the role of psychological factors in the success of athletes, there is the need to advance the psychological state of the athletes. Conditions should be provided in such a way that the athletes have the enthusiasm and are motivated to take steps to achieve their goals. One of the main and important tasks for skilled and efficient educators is the ability to regulate mental energy in athletes. Mental energy is developed by using mental exercises. Mental energy is considered as a resource for vital functions and is the basis of motivation.

In this study facility factors are third in their contribution towards the success of the Greco roman wrestling team. The results of this research is in according with research findings of Rahimi (2008), Pezeshki (2005), Sajadi (2001) and Dukla (2002), in all of which facility factors were mentioned as important in the success of sport teams. Considering the role of the facilities in the success of teams wrestling federation and physical education organization should support the country's first sport by preparing any need of this sport. Wrestling Federation should manage facilities and sport spaces in a way that athletes and coaches practice without any problems related to facilities.

Finally, physiological and physical factors were indicated as the fourth factor in the success of the Greco roman wrestling team in 2009. This finding is consistent with the Pezeshki (2004), Astarusta and Asturkuvich (2005), Sultani and et.al (2005), Efrati (2004), Walidi (2001), Nicolson (1979), Frey and et.al (1991), Cramer and et.al (2004), Vardar and et.al (2007) research results.

PRACTICAL APPLICATIONS

The overall results of this study indicate that management factors are most important and contributory factors in the success of the national Greco roman wrestling team in 2009. The head coach interacting behavior with the

wrestlers plays a very large role this area. Therefore, wrestling federation should carefully select the national team coaches and pay more attention on their management skills.

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ASSESSING THE DEGREE OF SATISFACTION OF THE WRESTLERS AND TECHNICAL BOARD TO THE NATIONAL TRAINING CAMP OF IRAN

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ABSTRACT
The main objective of this research was to evaluate the degree of satisfaction among the technical board and the wrestlers of the national team from the Wrestling Camp of Iran, in order to improve the performance of the camp and to increase the satisfaction The sample for this research consisted of the technical board (coaches and managers of Iranian national teams) and national wrestlers of Iran (junior and senior). The measurement instrument for this research included 1) a personal characteristics questionnaire of the technical board and national wrestlers of Iran; 2) a researcher made questionnaire of the participant's satisfaction with the training camp. The reliability was established through a measure of Chronbach's alpha. This internal consistency value was an adequate value of 0.79. The content validity for this questionnaire was assessed from experts and university professors in management and sport management. 114 people took part in the study. In order to examine the hypothesis of the research, deductive statistics with SPSS software were used. Responses were tested through an independent T-test for normal distribution parameters and the Mann-Whitney Test for the parameters with abnormality in the distribution. In order to check the homogeneity of variances we used the Leven Test and for assessing the degree of satisfaction of the technical board and national wrestlers' different aspects of the Binomial Test was executed. The results shows that the technical board for the national wrestling teams of Iran are satisfied with the managerial executives and facilities of the Wrestling Camp, whereas they are not satisfied with the general aspects of the wrestling camp. On the other hand, the wrestlers of the national team are satisfied with the managerial executives and facilities of the wrestling camp, whereas they are not also satisfied with the general aspects of the Wrestling Camp.
KEY WORDS: satisfaction, Technical Board, training camp, Wrestlers of the National Teams

INTRODUCTION

In this century, the existence of the global markets which point to the productivity and customer based strategies and international management to eliminated national boundaries, hardens the challenge and made it more complex. As a result of the presence of such markets or such characteristics, all efforts of managers are to find strategies that enable them to reach to higher places in business. Reaching to these higher levels would be only possible by having much more customers. In every institute, attention to the needs and demands of customers, is the main factor to success. Priority in every organization should be attraction and retaining customers. Failure in this matter would be equal to not earning profit, having no growth, no job and at last losing the business. Success in this challenging world would be for the organizations, who well understand that the customers are the largest assets of every institute (4). Today in productive or service organizations, satisfaction degree of customers is as an important criterion for evaluating the quality of their services; this concern is growing everyday. The importance of customers and their satisfaction is associated to the global challenge. As in Malcom Baldridge National Prize of Quality, about 30% of the total points are given to the degree of the customer satisfaction. Among these aspects, total quality management was not away of this issue, TQM was worried about fulfilling needs and demands of the customer to the full satisfaction (5). Managers of sport organizations which are defined as service organizations should try their best to bring customer satisfaction with allocating the services with good qualities. As much as the quality of services from sport facilities managers improves, people's tendency to do sport activities increases (7).

METHODOLOGY

This research is a comparative-measurable method classified among the descriptive research; and for gathering the data we made a field study. Since we couldn't find any other researches close to this research, due to the present references, for measuring the customer satisfaction and the quality of the services in the Wrestling Camp of Iran, researcher's made questionnaire were used.

The statistical population used in this research consisted of the technical board and the wrestlers of Iran national teams, which the population was equal to the sample of the test. Our samples were 114 people including 20 technical board and 94 wrestlers. After distributing and collecting back the questionnaires, 18 technical board and 93 wrestlers had completely participated in this research. In order to have the demographic classification of the participants, personal characteristics questionnaire was developed which distributed with the main questionnaire to the participants. The customer satisfaction questionnaire was used as the most important one in this research for evaluating the satisfaction degree of the sample.

To establish the content validity the questionnaire was distributed among the experts-sport administrators and sport management professors. Their comprehensive corrections helped the research group remove the ambiguous items from the instrument and therefore improve the validity of the questionnaire. Cronbach's alpha was used to assess the reliability of the questionnaire. The satisfaction questionnaire was evaluated by SPSS software and yielded a satisfactory coefficient of 0.79. According to this number of reliability, we can introduce this questionnaire as a good instrument to be used in further studies by experts and researchers of sport management.

Descriptive statistics were used for data classification, frequency distribution table, measuring other indexes such as the mean, variance, standard deviation. For testing the hypothesis of the research, deductive statistics was used with the support of SPSS software. The Binomial Test was used measuring the satisfaction degree of technical board and wrestlers of the national team in different arenas (management, facilities and general) in the Wrestling Camp of Iran.

RESULTS

The data describing the participants is listed in Table 1.

Table 1. Personal characteristics of the samples

		Style		ranking		Age				membership period				education level			
		Greco-Roman	Freestyle	Youth	Adults		21 to 25	26 to 30	Older than 30	Less than 1	1 to 3	4 t0 7	More than 7	Diploma	Post diploma	B.A	Master or higher
official	number	10	8	10	8	0	0	1	17	4	6	6	2	6	3	3	6
	percent	55.6	44.4	55.6	44.4	0	0	5.55	94.45	22.22	33.33	33.33	11.11	33.33	16.66	16.66	33.33
wrestlers	number	71	22	50	43	47	30	10	6	20	52	13	8	53	21	15	4
	percent	76.35	23.65	53.76	46.24	50.54	32.25	10.75	6.45	21.5	55.91	13.98	8.6	56.99	22.58	16.13	4.3

The descriptive results from the the ages of the participants show that 50.54% of wrestlers were younger than 20 years old, 32.25% of wrestlers were 21 to 25 years old, 6% of the technical board and 11% of the wrestlers were 26 to 30 years old, and 94% of the technical board and 6.45% of the wrestlers were elder than 31 years old. The descriptive results regarding the style of the wrestling showed that 55.6% of the technical board and 76% of the wrestlers were executing in the Greco-Roman, and 44% of the technical board and 24% of the wrestlers were active in freestyle. These results regarding the period of the membership on the national team show that for 2% of the technical board and 22% wrestlers, membership was shorter than one year, 33% of the technical board and 56% of the wrestlers' membership period was between one to three years, for 33.33% of the technical board and 13% of the wrestlers it was four to seven years, and for 11.11% of the technical board and 8.6% of the wrestlers it was longer than seven years.The descriptive results about team ranking illustrated that 56% of youths and 44% of adults were active in Greco-Roman and 54% of youths and 46% of adults were performing in freestyle. Also, results about the level of education showed that 33.33% of the technical board and 56% of the wrestlers were in the diploma group, 17% of the technical board and 23% of the wrestlers were in the post diploma group, 17% of

the technical board and 16% of the wrestlers were in the BA group, and 33% of the technical board and 4% of the wrestlers were in the master or higher group.

Table 2. Satisfaction degree of technical board and wrestlers of national team of the Wrestling House

Field / Sample	**management field**	**facility field**	**general field**	**Total**
Wrestlers	3/49	3/32	3/28	3/36
Officials	2/99	2/62	2/86	2/82

The descriptive results regarding the ages of the samples showed that 2.99% of the technical board and 3.49% of the wrestlers of national team were satisfied with the management field of the Wrestling Camp. 2.62% of the technical board and 3.32% of the wrestlers, and 2.99% of the technical board and 3.49% of the wrestlers, respectively were satisfied with the facility and general fields of the Wrestling Camp. In all the fields, the technical board comparing to the wrestlers, graded the Wrestling Camp less than mean value. Considerably, both samples were least satisfied with the general field, and they had their highest satisfaction in the management field of the Wrestling Camp.

Hypothesis 1: Technical board of the wrestling national teams is dissatisfied with management field of the Wrestling Camp.
To evaluate this hypothesis, a Binomial Test was used. Results are shown in the table 3.

Table 3. Result of the evaluation of the first hypothesis

Parameter	number of samples	meaningfulness level	cutting point	P-value
management field – technical board	18	0.05	72	0.031

As it is seen on the table 3, according to the P-value, which is less than 0.05, H_0 is not accepted. This means that the technical board of wrestling national teams is satisfied with the management field of the Wrestling Camp.
Hypothesis 2: Technical board of the wrestling national teams is dissatisfied with facility field of the Wrestling Camp.
To evaluate this hypothesis Binomial Test was used. Results are shown in table 4.

Table 4. Results of the evaluation of the second hypothesis

Parameter	number of samples	meaningfulness level	cutting point	P-value
facility field – technical board	18	0.05	72.5	0.001

As it is seen in the table 4, the P-value is less than 0.05. So the H_0 is not accepted. i.e. the technical board of wrestling national teams is satisfied with the facility field of the Wrestling Camp.
Hypothesis 3: Technical board of the wrestling national teams is dissatisfied with general field of the Wrestling Camp.
To evaluate this hypothesis, Binomial Test was used. Results are shown in table 5.

Table 5. Results of the evaluation of the third hypothesis

Parameter	number of samples	meaningfulness level	cutting point	P-value
general field – technical board	18	0.05	37.5	0.815

As it is seen in the table 5, you can see that the P-value is more than 0.05. So the H_0 is accepted. This means that the technical board of wrestling national teams is dissatisfied with the general field of the Wrestling Camp.
Hypothesis 4: Wrestlers of the wrestling national teams are dissatisfied with management field of the Wrestling Camp.
To evaluate this hypothesis Binomial Test was used. You can see the results in table 6.

Table 6. Results of the evaluation of the fourth hypothesis

Parameter	number of samples	Meaningfulness level	cutting point	P-value
management field – wrestlers	93	0.05	72	0.00

As you can see in the table 6, according to the P-value less than 0.05, H_0 is not accepted. i.e. wrestlers of the national teams are satisfied with the management field of the Wrestling Camp.
Hypothesis 5: Wrestlers of the wrestling national teams are dissatisfied with facility field of the Wrestling Camp.
To evaluate this hypothesis Binomial Test was used. Results are shown in table 7.

Table 7. Results of the evaluation of the fifth hypothesis

Parameter	number of samples	Meaningfulness level	cutting point	P-value
facility field – wrestlers	93	0.05	72.5	0.00

As the P-value mentioned in table 7 is less than 0.05, H_0 is not accepted. So wrestlers of the wrestling national teams are satisfied with the facility field of the Wrestling Camp of Iran.
Hypothesis 6: Wrestlers of the wrestling national teams are dissatisfied with general field of the Wrestling Camp.
To evaluate this hypothesis, Binomial Test was used. Results are found in table 8.

Table 8. Results of the evaluation of the sixth hypothesis

Parameter	number of samples	Meaningfulness level	cutting point	P-value
general field – wrestlers	93	0.05	37.5	0.097

According to the amount of the P-value in the above table, which is more than 0.05, H_0 is accepted. This means that the wrestlers of the wrestling national teams are dissatisfied with the general field of the Wrestling Camp of Iran.

DISCUSSION

Although previous research published in magazines and books by other authors about customer satisfaction and its aspect was not directly connected to our research, we used some ideas from them in finding the effective factors in customer satisfaction. We used some of their criteria as the sub groups of our research and eventually the deductive results of our research were as follows.

In this research the calculated results showed that the technical board and wrestlers are satisfied with the performance of the managerial area in the Wrestling Camp of Iran, which can result in more preseason and preparation camps in the Wrestling Camp of Iran. We can also identify some other reasons for increasing satisfaction. These include more managerial evaluation on the performance of services, restaurants, and medical board; inviting the head officials of Iran's Sport Organizations and media to the Wrestling Camp; having respectful behavior with the technical board and the national wrestlers; and developing a clear and descriptive by-law for the responsibilities and functions of managerial personnel. All of these could improve the degree of satisfaction of technical and wrestlers with the training camp of Iran.

The results of the Binomial Test showed that the technical board and the wrestlers of the national teams are satisfied with the facilities of the Wrestling Camp, which can support the growth and development of the intrinsic abilities of the wrestlers and the technical board, effectively. There are some other methods in this arena to enhance the satisfaction such as improving the qualitative and quantitative levels of the facilities; improving the health; developing libraries and restaurants; installing ATM, telecommunication, internet, and computer games services.

The results of the Binomial Test also showed that the technical board and the wrestlers of the national teams are not satisfied with the general arena of the Wrestling Camp, which can be one of the main reasons for decreasing the effectiveness of wrestlers and the technical board. In order to attract the attention, and retain and enhance the

performance of wrestlers, the functional aspects of the general field should be promoted. The most dissatisfying factors were low salary payment, lack of recreational and cultural programs, the transportation system, spectators' presence, music and uniform clothing. The most satisfying factors were good appearance and presence of the managers, the safety of the gyms and the punctuality of the technical board and wrestlers.

Valois et al. (2004), Club Haus magazine (2002), and Chakravarthi et al. (2003) identified other factors that affect customer satisfaction such as good looking and presence of officials, audio-visual activities, spiritual level and solidarity of lifestyle, the marketing environment, reality between costs and services, and etc. In these mentioned aspects, the results of our research were consistent. After evaluating the satisfaction degree of technical board and wrestlers of national team from these three arenas, the research group found that samples are satisfied with facilities and management, but they are dissatisfied with the general field. These results are consistent with Bahlakeh (2005) and the Club Haus magazine (2002) which identified the effective factors of customers' satisfaction in different aspects. In order to sum up, we can say that there is not only one unique factor that affects customers' satisfaction and this kind of satisfaction is related to many issues.

By studying the results of other research, it is clear that some criteria and characteristics of satisfaction are similar in all of them, and in a wide range of studies three areas of management, facilities, and general fields are introduced. These mentioned criteria were also evaluated in our research and the results showed the importance of them for increasing the satisfaction degree among technical board and wrestlers of national teams. Since the satisfaction degree of the samples were not high in the ranking for any areas, it seems necessary for the wrestling amp to find proper ways for increasing the satisfaction rate of the samples to attract and retain them by paying attention to all areas of managerial, facility and general satisfaction.

The next interesting point of this study was assessed after comparing the mean satisfaction of technical board and wrestlers, which showed that the technical board had reported lower points to all aspects for the Wresting Camp of Iran when compared with the wrestlers. This means that wrestlers are totally more satisfied than the technical board. In spite of training in the same managerial, facility, and the general situations; wrestlers' higher satisfaction might be related to the lower levels of their expectation; which could be the result of the shorter membership period in the national wrestling teams, lower levels of education, or being younger, that were found in their personal characteristics questionnaire. These results were different from the findings of Koozechian et al.'s (2001) whom found no significant relationship between satisfaction among sport managers and coaches form men's sport facilities and equipments.

Eventually, it can be mentioned that any researcher can evaluate customer satisfaction with emphasis on some special factors as the parameters for the success of the business. Showing the importance of some factors on customer satisfaction in this research is vital for the success of wrestling camp of Iran.

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PHYSIOLOGICAL PROFILE EVALUATION THROUGH LACTATE AND HEART RATE IN NATIONAL LEVEL GRECO-ROMAN WRESTLERS

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ABSTRACT
The purpose of this study was to evaluate the physiological profile of top-level wrestlers in a simulated competition. 12 male athletes, aged 23.2±4.5yrs who were participants in the 74kg division at the Greece National Greco-Roman Championship were the evaluated subjects. During all competitions the heart rates were measured and stored with a transmitter with a digital display while the capillary blood samples were collected 3 minutes after each round was completed in order to evaluate the lactate concentrations. The statistical design was based on the One-Sample T-Test analysis. The statistics showed that the mean-max heart rate values ($b \cdot min^{-1}$) and mean-max lactate concentrations ($mmol \cdot l^{-1}$) in 2nd and 3rd round were significantly higher than in the 1st round. Specifically, the values were as follows: 1st round HR_{mean} 138±4 - HR_{max} 143; La_{mean} 12.43±2.8 - La_{max} 15.80, 2nd round HR_{mean} 172.2±5.6 - HR_{max} 178; La_{mean} 13.67±2.7 - La_{max} 19.3, 3rd round HR_{mean} 183±6.3 - HR_{max} 193; La_{mean}14.6±2.7 - La_{max} 20.26. The results indicate that the physiological profile of these wrestlers was both aerobic and anaerobic. Conclusively, the wrestling aerobic training with a simultaneously increase in anaerobic threshold could contribute to a benefit in tactical especially in the last round of a Greco-Roman wrestling competition.
KEY WORDS: wrestling, aerobic component, anaerobic threshold

INTRODUCTION

Wrestling was one of the most favored events in the Olympic Games in Ancient Greece. From the Athens Games in 1896, until today, the wrestling events are also an also an important part of the modern Olympic Games. The superior performance of today's wrestlers is the result of a complex blend of many factors such as the genetic endowment, as well as the coaches' knowledge in new training techniques. The pure coach knowledge of any one of their athlete physical condition is important in order to plan the optimal training strategies for winning. The ideal physical and physiological profile of top-level Greco-Roman wrestlers must be based on a high aerobic training accompanied with good flexibility and low percentage of body fat (Utter et al. 2002). Similarly, present study reported that aerobic capacity is one of the most important factors for success in wrestling with the athlete's ability to maintain the maximal aerobic power in a period of time gives an advantage in top-level wrestlers, (Yoon, 2002).

In addition, research has revealed that the well aerobically trained wrestlers compete before the initiation of the feeling of muscular fatigue in the intensity of 85% of their VO_{2max} (Pulkkinen, 2002). According to the wrestlers level, the National level athletes' have VO_{2max} from 53 to 56 $ml \cdot kg^{-1} \cdot min^{-1}$ while the participants in Seoul 1988 Olympic Games reported to have mean VO_{2max} values of 60 $ml \cdot kg^{-1} \cdot min^{-1}$, (Kelly, et al. 1998). However, in other studies World-class wrestlers recorded a mean VO_{2max} of 54.3 $ml \cdot kg^{-1} \cdot min^{-1}$ while the young and elite free-style wrestlers reported to have VO_{2max} 52.6±2 $ml \cdot kg^{-1} \cdot min^{-1}$ and 54.6±2 $ml \cdot kg^{-1} \cdot min^{-1}$ respectively, (Callan, et al. 2000; Zen-Pin, & Ryder, 2004). In the point of view of the anaerobic performance, which usually used to describe an athletes' capacity for high intensity short-term exhaustive exercise where the force generated by repeated muscular contractions, is primarily dependent upon anaerobic processes for energy release.

The top-level wrestlers' anaerobic profile is characterized by an increase in production of lactic acid, creatine phosphate and the buffer capacity of muscles and blood. The mean power output of an expert wrestler ranged from 6.1 to 7.5 $W \cdot kg^{-1}$ for the upper body (arm cranking) while the average mechanical power that is elicited from the wrestler for the lower body (30s max cycling) counted from 11.5 to 19.5 $W \cdot kg^{-1}$, (Horswill, 1992). In addition, the lactic acid accumulations in top-level wrestlers after the 30s Wingate Anaerobic Test (WAnT) was 11.9 $mmol \cdot l^{-1}$ for max cycling and 11.8 $mmol \cdot l^{-1}$ for arm cranking, (Hubner-Wosniak, et al. 2004).The recent rule changes

related with the competition duration (2-3 rounds of 2min with rest-time of 30s) has changed the metabolic and training profile in today's wrestlers. Despite of the fact that wrestling in Greece gives a large number of champions in International Championships, limited research has been applied in the evaluation of lactic acid concentration and heart rate variation in top-level wrestlers. The purpose of this study was to estimate the physiological profile of top-level wrestlers during the a simulated competition.

METHODOLOGY

12 male specialists in Greco Roman wrestlers aged 23.2±4.5yrs who were participated in the 74kg division at the National Championship was this study subjects. During all the competitions (3 periods of 2min) the heart rate data were measured and stored with a transmitter with digital display (Polar RS100^{TM}, Polar Electro Oy, Kempete, Finland). The capillary blood samples collected from the earlobe 3min after each round of completion. The tubes with capillary blood from each sampling were analyzed with the use of a calibrated portable mini Photometer Accusport (Boehringer Mannheim) in order to evaluate the subject's blood lactate concentration. The statistical design for the measured variables of this study was based on the One-Sample T-Test for repeated measures. The acceptable level of significance was set at 0.05 and all results were reported as mean ± standard deviation. SPSS statistical software version 16.0 for Windows (SPSS Inc., Chicago, IL, USA) was used for data management and statistical calculations.

RESULTS

The exploration analysis showed that in the 1st round in wrestlers with high heart rate the lactate concentration linearly increased with the energy contribution in this competition round to be primarily aerobically, (Figure 1.)

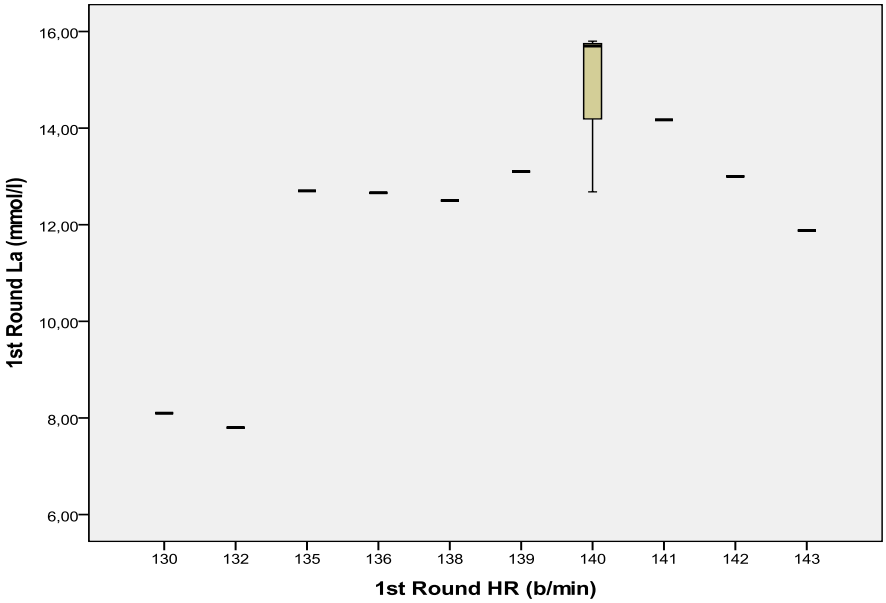

Figure 1. Graphical displays (mean) of heart rate and lactate concentration during the wrestlers 1st round in Greco-Roman competition.

However, the descriptive statistics showed that in the 2nd round in wrestlers with high heart rate, the lactate concentration linearly increased above the anaerobic threshold with the metabolic energy supplies to be both aerobic and anaerobic, (Figure 2.).

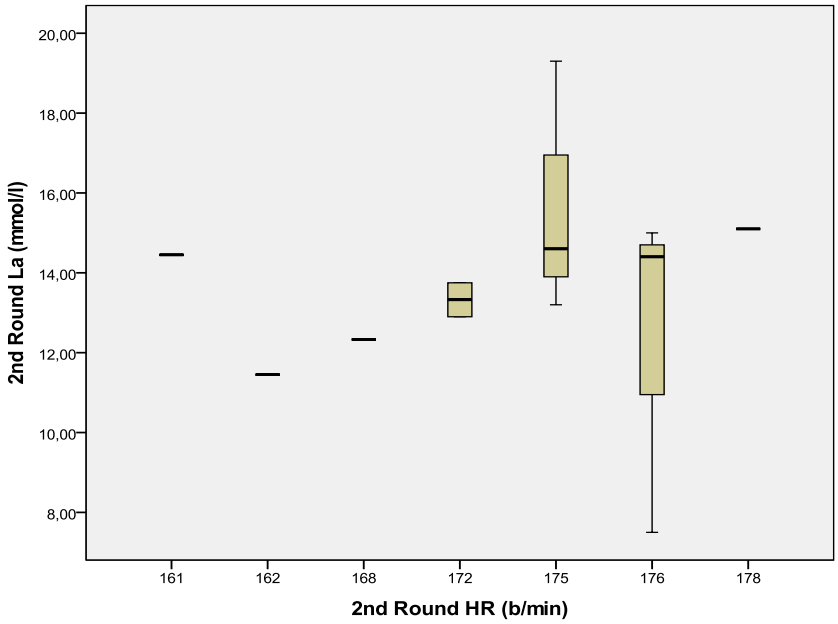

Figure 2. Graphical displays (mean) of heart rate and lactate concentration during the wrestlers 2nd round in Greco-Roman competition.

Similarly in the 2nd round the summary procedure showed that in 3rd round the wrestlers observed to work above the heart rate the lactate anaerobic threshold primarily anaerobically, (Figure 3.).

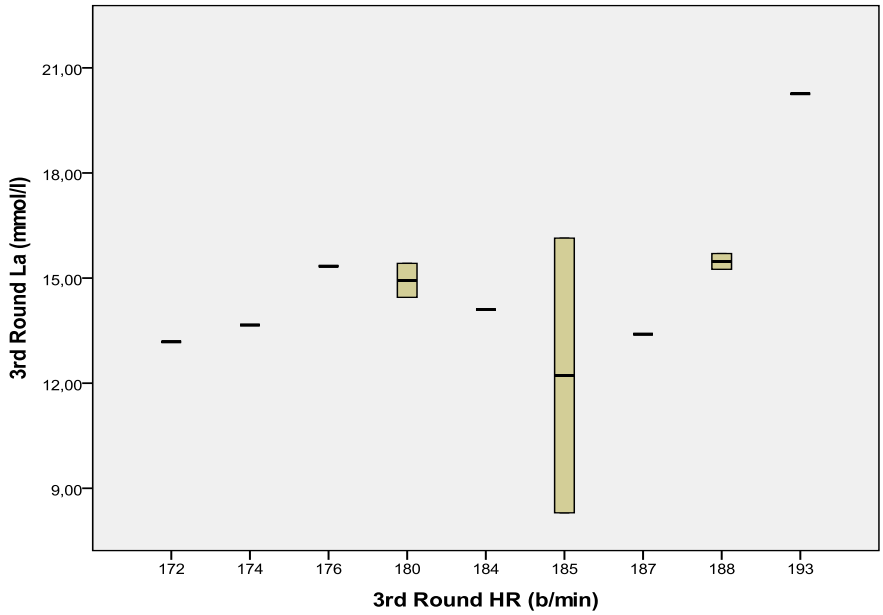

Figure 3. Graphical displays (mean) of heart rate and lactate concentration during the wrestlers 3rd round in Greco-Roman competition.

The T-test statistical procedures showed that both the mean heart rate values and lactate concentrations, in the 2nd and 3rd round were significantly higher than in the 1st round, (Table 1).

Table1. Athletes' Heart Rate values (mean-max) and Lactate accumulation (mean-max) after each of the 3 rounds of Greco-Roman wrestling competition.

	HR	HR max	La	La max
	$b.min^{-1}$	$b.min^{-1}$	$mmol.l^{-1}$	$mmol.l^{-1}$
1st Round	138±4	143	2.43±2.8	15.8
2nd Round	172±5 *	178	13.67±2.7 *	19.3
3rd Round	183±6 †	193	14.6±2.7 †	20.26

* significantly higher than in 1st Round, ($p<0.001$-2-tailed),
† significantly higher than in 1st Round, ($p<0.001$-2-tailed)

DISCUSSION

This study results confirmed that the Greco-Roman wrestling according to the new rules for competition duration begins aerobically while it finishes anaerobically. For this reason the coaches must determine the importance of the aerobic training in the annual planning especially in top-level wrestlers. The benefit of the highly aerobically trained athletes' is the fatigue resistance, especially at the 3rd round of the wrestling competition. The lactate values of the wrestlers who participated in this study increased gradually from the first to the last round. In the present study, wrestlers' recorded lactate concentrations were similar with other studies which evaluated with a competitive research design top-level wrestlers lactate accumulation, (Horswill, et al. 1989; Schmidt, et al. 2005).

While a number of studies proposed that important factors for outstanding performance in top-level Greco-Roman wrestlers is to focus in maximal power and strength endurance training, (Sharratt, et al. 1986; Nilsson, et al. 2002; Yoon, 2002) this study findings reported that improvements in both the aerobic and anaerobic profiles could give a boost to muscular fatigue resistance, mainly in the 3rd round. This advantage could be an important training tool, which can diversify the coach's tactical actions focusing on the wrestler win in the competition. In conclusion the role of aerobic-anaerobic training is still crucial in today's Greco-Roman wrestlers. In very well aerobically prepared athletes the muscular resistance can give an advantage to the coach for the tactical manipulation for winning the competition.

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VIEWPOINT

THE PROFESSIONAL KNOWLEDGE AND ABILITY OF THE COACH IN THE REGULATION OF BODY WEIGHT OF WRESTLERS

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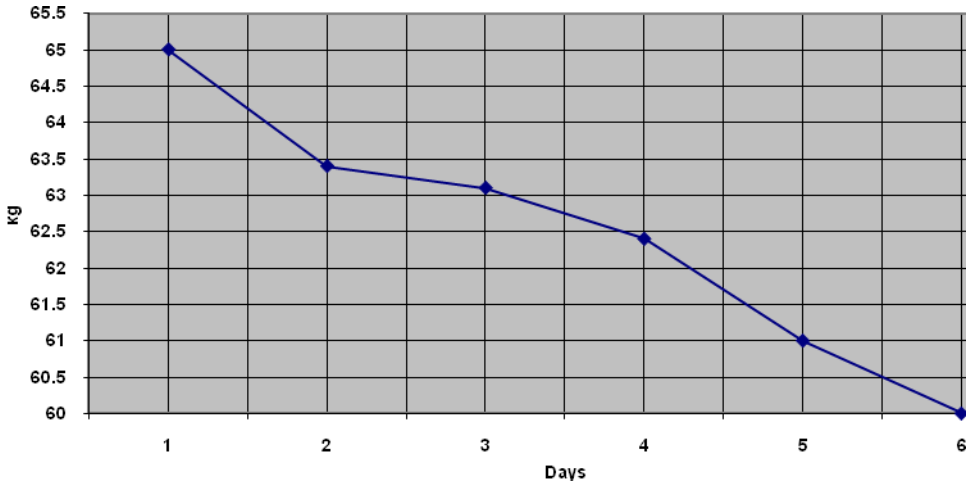
Study of the practice of combat sports has shown that athletes wishing to be stronger than their opponents, in one degree or another attempt to decrease their body weight (except for wrestlers heavy-weight categories). This decrease in body weight, beginning with participation in the first competition, has almost become a mandatory attribute of wrestling. This fact leads to the point that almost all the wrestlers and coaches have their own opinions about how quickly and without a loss in sports fitness should one drop those extra pounds in the competitive season. These opinions and practices are not always aligned with scientific approaches to weight reduction in wrestlers. Decrease in body weight is transferred and the young wrestlers, damaging their health and development of a growing organism.

In the literature there are extensive presentations on the results of scientific research into various means and ways to reduce the weight of the wrestlers. In this case, as a rule, the researchers argue that they have developed a way to weight loss is the best and most effective, forgetting that weight loss is time consuming and complicated, and most importantly, an individual process that depends on several factors (socio-economic, psychological and physiological). Therefore, the only professionally competent coach who possesses the necessary knowledge and skills, a set of science-based technologies, as well as an awareness of his pupil, may help him in the individual selection of a specific process for the reduction of body weight. Only in this context can we understand the totality of knowledge about the ways and means of reduction of body weight.

The integration of theoretical and empirical scientific knowledge and methods to combat allowed us to identify ways and identify the main and auxiliary means of reducing body weight, wrestlers used in the process of reducing body weight in preparation for the competition, and develop technologies to reduce weight: forced, shock, uniform, gradually increasing, interval-a lot of impact, wavy.

Each of the methods developed for weight loss in wrestlers involve the decline of body weight in a way that is carried out in a clear sequence and in close unity with the goals of the individual wrestler, and differences between the proposed technology is determined by the duration of the temporary decrease in body weight, the amount of excess weight, significance and degree of involvement of various funds in the process of reducing body weight. A sample schedule to reduce body weight through the use of weight loss program is shown in Figure 1.



The main means of reducing body weight the wrestler in the technology are: diet, reduced fluid intake, sauna sweat suit, sauna. Additional means of reducing body weight include: running, sports, exercise bike, massage, and starvation.

Selecting a wrestler of any means to reduce body weight in preparation for a competition is determined by individual mental and physical characteristics, the degree of influence on it of any means of reducing body weight. Weight loss by any of the technologies to reduce body weight in conjunction with the preparation of a wrestler to compete - a difficult, important and individual process. Based on this very important that the athlete is constantly kept under observation coach and doctor. Increased physical activity and nervous excitability fighter during weight loss require a coach to an increased attention to their pupils. Are very important skills a coach on the correct restoration of body weight after weighing wrestler, which he must pass an athlete through theoretical training. Distinguish the basic professional knowledge and skills necessary to coach the organization and implementation of process control body weight.

The coach must remember and follow closely to ensure that young wrestlers do not engage in weight reduction, as often happens in youth wrestling. Only at the stage of advanced improvement, when the athlete's weight has stabilized, and the psychophysical process of becoming a wrestler has reached a climax, the coach and his pupil should determine the appropriate weight category for major competitions. Up to this point any significant weight loss should not be considered. At the same time, from 14-15 years, the young wrestler is allowed to drop his weight by 1-2 kg for a major competition of the year, but not more than 3% of the original weight. This can also prepare the the youngster for the future and provide the necessary experience to reduce body weight and, more importantly, develop important volitional qualities.

Before an athlete will proceed to develop their own individual way of losing weight, the trainer needs to tell him that body weight manipulation in wrestling has many effects. The trainer must provide the following theoretical knowledge: dynamics of body weight in the long-term process of athletic training, during the year, day to day training; weight loss technology, basic and additional weight reduction, the characteristics of particular methods, and the process of recovery from body weight loss. The coach also begins to form his pupil's "sense of weight, which develops on the basis of systematic weight monitoring at different times of day, before and after exercise, bath treatments, sports games.

Beginning with the first attempts at weight loss, the coach has to form a stable plan for a wrestler to achieve the projected weight and addressing emerging challenges. The ability to control their psycho-physical state on the basis of acceptable and individual performance (the desire to train and perform in competition, sleep, appetite, relationships with friends team, changes in subjective feelings of strength, endurance, etc.). At the same time the coach must constantly monitor his physical and mental state on the basis of the following methods: regular weigh-in, teacher observation, monitoring heart rate, determining the composition of blood urea, creatine in urine, etc.

Guidelines for the coach:
The wrestler must clearly understand that the weight loss in conjunction with the preparation for the competition is fundamentally contrary to good health and sporting longevity. It is contrary to the laws of a biological organism’s growth and development, of its functionality, as well as the formation of an optimal physique. It is therefore prohibited from weight loss to the wrestler whose weight is not stabilized, and the process of psycho-physical development is not complete. Successful implementation of the regulation of body weight requires an athlete having a strong motivation, discipline and manifestation of strong moral and volitional qualities.The wrestler must set a goal to lose weight and constantly strive to do so, keeping a diary of self-control. In the diary of the wrestler, you should regularly observe their psychological and physical state during weight loss and the dynamics of change in body weight. Keeping a diary is of as great importance as the choice of a weight loss strategy. It ahelps in the formation of "a sense of weight".

Begin practice in reducing body weight based on the approach needed, from longer to less time-consuming, ie, from the undulating method to a gradual decrease in body weight. This is mainly due to the fact that the wrestler must adapt to the changes in him as a result of reduction of body weight. Strive for a successful competitive activities necessary to carry out selection of the most "comfortable" for a method to reduce body weight and with each subsequent reduction of body weight they should hone their expertise (based on subjective feelings) within the selected plan. Try to drive "normal" weight (up to 5-6% from baseline). Remember that extreme weight loss (6%) - is stressful for the body and can endanger your health. Weight loss of more than 9% of the original should be done only under the supervision of a coach and, if possible, a doctor.

It should be remembered that the more the body is adapted to the state of hunger, the easier it carries weight loss and there is a quicker recovery period. It is recommended to start weight loss with a gradual decline in total caloriic intake and a simultaneous increase in physical activity. Meals should be qualitatively high-grade, but quantitatively insufficient. Nutrition should be a regular 4-5 and even 6 times a day in small portions. In drawing up the daily menu should take into account the chemical composition and caloric content of foods. The foods recommended to reduce calories: lean meat, fish, nonfat cottage cheese, vegetables and fruits. Reduced caloric intake is carried out mainly by reducing the carbohydrates (sugar, jam, white flour) and some restriction of fats, especially refractory (mutton fat, lard, fatty meats and fish). You cannot dramatically reduce the fat, it can lead to deficiency of fat-soluble vitamins and essential substances. Proteins cannot be reduced – as reserves of protein in the body are limited. Protein deficiency can lead to severe health consequences.

After the official weigh-in competition based food should be digestible energy-dense foods and the usual small amounts (500-1300 g), prepared in advance at home. The diet should be enriched with carbohydrates. Preference should be given glucose and fructose, contributing to the rapid formation of muscle and liver glycogen and improve nutrition of the heart muscle. We should not forget about food fortification, using organic foods rich in vitamins or in their absence, multivitamin preparations. Encourage your wrestler to drink an alkaline mineral water without gas, as well as drinks prepared at home.

Restoration of body weight should be slow and gradual. Eliminate overeating and unrestricted fluid intake. We must remember that feeling of fullness occurs 30 minutes after a meal. In order not to overeat, you must learn to count calories in foods and ready meals. Indicators of proper nutrition iinclude the stabilization of body weight, and this requires regular monitoring of the weight.

ПРОФЕССИОНАЛЬНЫЕ ЗНАНИЯ И УМЕНИЯ ТРЕНЕРА В РЕГУЛИРОВАНИЯ ВЕСА ТЕЛА БОРЦА

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Исследование практики спортивной борьбы показывает, что спортсмены, желая оказаться сильнее своих противников, в той или иной степени занимались и занимаются снижением своего веса (за исключением борцов тяжелого веса). При этом снижение веса тела, уже начиная с участия в первых соревнованиях, становится чуть ли не обязательным атрибутом спортивной борьбы. Это обстоятельство привело к тому, что почти все борцы и тренеры имеют свое мнение по поводу того, как быстро и без потерь в спортивной подготовленности следует сбрасывать лишние килограммы в предсоревновательный период. К сожалению, данное мнение далеко не всегда соответствует научно обоснованным подходам к решению такой серьезной проблемы, как снижение веса спортсмена. Подобная практика переносится и на молодых борцов, нанося вред их здоровью и развитию растущего организма.

В специальной литературе достаточно широко представлены результаты научных исследований различных средств и способов снижения веса спортсмена в единоборствах. При этом, как правило, исследователи доказывают, что разработанный ими способ сгонки веса является самым лучшим и эффективным, забывая, что снижение веса тела трудоемкий и сложный, а главное, индивидуальный процесс, который зависит от целого ряда факторов (социально-экономических, психологических и физиологических). Поэтому только профессионально грамотный тренер, владеющий необходимыми знаниями и умениями, совокупностью научно обоснованных технологий и хорошо знающий своего воспитанника, может помочь ему в индивидуальном подборе конкретной технологии сгонки веса. В данном контексте под технологией сгонки веса мы понимаем совокупность знаний о способе и средствах осуществления процесса сгонки веса.

Интеграция теоретических и эмпирических научных знаний и результатов исследований практики спортивной борьбы позволила нам выявить способы и определить основные и вспомогательные средства снижения веса тела, применяемые борцами в процессе сгонки веса в предсоревновательной подготовке, а

также разработать технологии сгонки веса: форсированную, ударную, равномерную, постепенно нарастающую, интервально-многоударную, волнообразную.
Каждая из разработанных технологий сгонки веса борца подразумевает построение процесса снижения веса тела таким образом, что он осуществляется в четкой последовательности и в тесном единстве отдельных средств сгонки веса, а различия между предлагаемыми технологиями определяются временной продолжительностью процесса сгонки веса, количеством лишнего веса, значимостью и степенью вовлечения различных средств в процесс снижения веса тела.
График снижения веса тела на основе использования технологии ударной сгонки веса представлен на рисунке.

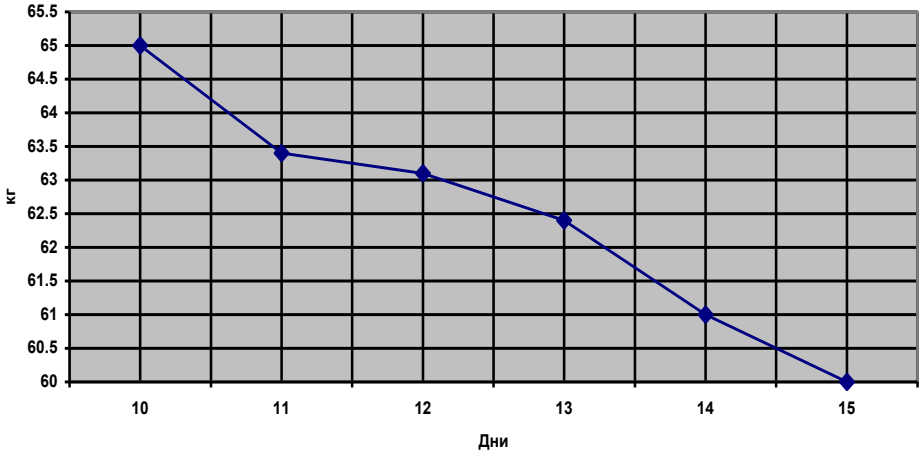

Рисунок. График снижения веса тела (5 дней) на основе использования технологии ударной сгонки веса борца
Основными средствами сгонки веса борца в разработанных технологиях являются: диета, сокращение потребления жидкости, сгоночный костюм, специальная тренировочная работа, банные процедуры. К вспомогательным (дополнительным) средствам снижения веса тела относятся: кросс, спортивные игры, велотренажер, массаж, голодание и медицинские средства.
Выбор борцом какой-либо технологии для снижения веса тела в процессе предсоревновательной подготовки определяется индивидуальными психофизическими особенностями, т.е. степенью влияния на него тех или иных средств сгонки веса, и социально-экономическими факторами, т.е. экономической доступностью продуктов необходимого рациона питания.
Снижение веса тела при помощи любой из технологий сгонки веса в сочетании с подготовкой борца к соревнованию – трудный, ответственный и индивидуальный процесс. Исходя из этого очень важно, чтобы спортсмен постоянно находился под наблюдением тренера и, по возможности, врача. Повышенные физические нагрузки и нервная возбудимость борца в период сгонки веса обязывают тренера к усиленному вниманию к своему воспитаннику. Очень важны знания тренера по правильному восстановлению веса тела борцом после взвешивания, которые он должен передать спортсмену посредством теоретической подготовки.
Выделим базовые профессиональные знания и умения, необходимые тренеру для организации и осуществления процесса регулирования веса тела.
Тренер должен помнить и внимательно следить за тем, чтобы юные борцы не занимались сгонкой веса, как это зачастую бывает в практике спортивной борьбы. Только на этапе углубленного совершенствования, когда вес спортсмена стабилизировался, а процесс психофизического становления борца достиг кульминации, тренер и его воспитанник должны определиться, в какой ближайшей более легкой весовой категории будет выступать борец на главных для него соревнованиях и какой технологией сгонки веса будет пользоваться. До этого момента ни о какой более-менее существенной сгонке веса не может быть и речи. При этом с 14-15 лет юному борцу целесообразно перед 1-2 главными соревнованиями года «придержать» вес на 1-2 кг, но не более 3% от исходного, с целью формирования у него необходимого опыта снижения веса тела, а главное, морально-волевых качеств.
Прежде чем спортсмен приступит к поиску своего индивидуального способа снижения веса, тренеру необходимо сообщить ему следующие теоретические знания: вес тела и практика его регулирования в спортивной борьбе (причины и следствия); динамика веса тела в многолетнем процессе спортивной подготовки, в течение года, суток и одной тренировки; технологии сгонки веса; основные и дополнительные средства снижения веса, их характеристика и особенности применения; гигиена сгонки и восстановления веса тела. При этом тренер начинает формировать у своего воспитанника «чувство веса», которое развивается на основе систематического сопоставления самоощущений своего веса с

результатами взвешивания борца в разное время суток, до и после тренировки, банных процедур, спортивных игр и т.д. «Чувство веса» очень важно для самопознания и дает возможность борцам с достаточной точностью определять и регулировать свой вес в период предсоревновательной подготовки.

Начиная с первых попыток сгонки веса, тренер должен сформировать у борца стабильную установку на достижение запланированного веса и преодоление возникающих трудностей, умения контролировать свое психофизическое состояние на основе приемлемых и индивидуальных показателей (желание тренироваться и выступать на соревновании, сон, аппетит, отношения с товарищами по команде, субъективные ощущения изменения силы, выносливости и др.). В то же время тренеру в процессе сгонки веса своего воспитанника необходимо самому постоянно осуществлять контроль за его физическим и психическим состоянием на основе следующих методов: регулярного взвешивания, педагогического наблюдения, контроля ЧСС, сейсмокардиографии, определения состава мочевины крови, креатина в моче и др.

Тренеру нужно добиться осознания и принятия борцом следующих рекомендаций по регулированию веса тела.

Борцу необходимо четко понимать, что снижение веса тела в сочетании с подготовкой к соревнованию – тяжелый и сложный процесс, небезопасный для здоровья и спортивного долголетия, который противоречит биологическим закономерностям роста организма и развитию его функциональных возможностей, а также формированию оптимального телосложения спортсмена. Именно поэтому запрещается снижение веса тела борцу, вес которого не стабилизировался, а процесс психофизического становления не достиг кульминации.

Успешное осуществление процесса регулирования веса тела требует от спортсмена наличия сильной мотивации, дисциплинированности и проявления морально-волевых качеств.

Приобретение опыта и определение наиболее подходящей для себя технологии снижения веса тела борцу целесообразно начинать с 14-15 лет путем сгонки 1-2 кг веса (но не более 3% от исходного) перед 1-2 главными соревнованиями года. При этом борец должен поставить перед собой цель сбросить лишний вес и постоянно стремиться к этому, вести дневник самоконтроля. В дневнике борцу необходимо регулярно отмечать свое психофизическое состояние в процессе сгонки веса и динамику изменения веса тела. Ведение дневника имеет большое значение как при выборе борцом технологии сгонки веса, так и при формировании «чувства веса».

У борца-сгонщика «чувство веса» имеет очень большое значение, т.к. позволяет с достаточной точностью определять и регулировать свой вес в период предсоревновательной подготовки. Данное чувство формируется путем систематического сопоставления самоощущений своего веса с результатами взвешивания в разное время суток, до и после тренировок, банных процедур, спортивных игр и т.д. Причем борец должен помнить, что в процессе сгонки веса взвешивание лучше проводить утром натощак в одно и то же время, без одежды, а результаты взвешивания записывать в дневнике самоконтроля или в ежедневном графике веса тела.

Начинать практиковаться в снижении веса тела на основе предлагаемых технологий нужно от более длительных к менее длительным, т.е. от волнообразной технологии сгонки веса к форсированной. Это связано главным образом с тем, что организму борца необходимо приспособиться к изменениям, происходящим в нем в результате снижения веса тела.

Борцу для успешной соревновательной деятельности необходимо осуществить подбор наиболее «комфортной» для себя технологии сгонки веса и при каждом последующем снижении веса тела оттачивать свой опыт (на основе субъективных ощущений) в рамках выбранной технологии.

Старайтесь сгонять «обычный» лишний вес (до 5-6% от исходного). Помните, что сгонка «максимального» лишнего веса (более 6%) – это стресс для организма и опасность для вашего здоровья.

Снижение веса тела более чем на 9% от исходного необходимо проводить только под наблюдением тренера и, по возможности, врача.

Следует помнить, что чем больше организм адаптирован к состоянию голода, тем легче переносится сгонка веса и быстрее происходит период восстановления.

Рекомендуется начинать снижение веса тела с постепенного снижения калорийности рациона питания и одновременного увеличения физической нагрузки.

Питание должно быть качественно полноценное, но количественно недостаточное.

Питание должно быть регулярным 4-5 и даже 6 раз в день небольшими порциями.

При составлении ежедневного меню необходимо учитывать калорийность и химический состав продуктов.

В пищу рекомендуется употреблять малокалорийные продукты: нежирное мясо, рыбу, обезжиренный творог, овощи и фрукты.

Снижение калорийности питания осуществляется главным образом за счет уменьшения углеводов (сахара, варенья, белой муки) и некоторого ограничения жиров, особенно тугоплавких (бараньего жира, свиного сала, жирного мяса и рыбы).

Нельзя резко снижать жиры, это может привести к недостаточности жирорастворимых витаминов и незаменимых веществ.
Белки снижать нельзя – запасов белка в организме нет. Белковая недостаточность приводит к тяжелым последствиям для здоровья.
После официального взвешивания на соревновании основу питания должны составлять легкоусвояемые высококалорийные и привычные продукты небольшого объема (500-1300 г), приготовленные заранее в домашних условиях. Рацион питания необходимо обогатить углеводами. Предпочтение следует отдавать глюкозе и фруктозе, способствующим быстрому образованию в мышцах и печени гликогена и улучшающим питание сердечной мышцы. Нельзя забывать и о витаминизации питания, используя для этого богатые витаминами натуральные продукты или при их отсутствии поливитаминные препараты. Пить рекомендуется щелочную минеральную воду без газа, а также напитки, приготовленные дома.
Восстановление веса тела должно проходить медленно и постепенно. Исключается переедание и неограниченное потребление жидкости.
Нужно помнить о том, что чувство насыщения наступает через 30 минут после приема пищи. Чтобы не переедать, надо научиться считать калории в продуктах и готовых блюдах.
Показателем правильного питания является стабилизация веса тела, поэтому необходим регулярный контроль за своим весом.

VIEWPOINT

FORCE – THE ONLY CONDITIONAL QUALITY? POINTS OF VIEW ON CERTAIN ASPECTS OF THEORY OF SPORTS TRAINING

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but there will be a time when this present,
will become past"

ABSTRACT
The current article is an innovative approach which promotes the hypothesis that there is only one conditional motric ability, and that is force. Even though the specialized literature is concordant with respect to the three conditional motric attributes, speed, force and resistance, we try to demonstrate that the force is the single conditional motric attribute manifested by man, as it represents the direct byproduct of the muscle contraction, as a result of the energy resulted from the metabolic reactions. From our point of view, speed and resistance are consequences of the manifestation of force, or different forms of force manifestation, corresponding to various requirements of the activities that the human individual performs or to the adaptation level manifested by him.
Keywords*: sports, muscle contraction, force, speed, resistance*

Far from us the thought of contradicting the specialists, nonetheless we will put in a new light arguments of theory and practice of physical training in order to bring clarification to a science in which some of the concepts are sometimes mistaken or approximately valued. These clarifications refer to human conditional motric attributes: speed, force, resistance.
The history of physical training reveals that the first specialists who studied the human movement observed the movement attributes empirically and it was thus that they defined the motric attributes. Ever since, all those who studied the practical and theoretical aspects of physical training and competition were circumscribed within the framework of this idea.
To the best of our knowledge, all the specialists of the sports science differentiate the motric attributes as follows: speed, force, resistance and skill.
R. MANNO[1] (and not only) is the first specialist to differentiate motric abilities as conditional and coordinative.
We shall not attempt to review all the definitions of the motric abilities enunciated over time by different authors. We intend to emphasize some aspects that seemed relevant in order to support the theory that *there is only one conditional motric ability (capacity) - force, which represents the frame of action of the human movement according to the adaptation needs to different demand types.* The analysis of force ability and combined force action is very complex and any attempt at making a schematization would only be an imperfect didactic emphasis of certain biomechanical, biochemical, physiological mechanisms involved that produce synergies, correlations and interdependencies. These are potentiated by the factor that has a preponderant psychological adaptive role through the functions of orientation, regulation and support and may only be approximated.
In relation to this fact, it is stated that *"Force, as a physical concept, usually represents the physical cause of movement"*[2]. Relative to force,"*it is notable that no physicist or other scientist has yet measured the force, but only its effects (especially deformation and movement)."*[3] Moreover, Oxford Dictionary (quoted by GAGEA, A., 2005) [4]

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[1] MANNO, R., *Les bases de l'entraînement sportif*, Ed Revue EPS, 1989
[2] WITTEKOPF, G., MARHOLD, G., PIEPER K., S., *Biologische und Biomechanische Grundlagen der trainingsmethodischen Kategorie »Kraftfähigkeiten« und Methoden ihrer Objektivierung*, Med. u. Sport 21 (1981), 225–231, In: Sportul de Performanță, Nr.281, CCEFS, Bucureşti, 1988, p.5

[3] GAGEA, A., Biomecanica analitică, Bucureşti, 2006, pag. 33
[4] Ibidem, pag. 33

states that: *"Force is the cause of effects"*. From this perspective, *"force - as expression of movement cause"* is one of the irreductible basic quantities of the biomechanics, alongside *distance* and *time*[5]*".*
In our opinion, force is the factor that generates movement. Movement per se has some characteristics: trajectory, acceleration, speed, time etc.
The concepts used in the specialized literature with reference to the force are as follows: "*the active force is the force that is generated by the muscle contraction in order to perform a movement; the resistive force is represented by the weight that antagonizes movement;* and*... movement is produced by the net force, i.e. the vectorial difference between active and resistive forces.*[6]"
The muscle force can be defined as the tension in a muscle or group of muscles which antagonizes a resistance. *"One of the most important functions of the muscles is to generate force on bone extremities in order to produce movement or to maintain positions*".[7]
According to the definition of force from Oxford Dictionary quoted by GAGEA, *"muscle contraction produces muscle force"*[8], and from our point of view, speed and resistance represent either an attribute of the movement, like speed, or a particularity of force manifestation, like resistance. Muscles don't produce speed, nor resistance, nor grace... Muscles produce contractions, and contractions produce muscle force.

Analysis and debate

In biology systems, the physical occurrence of force is related to the muscle activity, specifically the properties of the muscle fiber: excitability, contractility, elasticity, and plasticity.
Muscle contractions can be fast or slow. They may involve a large number of fibers or a very small one. Muscle contractions produce a force of a certain magnitude under the action of efferent nerve impulses. Physical factors of orientation, regulation and support play a crucial role in the performance of movements, just as physiologic (hormonal) and biochemical factors are essential for initial and subsequent adaptation to the charge. Level, speed and performance (exercise) time of the human force in an activity are dependant on physical and hormonal regulations, which determine the intensity and depletion volume of ATP (adenosine triphosphate) molecules and also the resulted energy. Consequently, the magnitude of the force produced by muscle contraction is dependant on the decomposed ATP amount.
"ATP represents the sole chemical energy source immediately movable for the muscle contraction, in accordance with the following hydrolysis reaction:
ATP + H_2O → ADP + Pi +H energy
This reaction releases almost 50kJ/ ATP molecule and is catalysed by ATPases at the end of myosin filaments in the muscle cell"[9].
Biologically, force is a manifestation of effort capacity and is produced by neuropsychic and muscular effort.
Physiologically, force is a neuro-muscular manifestation because the morphofunctional support of the force is nervous and muscular. It is neither exclusively neuropsychic nor exclusively muscular. Or, better said, it is psychic by control and support attributes, nervous by impulse transmission and muscular by performance.
Morphofunctionally, there are three types of muscle fibers: slow twitch, fast twitch and intermediate twitch. Regardless of the enzymatic equipment, of the required "fuel" or the energy mechanism that produces the energy necessary for contraction, the attribute of all these fiber types is muscle force. Consequently we cannot imagine that the recovery of ATP molecules decomposed in ADP, AMP and the energy necessary for contraction, using one energy mechanism or the other, may develop preponderantly one motric quality or the other.
For the manifestation capacity of the muscle force, the level of intensity and the duration of the performed effort depend both on the ATP amount and on the balance between the disintegrated ATP amount and the recovered ATP amount. The moment when the recovered ATP does not satisfy the energetic needs of the organism at a certain level of duty, the body either glides reflexively to a lower demand level, or the respective activity ceases.
There is a quasi-unanimity of the specialists regarding the statements referring to the manifestation modality of the motric abilities, i.e. they manifest natively only in isolated cases. We believe that they cannot even manifest in a pure state, because this statement in fact refers to *movement per se, with all its characteristics, which uses muscle contraction as source.* This is about the manifestation of a single attribute - force in different shapes, according to adaptation needs to a submitted request.
When statements are made about the manifestation mode of the motric abilities, they often include: *force-speed, resistance to force, force-resistance* etc. Regarding these formulations, we wondered many times: how much

[5] Ibidem, pag. 41
[6] GAGEA, A., *Biomecanica analitică*, Bucureşti, 2006, p. 41
[7] DUPONT, G., BOSQUET, L., *Metodologie de l'entrainment*, Ellipses, 2007, p.17

[8] GAGEA, A., *Biomecanica analitică*, Bucureşti, 2006
[9] KOOLMAN, J., RÖHM, K., H., *Atlas de poche de biochimie*, 2eme edition, Flamarion, 1999, 462 p.

does one attribute represent and how much does another one, in such enunciations. Let alone enunciations such as: *force-speed in resistance mode* or others alike.
Moreover, we believe that we can state that *force is the sole biomotric attribute generated by muscle contraction, while the rest of the muscle manifestations may be related to the force itself which forms the time and space action frame.*
Speed is an attribute of movement and is reported to the muscle contraction speed, which may depend on the number of nervous impulses, the number of contracting muscle fibers, the ATP amount that breaks down in a time unit, resistive force, the internal and external environment temperature etc. To GAGEA (2006), *"force by its variation is the factor that generates speed and its variation"*[10].
It is our opinion that *resistance as a motric quality is nothing else but individual action modes of muscle force.* It is the fact that resistance may be of short, medium or long duration, that determines us to make this statement. During movement performance the force magnitude is inversely proportional with its application time. The greater the applied muscle force, in comparison with the potential of the reference individual, the shorter the action time, in which case the specialists discuss about *"short time resistance or anaerobic resistance".* If we change the reference, the lower the applied muscle force, the greater it becomes the possibility of applying it during a longer period. In this case specialists discuss about *"long time resistance, endurance or anaerobic resistance".* Generally, the motric resistance is nothing else but the reliability of the human body to maintain/ apply a relatively constant force during a longer period.
These statements lead us to the elaboration of a principle according to which, regardless of the human activities, the magnitude of the applied force is proportional with the activity time length.

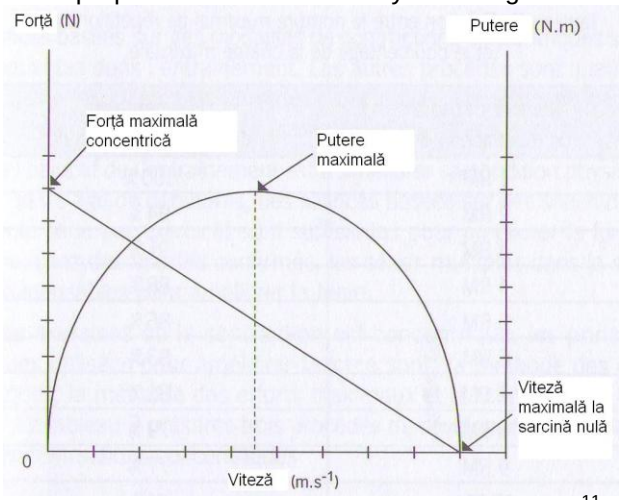

Figure 1: The relation between force and speed[11]

To this purpose we may affirm that both speed and resistance are proportional with force and depend on it. Form this perspective, if we analyze the relation between force and speed, as mentioned in the theory of physical training, we may notice that there is an inversely proportional relationship in the manifestation of one or the other of the mentioned abilities.
We also notice that this relation may be correct in the left area of the chart: the greater the resistive force, the smaller the net force and as a consequence the speed of movement is also smaller. This claim seems erroneous to us, when we study the axis of speed. It seems that the smaller the resistive force, the greater the speed of movement.
There are two questions we may ask ourselves:

1. What happens to speed when the resistive force decreases continuously to zero? Does this speed increase progressively? To what extent?
2. And if the magnitude of the active force tends asymptotically to zero, what will the speed magnitude be?

In order to be more categorical, in this relation we could also input values. Specifically, if the force F is null (F = 0), what magnitude would the speed and the resistance have? The question is rhetorical, and the answer is more than obvious.

[10] GAGEA, A., *Biomecanica analitică*, p. 57
[11] DUPONT, G., BOSQUET L., *Metodologie de l'entrainment*, Ellipses, 2007, p.19

A possible formula of the force developed by the individual should contain many more parameters that refer to the total quantity of energetic substances, to psychical factors with imponderable value, yet determinant, to the efficiency of metabolic processes etc., all being related to the time factor. However, this formula would contain even a larger number of variables which interact and whose significance is difficult to establish due to several reasons.

Regardless of the human activities, the force may manifest under the following aspects:

- *"of maximum acceleration;*
- *of maximum speed;*
- *of maximum distance or duration.*[12]"

Moreover, GAGEA details that the measure of force may refer to *"speed variation in time, namely the second space derivative, which is acceleration",* to "*space variation in time, namely the first derivative of space, which means speed*" and in the third case *"the measure of force may refer simply to space (distance)*[13]*".*

Concordantly with the modalities of force manifestation, according to the planned and scheduled activities and goals, the muscle exercise may have as purpose: "*development of force increase phase, increase of force maximum, to increase the contraction tension sustentation time*[14]" or to enable the highest number of consecutive contractions.

Moreover, regardless of the performance of the human individual or the "motric attributes" required during the performed actions, we can assert that the effect of all these qualities may be quantified as energy which is converted to heat and mechanical work.

"The energy is a physical quantity that characterizes the state of systems at a certain moment and the mechanical work is a form of energy exchange, which is a process or state transformation physical quantity"[15]. The kinetic energy theorem (KE) refers to the mechanical work performed by the resultant force, applied against the material point. The mechanical work equals the variation of kinetic energy of the material point.

If $Mw = F * d * \cos \alpha$; whereas *Mw* = the mechanical work, F= force, d = displacement, cos *α*= the angle between *F* and movement direction),

and $P = \frac{Lm}{t} = \frac{F * d * \cos \alpha}{t}$, whereas *P* = power, *Mw* = mechanical work, t = time,

then from the formulas of mechanical work and power it may be deducted that *F* force is not only the common factor but also the principal factor that generates movement.

If the resultant of the applied forces is null at all times, the kinetic energy of a material point is preserved: a material point may not modify its kinetic energy unless a force is applied on it. Namely, the kinetic energy equals the *Mw* spent in order to get the material point from stop to *V* speed or the *Mw* necessary to stop the material point, or, at last, with the *Mw* returned by the material point when it is stopped. The kinetic energy is a scalar quantity (temporal type) of movement. The existence of the physical quantity KE and of the physical law of KE conservation is related to the property of time homogeneity (time translation symmetry).

From a physical point of view, speed may be an expression of acting force dynamics with all the movements' characteristics: *duration, trajectory, acceleration, inertia, deceleration* etc. Per se, speed is a movement quality and not at all a conditional attribute. In fact, it is unanimously accepted that speed is more of an ability that has the central nervous system and the dynamics of the fundamental nervous processes - excitation and inhibition, with all their expression characteristics: force, mobility and balance, as morphofunctional support. A human individual may be born with this aptitude under different manifestation degrees, insomuch as he/she can be born with one temperamental constitution or another, according to these characteristics. The speed manifestation support is the cerebral cortex and it acts according to the dynamics of the fundamental nervous processes, excitation and inhibition, relating to the characteristics of the above mentioned. Insomuch as a temperamental constitution generated by the genetic matrix may not "progress", we believe that this aptitude of the human individual also cannot "progress".

Therefore we consider that it is wrong to state that *"speed may progress".* We believe that the movement speed may only be optimized and this optimization may take place, mainly, by two means: movement rationalization (learning, improvement and automation) and increase of the maximum force. Moreover, we cannot assert that the theoreticians and practitioners in the field of physical training underlie programs for *"speed development".* From our point of view, all these programs that contribute to the *"speed development"* are only addressed to the

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[12] Idem - quoted work, p. 52

[13] Idem

[14] DUPONT, G., BOSQUET L., *Metodologie de l'entrainment*, Ellipses, 2007, p.19

[15] HRISTEV, ANATOLIE, *Mecanică şi acustică*, Ed. Didactică şi Pedagogică, Bucureşti 1982, p.58

manifestation of force in a certain movement regime, singularized by the energetic requirements of the reference sports discipline, by the typology of technique and tactics, metabolic modeling to which the human individual was conditioned during the training, correlated with the competition requirements of a certain discipline etc.
On the other hand, a motric capacity can be exclusively developped by stimuli activity on the morphological and functional pattern. How many specialists are there, that act on the dinamics of fundamental nervous processes for increasing speed through intense training, regardeless of speed's form of expression?
In any type of activity moving speed can be exteriorized through the muscle ability to overcome external resistance. Thus, the speed of movement depends on the types of muscle strength manifestations and does not appear isolated in sports as an independent quality.
According to VERKHOSHANSKY I., *"speed occurs as a functional attribute of the human body, but it is manifested individually only when the outer resistance is not higher than 15% of the maximum muscle force, which is not characteristic to most of the physical exercises.*[16]. It results that in these cases the maximum force does not have a decisive influence over the movement speed, but even for these movements, force is required to overcome the inertia and the intrinsic resistive force of the segments and of the entire body, which is at rest or moving.
Moreover, VERKHOSHANSKY considers that *"...there are no certain special mechanisms that are responsible only for the speed, force or resistance of the athlete. The various motric abilities are enabled by some and the same functional systems of the body. However, as a result of the specialized training these systems are improved in compliance with the objective particularities of the sport branch.*[17]. The case analysis may reveal that there were athletes who obtained remarkable results during different events: athletics, swimming etc.
To us, the muscle force is a fundamental parameter of the effort capacity which an individual can express while performing the movements. The magnitude of the muscle force depends on the modality in which its making was conditioned (training and adaptation), and also on internal (muscles and tendons rigidity) and external (time, position, speed) factors. These only customize various particular modalities of applying of (a potential of) the muscle force.
Moreover, different approaches in the methodology of force development in the performance sport are differentiated according to the specific modality of manifestation/ action of athletes in obtaining different types of performance, specific to different sports disciplines.

As performance potential, the force of the human individual is, among others, dependant on the functioning of the metabolic pathways for producing the energy required for the contractions. These are based on two characteristics: ***power*** and ***capacity.*** Both these terms refer to the fundamental characteristics of energetic systems (channels) running. Therefore it is useful to set out these characteristics.
Power respects the availability of the considered energetic pathways. It is measured in kJ. The image of a container out of which a liquid flows is often used. We can imagine that the container tap represents the power and expresses the output and the speed of producing/ using the energy per time unit. It is known that each of the three energetic processes are limited by certain highly specific characteristic factors, as follows:

-the alactacid anaerobic power depends on the ATP content and the ATPase enzymes amount;
-the lactacid anaerobic power depends on the glycolytic enzymes content;
-the aerobic power depends on the oxidative enzymes content of the striate muscle fibers, on one hand, and on the cardiac output, on the other.

Capacity is represented by the time in which this energetic system (the container's volume) can work.
Like *power*, *capacity* has limiting factors:

- for the anaerobic alactacid energetic pathway, the capacity depends on the amount of creatin-phosphate from the skeletal muscles;
- for the anaerobic lactacid energetic pathway, the capacity depends on the importance and efficacy of the buffer systems (neutralization of H^+ ions of the lactic acid).

The capacity of the aerobic system depends on many factors. These factors are:

- the rate of muscle and hepatic glycogen;
- preferential use of lipids;
- thermolysis capacity;

For the science of corporeal activities, from our point of view, the force is a fundamental category, similar to, for example the matter in philosophy. Insomuch as matter - fundamental philosophic category - manifests through

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[16] VERKHOSHANSKY, I., quoted by DAHNOVSCHI, V., S.., LESCENKO, S. S., *Подготовка борцов высокого* ***класса***, Zdorovia, Kiev, 1989.

[17] Ibidem

substance and field in *"n"* particular shapes, the force may also have a variety of manifestation forms or aspects, according to internal and external movement parameters.
Regarding the problem of supporting our hypothesis, from the practitioner's point of view force may be developed through the repeated stimulation of the morphofunctional support, leading to biochemical, physiological and structural regulations, which potentiates/ maximizes, more or less, action complexes either in the sense of aerobic demand, or that of combined and/or anaerobic demand.
For this purpose, *"every physical effort produces modifications in the human body, defined by Volkov as direct, gradual and cumulative*[18]", being related to the volume, intensity, density and duration of the stimulus action.
The force is dependant to the ATP amount that the human individual is able to release in order to perform the physical effort.
At the beginning of effort, the body has a certain amount of ATP available, which is consumed during the physical activity. The ATP molecules are resynthesized by the human body through the conversion of ADP and AMP through all the available energetic channels. *"The energy production is not performed at the expense of just one metabolic pathway activation (i.e. the phosphagen system, glycolysis and oxidative phosphorilation) but through an interrelation of these systems, dictated by the intensity and duration of the effort."*[19].
According to PERONNET and FERGURSON[20], the three energetic processes (aerobic, lactacid anaerobic and lactacid anaerob) recompose the ATP molecules and differentiate by their capacities, their maximal power and by their moments of intervention and response.

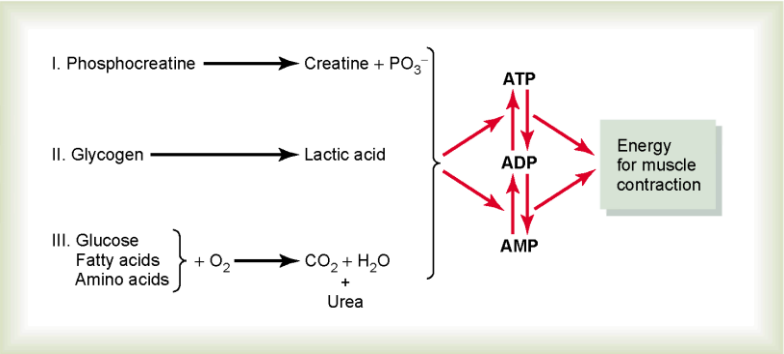

Figure 2. Important metabolic systems that deliver energy for the muscle contraction[21]

Biochemically, the only trade good for energetic exchange is the ATP molecule, regardless of the energetic process to recover it and especially regardless of the required motric abilities combination.
If the ATP recovered through the metabolic processes based on phosphocreatine (PC) and glycolysis depletion, contributes to the manifestation of maximum force and combined force qualities, is it normal to think that the ATP which results from the aerobic energetic processes cannot underlie the manifestation of muscle contractions that develop a force, regardless of its magnitude? Our opinion is that the energy from the ATP recovered through the oxidative processes and implicitly the contraction force are lower because the body has access to a smaller ATP amount per time unit. Regarding the final product, namely the ATP recovery, concerning the energetic channels, one of the significant differences is probably in the speed at which the sequences run.
We believe that if there is only one energy trade good, why wouldn't there be a single conditional motric attribute, since speed and resistance are manifested according to force or can be considered as particular modalities of applying the for ce in different work regimens?

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[18] VOLKOV quoted by WITT, A., *Power changes depending on the sport*, translated in: Sportul de Performanță, Nr.281, CCEFS, Bucureşti, 1988, p.83

[19] URSTA, M., *Cuantificarea metabolismului energetic în timpul efortului fizic*, http://www.medicinasportiva.ro/medicina%20sportiva/fiziologie/Cuantificarea%20metabolismului%20energetic%20in%20timpul%20efortului%20fizic.html#articol_specialitate

[20] PERONNET, FERGURSON, quoted by DRAGNEA, C., A., Mate-Teodorescu Silvia, Teoria sportului, FEST, Bucureşti, 2002, p. 139

[21] GUYTON A., C., *Textbook of Medical Physiology*, eleventh edition, by Elsevier Inc., 1600 John F. Kennedy Blvd., Suite 1800 Philadelphia, Pennsylvania 19103-2899, 2006, p.1057

If we analyze the *marathon* from the point of view of the dominant motric attribute that determines the performance, the specialized literature is consistent in asserting that the long time resistance is a common place for the vast majority of specialists. If we analyze the event biomechanically, running represents a succession of jumps from one foot to the other, with a floating phase. For each of these jumps, muscle contraction is required, and out of it muscle force results as primary manifestation.

Moreover, the runner in the marathon event, even if he performs a tremendous physical exertion during the race, he runs the last stadium tour in less than 1 min., achieving an average speed of ≈ 5.71 m/sec[22] (almost 60% of the maximum speed!) throughout the 42.193 km. That is, if the athlete would run only on the classic running track the average speed would be ≈ 70 sec per each tour. We believe it is true that starting with the moment of the first contraction, no matter how long it lasts, in the human body there are spontaneously triggered all the metabolic energetic processes that ensure the energy required for the recovering of ATP molecules[23], with the remark that there is a different inertia for each of the energetic pathways, according to the location of the energetic substratum reserves, the breakdown modality, the pause of action, the efficacy etc.

The physical training seeks, through adequate methods, to improve the *power* and *capacity* of athletes for each sports discipline, adequately to the specific requirements generated by the competition for each branch.

The effects on the human body produced through training are individualized not as much from the reactivity of the athletes, but from the effort dosing during training and competition. By temporal projection of the training effort, the individuals selected to be professional athletes will develop from childhood to maturity different types of reactivity as adaptations to competence requirements. By disregarding the *"technical field"* of each sports discipline, *"the engine"* of the performer will release the required energy in accordance with all the requirements that determined over time the power and capacity. Currently a series of specialists are still searching empirically, not knowing for many sports disciplines which is the best "*engine*", what sort of "*fuel*" it uses, what is the *"optimal speed of revolutions"* regimen. Biochemically, the only trade good for energetic exchange is the ATP molecule, regardless of the energetic process to recover it and especially regardless of the required motric abilities combination.And if there is only one energy trade good, why wouldn't there be just one conditional motric attribute, the force, as long as the other conditional attributes are manifested according to the force or might be considered particular modalities of force implementation in different work regimens?

CONCLUSIONS

The consequences of this study are difficult to anticipate. From our point of view there may occur a series of mutations and reconsiderations in the field of the science of theory and practice of physical training and consequently in the understanding of the performance phenomenon and the concept of performance in a series of sports branches. We also believe that some mutations and changes may occur in the "center of gravity" in the methodology of preparing the performance in some sports branches, according to the new meanings that these ideas will have in the reassessment of the performance concept for those branches.

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[22]The quoted example takes into consideration the actual record of "marathon event" which is 2:03.59, set by Haile Gebrselassie, Berlin, 2008.

[23] The ATP molecules recover constantly from the moment when the body begins using them to perform physical effort.

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Manuscripts, along with a cover letter to the Editor that a new manuscript is being submitted for consideration, must be sent by e-mail to: davcurb@gmail.com Manuscripts will be blindly reviewed by two reviewers. Acceptance for publication will be based on quality, originality and reliability of the presented material. Whenever necessary, accepted manuscripts are returned by e-mail to the authors for corrections. After making the corrections, the authors have to resend the manuscript, along with a new cover letter to the Editor with detailed information about the alterations for each one of the reviewers' comments.

FORMAT
The complete manuscript must include:
The title page, with:
a) Complete title, b) names and affiliations of all authors in the order they appear, c) a running head, and d) contact information for readers (name, address, e-mail, phone number, fax).

ABSTRACT (one in English):
Abstract and Key words on a separate page, following the title page. Length should be less than 200 words.

INTRODUCTION
Introduction, starting on a separate page, and ending with the purpose of the study
and the corresponding hypotheses.

METHODS
Method, which includes a) Participants, b) Instruments-Tests, c) Procedures, d) Research design, and e) Statistical analysis.

RESULTS

DISCUSSION – CONCLUSIONS

PRACTICAL IMPLICATIONS/ADVICE FOR ATHLETES AND COACHES

REFERENCES
A reference list in **alphabetical order** should be included at the end of the paper. Authors should only include references which have been published or accepted for publication. They should also check that all references are actually cited in the body of the paper **(by number)**, and all citations in the paper are included in the Reference list. All references must be alphabetized by the first author's surname and numbered. They should be written according to the following examples:

1. BECK, B., and C. SNOW. Bone health across the lifespan – exercising our options. *Exercise and Sport Sciences Reviews*, 31 (3), 117-122, 2003.
2. ECKERSON, J., D. HOUSH, T. HOUSH, and G. JOHNSON. Seasonal changes in body composition, strength, and muscular power in high school wrestlers. *Pediatric Exercise Science*, 1, 39-52, 1994.
3. FREISCHLAG, J. Weight loss, body composition, and health of high school wrestlers. *Journal of Physical Sports Medicine*, 12, 121-126, 1984.

Tables and Figures:
The number of tables and figures must be limited. They should be added at the end of the paper, after the Reference List. Tables and Figures must be explanatory, supplementary and non-repetitious of the text. A brief title is given on the top (for the tables) or on the bottom (for the figures). It is forbidden to cite other authors' tables or drawings unless a copy of written permission is enclosed to the Editorial Staff of the Journal. Information about reference writing in historical papers is provided in the webpage of the European Committee for Sport History (http://www.cesh.info).