TRAINING HABITS OF NON-ELITE MARATHON RUNNERS

By

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Abstract: Marathon running has become an increasing trend in the United States among non-elite marathon runners. Distance training is a demanding and physical task and a runner needs the proper training program to meet the demand of distance running. Non-elite runners typically lack formal running training and may not realize the damage they could cause to their body with improper running techniques through long distance training. With the increase in non-elite runners, it is probable that there will be an increase in these runners seeking advice from personal trainers or running coaches. Using research on how successful runners are training for performance, coaches and trainers may better prepare their clients for distance training, races and recovery. The purpose of this study was to examine the training methods of non-elite marathon runners. One hundred and fifteen participants, 58 male and 57 female (age 37.20 ± 12.34) completed the web-based survey. Questions regarding their run training practices, training surface, cross-training and if they worked with a running coach or personal trainer were assessed. Results of the survey determined that males ran faster (P= .000) and ran more miles both while training for a marathon (P = .015) and when not training for a marathon (P = .020) than women. Those runners who trained more years are more likely to work with a running coach (P = .000), run more miles (P = .057) and train longer (P = .104) during marathon training. The survey also revealed that majority of runners training on concrete during marathon training and when not training. Results also determined that majority of respondents cross-trained while marathon training (n=89) with their primary choices of cross-training activity being cycling (n=60) and strength training (n=59). 37 respondents worked with a running coach during marathon training with their primary motivation for doing so being to increase speed. While these findings may provide a better understanding of non-elite marathon runners and their training practices, further research should be conducted to even better understand this population. In all, this study provided an overall view of the motivations and training practices of non-elite marathon runners.

TABLE OF CONTENTS

Chapter Page

LIST OF TABLES

Table Page

CHAPTER I

INTRODUCTION

Distance running has become an increasing trend among adults in the United States. In 1980, there were roughly 143,000 US marathon finishers and by 2009 the number had increased significantly to 467,000 (Voight, Roberts, Lunos, & Chow, 2011). In 2011, the number of marathon finishers was a record high of 518,000 (Running USA Incorporated, 2013). With the average marathon finishing time increasing by more than 50 minutes in the recent decades, it has been shown to be attributed to non-elite or recreational runners who chose to run for reasons such as goal achievement, health, affiliation and self-esteem rather than elite competition (Masters, Ogles, & Jolton, 1993). Distance training is a demanding and physical task and a runner needs the proper training program to meet the demand of distance running. Non-elite runners typically lack formal running training and may not realize the damage they could cause to their body with improper running techniques through long distance training (Holmich, Christensen, Darre, Jahnsen, & Hartvig, 1989).

For both elite and non-elite marathon runners, regular training is required for successful marathon running (B. Knechtle, P. Knectle, Barandun, Roseman, & Lepers, 2011). Frequency, intensity and volume of training seem to be of the greatest importance (Bale, Bradbury, & Colley, 1986). While regular training is required for both types of athletes, elite marathoners run more kilometers per week and at a higher velocity than recreational runners (Billat, Dermarle,

Slawinski, Paiva, & Koralsztein, 2001). That being said, the frequency of training per week for non-elite marathon runners is a debatable topic between researchers and runners.

Researchers have sought to identify the training habits and the impact of the habits on elite marathon runners. While some predictor variables have been identified, discrepancies do exist on the impact of these factors. Tanda (2011) found that mean distance per week and the mean training pace were strongly correlated with Marathon Performance Time (MPT). Schmid et. al. (2012) determined that the only predictors related to marathon race time were maximal distance ran per week, the number of running training sessions per week, and the running speed of the training sessions with the running speed of the training sessions being the most important predictor. Ferreira & Rolim (2006) found with elite runners, that a traditional method of training at a lower intensity (62-82%) of HeartRate Max(HRmax) with a running volume of approximately 150-200 km (94-125 miles) per week can lead to successful results for marathon runners as long as they have increased training distances over many years. However, in contrast, Barandun et. al. (2012) say that they could not confirm finding an equation between training duration and marathon race time.

While most of these studies are based on elite runners and show conflicting findings on frequency, duration and intensity of training for marathon runners, there is still more research and findings that can be done to help determine what is best for non-elite marathoners. Dolgener, Kokhorst, & Witsett (1994) focused on non-elite runners and the minimum training distance possible for them to complete a marathon. Two groups of novice runners (male and female) were asked to run either four (three short runs and one long run) or six (five short runs and one long run) days a week. Unfortunately, no differences were noted between the race performances during the marathon for the two groups with both groups able to complete and have a successful marathon performance regardless of training technique.

Another area of interest in marathon running is the topic of cross-training. Cross-training can be a means for injury prevention but also for the improvement of overall fitness and health while avoiding boredom. Cross-training can be extremely helpful for marathon runners during extensive training periods to give their body a break from their normal routine by participating in another form of exercise to prevent injury as well as potentially improving running performance. Whether or not cross-training improves running performance is controversial as studies have shown improvement with certain types of cross-training while others have shown no improvement of running performance with cross-training (Flynn et al., 1998). There are very few studies on other types of cross-training, such as biking and swimming, and its affect on marathon training and race performance.

Voight, et. al., (2011) conducted research on non-elite Boston Marathon qualifying and non-qualifying runners and their participation in cross-training (most commonly biking and weightlifting) before the marathon, one month after and six months after the race. They found over half of participants surveyed participated in cross training before the marathon. The number increased to 74% one month after race and remained steady at 71% six months after the race. Another example of cross-training is resistance training and it has been suggested to positively impact distance running performance by adding it to the aerobic training program already in place by the runners (Johnson, Quinn, Kertzer, & Vroman, 1997). One study emphasized heavy resistance training with the leg muscles for trained and untrained participants and demonstrated improved performance in long-term and short-term endurance based off of time to exhaustion at 80% and 100% of VO2max (Hickson, Dvorak, Gorostiaga, Kurowski, & Foster, 1988).

Successful marathon running may require more than just focused training techniques. With the increase in non-elite runners, it is probable that there will be an increase in these runners seeking advice from personal trainers or running coaches. Potential reasons for seeking out personal trainers or coaches are instruction on proper running techniques for optimal performance

and injury prevention. Running coaches and personal trainers need to be able to assist their clients in creating training programs that are effective and safe. In all, using research on how successful runners are training for performance, coaches and trainers may better prepare their clients for distance training, races and recovery. With the limited information on non-elite marathon runners training the purpose of this study was to examine the training methods of non-elite marathon runners.

CHAPTER II

REVIEW OF LITERATURE

Due to the lack of information on non-elite marathon runners training a comprehensive literature review was conducted concerning the training methods and dietary practices of amateur marathon runners. Studies concerning frequency, duration and type of exercise performed by runners and dietary practices as well as eating disturbances of distance runners were reviewed. Sources of information included but were not limited to internet sites, professional research journals, library indexes and dissertations. The studies will be grouped based on the results found and used to provide a literature review to determine running habits of amateur marathon runners.

Frequency, Duration and Intensity

For both elite and non-elite marathon runners, regular training is required for successful marathon running (Knechtle, Knectle, Barandun, Roseman, & Lepers, 2011). Frequency, intensity and volume of training seem to be of great importance (Bale, Bradbury, & Colley, 1986). It has been shown that elite marathoners run more kilometers per week and at a higher velocity than recreational runners (Billat, Dermarle, Slawinski, Paiva, & Koralsztein, 2001). That being said, the frequency of training per week for non-elite marathon runners is a debatable topic between researchers and studies. Tanda (2011) show that mean distance per week and the mean training pace were strongly correlated with Marathon Performance Time (MPT).

Schmid et. al. (2012) also found that only predictors related to marathon race time were maximal distance ran per week, the number of running training sessions per week, and the running speed of the training sessions with the running speed of the training sessions being the most important predictor. Ferreira & Rolim (2006) showed, through a study with elite runners, that a traditional method of training at a lower intensity (62-82%) of HeartRate Max(HRmax) with a running volume of approximately 150-200 km (94-125 miles) per week can lead to successful results for marathon runners as long as they have increased training distances over many years.

In a study that focused on non-elite runners and the minimum training distance possible for them to complete a marathon, the researchers took two groups of novice males and females and had them run either four days a week (three shorter runs and one longer run), or six days a week (five shorter runs and one longer run) for a training period of fifteen weeks. The researchers had the participants focus on slow training for the beginning runners to prevent injuries. The study did not find a difference between the race performance during the marathon for the two groups but did note that the runners who ran six days a week did not experience injuries due to more training than the four days a week run participants (Dolgener, Kokhorst, & Whitsett, 1994). In contrast, Barandun et. al. (2012) say that they could not confirm finding an equation between training duration and marathon race time. The same researchers did, however, find a correlation between running speed during training sessions and race time.

A few other articles that focus on speed and intensity show that endurance athletes who were moderately trained and performed high intensity interval training (85-95% of Vo2max (maximal rate of oxygen consumption)) enhanced performance. The results also showed that the higher intensity training model helped enhance the performance of highly-trained endurance athletes (Laursen & Jenkins, 2002; Helgerud et. al., 2009; Iaia, Rampinini, & Bangsbo, 2009). While most of these studies are based on elite runners and show conflicting findings on frequency

duration and intensity of training for marathon runners there is still more research and findings that can be done to help determine what duration, frequency and intensity is best for non-elite marathoners.

Type of Exercise

There is much interest in cross-training for marathon runners. Cross-training can be a means for injury prevention but also for the improvement of overall fitness and health as well as the avoidance of boredom. Cross-training can be extremely helpful for marathon runners during extensive training periods to give their body a break from their normal routine and participate in another form of exercise to prevent injury as well as the possibility of improving running performance.

Voight, et. al., (2011) conducted research on non-elite Boston Marathon qualifying and non-qualifying runners and their participation in cross-training before the marathon, one month after and six months after the race. They found over half of participants surveyed participated in cross-training before the marathon. The number increased to 74% one month after race and remained steady at 71% six months after the race. The most common types of cross-training were biking and weightlifting.

Another example of cross-training is resistance training. Resistance training has been suggested to positively impact distance running performance by adding it to the aerobic training program already in place by the runners (Johnson, Quinn, Kertzer, & Vroman, 1997). One study emphasized heavy resistance training with the leg muscles for trained and untrained participants. The study showed improved performance in long-term and short-term endurance based off of time to exhaustion at 80% and 100% of VO2max (Hickson, Dvorak, Gorostiaga, Kurowski, & Foster, 1988).

Explosive training is an additional method of cross-training that has been shown to possibly enhance running performance Explosive training, or plyometric training, includes jumping exercises weighed or un-weighted. One research study looked at adding explosive exercise training to the training regimen of distance runners and found that the explosive training improved 5km running time as well as running economy (Paavolainen, Hakkinen, Hamalainen, Nummela, & Rusko, 1985). Another study looked at maximal, explosive and circuit training programs in endurance runners (Taipale et al., 2010). The runners were put through a 28-week study that focused on the leg extensors. The participants participated in 20-30 minutes of low-intensity endurance exercise before strength training. There was a preparatory phase that was 6 weeks long, an 8-week intervention phase and lastly a reduced volume strength-training phase that was 14 weeks. During the preparatory phase, the participants performed loads that were from 50-70% of 1RM (repetition max). During the intervention phase, participants were put into one of the three groups of maximal, explosive or circuit training groups. The maximal group preformed 3 sets of 4-6 repetitions at 80-85% 1RM of Smith machine squats and leg press. They also completed 2 sets of 12-15 repetitions at 50-60% 1RM of calf raises. The explosive group preformed 3 sets of 6 repetitions at 30-40% 1RM of explosive Smith machine squats and leg press. Next, the participants in the explosive group did 2-3 sets of 10-second scissor jump with 20kg load. Following that the explosive group preformed 2-3 sets of 5 maximal squat jumps and lastly 2-3 sets of 5 maximal squat jumps with 20kg load between jumps 4-8. The last group was the circuit training group. They completed 3 sets of 40-50 seconds of squats, push-ups, lunges, sit-ups, calf raises and back exercise. During this phase, strength training was to be performed twice a week and running was to be completed on other days. During the last phase, strength training was reduced to less than or equal to 1 session a week and endurance training was increased for marathon preparation. The results demonstrated that maximal and explosive strength training improved strength, power and maximal muscle activation through the

preparatory and intervention phases and the running velocity at VO2max and running economy improved significantly (Taipale et al., 2010).

Whether or not cross-training is improves running performance is controversial as the above studies have shown improvement with certain types of cross-training while others have shown no improvement of running performance with cross-training (Flynn et al., 1998). There are very few studies on other types of cross-training, such as biking and swimming, and its affect on marathon training and race performance.

Dietary Practices

Muscle glycogen is a key fuel for training and racing in a marathon. Sports nutrition guidelines recommend that runner consume proper carbohydrate intake to promote restoration of muscle glycogen between training sessions and after races (Burke, 2007a). Carbohydrate loading, or super compensating the muscle glycogen stores in preparation for prolonged exercise, resulted from studies in the late 1960s (Ahlyborg, Bergstrom, & Brohult, 1967). The original carbohydrate loading plan was a 7-day model. 3-4 days of hard training and low carbohydrate diet to deplete glycogen stores followed by 3-4 days of higher carbohydrate intake and exercise taper. A modified version was developed when well-trained runners were shown to over compensate their glycogen stores without severe depletion phase (Sherman, Costill, Fink, & Miller, 1981).

In chronic studies of diet and training interventions in well trained runners, higher carbohydrate intakes that allow greater glycogen recovery are associated with fewer symptoms of overtraining during high-volume periods and greater training adaptations (Burke, 2007b). In comparison, Holmich, et al. (1989) found in a study of 1426 running survey replies that 50% of runners used dietary manipulation to optimize performance. Seventeen percent used the classic high carbohydrate diet involving three days of low carbohydrate diet and intense exercise followed by three days of high carbohydrate diet without exercise. The other 33% used different

dietary methods but most followed a high carbohydrate diet a few days before a race without a depletion period. Atkinson, Taylor, Morgan, Ormond, and Wallis (2011) showed an improved response from carbohydrate intake the day before the race on race performance as opposed to looking at carbohydrate intake the week before. Their study showed that runners who ingested more than 7grams carbohydrate per kilogram of body mass during the day before the race, ran faster in general and also maintained their running speed to a greater extent than those participants who consumed lower quantities of carbohydrate.

Hydration dietary practices are very important for runners during training and competition for performance as well as safety purposes. However, there is not a consensus for hydration guidelines in the scientific community and the information different runners experience varies (Beltrami, Hew-Butler, & Noakes, 2008). Recent studies and position stands have placed the importance of hydrating before, during and after exercise to replace fluid loss and have promoted the addition of carbohydrates and electrolytes to fluids with prolonged exercise (generally exceeding an hour) and when large sweat losses are expected to occur (Swaka & Burke, 2007; Casa, Armstrong, & Hillman, 2000; Rodriquez, Dimarco, & Langley, 2009). There is also an opposing view by the International Marathon Medical Directors Association that suggests thirst be the main influence for fluid intake and deemphasizes the ingestion of sodium during endurance events (Hew-Butler, Verbalis, & Noakes, 2006).

Eating Disturbances Among Marathon Runners

Health professionals, more specifically ones who specialize in eating disorders, have been critical of runners and other types of endurance athletes for their practices and tendencies (Virnig & McLeod, 1996). One study found that the number of hours spent running positively correlated with exercising alone and eating disturbance attitudes (Richert & Hummers, 1986). This is especially an issue with marathon runners due to the hours that are required for training to

prepare the body to run a marathon. Another issue for runners is that they typically strive for a leaner physique for performance purposes and sometimes their attitudes about excess weight as well as food can be negative. In contrast, other endurance athletes such as triathletes, have to focus on three sports (swim, bike, run) and view a little more weight as valuable for buoyancy in swimming and strength and stamina in biking (Virnig & McLeod, 1996).

Summary

There are many studies conducted on elite marathoners and professional running athletes but studies on non-elite marathon runners are lacking. While the literature on frequency, duration, intensity, type and dietary practices is credible, it is minimal and conflicting or aged. My goal of this literature review was to review the information available and to collaborate with fellow researchers and create a survey for non-elite marathon runners to gather more information. With this study, the economy of amateur running can be bettered by assisting running coaches, personal trainers and runners themselves in gaining the knowledge to better marathon training and performance as well as the possibility of injury prevention.

CHAPTER III

METHODOLOGY

One hundred fifteen participants completed a university human subjects approved, web-based survey. The age of the participants was determined to be 37.20 ±12.34 with 58 of them being male and 57 female. The height and weight of the participants were 68.43 ±4.30 inches and 155.29 ± 29.26 pounds. The highest education achieved of the participants was acquired and found that the majority of the participants had a Graduate degree (49) or a Bachelor's degree (48). Twelve respondents had served or are serving in the United States Armed Forces.

Participant recruitment

Run Club Directors from Oklahoma, Texas and Arkansas were contacted and asked to forward an email with the web-based survey link and information to their running club members. Additionally, information about the study and the link to the survey were posted to various forms of social media. It was estimated that through various forms of social media, we reached approximately 15,000 possible respondents. However, due to the use of social media it was difficult to keep track of actual possible respondents reached, so a correct response rate could be calculated and therefore subject recruitment focused on total number of responses. This is similar to the Barefoot Running Survey: Evidence from the field who reported numbers instead of response rate (Hryvniak, Dicharry, & Wilder, 2014).

Survey content

A group of exercise scientists with experience and knowledge in marathon and cross training created the survey. Respondents to the survey provided their age, gender, height, weight, age when completed first marathon, fastest marathon time (Zillman et al., 2013), highest education achieved and if they had or were currently serving in the United States Armed Forces. Questions about previous running experience and how many years and months they had been running on a regular basis (3 or more days a week) and current training programs while training for both marathon and non-marathon were included (Zillman et al., 2013; Barandun et al., 2012). The following training program elements were assessed: number of running hours per week, running distance per week (Voight et al., 2011; Zillman et al., 2013; Barandum et al., 2012), and total mileage on different running surfaces (Treadmill, Trail/Offroad, Track, Concrete/Asphalt, other). All measures were determined for both marathon and non-marathon training times. To measure cross training, subjects were asked whether they included non-running activities during marathon and non-marathon training times. If the answer was "yes", then cross-training options were given (cycling, swimming, high intensity interval training, strength training or group exercise classes). The subjects were also asked how many hours a week they participated in cross-training activities (Voight et al., 2011). Additionally, they were asked if they had worked or are currently working with a Personal Trainer or Running Coach. If answered yes, respondents were asked how often the met or are meeting with a coach or trainer and also what percentage of their marathon training they met with coach or trainer. Respondents were also asked their motivation for contacting a Running Coach or Personal Trainer. To assess the percentage of where the runners obtained information related to marathon training a sliding scale percentage was given for various source options (internet, magazines, books, running store, word of mouth, running coach, fitness professional). The full survey can be shared by contacting the authors. Overall, validity of the survey was determined with a Cronbach's alpha of 0.63.

Statistical Analysis

Data from the survey was collected and entered into the SPSS 21.0 software for analysis. Means and standard deviations were calculated. Dependent variables were age during first marathon, fastest marathon time, years training, miles run a week during marathon training, miles run a week when not marathon training, hours ran per week during marathon training and hours ran per week when not marathon training. Independent variables were gender, cross-trained during marathon training, cross-trained when not marathon training, worked with a running coach and worked with a personal trainer. Multiple 1-way analyses of variance (ANOVAs) were performed for each dependent variable by each independent variable. An alpha level of .05 was utilized to determine significance.

CHAPTER IV

FINDINGS

The mean and standard deviation of the age during first marathon, fastest marathon time, years training, miles ran per week when marathon training, miles ran per week when not training, hour ran per week during marathon training, hours ran per week when not marathon training as well as the percent of time ran during marathon training and when not marathon training on different surfaces (Treadmill, Track, Off-road/Trail, Concrete, Other) can be found in Table 1. Frequencies demonstrated that the majority of respondents cross-trained while marathon training (89) with their primary choice of cross-training activity being cycling (60) and or strength training (59). The respondents also reported that 37 of them had worked with a running coach during their marathon training and 9 had worked with a personal trainer. The full frequency distribution can be found in Table 2. Participants who answered that they had worked with a running coach or personal trainer, were asked to identify their motivation for doing so. The majority responded with the motivation to increase their speed during marathon training and the marathon. Other motivational factors can be found in Table 3.

Various ANOVAs were performed to identify the differences within gender, cross-training and if the respondent worked with a run coach or trainer and compare it to their recorded survey results such as fastest time, years training, etc. Eight ANOVAs resulted in statistical significance. When making comparisons by gender, males ran faster than women ($F_{1,94}$= 25.25, P= .000) and ran more miles both while training for a marathon ($F_{1,111}$ = 6.11, P = .015) and when

not training for a marathon ($F_{1,109} = 5.54$, $P = .020$). When comparing the number of years training, ANOVA results also demonstrated that the more years a runner has trained, they are more likely to work with a running coach ($F_{1, 109} = 29.54$, $P = .000$), run more miles ($F_{1, 109} = 3.69$, $P = .057$) and train longer ($F_{1, 107} = 6.28$, $P = .014$) during marathon training. When not marathon training, those that have trained longer ran more miles ($F_{1, 107} = 5.30$, $P = .023$) and for longer ($F_{1, 106} = 8.66$, $P = .004$). The full ANOVA results are shown in Table 4.

Table 1

Descriptive Statistics for Survey Respondents (N=115)

Variable	N	Mean	Standard Deviation
Age when ran first marathon	115	37.20	12.34
Fastest marathon time (minutes)	96	247.34	51.48
Years training	113	7.79	9.18
Miles run per week during marathon training	113	38.01	14.48
Miles run per week when not training	111	25.19	13.14
Hours running per week during marathon training	111	7.40	4.41
Hours running per week when not training	109	5.80	5.93
% of time marathon training on treadmill	52	13.27	18.31
% of time marathon training on trail/off road	74	25.04	20.81
% of time marathon training on track	57	11.42	10.12
% of time marathon training on concrete	114	71.63	25.45
% of time marathon training on other	10	2.10	3.51
% of time running on treadmill when not training	39	19.79	18.28
% of time running on trail/off road when not training	70	28.79	21.80
% of time running on track when not training	39	16.13	15.38
% of time running on concrete when not training	110	69.47	27.31
% of time running on other when not training	6	4.17	8.01

Table 2

Frequency Analysis of Training Techniques

Variable	Column2	N
Cross-training while marathon training		
	Yes	89
	No	26
	Cycling	60
	Swimming	26
	High-intensity Interval Training (bootcamp, e	26
	Strength Training	59
	Group exercise classes (zumba, yoga, etc)	13
Cross-training when not marathon training		
	Yes	90
	No	25
	Cycling	29
	Swimming	7
	High-intensity Interval Training (bootcamp, e	16
	Strength Training	40
	Group exercise classes (zumba, yoga, etc)	8
Worked with a Running Coach during marathon training		
	Yes	32
	No	81
Worked with a Personal Trainer during marathon training		
	Yes	9
	No	103

Table 3

Motivation For Working With A Running Coach

Reason	N
New to running	7
Improve running form	4
Improve running speed	15
Improve accountability for run training	4
Coming back from an injury or injury prevention	3

Table 4

ANOVA Results

Dependent Variable	Independent Variable	Mean	SD	F	P
Age when completed first marathon	Male	33.39	10.24	F(1, 113) = .101	0.751
	Female	32.81	9.59		
Fastest marathon time (minutes)	Male	224.26	34.77	F(1, 94) = 25.25	0.000
	Female	271.40	55.25		
Years training	Male	8.54	11.13	F(1,111) = .775	0.380
	Female	7.02	6.65		
Miles ran per week during marathon training	Male	41.27	15.62	F(1, 111) = 6.11	0.015
	Female	34.69	12.49		
Miles ran per week when not training	Male	28.04	14.66	F(1, 109) = 5.54	0.020
	Female	22.29	10.75		
Hours ran per week during marathon training	Male	7.51	5.25	F(1, 109) = .071	0.791
	Female	7.29	3.44		
Hours ran per week when not training	Male	5.58	4.22	F(1,107) = .140	0.709
	Female	6.00	7.31		
Fastest marathon time (minutes)	Cross-training during marathon training (CTM) -Yes	246.78	53.85	F(1, 94) = .038	0.846
	CTM - No	249.23	43.63		
Years training	CTM - Yes	8.31	9.61	F(1, 111) = 1.308	0.255
	CTM - No	5.94	7.29		
Miles ran per week during marathon training	CTM - Yes	37.53	14.20	F(1, 111) = .436	0.510
	CTM - No	39.70	15.59		
Miles ran per week when not training	CTM - Yes	24.45	12.75	F(1, 109) = 1.233	0.269
	CTM - No	27.76	14.37		
Hours ran per week during marathon training	CTM - Yes	7.16	3.39	F(1, 109) = 1.127	0.291
	CTM - No	8.22	6.89		
Hours ran per week when not training	CTM - Yes	5.82	6.31	F(1, 107) = .010	0.922
	CTM - No	5.69	4.43		
Fastest marathon time (minutes)	Cross-training when not marathon training (CTNM) - Yes	247.92	54.33	F(1, 94) = .043	0.837
	CTMN - No	245.29	40.73		
Years training	CTMN - Yes	8.46	9.65	F(1, 111) = 2.246	0.137
	CTMN - No	5.31	6.76		
Miles ran per week during marathon training	CTMN - Yes	37.22	14.02	F(1, 111) = 1.250	0.266
	CTMN - No	40.94	16.03		
Miles ran per week when not training	CTMN - Yes	24.33	12.75	F(1, 109) = 1.760	0.187
	CTMN - No	28.33	14.29		
Hours ran per week during marathon training	CTMN - Yes	7.20	3.34	F(1, 109) = .851	0.358
	CTMN - No	8.15	7.23		
Hours ran per week when not training	CTMN - Yes	5.81	6.28	F(1, 107) = .002	0.961
	CTMN - No	5.74	4.50		
Fastest marathon time (minutes)	Worked with Running Coach during marathon training (RC) - Yes	236.38	49.84	F(1, 92) = 2.607	0.110
	RC - No	254.39	51.32		
Years training	RC - Yes	14.67	13.58	F(1, 109) = 29.54	0.000
	RC - No	5.21	4.84		
Miles ran per week during marathon training	RC - Yes	41.76	13.55	F(1, 109) = 3.691	0.057
	RC - No	36.07	14.16		
Miles ran per week when not training	RC - Yes	29.31	14.14	F(1, 107) = 5.308	0.023
	RC - No	23.16	11.61		
Hours ran per week during marathon training	RC - Yes	9.00	6.65	F(1, 107) = 6.283	0.014
	RC - No	6.70	2.95		
Hours ran per week when not training	RC - Yes	8.40	9.66	F(1, 106) = 8.662	0.004
	RC - No	4.76	3.23		
Fastest marathon time (minutes)	Worked with Personal Trainer during marathon training (PT) - Yes	246.13	71.62	F(1, 91) = .004	0.952
	PT - No	247.28	50.29		
Years training	PT - Yes	17.22	16.82	F(1, 108) = 10.81	0.001
	PT - No	7.07	7.89		
Miles ran per week during marathon training	PT - Yes	43.89	24.38	F(1, 108) = 1.752	0.188
	PT - No	37.23	13.36		
Miles ran per week when not training	PT - Yes	31.50	24.93	F(1, 106) = 2.014	0.159
	PT - No	24.60	11.99		
Hours ran per week during marathon training	PT - Yes	6.78	2.33	F(1, 107) = .172	0.679
	PT - No	7.42	4.57		
Hours ran per week when not training	PT - Yes	4.93	2.77	F(1, 104) = .172	0.679
	PT - No	5.86	6.20		

CHAPTER V

CONCLUSION

Discussion

Several studies have been conducted on marathon running but few focus on non-elite runners and their training programs. The average age range observed in this study was consistent with similar studies. This study's findings for average age were 37 with a range of 20-72. This is similar to the studies of Satterthwaite, Norton, Lamer, and Robinson (1999), where the average age being 38.6 with a range of 19-74 and the study of Fuller (2005), where the average age was 43.2 with a range of 13-71. The average Body Mass Index (BMI) of the survey participants was 22.9 which is lower than but still comparable to similar marathon studies of Voight et al., (2011) (BMI of 23.4), Barandun et al., (2012)(BMI of 23.4) and Zillman et al.,(2013)(BMI of 23.3). The body mass index found in this study is within the normal adult range of 18.5 to 24.9, which is to be expected with the amount of physical activity and training that it takes to prepare a runner to complete a marathon.

This survey's findings were similar to previous research studies that found that men typically run faster marathons than women, which is linked to a genetically higher Vo2max and body composition factors (Loftin et al., 2009). Results of this study also found that men ran more miles and trained longer each week during both marathon and non-marathon training than women. This increased mileage may be an additional contributor to faster marathon performance

as shown in this marathon study and previous research rather than just gender differences (Tanda, 2011; Schmid et al., 2012; Ferreira & Rolim, 2006). Average fastest running time of the respondents was approximately four hours which is comparable to prior research where the majority of non-elite respondents ran the marathon between four and five hours (Fuller, 2005).

Training surfaces for marathoners is not a topic that is well researched but with the majority of races being road races, concrete is generally the main surface for marathon runners for the purpose of specificity and training their body for the impact of 26.2 miles (Davis, 2012). This was verified in this survey as the respondents reported that they spent an average of 72% of the marathon training on concrete surfaces. Respondents reported their average time spent on other training surfaces with 25% training on trail, 13% on treadmill, 11% on track and 2% on other, with training surfaces when not marathon training followed similar trends.

Cross-training is another topic of controversy for overall running performance as some have shown that there is an improvement in running performance with the addition of cross-training (Johnson et al., (1997), while others have shown no effect (Flynn et al., 1998). However, cross-training during marathon training lacks research. In this study, 77% of respondents reported to have cross-trained while marathon training with cycling (52%) and strength training (51.3%) being the most prevalent. The respondents' participation in cross-training activities increased only slightly when not training (78%) with strength training (34.8%) being the activity most participated in followed by cycling (25%).

While our results showed that the majority of runners participated in some form of cross-training, we did not find any significance showing that cross-training improved running time or affected the miles ran or hours spent running during marathon and non-marathon training. An interesting finding from these results are the hours spent cross-training during and when not marathon training. While marathon training and when not training the majority of respondents

participated in one to four hours of cross-training per week (60% and 55%). When not marathon training the percentage of runners participating in five or more hours per week of cross-training increased from 8.7% to 17.4%. These results could mean that runners are participating in more cross-training activities when not marathon training for the potential benefits of a break from running, injury healing, injury prevention or to benefit running performance.

Minimal research exists on non-elite marathon runners working with personal trainers or running coaches during marathon training. In this study, 32 respondents reported working with a running coach and 9 with a personal trainer with the majority working with them once a week. The runners' main motivation for seeking out a running coach or trainer was to increase speed (13%) with the other reasons being new to running (6.1%), to improve running form (3.5%), to have accountability (3.5%) and to come back from or prevent an injury (2.6%). Interestingly, the runners who worked with a running coach or personal trainer had been training for more years than those who did not work with a coach or trainer. These runners may have plateaued in their running performance and realized that they have come as far as they can with their own training programs and they seek out professionals to work with to help them perform better. While the results show that runners who have worked with running coaches run more miles and run longer during marathon and non-marathon training, their running times were not faster than those who did not work with a running coach. These runners could be older runners, since they had trained for more years, and their times may be slower than the younger respondents to the survey but further research should look at just the runners who worked with coaches and see if their running times improved from before they had worked with a coach.

Limitations and Further Research

As with any study, limitations do exist. One such limitation is that the survey asked for participants' self-reported marathon training program and this could potentially lead to misreporting of actual time spent marathon and cross-training. Another limitation was that the researchers assumed that all participants were non-elite runners when, in theory, there was a possibility that a few may be elite runners who participated in running clubs, thus received the link to the survey. The survey also focused on miles ran and hours trained per week and did not ask the intensity as to which the runner trained during these miles and hours. This could be an area of focus for further research to see what is the pace or intensity as to which most non-elite runners train. Another weakness in the study was that the survey focused on cross-training as an added part to a marathon training program, yet did not ask the motivation for cross-training. Many runners may cross-train to recover from a running injury or to prevent injury during marathon training. The motivation for marathon runners to participate in cross-training could be an area for further research. Because of the controversy of whether cross-training improves running performance, it would be interesting to study the motivation for cross-training whether as injury prevention or a way to get back to normal marathon training from a running injury. Another possible area of future research could be whether those runners who work with a running coach have faster running times compared to runners who do not work with a coach. In the present study, the survey results revealed that the runners who worked with running coaches ran more miles and trained longer each week but they did not have faster race times than the runners who had not worked with a running coach. A future study could look at running times before working with a running coach and after to compare if each person's running time improved after beginning to work with the coach.

Conclusion

In summary, the purpose of this survey was to study the training programs of non-elite marathon runners. The study found that male runners ran faster marathon times, more miles and trained more hours than females. The majority of runners cross-trained during both marathon and non-marathon training with the main forms participated in being cycling and strength training. While the majority of runners cross-trained, the results did not find any improvement in marathon time or an effect on miles run or hours trained. Results revealed that a percentage of the runners worked with a running coach or personal trainer with the main motivation for seeking out these professionals being to increase running speed. The respondents who had worked with a running coach or trainer had trained for more years than those who did not work with a coach or trainer. The respondents who worked with a running coach trained longer each week and ran more miles than those who did not work with a coach, however, their fastest marathon times were not better than those who had not worked with a coach. While these findings may provide a better understanding of non-elite marathon runners and their training practices, further research should be conducted to even better understand this population. Further research could investigate cross-training during marathon training as well as the motivation for cross-training in marathon runners. In all, this study provided an overall view of the motivations and training practices of non-elite marathon runners.

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APPENDICES

APPENDIX A

IRB Approval Form

Oklahoma State University Institutional Review Board

Date:	Friday, December 20, 2013
IRB Application No	ED13200
Proposal Title:	Training Practices an Dietary Habits of Nonelite Marathon Runners
Reviewed and Processed as:	Exempt

Status Recommended by Reviewer(s): Approved Protocol Expires: 12/19/2016

Principal Investigator(s):

John Sellers
226 Hartford Street
Stillwater, OK 74078

Katherine Williams
101 CCR
Stillwater, OK 74078

Gena Wollenberg
1015 E Franklin
Stillwater, OK 74075

Douglas Smith
180 CRC
Stillwater, OK 74078

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

☒ The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval. Protocol modifications requiring approval may include changes to the title, PI, advisor, funding status or sponsor, subject population composition or size, recruitment, inclusion/exclusion criteria, research site, research procedures and consent/assent process or forms.
2. Submit a request for continuation if the study extends beyond the approval period of one calendar year. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of this research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Dawnett Watkins 219 Cordell North (phone: 405-744-5700, dawnett.watkins@okstate.edu).

Sincerely,

Shelia M. Kennison

Shelia Kennison, Chair
Institutional Review Board

APPENDIX B

Information Sheet

INFORMATION SHEET

for the research study on:

Training practices and dietary habits of non-elite marathon runners

The purpose of this research study is to investigate the marathon preparation practices among non-elite runners. The study will involve the completion of an online, anonymous survey through the use of Qualtrics. The hyperlink to the survey will be forwarded to the runners by their respective running club representatives. Questions will include topics including, but not limited to, the runners' demographic information, training strategies and programs, and dietary practices during marathon preparation.

Participation in this research study is completely voluntary and you may discontinue your participation at any time without penalty. This information sheet is yours to keep or discard at your discretion.

This research study has been approved by the Institutional Review Board at Oklahoma State University. If you would like to know more about the research please contact one of the Co-Principal Investigators, their contact information is listed below.

Sincerely,

John Sellers, MS, CSCS
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APPENDIX C

Letter to Running Club Directors

Dear Run Club Director,

My colleagues and I are currently investigating the training habits and dietary practices of non-elite marathon runners. We are doing so with the hope of gaining more insight in this area in order to assist the runners, registered dieticians, sport nutritionists, personal trainers, running coaches, and all health and wellness professionals who may have clients interested in participating in, or currently training for, marathons.

The study involves the completion of an anonymous online survey, which contains questions regarding demographic information, training strategies, and dietary practices during marathon preparation. Completion of the survey is both completely voluntary and anonymous as no identifiers will be used. With your approval of your club's participation, we would ask that you forward this email containing the hyperlink to the survey below to all club members. The survey should take approximately 15 – 20 minutes to complete and participants may discontinue their participation at any time. The link to the survey will remain open until December 31, 2014.

I have attached the Information Sheet for this study, which includes the specifics of the study, as well as the contact information of all principal investigators. This study has been approved by the Institutional Review Board at Oklahoma State University.

If you or any running club member have any questions regarding this study, please feel free to contact me at any time.

Thank you in advance for your time.

Sincerely,

Katherine "Bond" Williams, B.S., ACSM-HFS, CPT
Graduate Teaching/Research Assistant
Health & Human Performance Program
Oklahoma State University
197 Colvin Recreation Center
Stillwater, OK 74078
(405) 747-7464

APPENDIX D

Survey Questions

1. Please indicate your gender (male or female).
2. Please indicate your current age (in years).
3. Please indicate your height (in inches).
4. Please indicate your highest level of education achieved.
    a. High school diploma
    b. Some college
    c. Associate's Degree
    d. Bachelor's Degree
    e. Graduate Degree (MS, MA, or PhD)
5. Please indicate your age (in years) at the time you completed, or will complete, your first marathon.
6. Are your currently serving or have you previously served as a member of the United States Armed Forces?
    a. Yes
    b. No
7. Please indicate under which branch you are serving/served.
    a. U.S. Army
    b. U.S. Air Force
    c. U.S. Navy
    d. U.S. Marine Corps
    e. U.S. Coast Guard
    f. U.S. Army Reserve
    g. U.S. Air Force Reserve
    h. U.S. Navy Reserve
    i. U.S. Marine Corps Reserve
    j. U.S. Coast Guard Reserve
    k. Army National Guard
    l. Air National Guard
8. How many years and months have you been running on a regular basis (3 or more days per week)?
9. On average, how many miles per week do you run when training for a marathon?
10. On average, how many hours per week do you run when training for a marathon?
11. On average, how many miles per week do you run when not in training for a marathon?
12. On average, how many hours per week do you run when not in training for a marathon?
13. Please indicate the percentage (%) of the miles run when training for a marathon that you complete on each of the following surfaces.
    a. Treadmill
    b. Trail/Offroad
    c. Track
    d. Concrete/Asphalt
    e. Other

14. Please indicate the percentage (%) of the miles run when not training for a marathon that you complete on each of the following surfaces.
    a. Treadmill
    b. Trail/Offroad
    c. Track
    d. Concrete/Asphalt
    e. Other
15. Do you participate in any form of cross-training when training for a marathon?
    a. Yes
    b. No
16. Please indicate all forms of cross-training performed when training for a marathon.
    a. Cycling/Stationary biking
    b. Swimming
    c. Boot camp/Crossfit
    d. Strength training
    e. Group exercise class (i.e. Zumba, Kickboxing)
17. How many hours per week, on average, do you spend cross-training when training for a marathon?
18. Do you participate in any form of cross-training when not training for a marathon?
    a. Yes
    b. No
19. Please indicate all forms of cross-training performed when not training for a marathon.
    a. Cycling/Stationary biking
    b. Swimming
    c. Boot camp/Crossfit
    d. Strength training
    e. Group exercise class (i.e. Zumba, Kickboxing)
20. How many hours per week, on average, do you spend cross-training when not training for a marathon?
21. Have you ever worked, or are you currently working with, a running coach while training for a marathon?
    a. Yes
    b. No
22. Which of the following statements best describes your primary motivation for seeking the instruction of a running coach?
    a. I was new to running
    b. I wanted to improve my running technique
    c. I wanted to improve my running speed
    d. I wanted to improve my accountability
    e. I wanted assistance with a post-injury return to running
23. How often did you meet with your running coach?
    a. 1-2 times per month
    b. 3-4 times per month
    c. 1-2 times per week

d. 3-4 times per week
e. Other

24. As a percentage (%) of the time in months during your training, how long did you meet with your running coach?
    a. < 20%
    b. 21-40%
    c. 41-60%
    d. 61-80%
    e. > 80%
25. Have you ever worked, or are you currently working with, a personal trainer while training for a marathon?
    a. Yes
    b. No
26. How often did you meet with your personal trainer?
    a. 1-2 times per month
    b. 3-4 times per month
    c. 1-2 times per week
    d. 3-4 times per week
    e. Other
27. As a percentage (%) of the time in months during your training, how long did you meet with your personal trainer?
    a. < 20%
    b. 21-40%
    c. 41-60%
    d. 61-80%
    e. > 80%
28. Where do you get the majority of your marathon training information?
    a. Internet
    b. Magazines
    c. Books
    d. Running store
    e. Word of mouth
    f. Running Coach
    g. Fitness professional (CPT, CSCS)
29. Do you consume energy drinks? If so, how often?
    a. Daily
    b. Weekly
    c. Monthly
    d. More than one/day
30. Do you consume a multivitamin? If so, how often?
    a. Daily
    b. Weekly
    c. Monthly
    d. 2-3x/week

31. Do you consume any vitamin, mineral, or herbal supplements other than a multivitamin? If so, how often?
    a. Daily
    b. Weekly
    c. Monthly
    d. 2-3x/week
32. Do you take creatine? If so, how often?
    a. Daily
    b. Weekly
    c. Monthly
    d. 2-3x/week
33. Do you take whey protein? If so, how often?
    a. Daily
    b. Weekly
    c. Monthly
    d. 2-3x/week
34. Where do you get the majority of your nutrition information?
    a. Internet
    b. Magazines
    c. Books
    d. Myplate.gov
    e. Supplement store
    f. Word of mouth
    g. Medical professional (MD's, RD's)
35. During exercise, do you use energy supplements (ie: gu, gels, beans, etc.)? If so, what kind?
36. During exercise, do you use a sports drink? If so, what kind?
37. Have you changed your eating habits since you started your marathon training?
    a. Yes
    b. No
38. Have you changed your eating habits in the last 3-6 months?
    a. Yes
    b. No

Eating Attitudes Test (EAT-26)©

Instructions: This is a screening measure to help you determine whether you might have an eating disorder that needs professional attention. This screening measure is not designed to make a diagnosis of an eating disorder or take the place of a professional consultation. Please fill out the below form as accurately, honestly and completely as possible. There are no right or wrong answers. All of your responses are confidential.

Part A: Complete the following questions:

1) Birth Date	Month:		Day:		Year:		2) Gender:	Male	Female
3) Height	Feet :		Inches:					□	□
4) Current Weight (lbs.):			5) Highest Weight (excluding pregnancy):						
6) Lowest Adult Weight:			7: Ideal Weight:						

	Part B: Check a response for each of the following statements:	Always	Usually	Often	Some times	Rarely	Never
1.	Am terrified about being overweight.	□	□	□	□	□	□
2.	Avoid eating when I am hungry.	□	□	□	□	□	□
3.	Find myself preoccupied with food.	□	□	□	□	□	□
4.	Have gone on eating binges where I feel that I may not be able to stop.	□	□	□	□	□	□
5.	Cut my food into small pieces.	□	□	□	□	□	□
6.	Aware of the calorie content of foods that I eat.	□	□	□	□	□	□
7.	Particularly avoid food with a high carbohydrate content (i.e. bread, rice, potatoes, etc.)	□	□	□	□	□	□
8.	Feel that others would prefer if I ate more.	□	□	□	□	□	□
9.	Vomit after I have eaten.	□	□	□	□	□	□
10.	Feel extremely guilty after eating.	□	□	□	□	□	□
11.	Am preoccupied with a desire to be thinner.	□	□	□	□	□	□
12.	Think about burning up calories when I exercise.	□	□	□	□	□	□
13.	Other people think that I am too thin.	□	□	□	□	□	□
14.	Am preoccupied with the thought of having fat on my body.	□	□	□	□	□	□
15.	Take longer than others to eat my meals.	□	□	□	□	□	□
16.	Avoid foods with sugar in them.	□	□	□	□	□	□
17.	Eat diet foods.	□	□	□	□	□	□
18.	Feel that food controls my life.	□	□	□	□	□	□
19.	Display self-control around food.	□	□	□	□	□	□
20.	Feel that others pressure me to eat.	□	□	□	□	□	□
21.	Give too much time and thought to food.	□	□	□	□	□	□
22.	Feel uncomfortable after eating sweets.	□	□	□	□	□	□
23.	Engage in dieting behavior.	□	□	□	□	□	□
24.	Like my stomach to be empty.	□	□	□	□	□	□
25.	Have the impulse to vomit after meals.	□	□	□	□	□	□
26.	Enjoy trying new rich foods.	□	□	□	□	□	□

	Part C: Behavioral Questions: In the past 6 months have you:	Never	Once a month or less	2-3 times a month	Once a week	2-6 times a week	Once a day or more
A	Gone on eating binges where you feel that you may not be able to stop? *	□	□	□	□	□	□
B	Ever made yourself sick (vomited) to control your weight or shape?	□	□	□	□	□	□
C	Ever used laxatives, diet pills or diuretics (water pills) to control your weight or shape?	□	□	□	□	□	□
D	Exercised more than 60 minutes a day to lose or to control your weight?	□	□	□	□	□	□
E	Lost 20 pounds or more in the past 6 months	Yes □		No □			

* Defined as eating much more than most people would under the same circumstances and feeling that eating is out of control

VITA

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Jacobson,. H., Conchola, E., Sellers, J., **Williams, K**., Pope, Z. (2014). The influence of energy shots on power and velocity of a simulated forehand stroke utilizing medial rotation of the shoulder. 2014 National Strength and Conditioning Association Conference, Las Vegas, NV,July 2014.

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