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RESEARCH

How Aging Impacts Runners' Goals of Lifelong Running

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Running and jogging are listed as two of the most popular outdoor leisure activities for adults (The Outdoor Foundation 2017). Male and female adult runners attending a four-day workshop conducted by the authors from 2007–2018 indicated that learning how to be lifelong runners was their primary goal for attending the workshop. These recreational runners with an average age of 50 years, who attended one of the 20 workshops, were chosen for the study to see how successful they had been years later in pursuit of their goal of lifelong running and what changes in training and health they had incurred. The study surveyed workshop participants to examine their running frequency, injuries, body weight changes, and supplemental training as they aged. Among respondents there was no difference in the percentage who are still running with regard to age and sex. Comparisons of those runners 60 years old and over with those under 60 years of age were made to see if there were differences in how their running activities had changed over 10 years. Current runners 60 and older reported running "less frequently." There was no significant difference in running interruption due to injury in those 60 and over compared to those under 60. Two-thirds of the runners had a normal BMI classification in strong contrast to national norms. Nearly ninety percent were cross-training to supplement their running. These former workshop participants have been able to continue their favorite physical activity and enjoy running after the age of 60 and beyond.

Keywords: running; BMI; active aging; physical activity

Introduction

Runners show a slowing of training and racing paces with aging, generally beginning around 35 years of age, cross-sectional studies showed (Nikolaidis & Knechtle 2017; Fair 1994; Heath et al. 1981; Trappe et al. 1996). Aging begins to have a significant effect on participation in training and racing at age 55 (Pierce & Murr 2017).

In the United States, there is an obesity crisis. Are runners less likely to be a part of this epidemic? Engaging in physical activity is recommended in public health campaigns as a means to help Americans maintain healthy body weight and reduce the risk of chronic diseases (Tucker et al. 2011; Gremeaux et al. 2012; Bennett et al. 2009; Leitzmann et al. 2007; Haskell et al. 2007; Prohaska et al. 2006; Fulton et al. 2004; Conn et al. 2003; Rafferty et al. 2002). According to the National Center for Health Statistics (NCHS) from the Centers for Disease Control and Prevention (CDC), in 2016 the overall obesity rate, as defined by Body Mass Index (BMI) greater than 30, in the U.S. is 39.8% with another third of the population overweight (BMI ≥ 25.0) (Gamble et al. 2017). Forty-eight (48) states had a rate of obesity greater than 25%. (https://www.cdc.gov/nchs/data/hus/2017/053.pdf; https://www.cdc.gov/brfss/brfssprevalence/; Yun et al. 2006). Compared to the average American's tendency to become overweight or obese with aging, are runners who engage in vigorous physical activity three times per week or more able to maintain a "Healthy Weight" as they age?

Although running is a popular form of exercise, the major negative aspect of running often comes down to a single issue: injuries. The estimates for the percentage of runners who will sustain a running-related injury in a given year vary from 40 to 80 percent (Macera 1992; Pollock et al. 1977; Hootman et al. 2002;

Taunton et al. 2002; Marti et al. 1988). Injuries, whether running-related or not, often create an interruption or a setback in training that causes an individual to become reluctant to return to vigorous exercise for fear of another injury. To what extent do injuries contribute to runners' having to drop out of their preferred activity?

Cross-training, the inclusion of physical activity other than running, is considered a method for maintaining fitness while reducing the risk of running-related injuries. However, the scientific literature supporting this approach is limited. Mutton et al. (1993) did show that runners who alternated running and cycling performed equally as well as non-cross-training runners who ran in 1 mile and 5K events. The 2018 National Runner Survey (Running USA) reported that 27 percent of running respondents indicated they included cycling as a regular part of their training (https://runningusa.org/).

Runners frequently seek advice for improving running performance. However, few educational programs exist that assist age group runners with their lifelong pursuit for continued performance. The primary purpose of this study is to investigate the continued participation in regular physical activity for runners as they age. Furthermore, identifying the association of self-reported running and physical activity and musculoskeletal injury in a diverse group of non-elite runners will be examined. Finally, the study examines body mass changes over a 10-year period for these runners.

Running workshops

Since 2007, the authors have promoted running as a healthy life-long physical activity by conducting educational running workshops based on scientific principles. The workshops are designed for runners who wish to optimize their training, maximize their running performance, and minimize injuries. Over the past 12 years, 297 runners traveled from 40 states and 12 countries to attend one of the annual running workshops. Because the runners who attend the running workshops devote four days and several thousand dollars (travel, lodging, etc.) to further their knowledge about running and training, it is reasonable to describe them as dedicated and committed runners.

It is common for the runners who attended these workshops to list "running into old age" as their primary goal. In addition to their desire for lifelong running, they also indicate that weight management and race participation supply motivation for continuing to train. The running workshop is conducted to provide age-group runners with the information needed to maintain and improve their running performances and to enjoy life-long running.

The four-day running workshop provides physiological and biomechanical assessments for each participant. Runners complete a maximal oxygen consumption (VO_{2MAX}) and lactate threshold (LT) test along with an assessment of body composition (BodPod or DXA) and running gait. In addition to the extensive laboratory assessment, participants attend lectures on nutrition, strength training, cross-training, stretching for flexibility, injury prevention, good running form, smart racing strategies and designing an effective training plan. They also participate in activities with an instructor demonstrating proper form and technique. Each participant receives an individualized training plan following the completion of the workshop. The comprehensive nature of the running workshops is the most common reason given for the participants' decisions to attend the workshops.

This study was designed to determine if these dedicated runners, most between the ages of 50 and 75, are still running and whether their training and racing regimens changed as they aged. Have the runners who attended these running workshops defied the national trend in body weight changes? Have these workshop participants been able to avoid or cope with injuries in order to sustain their participation and continue running?

Methods

Participants and procedure

The subjects for the study included the past participants in one of the running workshops conducted by the authors from 2007–2018. Because they had shown to be dedicated, disciplined runners, the authors were curious to see how the runners had fared in achieving their running goals.

An online survey asking about running and racing frequency, injuries, body weight, and supplemental training was sent in an email message with a link to a Qualtrics survey to runners who had attended one of the four-day running workshops. Two follow-up reminder messages were sent in late 2018 and early 2019.

The 10-item survey required less than 10 minutes to complete. The study was approved by the university Institutional Review Board. Runners were assured confidentiality and that any publication of data would

include only aggregated data. The running workshop participants were asked to include their names on their survey responses so that their participation year and profile could be linked to their survey responses.

The survey asked whether the workshop participants were still running, how many times per week they were running, if they had lost training time due to injury, if they supplemented their running with cross-training, their annual racing participation, and their current body weight. The questions regarding the frequency of training runs and races asked not only about present frequency, but also about frequencies ten years ago.

The survey respondents who indicated they were no longer running were asked to indicate why they no longer were running. Those who were no longer running were asked if they had replaced running with cross-training and to indicate which activities they now participated.

Survey respondents were asked to report any injuries that caused them to miss more than two weeks of training runs. The injury inquiry asked runners to indicate how much training time was lost.

The respondents were asked to list their current weight on the survey. Because their weights were recorded at the workshop, a comparison could be made between their weight at the time of workshop attendance and their current body weight. For both their current weight and workshop weight, BMIs were calculated to determine the respective BMI classifications – "Underweight," "Healthy Weight," "Overweight," and "Obese." The participants' heights were recorded at the time of their workshop attendance.

Results

Descriptive statistics present the number and percentage of survey respondents, the survey respondents who are still running, the current and previous running and racing frequencies, the percentage of cross training modes chosen by runners, the number and percentage of runners with injuries that caused loss of training, and changes in BMI categories. When group means could be calculated t-tests were used. t-tests were used to determine if survey respondents were representative of all former workshop participants and if differences existed between former workshop participants under 60 years of age and those 60 and older for changes in training and racing frequencies. Chi-square analysis was used when survey responses were binary. This analysis was used to determine if there was a relationship between the age of workshop participants and those who are still running. The Chi-square analysis was also used to determine if there existed a relationship between age and running interruption due to injury.

Survey respondents

Of the 297 (164M, 133F) running workshop participants, surveys were sent to those with valid e-mail addresses. **Table 1** provides a summary of the survey response rate.

Table 2 presents demographic descriptions of all females who had attended a workshop and those who responded to the survey. Statistical comparisons using t-test for unequal sample and variance sizes of the two groups were performed to determine if the survey respondents were a representative sample of all workshop participants. It was determined that the female survey respondents were representative of all female workshop participants.

Table 1: Number and Percentage of Survey Respondents.

Participants	M	F	All
Surveyed	146	119	265
Respondents	106	79	185
Response Rate	72.6%	66.4%	69.8%

Table 2: Workshop Participants and Survey Respondents-Female Demographics.

Females	n	age (years)	height (cm)	weight (kg)	BMI	Body fat (%)	VO_{2MAX} (ml/kg/min)
Participants	133	46.4 ± 8.3	164.4 ± 6.3	60.8 ± 8.9	22.5 ± 2.7	26.0 ± 7.5	43.5 ± 6.4
Respondents	79	46.9 ± 7.6	164.7 ± 6.2	60.3 ± 8.3	22.5 ± 2.9	25.3 ± 7.2	44.2 ± 5.9
p value		$p = .67$			$p = .99$	$p = .54$	$p = .39$

Table 3 presents demographic descriptions of all males who had attended a workshop and those who responded to the survey. Statistical comparisons using t-test for unequal sample and variance sizes of the two groups were performed to determine if the survey respondents were a representative sample of all workshop participants. It was determined that the male survey respondents were representative of all male workshop participants.

Table 4 presents the number and percentage of respondents currently running by age group and gender.

Table 5 presents the Chi-square analysis used to determine if there were differences in running participation between males under and over age 60. The statistical comparison did not show any difference in the percentage of respondents still running by age group.

Table 6 presents the Chi-square analysis used to determine if there were differences in running participation between females under and over age 60. A statistical comparison did not show any difference in the percentage of respondents still running by age group.

Table 7 compares the average number of current training runs per week with the average number of training runs the respondents reported having run ten years ago.

In **Table 8**, t-test results show that male runners under 60 years of age did not report a significant reduction in running frequency. Those male respondents 60 years of age and older reported a significant reduction in the current number of weekly training runs compared with what they were doing ten years ago.

Table 3: Workshop Participants and Survey Respondents-Male Demographics.

Male	n	age (years)	height (cm)	weight (kg)	BMI	Body fat (%)	VO_{2MAX} (ml/kg/min)
Participants	164	50.5 ± 8.9	177.4 ± 7.0	77.9 ± 10.1	24.7 ± 2.9	20.6 ± 7.4	48.2 ± 7.2
Respondents	106	51.1 ± 8.9	177.2 ± 7.6	77.6 ± 10.3	24.6 ± 3.0	20.7 ± 7.5	47.6 ± 9.9
p value		*p* = .61			*p* = .91	*p* = .95	*p* = .78

Table 4: Survey Respondents Still Running by Age Group and Gender.

Age	All Respondents			Still Running			Percent Still Running		
	M	F	All	M	F	All	M	F	All
<60 yrs.	59	65	124	54	59	113	92%	91%	91%
≥60 yrs.	47	14	61	41	12	53	87%	86%	87%
All	106	79	185	95	71	166	90%	90%	90%

Table 5: Male Respondents Running Status by Age Group.

Age Group	Still Running	No Longer Running
<60 yrs.	54 (91.5%)	5 (8.5%)
≥60 yrs.	41 (87.2%)	6 (12.8%)

Note: X^2 (1) = .518 *p* = .47 Numbers in parentheses indicate row percentages.
* *p* < .05 There is no difference in the percentage of respondents still running related to age group.

Table 6: Female Respondents Running Status by Age Group.

Age Group	Still Running	No Longer Running
<60 yrs.	59 (90.8%)	6 (9.2%)
≥60 yrs.	12 (85.7%)	2 (14.3%)

Note: X^2 (1) = .323 *p* = .57 Numbers in parentheses indicate row percentages.
* *p* < .05 There is no difference in the percentage of female respondents still running related to age group.

In **Table 9**, t-test results show that female runners under 60 years of age did not report a significant reduction in running frequency. Those female respondents 60 years of age and older reported a significant reduction in the number of weekly training runs compared with what they were doing ten years ago.

Table 10 compares the average number of current annual races with the average number of annual races the respondents reported having raced ten years ago.

In **Table 11**, t-test results show that neither age group of male runners had a significant reduction in the number of current annual races compared to the number of annual races 10 years ago.

In **Table 12**, t-test results show that neither age group of female runners had a significant reduction in the number of current annual races compared to the number of annual races 10 years ago.

Table 7: Current vs. Previous Number of Weekly Runs by Age Group and Gender.

Age Group	Average Runs per Week Currently			Average Runs per Week 10 Years Ago		
	M	F	All	M	F	All
<60 yrs.	3.15	3.38	3.27	3.08	3.77	3.43
≥60 yrs.	2.80	2.92	2.82	3.45	4.08	3.60

Table 8: Average Weekly Running: Current vs. 10 years Ago by Age Group-Male.

Age Group	Average Current Weekly Runs	Average Weekly Runs 10 Years Earlier	*p* value
<60 yrs. (n = 52)	3.15 ± 1.43	3.08 ± 2.37	$p = .58$
*≥60 yrs. (n = 39)	2.80 ± 1.03	3.45 ± 1.87	$p = .03$

* $p < .05$ One-tailed t-test. The 60 or older age group has a significantly lower average number of runs. The less than 60 age group does not have a significantly lower average number of weekly runs.

Table 9: Average Weekly Running: Current vs. 10 years Ago by Age Group-Female.

Age Group	Average Current Weekly Runs	Average Weekly Runs 10 Years Earlier	*p* value
<60 yrs. (n = 53)	3.38 ± 1.18	3.77 ± 2.10	$p = .12$
*≥60 yrs. (n = 12)	2.92 ± 1.08	4.08 ± 1.62	$p = .03$

* $p < .05$ One-tailed t-test. The 60 or older age group has a significantly lower average number of runs. The less than 60 age group does not have a significantly lower average number of weekly runs.

Table 10: Current vs. Previous Annual Racing Frequency by Age Group and Gender.

Age Group	Average Races per Year Currently			Average Races per Year 10 Years Ago		
	M	F	All	M	F	All
<60 yrs.	4.54	4.19	4.36	3.92	5.58	4.76
≥60 yrs.	3.64	4.83	3.92	4.37	6.41	4.85

Table 11: Average Annual Races: Current vs. 10 years Ago by Age Group-Male.

Age Group	Average Current Annual Runs	Average Annual Runs 10 Years Earlier	*p* value
<60 yrs. (n = 52)	4.54 ± 5.29	3.92 ± 4.33	$p = .23$
*≥60 yrs. (n = 39)	3.64 ± 4.42	4.37 ± 4.08	$p = .74$

* $p < .05$ One-tailed t-test. Neither age group has a lower average number of annual races.

Table 13 indicates the percentage of respondents who reported that they supplement their running with cross-training. Overall, cross-training is reported by 88% of the runners, with males reporting cross-training at a rate of 91% and females at 85%. Runners could select more than mode of cross training. **Table 13** presents the cross-training modes most often chosen from a list of cross-training activities.

Table 14 presents a comparison of reported injuries by age group.

Table 15 presents the Chi-square analysis used to determine if there were differences in reported injuries between males under and over age 60. A statistical comparison did not show any difference by age group in the percentage of males who reported injuries.

Table 16 presents the Chi-square analysis used to determine if there were differences in reported injuries between females under and over age 60. A statistical comparison did not show any difference by age group in the percentage of females who reported injuries.

Table 17 presents the Chi-square analysis used to determine if there were differences in loss of training time due to injury between males under and over age 60. There was no difference in these training interruptions between these two groups when comparing running interruptions of three months or more with interruptions of less than three months.

Table 18 presents the Chi-square analysis used to determine if there were differences in loss of training time due to injury between females under and over age 60. There was no difference in these training

Table 12: Average Annual Races: Current vs. 10 years Ago by Age Group-Female.

Age Group	Average Current Annual Runs	Average Annual Runs 10 Years Earlier	*p* value
<60 yrs. (n = 53)	4.19 ± 4.40	5.58 ± 6.87	$p = .23$
*≥60 yrs. (n = 12)	4.83 ± 4.43	6.41 ± 5.90	$p = .11$

* $p < .05$ One-tailed t-test. Neither age group has a lower average number of annual races.

Table 13: Selected Modes of Cross-Training.

Cross-Training Modes	M	F	All
Cycling	71%	58%	66%
Swimming	30%	24%	28%
Rowing	33%	40%	36%
Cardio Machines	32%	31%	32%
Yoga	22%	45%	31%
Other	40%	57%	47%

Table 14: Injury by Age Group and Gender.

Age	Not Injured		Injured		% Injured	
	M	F	M	F	M	F
<60 yrs.	27	28	32	36	54%	56%
≥60 yrs.	14	5	33	9	70%	64%
All	41	33	65	45	61%	58%

Table 15: Injury by Age Group-Male.

Age Group	Not Injured	Injured
<60 yrs.	27 (45.8%)	32 (54.2%)
≥60 yrs.	14 (29.8%)	33 (70.2%)

Note: X^2 (1) = 2.815 $p = .09$ Numbers in parentheses indicate row percentages.
* $p < .05$ There is no statistically significant difference in the percentage of male injury by age group.

interruptions between these two groups when comparing running interruptions of three months or more with interruptions of less than three months.

Table 19 presents the BMI weight classification by age and gender for all of the runners who responded to the survey. More females were in the "Healthy Weight" classification than males. More males were classified as "Overweight" compared to females. None of the female respondents had a BMI weight classification of "Obese."

Table 20 presents the BMI weight classification changes for those survey respondents who at the time of the workshop had a BMI in the "Healthy Weight" or "Underweight" classification. More than 90% of those in the "Healthy Weight" or "Underweight" classifications at the time of the workshop did not have a weight change that moved them to another BMI weight classification. No statistical analysis of the change in BMI classifications was made due to the small number that changed categories.

Table 21 presents the BMI weight classification changes for those survey respondents who at the time of the running workshop had a BMI in the "Overweight" or "Obese" classification. Positive changes in BMI

Table 16: Injury by Age Group-Female.

Age Group	Not Injured	Injured
<60 yrs.	28 (43.8%)	36 (56.2%)
≥60 yrs.	5 (35.7%)	9 (64.3%)

Note: X^2 (1) = .304 p = .58 Numbers in parentheses indicate row percentages.
* $p < .05$ There is no statistically significant difference in the percentage of female injury by age group.

Table 17: Injury Interruption by Age Group-Male.

Age Group	None or Less than 3 Months	3 Months or More
<60 yrs.	38 (64.4%)	21 (35.6%)
≥60 yrs.	28 (59.6%)	19 (40.4%)

Note: X^2 (1) = .260 p = .61 Numbers in parentheses indicate row percentages.
* $p < .05$ There is no difference in the percentage of male injury duration interruptions related to age group.

Table 18: Injury Interruption by Age Group-Female.

Age Group	None or Less than 3 Months	3 Months or More
<60 yrs.	42 (65.6%)	22 (34.4%)
≥60 yrs.	7 (50.0%)	7 (50.0%)

Note: X^2 (1) = 1.20 p =.27 Numbers in parentheses indicate row percentages.
* $p < .05$ There is no difference in the percentage of female injury duration interruptions related to age group.

Table 19: Current BMI Classification for Survey Respondents by Age Group and Gender.

Age Group	Underweight (<18.5)		Healthy (18.5–24.9)		Overweight (25.0–29.9)		Obese (≥30.0)	
	M	F	M	F	M	F	M	F
<60 yrs.	0%	6.7%	54.2%	80.0%	33.9%	13.3%	11.9%	0%
≥60 yrs.	2.1%	7.1%	61.7%	85.7%	27.7%	7.1%	8.5%	0%

Table 20: Healthy Weight or Underweight Runners Who Changed Classifications.

Age Group	Underweight To Healthy		Healthy to Underweight		Healthy to Overweight		Healthy to Obese	
	M	F	M	F	M	F	M	F
<60 yrs.	0%	1.7%	0%	1.7%	1.7%	5.0%	1.7%	0%
≥60 yrs.	0%	1.7%	2.1%	1.7%	2.1%	0%	0%	0%

Table 21: Overweight or Obese Runners Who Changed Classification.

Age Group	Overweight To Healthy		Overweight to Obese		Obese to Overweight	
	M	F	M	F	M	F
<60 yrs.	3.3%	6.7%	5.1%	0%	1.7%	1.7%
≥60 yrs.	12.8%	0%	8.5%	0%	2.1%	0%

classification were made by the participants who moved from a classification of "Overweight" to "Healthy Weight" and those who moved from a classification of "Obese" to "Overweight." Due to weight gain, there were males who moved from a classification of "Overweight" to "Obese."

Discussion

This study was designed to determine if these dedicated runners, primarily between the ages of 50 and 75, are still running and whether their training and racing regimens changed as they aged. In particular, have the runners 60 years and older maintained similar running habits to those runners under 60 years of age. Have the runners who attended these running workshops defied the national trend in body weight changes? Have these workshop participants been able to avoid or cope with injuries in order to sustain their participation and continue running?

Most runners who attended an educational running workshop are still running. The runners who attended the workshops are not elite runners, but they are committed to remaining physically active. The ten percent who are no longer running in most cases experienced an injury that prevented them from continuing to run. Most of those no longer running continue to be physically active with aerobic cross-training and other modes of physical activity.

Because runners report that one of the effects of aging is a need for more recovery time, it was not surprising that those survey respondents over 60 years of age reported that they ran less frequently per week. Runners under 60 years of age did not report a significant difference in the number of runs per week from what they did ten years earlier.

While male runners over 60 report fewer races per year currently versus 10 years earlier, the reduction is not significant. The same is true for females. Only males under the age of 60 report more frequent racing currently than they did 10 years earlier, but the increase is not significant. Again, these veteran workshop runners demonstrate a consistency in running habits over time.

Because cross-training is highly recommended to workshop participants, it is not surprising that 88% of those surveyed reported supplementing their running with cross-training. At the workshops, runners participate in a session where they are taught to cross-train on exercise cycles and rowing ergometers. They also receive instruction on how to structure a swim workout.

It is difficult to know if these veterans of these educational workshops are injured at a rate different from the rates reported in national studies. Because rates from 40 to 80 percent are found in the literature (Macera 1992; Pollock et al. 1977; Hootman et al. 2002; Taunton et al. 2002; Marti et al. 1988), the 60% rate of injury reported by the survey respondents seems consistent with that reported in other. The rate of injury was similar for males (61%) and females (58%). Most were able to continue running after time off for recovery. Runners in their 60s were no more likely to miss more than three months of running due to injury than runners under 60 years old.

At the workshops, runners are provided with an in-depth gait analysis and a one-on-one session with a physical therapist. Because muscular weaknesses and flexibility restrictions increase the risk of an injury, the physical therapist provided the runners with recommendations for strength exercises and stretches. Continued efforts need to be made by running coaches and researchers to develop recommendations and instruction for how running-related injuries can be minimized.

Often runners report that they run so they can eat what they want. They commonly report that they run to manage their weight. At the workshops, runners have their body composition assessed. Often, runners are shocked that their body fat percentage is as high as it is. This might be because compared to the general public these runners are relatively thin. Given the American rates of obesity and overweight, simple comparisons with the general public are not necessarily good indicators of healthy weights.

In general, runners are dedicated and disciplined. They train year-round in all types of weather and devote much time to their sport. They are aware that running performance is influenced by body weight. They also

report that their running goals are of great importance, important enough that they are willing to spend several thousand dollars and five days of their time to attend a running workshop so that they can get faster. Often, all that is holding them back is their excess body mass.

The survey results from this study illustrate the positive influence running has on weight management for these dedicated runners. Compared to 39.8% of the general public's being obese, the 6.1% obesity rate of the dedicated runners is a strong testament to the value of running as a healthy behavior. Similarly, comparisons of those respondents with healthy weights to that of the general public are another endorsement of running as a beneficial physical activity. On the other hand, the 31% rate of male survey respondents classified as overweight is perplexing, given their goals and dedication to physical activity. The difficulty that even dedicated runners have in maintaining healthy and performance-enhancing body weight illustrates the challenge presented by the cultural and environmental influences that contribute to excessive caloric intake.

This study examined the running-related behaviors of runners who attended a workshop to understand the science of running, to improve their running and to seek advice on how to minimize injuries. It is not the intention of this study to suggest attendance at the workshops has led to the runners' continued participation in their favorite recreational activity. This population of former workshop attendees was selected because 1) their attendance at the workshops verified their strong interest in running and desire to continue running for a lifetime and 2) data from their attendance at one of these workshops over a 12-year period provided an opportunity to study any changes in their running and racing frequencies, injuries, and body compositions. A survey response rate of 70% provides a good portrayal of this group of runners years later.

The majority of these dedicated and committed runners are still running. Reducing the frequency of training and racing, maintaining a healthy weight, supplementing fitness with cross training, and injury prevention are common characteristics of the survey respondents who are still running. By their having avoided the major factors leading to becoming running drop-outs – activity-restricting weight gain and serious injury – these aging runners have been able to continue their favorite leisure time activity.

The study was limited to non-elite, dedicated runners who had attended a four-day educational workshop over the past 12 years. The purpose of the study was to examine the physical activity behaviors of these workshop participants as they age. The results of the study cannot be generalized to the general running population. As with all self-reported survey data, the information is only as accurate as the respondents' reports.

Conclusions and Future Direction

This descriptive study of a select group of runners, who have maintained after the age of 50 their participation in vigorous physical activity for up to 12 years, well into their 60s and 70s, indicates the positive aspects of engaging in running as a serious recreational activity. The authors will continue to follow these runners as they continue to age to learn more about what factors are critical to life-long participation.

Future studies of runners – casual, as well as dedicated – are needed to determine the long-term effects of running on aging and the likelihood of maintaining a regular physical activity training regimen and a healthy body weight.

Additional File

The additional file for this article can be found as follows:

- **Summary of Survey Data.** Survey Data for Reproducibility. DOI: https://doi.org/10.5334/paah.42.s1

Competing Interests

The authors have no competing interests to declare.

References

2018 National Runner Survey. (2019). Retrieved from https://runningusa.org/

Bennett, G. G., Wolin, K. Y., Puleo, E. M., Mâsse, L. C., & **Atienza, A. A.** (2009). Awareness of national physical activity recommendations for health promotion among US adults. *Medicine and Science in Sports and Exercise*, *41*(10), 1849. DOI: https://doi.org/10.1249/MSS.0b013e3181a52100

Conn, V. S., Minor, M. A., Burks, K. J., Rantz, M. J., & **Pomeroy, S. H.** (2003). Integrative review of physical activity intervention research with aging adults. *Journal of the American Geriatrics Society*, *51*(8), 1159–1168. DOI: https://doi.org/10.1046/j.1532-5415.2003.51365.x

Fair, R. (1994). How fast do old men slow down? *Review of Economics and Statistics*, *76*(1), 103–118. DOI: https://doi.org/10.3386/w3757

Forty-eight (48) states had a rate of obesity greater than 25%. National Center for Chronic Disease Prevention and Health Promotion, Division of Population Health. BRFSS Prevalence & Trends Data. 2015. Retrieved from https://www.cdc.gov/brfss/brfssprevalence/

Forty-eight (48) states had a rate of obesity greater than 25%. Retrieved from https://www.cdc.gov/nchs/data/hus/2017/053.pdf

Fulton, J. E., Garg, M., Galuska, D. A., Rattay, K. T., & **Caspersen, C. J.** (2004). Public health and clinical recommendations for physical activity and physical fitness. *Sports Medicine*, *34*(9), 581–599. DOI: https://doi.org/10.2165/00007256-200434090-00003

Gamble, S., Mawokomatanda, T., Xu, F., Chowdhury, P. P., Pierannunzi, C., Flegel, D., & **Town, M.** (2017). Surveillance for certain health behaviors and conditions among states and selected local areas-behavioral risk factor surveillance system, United States, 2013 and 2014. *Morbidity and Mortality Weekly Report. Surveillance Summaries (Washington, DC: 2002)*, *66*(16), 1–144. DOI: https://doi.org/10.15585/mmwr.ss6616a1

Gremeaux, V., Gayda, M., Lepers, R., Sosner, P., Juneau, M., & **Nigam, A.** (2012). Exercise and longevity. *Maturitas*, *73*(4), 312–317. DOI: https://doi.org/10.1016/j.maturitas.2012.09.012

Haskell, W. L., Lee, I. M., Pate, R. R., Powell, K. E., Blair, S. N., Franklin, B. A., & **Bauman, A.** (2007). Physical activity and public health: Updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation*, *116*(9), 1081. DOI: https://doi.org/10.1249/mss.0b013e3180616b27

Heath, G., Hagberg, J. Ehsani, A., & **Holloszy, J.** (1981). A physiological comparison of young and older endurance athletes. *Journal of Applied Physiology*, *51*(3), 634–640. DOI: https://doi.org/10.1152/jappl.1981.51.3.634

Hootman, J., Macera, C., Ainsworth, B., Martin, M., Addy, C., & **Blair, S.** (2002). Predictors of lower extremity injury among recreationally active adults. *Clinical Journal of Sport Medicine*, *12*(2), 99–106. DOI: https://doi.org/10.1097/00042752-200203000-00006

Leitzmann, M. F., Park, Y., Blair, A., Ballard-Barbash, R., Mouw, T., Hollenbeck, A. R., & **Schatzkin, A.** (2007). Physical activity recommendations and decreased risk of mortality. *Archives of Internal Medicine*, *167*(22), 2453–2460. DOI: https://doi.org/10.1001/archinte.167.22.2453

Macera, C. A. (1992). Lower extremity injuries in runners. *Sports Medicine*, *13*(1), 50–57. DOI: https://doi.org/10.2165/00007256-199213010-00005

Marti, B., Vader, J. P., Minder, C. E., & **Abelin, T.** (1988). On the epidemiology of running injuries: The 1984 Bern Grand-Prix study. *The American Journal of Sports Medicine*, *16*(3), 285–294. DOI: https://doi.org/10.1177/036354658801600316

Mutton, D., Loy, S., Rogers, D., Holland, G., Vincent, W., & **Heng, M.** (1993). Effect of run vs combined cycle/run training on VO2max and running performance. *Medicine and Science in Sports and Exercise*, *25*(12), 1393–1397. DOI: https://doi.org/10.1249/00005768-199312000-00013

Nikolaidis, P., & **Knechtle, B.** (2017). Effect of age and performance on pacing of marathon runners. *Open Access Journal of Sports Medicine*, *8*, 171–180. DOI: https://doi.org/10.2147/OAJSM.S141649

Pierce, B., & **Murr, S.** (2017). *Train smart, run forever*. New York, NY: Rodale.

Pollock, M., Gettman, L., Milesis, C., Bah, M., Durstine, L., & **Johnson, R.** (1977). Effects of frequency and duration of training on attrition and incidence of injury. *Medicine and Science in Sports*, *9*(1), 31–36. PMID: 870782. DOI: https://doi.org/10.1249/00005768-197721000-00005

Prohaska, T., Belansky, E., Belza, B., Buchner, D., Marshall, V., McTigue, K., & **Wilcox, S.** (2006). Physical activity, public health, and aging: Critical issues and research priorities. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *61*(5), S267–S273. DOI: https://doi.org/10.1093/geronb/61.5.S267

Rafferty, A. P., Reeves, M. J., Mcgee, H. B., & **Pivarnik, J. M.** (2002). Physical activity patterns among walkers and compliance with public health recommendations. *Medicine and Science in Sports and Exercise*, *34*(8), 1255–1261. DOI: https://doi.org/10.1097/00005768-200208000-00005

Taunton, J. E., Ryan, M. B., Clement, D. B., McKenzie, D. C., Lloyd-Smith, D. R., & **Zumbo, B. D.** (2002). A retrospective case-control analysis of 2002 running injuries. *British Journal of Sports Medicine*, *36*(2), 95–101. DOI: https://doi.org/10.1136/bjsm.36.2.95

The Outdoor Foundation. (2017). 2017 Outdoor Participation Report. Washington, DC.

Trappe, S., Costill, D., Vukovich, M., Jones, J., & **Melham, T.** (1996). Aging among elite distance runners: A 22-yr longitudinal study. *Journal of Applied Physiology*, *80*(1), 285–290. DOI: https://doi.org/10.1152/jappl.1996.80.1.285

Tucker, J. M., Welk, G. J., & **Beyler, N. K.** (2011). Physical activity in US adults: Compliance with the physical activity guidelines for Americans. *American Journal of Preventive Medicine*, *40*(4), 454–461. DOI: https://doi.org/10.1016/j.amepre.2010.12.016

Yun, S., Zhu, B. P., Black, W., & **Brownson, R. C.** (2006). A comparison of national estimates of obesity prevalence from the behavioral risk factor surveillance system and the National Health and Nutrition Examination Survey. *International Journal of Obesity*, *30*(1), 164. DOI: https://doi.org/10.1038/sj.ijo.0803125

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