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Strength and conditioning habits of Polish amateur endurance runners

Zbigniew Jost
Department of Biochemistry; Gdansk University of Physical Education and Sport, zbigniew.jost@awf.gda.pl

Maciej Chroboczek
Department of Physiology, Gdansk University of Physical Education and Sport in Gdansk, Poland, maciej.chroboczek@awf.gda.pl

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Abstract

Introduction: Correctly performed Strength & Conditioning (S&C) training is important in terms of improving sports performance. This survey was to check S&C habits among amateur runners in Poland. Materials and Methods: The questionnaire dealt with 1) personal and anthropometric data, 2) advancement / fitness level and 3) training habits, which was correctly filled in by 923 people. The participants were matched to five fitness levels (LG1–LG5) depending on sex (W/M) and the selected distance (5K/10K/Half-Marathon). Results: More than half of the respondents (n = 467, 50.6%) considered S&C as very important. The most frequently used S&C activities were uphill runs (n = 608, 65.9%) and bodyweight exercises (n = 596, 64.6%). Some of respondents (n = 418, 45.3% and n = 152, 16.5%) performed resistance training (RT) and plyometric training (PT), respectively. Runners with a higher level of advancement (LG5) performed S&C twice a week ($p \leq 0.05$), while athletes from less advanced groups (LG1, LG2) showed a tendency to perform once a week ($p = 0.192$, $p = 0.317$), respectively. The respondents also more often chose a low range of repetitions when performing S&C. Conclusions: It is known that the performed S&C should be based on existing scientific evidence. Thus, coaches and practitioners should consider the usefulness of certain activities in the context of implementing them in their athletes' training plans.

Keywords

long-distance performance, bodyweight exercises, strength training, athletes

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Article

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Zbigniew JOST[1]*, Maciej CHROBOCZEK[2]

[1] Department of Biochemistry, Gdansk University of Physical Education and Sport, Gdansk, Poland; ORCID 0000-0001-9897-437X
[2] Department of Physiology, Gdansk University of Physical Education and Sport, Gdansk, Poland; ORCID 0000-0002-8491-4525

* Correspondence: Zbigniew Jost, e-mail: zbigniew.jost@awf.gda.pl

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Keywords: strength, conditioning habits, endurance, runners.

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1. Introduction

According to research on physical activity [1,2], a growing number of people engage in running training due to its simplicity and its availability at any age [3,4]. Undoubtedly, endurance training is key to achieving better results in long-distance events from 5K to marathon. Preparation under the supervision of a professional can be expensive, so websites offering running training programs "intended" for runners-amateurs (novice runners) who become athletes and coaches for themselves come to the rescue. As it turns out, 38.7% of amateur runners in Spain do not cooperate with a coach who is inherently responsible for deciding the correct training loads [5], so it is not sure if the athlete selects the appropriate training methods for their training regimen.

For many years, coaches, practitioners, and researchers have been looking for methods and/or the "golden standard" to increase the sports level of athletes to achieve the top form at the target competition. However, to this day, no optimal and universal path has been found for every athlete to reach the goal. It is known that endurance training is mainly based on types of running training sessions, such as easy runs, tempo runs, and short/long interval runs [6]. However, it is worth noticing that increasingly more attention is paid to strength and conditioning activities that increase the runners' exercise capacity, but are not strictly endurance training, such as, e.g., strength training (ST).

Many authors emphasize the importance of incorporating ST into the routine of an endurance runner [7]. A properly made ST will contribute to the improvement of the running economy (RE) [8–10], which is defined as the minimum amount of oxygen required to achieve submaximal running speed [11]. The key components include, among others, frequency, exercise selection and the type of ST (in terms of intensity or the nature of the musculoskeletal system loading). The above-mentioned elements could play a key role in the context of adaptive changes favoring long-distance athletes. At the turn of the 20th and 21st centuries, concurrent training tests (combination of endurance and strength training) were started to demonstrate the improvement in runners' exercise capacity. Hence, it is known that resistance training (RT) and plyometric training (PT) can improve runners exercise capacity by increasing musculotendinous stiffness (MTS) [12], neuromuscular activation [13] and muscle fibers type IIa recruitment [14].

Nevertheless, the above evidence is mainly based (with exceptions) on studies of intermediate to well-trained athletes. As previously noted [5], amateur runners or non-competitive endurance runners were not included, thus excluding an exceptionally high proportion of runners. The performance enhancing treatments mentioned above may not be the only ones. Hence, the aim of this study is to evaluate the general characteristics/habits of Polish endurance runners and whether they are correlated with the current knowledge about S&C training of runners.

2. Materials and methods

2.1. Experimental approach to the problem and subjects

A survey data from 1,008 Polish distance runners was collected. Due to insufficient data, 85 of them were excluded leaving a sample of 923 correctly filled questionnaires. All runners met the following inclusion criteria: 1) >18 years old, 2) were performing running training for more than last 6 months (as of the 2nd half of 2020). Additionally, any chronic disease (i.e., asthma, diabetes mellitus, chronic syndrome fatigue) was not an exclusion criterion and did not affect the study results. This study was conducted according to the guidelines of the Declaration of Helsinki (2013). All subjects were assured of the survey's voluntary nature and their ability to withdraw from the survey at any time.

2.2. Procedures

This study was a cross-sectional survey study of Polish long-distance runners' training habits who performed from 5K to a half-marathon race. The first step was to create a survey to investigate training habits among the target group. For this purpose, 30 subjects were questioned as a pilot-sample group. After receiving feedback on the survey's strengths and weaknesses, researchers made some minor adjustments and created the final version. Afterwards, questionnaires were distributed via Google Forms and via social networking sites like Facebook, Instagram, etc. (The survey is available after contacting the first author).

In García-Pinillos's study [5], participants were required to answer a question that was slightly modified to include the strength and conditioning habits performed in the last six months and were divided according to:

1) personal and anthropometric data (gender, age, region of origin, body weight, height);
2) preferable distance and sports level in the last 6 months;
3) questions about running habits in the last 6 months including distance covered per week (e.g., 36–45km and time spent on running e.g., 3–4h); perceived importance of S&C (through Likert-type scale, 1–3 rating, in which 1 means "S&C is perceived as not important" and 3 means "S&C is perceived as very important" in their training regimens); S&C sessions per week (ranging from 0 to >7 in their week program); duration (0 to >90 minutes per session); type ("none", "bodyweight exercises", "uphill/downhill runs", "skips", "resistance training",

"plyometric training"); timing of S&C sessions ("no S&C sessions", "just before running exercises, same day", "just after running exercises, same day", "same day, but at least 4–5 h between running and S&C", "every two days until running sessions", and/or "alternating days to running workouts"); and the range of repetitions per set ("no S&C sessions", "≤3","4–5","6–10","11–15", "16–20", ">20").

To assess the impact/correlation between strength training and fitness level as accurately as possible, the groups were divided in terms of personal records (PR) at distances from 5000m/5K to the half marathon and are presented in Table 1.

Table 1. Sports levels according to sexes and distance.

	5000m/5K (min: sec)		10000m/10K (min)		Half Marathon (h: min)	
Level	M	W	M	W	M	W
LG1	>25:00	>27:30	>55	>60	>2:00	>2:10
LG2	22:30–25:00	25:00–27:30	50–55	55–60	1:50–2:00	2:00–2:10
LG3	20:00–22:30	22:30–25:00	45–50	50–55	1:40–1:50	1:50–2:00
LG4	17:30–20:00	20:00–22:30	40–45	45–50	1:30–1:40	1:40–1:50
LG5	<17:30	<20:00	<40	<45	<1:30	<1:40

2.3. Statistical analysis

Descriptive data on the participants' mean age are presented as the counts and percentages for the group compartment. Descriptive data is given as counts, percentages, and frequencies for nominal variables. To analyze between-group differences among athletic levels, a chi-squared test was conducted, and we obtained the following data: Pearson chi^2 = 31.855a, df = 16, p = 0.010 concerning S&C per week, and Pearson chi^2 = 36.320a, df = 20, p = 0.014 regarding the range of repetitions. In order to compare the observed and predicted values, we further analyzed the obtained adjusted residual by applying the right-sided probability function of the chi-square distribution and represented the value in the text as a p-value. Statistical analyses were performed using the software IBM SPSS Statistics, version 26.0 (IBM Inc., Armonk, NY, USA). Statistical significance was set at $p < 0.05$.

3. Results

923 athletes participated in the cross-sectional survey, of which 488 (52.9%) were women and 435 (47.1%) were men. The participants' age considerably varied and was as follows: 259 (28.1%) aged 18–29; 370 (40.1%) in the range of 30–39 years; 234 (25.4%) in the range of 40–49 years of age, 55 (6%) in the range of 50–59 years of age and 5 (0.5%) of participants over 60 years of age. Among these athletes, 26 (2.8%) considered S&C as not important, 430 (46.6%) considered as moderately important and 467 (50.6%) considered as very important.

Moving on to the data that directly characterized the athletes in terms of their habits, the majority, i.e. 711 (77%), use more than one strength training activity, while 140 (15.2%) subjects use one strength training activity, and only 72 (7.8%) athletes do not use strength training activities in their training regimen. Additionally, athletes perform strength physical activity on average 1.85 ± 0.25 times a week. These data are crucial in the context of S&C activities, timing, and duration of S&C sessions as well as the range of repetitions, which are presented below in Figures 1–4.

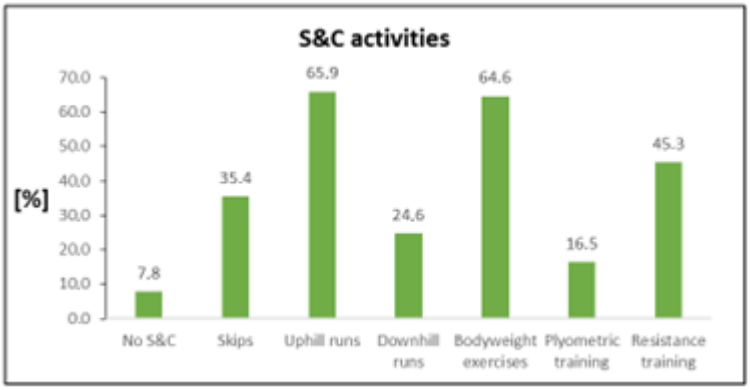

Figure 1. Strength and conditioning activities used by Polish amateur endurance athletes [%].

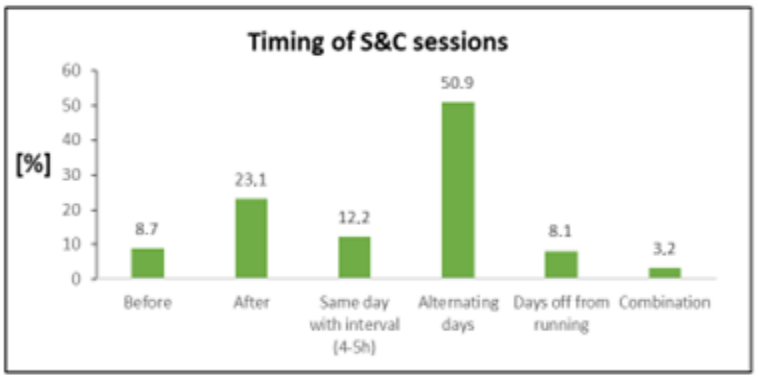

Figure 2. Timing of strength and conditioning sessions in relation to running sessions of Polish amateur endurance athlete.

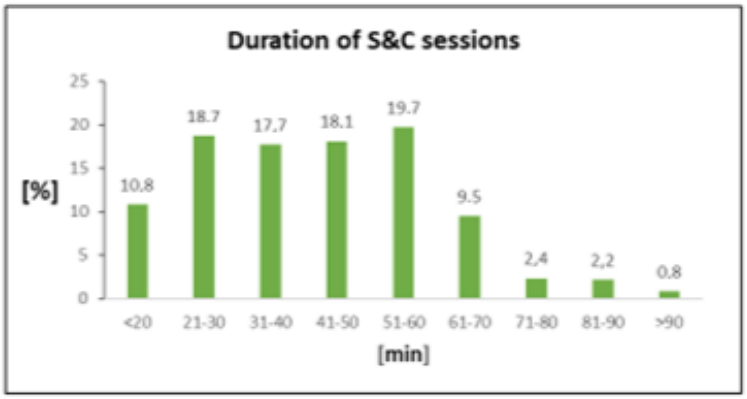

Figure 3. Duration of strength and conditioning sessions of Polish amateur endurance athletes.

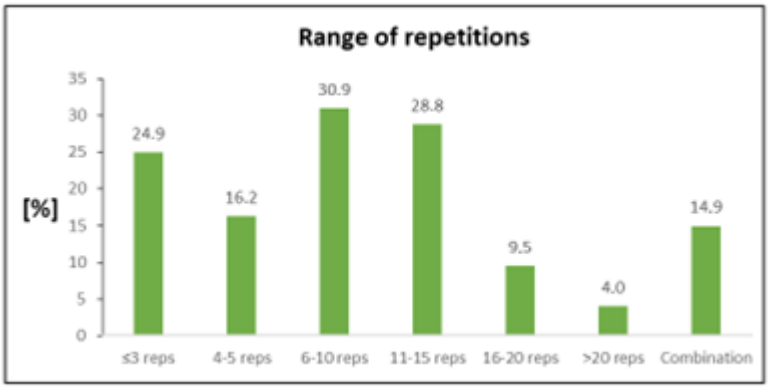

Figure 4. Range of repetitions (reps) during strength and conditioning activities of Polish amateur endurance athletes.

Figure 1 shows strength and conditioning activities performed by Polish endurance runners. Most of the athletes did uphill runs and bodyweight exercises – 608 (65.9%) and 596 (64.6%), respectively. In addition, almost half of the respondents – 418 (45.3%) did resistance training. Interestingly, only 152 subjects (16.5%) included plyometric training in their training regimen.

Figure 2 shows the time of strength and conditioning in relation to running training, which was the main training activity. Among the athletes who used at least one strength training activity, slightly more than half of the athletes – 433 (50.9%) performed S&C on days when they did not run, and only 26 (3.2%) athletes shared S&C times.

Figure 3 shows the duration of strength and conditioning sessions among respondents. As it turned out, the vast majority of the athletes – 724 (85.1%) performed their training sessions of up to 60 minutes.

Figure 4 shows the preferred repetition ranges among amateur runners. It turned out that 212 athletes (24.9%) chose up to 3 repetitions/set, 138 (16.2%) chose 4–5 reps/set, 263 (30.9%) chose 6–10 reps/set, (28.8%) chose 11–15 reps/set, 81 (9.5%) chose 16–20 reps/set and 34 (4%) chose more than 20 reps/set. Interestingly, only 127 participants (14.9%) shared different ranges of repetitions.

As can be seen from the responses above, there is a variety of characteristics of strength physical activity. However, there is no information on the relationship between this data and the sports level among amateur runners. For this purpose, an evaluation was made between the crucial variables in the context of performance – the range of repetitions and the frequency of strength and conditioning with the level of fitness of the respondents, and they are presented in Table 2.

LG4 and LG5 groups showed more interest in conducting S&C twice a week than the other groups. In the group with the highest athletic level, it was also statistically significant ($p = 0.05$). Among subjects from LG1 and LG2 groups, S&C activities were the most of-ten performed once a week, but there was no statistical significance ($p = 0.19$, $p = 0.32$ for LG1 and LG2, respectively).

The results for the second variable were ambiguous, although there was a trend among the different group levels to perform exercises in the range of less than 3 repetitions. In the group with the lowest sport level, this value was also statistically significant ($p = 0.05$). It should be noted that in the above table, respondents could have provided more than one answer (if the range of repetitions varied from week to week), so the analysis included a total of 972 responses (see the TOTAL column).

Table 2. Frequency and prevalence (n, %) of S&C variables for endurance runners regarding their sports level.

Variables	Quantity	LG1 (n = 171)	LG2 (n = 156)	LG3 (n = 228)	LG4 (n = 200)	LG5 (n = 168)	TOTAL (n = 923); (n = 972) for range of repetitions
S&C per week	No S&C	20 (11.7)	14 (9)	20 (8.8)	10 (5)	8 (4.8)	72 (7.8)
	1	63 (36.8) #	56 (35.9) #	72 (31.6)	73 (36.5)	39 (23.2)	303 (23.2)
	2	51 (29.8)	51 (32.7)	71 (31.1)	62 (31) #	81 (48.2) *	316 (34.2)
	3	22 (12.9)	24 (15.4)	45 (19.7) #	39 (19.5)	24 (14.3)	154 (16.7)
	≥4	15 (8.8)	11 (7.1)	20 (8.8)	16 (8)	16 (9.5)	78 (8.5)
Range of repetitions	≤3	50 (29.2) *	42 (26.9) #	47 (20.6)	37 (18.5) #	36 (21.4)	212 (24.9)
	4–5	24 (14)	25 (16)	34 (14.9)	32 (16)	22 (13.1)	138 (16.2)
	6–10	35 (20.5)	36 (23.1)	60 (26.3)	75 (37.5)	57 (33.9)	263 (30.9)
	11–15	29 (17)	36 (23.1)	64 (28.1)	58 (29)	57 (33.9) #	244 (28.8)
	16–20	9 (5.3)	13 (8.3)	26 (11.4) #	23 (11.5)	10 (6)	81 (9.5)
	>20	3 (1.8)	5 (3.2)	10 (4.4)	7 (3.5)	11 (6.5)	34 (4)

* $p \leq 0.05$. # – highest designated value in a specific athletic level despite lack of statistical significance level.

4. Discussion

This survey was aimed to evaluate the training habits of Polish distance runners and the impact of their training advancement in relation to the specificity of the training activities undertaken. This study included 923 participants at the amateur level, and this should be considered when discussing the results.

Attention should be paid to the fact that 7.8% of respondents did not include S&C in their training plan and, these data are consistent with an earlier publication [5] in which S&C was skipped by 8.4% of the respondents. In our study, more than half of the athletes (50.6%) found it very important to include S&C in their training regimen. However, despite the ever-increasing knowledge of S&C in runner training and its effectiveness in improving athletic performance, there is still concern about the hypertrophic effect of strength training on athletic performance in long-distance runners. Previously published meta-analysis [15] indicates that runners focused on improving aerobic performance do not have to worry about its decline following strength training. Nevertheless, some participants (2.6%) still thought that S&C was irrelevant in terms of improving performance.

The athletes mentioned uphill runs (65.9%) and bodyweight exercises (64.6%) as the most frequently chosen S&C activities among their responses, and these data are almost identical to those presented previously [5]. The above-mentioned preferences for S&C activities result, firstly, from the simplicity of their implementation, and secondly, from the fact the performance of these activities does not involve the use of specialized equipment, the availability of which is sometimes limited or difficult. Moreover, performing bodyweight exercises like core muscle strengthening is considered by runners themselves to be the best component in preventing injuries of the locomotor system, especially the lower limbs. Although the scientific evidence is small, literature confirms the relationship between core stability as a risk factor for lower limb injury [16], but more clinical research is needed to better understand this relationship.

Then, resistance training (RT) and plyometric training (PT) also deserve attention. The validity of usage of these training modalities is confirmed [17, 18], because they have been shown to improve running economy and time trail performance. Moreover, there

are reports that concurrent training (endurance + resistance training) is beneficial in improving neuromuscular characteristics [13]. Other data showed that 62.5% and 35.1% of participants used RT and PT [19], respectively, and these data indicate greater involvement of higher-level runners in strength training. In our study, 45.3% and 16.5% did RT and PT, respectively; however, these values are too small to find a correlation between the levels of advancement and the performance of the above-mentioned S&C activities. Blagrove et al. [19] suggest that even exercise with own body weight may be enough to induce adaptation to athletic performance improvement, and in our study 64.6% of the respondents undertake exercise with their own body weight, but the amount of evidence supporting this claim is still scarce.

Differentiation in terms of the time of S&C activities seems to be important as well. The results of our study show that more than half of the respondents performed strength training on alternating days (50.9%). These results are in line with recently published data [20], and this practice is also confirmed by other studies [7, 21]. On the other hand, there are also experiments in which endurance training was combined with strength training, but, according to the authors, it may disrupt (mute) the desired adaptations. Therefore, some researchers have implemented a minimum 3-hour break between endurance and strength training [22]. In our analysis, 12.2% of the respondents did strength training with a 4–5-hour interval, while 8.3% and 23.1%, respectively, combined these activities immediately before or immediately after running training, which may have a negative impact on induction adaptations to athletic performance improvement.

Amateur runners have limited time to do their running and strength training. Nevertheless, the respondents in this study performed S&C activities on average 1.85 ± 0.25 times per week, but this differed between the advancement groups. It turns out that subjects from the most advanced groups (LG4, LG5) undertake S&C activities twice a week, and in the LG5 group, it is almost half of the respondents (48.2%, $p = 0.05$). Interestingly, the conclusions of the study by Rhea et al. [23] indicate that for a non-strength training person, three strength training sessions per week is better than two. However, considering the time they can spend running, two sessions a week seems to be optimal, and this is consistent with our results. Moreover, participants from groups LG1 and LG2 were more likely to use one training course per week, but these data were statistically insignificant ($p = 0.19$ and $p = 0.32$, respectively). On the other hand, one S&C activity during the week gives moderate results in terms of improving the running economy (RE) [24].

The range of repetitions is related to the intensity at which the athletes will perform the S&C. Research shows that maximum strength training with a very high percentage of 1RM is suitable for inducing adaptations conducive to improving the running economy, and that a small amount of RT and PT added to running training will contribute to achieving the desired neuromuscular adaptations [17]. In this study, a correlation was found between LG1 performance level and ≤ 3 repetitions per series during S&C sessions, as also shown in previously published study [25], in which authors demonstrated positive outcomes when high-intensity exercises were used. These results are likely due to the slight differences in the level of athletes' training in this study as the breakdown into levels was also done among amateur runners and did not consider trained or well-trained athletes. Moreover, the scope of repetitions performed by the respondents concerned all S&C activities and did not consider the scope of repetitions performed, among others, by during RT. Therefore, the above result does not give an unambiguous answer whether the participants performed S&C with appropriate intensity.

Despite a lot of valuable information from this study, we believe that this study is not without its shortcomings and a few limitations should be pointed out. First, the sample of 923 respondents used in this study is small, so some data were not statistically powerful to find a correlation between the performance of resistance training and the sports levels. Secondly, the survey took place in the second half of 2020 (July–December), and we suspect that after the peak of the panic related to the Covid-19 pandemic, the habits of Polish long-distance runners may have changed. Third, we did not make a comparison

between the sexes in terms of the number of training sessions per week and the range of repetitions, but only unified the sports level based on Table 1 due to the comparable number of women and men. Lastly, it would be of interest to check S&C habits among adolescents and young adults at the national and international sports levels. Combined with the knowledge available in world literature, it would help increase the level of competitiveness of runners.

5. Conclusions

At this point, it should be emphasized that this is the first study to determine the training habits of Polish endurance runners. Future research should be expanded with more respondents, a more detailed analysis of S&C activities and long-distance runners with bigger experience (trained and well-trained).

From a practical point of view, this study should help coaches and practitioners to communicate and educate on the importance of incorporating S&C activities as strength training into runner training programs. It turned out that runners did S&C ± 2 times a week, regardless of sex, which is the optimal value for achieving better sports results. On the other hand, runners still have too little (in authors' opinion) awareness of the beneficial effects of S&C, which may turn out to be important in the context of improving personal bests.

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