Heliyon 9 (2023) e14756

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon

Research article

Weekly cumulative extracurricular core training time predicts cadet physical performance: A descriptive epidemiological study

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ARTICLE INFO

Keywords:
Military personnel
Physical education and training
Physical conditioning
Chinese army physical fitness test
Extracurricular training time
Physical performance

ABSTRACT

Background: Core training can enhance athletic performance by enhancing core strength and stability. To achieve this outcome, however, a tailored training program is required; the normal military training curriculum is inadequate. The connection between cumulative weekly extracurricular training time, cumulative weekly extracurricular core training time and cadet performance is unknown.
Methods: The association between cumulative weekly extracurricular training time, cumulative weekly extracurricular core training time and performance has been discovered using a descriptive epidemiological study methodology. Questionnaires were used to collect information on personal characteristics and weekly cumulative extracurricular (core) training time, as well as the results of the Chinese Army Physical Fitness Test (C-APFT), which included 100-m dash, 5000-m run, 3000-m armed training run, 400-m steeplechase, 800 m breaststroke, horizontal bar pull-ups, 2-min sit-ups, 2-min push-ups, and hand grenade throwing. This study recruited two hundred and twenty male cadets (aged 18 to 23 years, 19.68 ± 0.91) from a military medical university.
Results: (a) The correlation between cumulative weekly extracurricular training time and C-APFT score is significant. The 100-m dash, 5000-m run, 3000-m armed training run, 400-m steeplechase, and 2-min push-ups performed the best when participants exercised for 5 to 10 h per week. (b) The number of cadets scoring good or excellent on the C-APFT improves with cumulative weekly extracurricular core training time. The recommended amount of core training for cadets per week is 120 min. (c) The average cumulative weekly extracurricular core training time was a effective predictor of performance on the 400-m steeplechase ($R2 = 0.470$, $F = 10.641$, $P < 0.01$), horizontal bar pull-ups ($R2 = 0.238$, $F = 68.191$, $P < 0.01$), 2-min sit-ups ($R2 = 0.280$, $F = 84.710$, $P < 0.01$), 100-m run ($R2 = 0.031$, $F = 6.920$, $P < 0.01$), 3000-m armed training run ($R2 = 0.025$, $F = 5.603$, $P < 0.05$), 2-min push-ups ($R2 = 0.019$, $F = 4.295$, $P < 0.05$), and hand grenade tossing ($R2 = 0.025$, $F = 5.603$, $P < 0.05$).
Conclusions: Active participation in extracurricular core training can improve cadets' C-APFT scores. An average cumulative weekly extracurricular training duration of 5–10 h showed the most progress, and more than 120 min per week was ideal for extracurricular core training. The

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https://doi.org/10.1016/j.heliyon.2023.e14756
Received 1 November 2022; Received in revised form 10 March 2023; Accepted 16 March 2023
Available online 15 April 2023

amount of extracurricular time spent on core training exercises each week can be used as a predictor of the C-APFT.

1. Introduction

In physical training, the ability to control the core is essential, and core training improves this ability. It influences performance significantly by facilitating the transfer of power from the proximal body weight to the extremities [1], reducing training injuries, enhancing core stability, preventing injuries, and enhancing athletic performance [2–6]. It is important to note that core training plays a significant role in certain occupations (particularly those of soldiers, firefighters, and police officers) because they involve specialized tasks requiring unusual postures and movements, both of which increase the risk of injury [7]. Training the core enables the core muscles to develop sufficient flexibility and strength for performing tasks safely and effectively.

Core training consists of training core strength, core stability, and core endurance, etc. Core strength training maximizes strength, explosive power, and core muscle endurance by activating the trunk or core muscles to generate and maintain force [8,9]. Core stability training may increase the trunk flexion angle, vastus medialis to vastus lateralis muscle activation ratio, and quadriceps (H:Q) coactivation ratio, while decreasing the knee valgus and hip adduction angles [10], altering the motor control strategies and joint kinematics of the trunk and lower limbs. The relationship between core stability and dynamic balance stability (DBS) would be strong [11]. Core endurance is also closely related to overall performance because it enhances the ability to run intermittently and makes it easier to utilize maximum strength and power in a variety of activities [9]. Numerous military investigations corroborate the aforementioned research. For instance, a military training environment study demonstrated that 12 weeks of traditional core training improved the shape and symmetry of the abdominal muscles [1]. Other researchers suggest that an eight-week program of continuous core training could improve the biomechanics of the lower limbs and trunk and aid in the prevention of sports-related injuries [12]. In another study, a nine-week strategic core strengthening exercise program improved core stability [13].

However, these experiments were carried out under ideal conditions and do not correspond to actual army training scenarios. Among the most effective ways to improve core training, as demonstrated by these researches, are the following. (a) conducting an in-depth analysis of the trainee's personality and current skill level; (b) designing unique and adaptable training programs; and (c) monitoring progress and making adjustments to the program as necessary [2,3,10,11,14,15]. But these tactics provide significant challenges for military training planners. The army is more open to adopting a standard military training program in order to make administration easier. So, it's important to look at ways to make the most of the training settings that are already ideal and to steadily improve the efficiency of military physical training.

Although it has been shown that higher-intensity and more-frequent core training interventions lead to greater improvements in homeostasis stability [11], and consistent training content, accumulation of training volume could help cadets break through the bottleneck and improve their physical fitness further, no studies have been conducted to determine whether these Extracurricular training with differentiated content, particularly core train, improves cadets' physical fitness. The best amount of time to train for has not been recommended either.

Therefore, the goals of this study are as follows: (a) to understand a baseline of average cumulative weekly extracurricular training time and average cumulative weekly extracurricular core training time for third-year cadets in military medical universities; (b) to investigate the potential effects of weekly cumulative extracurricular (core) training time on the physical performance of cadets and to determine the optimal weekly cumulative extracurricular (core) training time.

2. Materials and methods

2.1. Experimental design

The relationship between average cumulative weekly extracurricular (core) training time and Chinese Army Physical Fitness Test (C-APFT) performance among cadets at Army Medical University in Chongqing was determined using a descriptive epidemiological study design. The Medical Ethics Committee of the Chinese Army Medical University authorized this study (exemption from review), and all participants provided informed consent.

2.2. Participants

The criteria for participant inclusion and exclusion were determined through group discussion. The inclusion criteria were as follows: (a) male; (b) third-year Army Medical University cadets; and (c) over 18 years old. The exclusion criteria are: (a) disease of any major organ, such as the heart, liver, lungs, or kidneys; (b) unwillingness to participate in the study. On the basis of an estimated sample proportion of 87% [16], we calculated the sample at the 95% confidence interval (CI) with a precision (allowable error) of 5%. With an expected attrition rate of 20%, the required sample size is 218 individuals. In the end, 220 individuals ranging in age from 18 to 23 years (mean 19.68 $\pm$ 0.91), height from 161 cm to 196 cm (mean 175.37 $\pm$ 6.46), weight from 50 kg to 93 kg (mean 69.93 $\pm$ 8.61), and BMI from 17.4 to 40.0 (mean 22.78 $\pm$ 2.31) were included in the study.

3. Procedures

Before the participants signed an informed consent form, the researchers explained the purpose and nature of the study. Then, demographic information, average weekly cumulative (core) training time, and C-APFT scores were collected via questionnaires. As suggested by retrospective studies, the time period used was six months (March 2021 to July 2021). When it's necessary, cadets can check their own arrival and departure timings at the stadium. Finally, correlations among demographics, cumulative (core) training hours per week, and C-APFT results were studied.

3.1. Chinese Army Physical Fitness Test (C-APFT) Procedure

All cadets are required to complete the following tests during the C-APFT: a 5000-m run, a 3000-m cross-country run with weapons and other equipment (henceforth referred to as a "armed training run"), a 400-m steeplechase, an 800-m breaststroke swim, a 100-m run, horizontal bar pull-ups, 2-min sit-ups, 2-min push-ups, and a hand grenade throw. Timed events included races, obstacle courses, and swimming competitions. Pull-ups were not timed and were scored according to the number of repetitions a participant could perform. Sit-ups and push-ups were scored according to the number of reps that could be completed within 2 min. The grenade test was graded according to distance thrown. Each C-APFT was given over the course of two days. The testing order was the same for all participants. Immediately after the test was completed, measurements were taken on-site. Throughout a given examination at a given location, performance was evaluated by the same examiner, and instantaneous test results were recorded. Participants wore military-issued footwear for all tests. To ensure that scores accurately reflected the current status of cadets, the most recent C-APFT test scores (1 month prior) were used.

3.2. Extracurricular improvisational exercises reference program

Teachers advocate for a weeklong extracurricular schedule that involves stretching, core exercises, weight training, and endurance competitions (see Appendix 1). There is no weekly training time maximum, but a minimum of 30 min must be devoted to core exercises. Before they are permitted to practice freely, cadets must be well-trained and pass an assessment designed by the instructors to ensure that they have mastered the fundamental training principles and techniques. The extracurricular training method is outlined in the appendix to the program for standard extracurricular core training (2020).

3.3. Questionnaire

The survey consisted of three components: (1) general questions regarding age, height, and weight; (2) inquiries regarding the average cumulative weekly extracurricular training time; and (3) the cadet's most recent C-APFT score. Cadets were given the option to review their training hall entry and exit records in order to help them remember their weekly training hours. Participants were divided into groups according to their assigned squads. Using the "Questionnaire Star Platform," information was collected. Researchers encouraged participants to respond accurately and truthfully to the questionnaire. The questionnaire was filled out in a single sitting. Researchers were available to answer survey participants' questions.

3.4. Statistical analysis

We performed a retrospective analysis of participant data. The descriptive continuous data with a normal distribution are presented as means standard deviations. As appropriate, categorical variables are expressed as numbers and percentages. Squad-based cluster sampling was used for randomization. A comparison of means analysis was conducted using SPSS. Means and 95% confidence intervals, in addition to P values, are provided for inferential tests, and P values less than 0.05 were deemed to indicate statistical significance. The relationship between weekly cumulative core training time and test score level was examined using Chi-square tests and simple linear regression, as well as potential predictors. F value $\geq$ 3.86 and T value $>$ 1.96 indicate that the regression effect is acceptable and that the model is valid. The association between the four categories of weekly extracurricular cumulative training time groupings and training performance data was analyzed using a one-way analysis of variance. When Cohen's f reflects effect size, the

Table 1
Results of recent military physical fitness tests.

Measurements	Minimum value	Maximum value	Mean $\pm$ SD
100-m run, s	11.30	15.70	13.81 $\pm$ 0.77
5000-m run, s	1140	2700	1335.11 $\pm$ 134.35
3000-m armed training run, s	690	1100	884.66 $\pm$ 67.72
400-m steeplechase, s	120	270	154.6 $\pm$ 20.61
800-m breaststroke, s	1020	2040	1405.69 $\pm$ 183.49
horizontal bar pull-ups, N	0	30	11.94 $\pm$ 4.7
2-min sit-ups, N	45	120	72.76 $\pm$ 11.9
2-min push-ups, N	25	110	60.02 $\pm$ 13.83
hand grenade throw, m	15	45	31.83 $\pm$ 5.01

differentiating points between small, medium, and large effect sizes are 0.10, 0.25, and 0.40. SPSS was utilized for the analysis (SPSS version 26.0, IBM Corporation, United States).

4. Results

Subjects' most recent scores on military fitness exams are shown in Table 1. (all measurement times are in seconds for ease of calculation of standard deviation and variance).

The 220 individuals spent an average of 9.42 ± 3.63 h per week (range: 1–30) on physical activity during their free time during the preceding six months, with weekly core training times ranging from 0 to 360 min (mean: 91.34 ± 64.42 h). Training consistently for 5–10 h per week improves performance in a variety of events, including the 100-m dash, 5000-m run, 3-km armed training run, 400-m steeplechase, and 2-min pushups. But when the overall weekly training time surpassed 10 h, all of these benefits were diminished (Table 2).

Pearson correlation study showed a weak to moderate link between average weekly cumulative extracurricular core training time and performance in the 100-m run, 3000-m armed training run, 400-m steeplechase, hand grenade throw, horizontal bar pull-ups, sit-ups, and push-ups (Table 3).

The 400-m steeplechase, the horizontal bar pull-up test, the 2-min sit-up test, and the 3000-m armed training run all correlate with weekly total extracurricular core training time, according to Chi-square analysis. As the total number of extracurricular core training hours per week increases, the proportion of pupils earning well above average grades increases (Table 4).

The total amount of weekly extracurricular core training was a good predictor of performance in the 400-m steeplechase, horizontal bar pull-ups, and 2-min sit-ups, and a potential predictor of performance in the 100-m dash, the 3-km armed training run, and the 2-min push-ups, according to the results of a simple linear regression analysis (Table 5). And the results of Cohen's f effect size analysis suggested that the impact size of grouping weekly extracurricular cumulative training time on the effects of horizontal bar pull-ups and 2-min sit-ups was substantial, while it had moderate effects on the 100-m dash, 400-m steeplechase, and hand grenade throw (Table 6).

5. Discussion

Combat effectiveness requires that military personnel be in peak physical condition. Numerous studies have analyzed the effects of particular training regimens on training performance [3,4,17,18]. Under- and overtraining can both result in an increase in injuries, a decline in physical fitness, and poor team performance [19]. Due to the sedentary nature of cadets in military medical universities, their core muscles are more prone to stiffness and weakness, necessitating additional training in order to pass the Chinese Army Physical Fitness Test (C-APFT), which consists of numerous strenuous activities. Clearly, military personnel required fundamental training [17]. However, few research have focused on the extracurricular physical training of military cadets, nor have they examined the correlation between extracurricular core training time and performance improvement.

To address this deficiency, we requested that cadets report autonomous training activity (i.e., training outside of their required basic training) and analyzed its effect on training performance. We discovered that a surprising number of trainees (n = 191, 86.82%) performed additional autonomous core training. It is interesting to note that this phenomenon is also common in the armies of other countries [16]. This further substantiates the necessity of this investigation.

Our study revealed that military cadets' performance enhanced with increasing weekly cumulative physical training time,

Table 2
Average weekly extracurricular (core) training time and C-APFT: Group statistics.[a]

Measurements	Weekly cumulative training time			Weekly cumulative core training time			
	≤5h (n = 22)	> 5h; < 10h (n = 85)	≥10h (n = 113)	≤30 min (n = 29)	> 30 min; ≤60 min (n = 78)	> 60 min; ≤120 min (n = 75)	> 120 min (n = 38)
100-m run, s	13.94 ± 0.84	13.73 ± 0.73	13.84 ± 0.79	13.67 ± 0.76	14.00 ± 0.62	13.87 ± 0.79	13.40 ± 0.89
5000-m run, s	1382.23 ± 298.72	1326.56 ± 122.00	1332.36 ± 83.06	1368.00 ± 280.01	1332.99 ± 69.00	1340.17 ± 126.06	1303.41 ± 59.67
3000-m armed training run, s	897.86 ± 81.86	877.51 ± 66.06	887.47 ± 66.00	894.90 ± 87.47	892.65 ± 59.29	882.99 ± 70.05	863.22 ± 59.17
400-m steeplechase, s	157.73 ± 22.18	153.45 ± 18.99	154.87 ± 21.55	160.10 ± 22.61	158.72 ± 21.23	152.76 ± 16.60	145.41 ± 22.19
800-m breaststroke, s	1370.18 ± 179.857	1429.21 ± 188.74	1394.91 ± 179.63	1403.59 ± 204.03	1400.44 ± 171.17	1435.84 ± 202.56	1356.49 ± 140.83
horizontal bar pull-ups, N	10.45 ± 5.01	13.46 ± 4.90	14.08 ± 5.11	12.59 ± 4.31	11.35 ± 5.09	13.50 ± 4.52	18.62 ± 2.909
2-min sit-ups, N	67.95 ± 8.99	76.91 ± 13.37	80.26 ± 13.54	69.45 ± 11.53	73.04 ± 11.05	79.42 ± 13.76	90.65 ± 8.674
2-min push-ups, N	56.45 ± 14.74	60.98 ± 13.30	60.17 ± 14.17	55.07 ± 12.91	60.12 ± 15.52	60.79 ± 13.23	62.65 ± 11.703
hand grenade throw, m	32.64 ± 5.05	30.82 ± 5.10	32.42 ± 4.84	32.55 ± 4.64	30.24 ± 4.95	32.41 ± 5.18	33.41 ± 4.272

[a] Values are reported as means ± SD.

Table 3
Average Weekly Extracurricular (Core) Training Time and C-APFT: Pearson correlation analysis.

Components of the C-APFT	Weekly cumulative training time	Weekly cumulative core training time
100-m run, s	0.061	−0.175**
5000-m run, s	−0.069	−0.107
800-m breaststroke, s	−0.016	−0.097
3000-m armed training run, s	−0.002	−0.158*
400-m steeplechase, s	0.046	−0.216**
horizontal bar pull-ups, N	0.045	0.158*
2-min sit-ups, N	0.153*	0.488**
2-min push-ups, N	0.200**	0.529**
hand grenade throw, m	−0.019	0.139*

*p < 0.05; **: p < 0.01.

Table 4
Average Weekly Extracurricular Core Training Time and C-APFT: Chi-square analysis.

Measurements	Evaluation level	core training (minutes) (%)			Total (N = 220)	χ^2	p
		≤60 (N = 107)	60-120 (N = 75)	>120 (N = 38)			
100-m run, s	Failed	13 (12.15)	9 (12)	2 (5.26)	24 (10.91)	10.5498	0.1033
	Pass	67 (62.62)	44 (58.67)	18 (47.37)	129 (58.64)		
	Good	21 (19.63)	16 (21.33)	10 (26.32)	47 (21.36)		
	Excellent	6 (5.61)	6 (8)	8 (21.05)	20 (9.09)		
5000-m run, s	Failed	18 (16.82)	12 (16)	2 (5.26)	32 (14.55)	7.1136	0.3105
	Pass	56 (52.34)	43 (57.33)	18 (47.37)	117 (53.18)		
	Good	27 (25.23)	17 (22.67)	14 (36.84)	58 (26.36)		
	Excellent	6 (5.61)	3 (4)	4 (10.53)	13 (5.91)		
3000-m armed training run, s	Failed	52 (48.6)	30 (40)	7 (18.42)	89 (40.45)	16.6002	0.0109
	Pass	40 (37.38)	33 (44)	21 (55.26)	94 (42.73)		
	Good	9 (8.41)	6 (8)	9 (23.68)	24 (10.91)		
	Excellent	6 (5.61)	6 (8)	1 (2.63)	13 (5.91)		
400-m steeplechase, s	Failed	42 (39.25)	19 (25.33)	8 (21.05)	69 (31.36)	40.8574	0.0000
	Pass	53 (49.53)	42 (56)	8 (21.05)	103 (46.82)		
	Good	11 (10.28)	10 (13.33)	17 (44.74)	38 (17.27)		
	Excellent	1 (0.93)	4 (5.33)	5 (13.16)	10 (4.55)		
800-m breaststroke, s	Failed	21 (19.63)	20 (26.67)	3 (7.89)	44 (20)	6.7172	0.3478
	Pass	73 (68.22)	46 (61.33)	29 (76.32)	148 (67.27)		
	Good	8 (7.48)	6 (8)	5 (13.16)	19 (8.64)		
	Excellent	5 (4.67)	3 (4)	1 (2.63)	9 (4.09)		
Horizontal bar pull-ups, n	Failed	7 (6.54)	0 (0)	0 (0)	7 (3.18)	55.5858	0.0000
	Pass	22 (20.56)	14 (18.67)	0 (0)	36 (16.36)		
	Good	48 (44.86)	29 (38.67)	2 (5.26)	79 (35.91)		
	Excellent	30 (28.04)	32 (42.67)	36 (94.74)	98 (44.55)		
2-min sit-ups, n	Failed	24 (22.43)	10 (13.33)	1 (2.63)	35 (15.91)	19.9731	0.0005
	Pass	15 (14.02)	4 (5.33)	0 (0)	19 (8.64)		
	Good	68 (63.55)	61 (81.33)	37 (97.37)	166 (75.45)		
2-min push-ups, n	Failed	1 (0.93)	2 (2.67)	0 (0)	3 (1.36)	9.8402	0.1315
	Pass	12 (11.21)	4 (5.33)	0 (0)	16 (7.27)		
	Good	24 (22.43)	12 (16)	6 (15.79)	42 (19.09)		
	Excellent	70 (65.42)	57 (76)	32 (84.21)	159 (72.27)		
Hand grenade throw, m	Failed	40 (37.38)	13 (17.33)	7 (18.42)	60 (27.27)	12.4567	0.0525
	Pass	40 (37.38)	35 (46.67)	16 (42.11)	91 (41.36)		
	Good	19 (17.76)	20 (26.67)	9 (23.68)	48 (21.82)		
	Excellent	8 (7.48)	7 (9.33)	6 (15.79)	21 (9.55)		

particularly with increased weekly cumulative core training time. When weekly cumulative extracurricular training time is at least 5 h (but no more than 10 h) performance on the C-APFT exam improves significantly. Our findings confirm the significance of extracurricular cumulative training time and are consistent with other athletic training research demonstrating that progressive and systematic increases in training increase the "safety margin" that reduces injury risk and expands the range of possible performance [16,20,21]. Notably, a diminishing training effect occurs with prolonged periods of high intensity. As shown in this study, when cumulative extracurricular training time exceeds 10 h per week, the effectiveness of performance enhancement declines and may even be diminished due to injuries caused by excessive workload [22]. And a linear circuit training program is perhaps the key way to increase cadets' physical fitness (for example, three weeks of activity, 1 h each Monday, Wednesday, and Friday; active relaxation for the fourth week) [18]. Furthermore, although athletes who are accustomed to high-load training are less likely to sustain injuries than athletes who are accustomed to low-load training [19], however, the premise is that high-load training is conducted under the supervision of trained professionals [23]. Therefore, in the lack of sufficiently highly skilled physical education teachers, it is vital to specify the ideal

Table 5
Average Weekly Extracurricular Core Training Time and C-APFT: Simple linear regression.

Measurements	R Square	F value	T value	P value
100-m run	0.031	6.920	−2.631	0.009
5000-m run	0.012	2.545	−1.595	0.112
3000-m armed training run	0.025	5.603	−2.367	0.019
400-m steeplechase	0.470	10.641	−3.262	0.001
800-m breaststroke	0.009	2.083	−1.443	0.150
horizontal bar pull-ups	0.238	68.191	8.258	0.000
2-min sit-ups	0.280	84.710	9.204	0.000
2-min push-ups	0.019	4.295	2.072	0.039
hand grenade throw	0.025	5.603	2.367	0.019

Table 6
Effect Size Indicators: a one-way analysis.

Measurements	SSB	SST	Partial η^2	Cohen's f
100-m run	9.778	131.073	0.075	0.284
5000-m run	70860.699	3952703.382	0.018	0.135
3000-m armed training run	25249.831	1004193.432	0.025	0.161
400-m steeplechase	5585.455	92998.595	0.060	0.253
800-m breaststroke	160953.419	7373590.982	0.022	0.149
horizontal bar pull-ups	1356.495	5706.886	0.238	0.558
2-min sit-ups	10098.161	40133.177	0.252	0.580
2-min push-ups	1010.494	42263.382	0.024	0.157
hand grenade throw	328.618	5489.436	0.060	0.252

extracurricular training time to avoid damage caused by too high-intensity exercise [24]. And when any aspect of the training process is overlooked, the likelihood of incurring an injury increases. Consequently, when designing training programs, a balance must be struck between physical demands and increased risk of injury [25]. Therefore, for extracurricular training without on-site teacher supervision, the cost-benefit ratio of excessive or dangerous training is extremely low. In addition, excessive training is unnecessary based on the official physical requirements for military medical cadets.

We also found that the weekly accumulative extracurricular core training time can be an effective predictor of C-APFT performance. When it is more than 2 h (more than 20% of their total weekly training time), cadets are at their best in the C-APFT. The most significant benefit of weekly accumulation of extra-core training time is its effect on running events, which is consistent with previous research showing that just six weeks of core training improves runners' performance over 5,000 m [26]. This may be a result of the influence of extracurricular core training on running dynamics and motor control strategy [10]. Added to that, we confirmed that accumulated extracurricular core training time may boost performance in horizontal bar pull-ups, 2-min sit-ups, 2-min push-ups, and the hand grenade throw. This could be due to increased core stability, increased VO_2 max, and decreased muscle damage [18]. Core training also can enhance squat exercise strength and speed, increases abdominal stability [27,28], reduces knee injuries [29], particularly those involving the anterior cruciate ligament (ACL) [10], and so optimize young men's strength conditioning [30].

Overall, although core training has a protective effect against injury, the relationship between training and performance is dynamic and complex [30]. We found that increasing training intensity or training time alone does not necessarily result in improved performance, with the exception of extracurricular core training for longer periods of time, particularly when focusing on core training, which is advantageous for improving training performance through the accumulation of time effects. In light of this, we will recommend to cadets that the total training time per week not exceed 10 h, and that the proportion of time spent on core training be greater than 20%. Moreover, this cumulative effect is contingent on successful training, i.e., teachers must train students to correctly understand the fundamentals and principles of the training method before allowing students to engage in extracurricular free training.

The effects of other forms of incidental load (e.g., drills, field exercises) were not taken into account in this study. Note that the retrospective, self-reported, and non-control group design of the study does not rule out the possibility of recall bias, and that our conclusions are primarily applicable to guiding the extracurricular core training of military cadets. If a broader scope is desired, sample inclusion criteria should be broadened. A control group must be designed and prospectively observed, and it may be necessary to modify the observation indicators. Obtaining longitudinal datasets large enough to capture the time-varying nature of weekly cumulative extracurricular training time on training performance will be a future challenge for researchers. Further prospective research is required to clarify how to strategically allocate core training time for each day of the week in order to maximize training effectiveness.

6. Conclusions

Understanding the ideal duration of weekly cumulative extracurricular core training for cadets helps drive autonomous training and improve training effectiveness. Five to 10 h of extracurricular training per week and more than 120 min of extracurricular core exercise per week were associated with the greatest improvement. Extracurricular spontaneous core training provides some insight into military fitness.

Author contribution statement

Zenghui Chen: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.
Jiang Du: Conceived and designed the experiments; Analyzed and interpreted the data.
Yan Hu: Conceived and designed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data.
Kai Ou; Tao Meng; Wei Zhou: Performed the experiments; Analyzed and interpreted the data.
Haiming Li; Hang Zhao: Performed the experiments.
Xuanjun Li: Performed the experiments; Contributed reagents, materials, analysis tools or data.
Qin Shu: Conceived and designed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Funding statement

This work was supported by Teaching Reform Research Project of Army Medical University [2019B15].

Data availability statement

Data included in article/supplementary material/referenced in article.

Declaration of interest's statement

The authors declare no conflict of interest.

Acknowledgements

The authors would like to express their appreciation to Xi Yang, Hengyu Liu, and Jie Li for assisting with data collection.

Appendix 1. Program of standard extracurricular training

	Monday	Tuesday	Wednesday	Thursday	Friday
Stretch	Tricep Stretch	Slow Waist Bends to Left and Right	Triceps Stretch	Slow Waist Bends to Left and Right	Tricep Stretch
	Latissimus Dorsi Stretch	Lunge Leg Press	Latissimus Dorsi Stretch	Lunge Leg Press	Latissimus Dorsi Stretch
	Shoulder Stretch	Side Step Press	Shoulder Stretch	Side Step Press	Shoulder Stretch
	Pectoralis Stretch	Step Forward Squat	Pectoralis Stretch	Step Forward Squat	Pectoralis Stretch
core training	Crawling Plank		High Lunge		Four-Point Arm & Leg Extension
	Kneeling Plank		Single-Leg Glute Bridges		Seated Side Bend
	Lateral Plank		Front Plank		Plank
	Lying Pendulum Exercises		Wall Squats		Single-Leg Side Plank
Strength Training	Push Ups		Mixed Grip Pull-Up		Heart Pushup
	Bench Press		Rapid Arm Thrusts Against Opposing Partner		Wave Pushup
	Standing Leg Raises		Mountain Climber Plank		Wall-Supported Single-Leg RDL
	Double Leg Tuck Jump		Open Close Jump		Wide Squat
Endurance Training		Combination Training Of 100-Meter Run, 200-Meter Run, 300-Meter Run, And 400-Meter Interval Fast Run		Combination Training Of 200-Meter Run, 400-Meter Run, And 800-Meter Interval Fast Run	
Stretch	Tricep Stretch	Lunge Leg Press	Tricep Stretch	Lunge Leg Press	Tricep Stretch
	Latissimus Dorsi Stretch	Side Step Press	Latissimus Dorsi Stretch	Side Step Press	Latissimus Dorsi Stretch

(*continued on next page*)

(*continued*)

	Monday	Tuesday	Wednesday	Thursday	Friday
	Shoulder Stretch	Sit To Stand Split Stance	Shoulder Stretch	Sit To Stand Split Stance	Shoulder Stretch
	Pectoralis Stretch	Kneeling Lean Back	Pectoralis Stretch	Kneeling Lean Back	Pectoralis Stretch

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