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Comparison of Weekly Training Load and Acute: Chronic Workload Ratio Methods to Estimate Change in Training Load in Running

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Context: Before examining the impact of training load on injury risk in runners, it is important to gain insight into the differences between methods that are used to measure change in training load.

Objective: To investigate differences between 4 methods when calculating change in training load: (1) weekly training load; (2) acute : chronic workload ratio (ACWR), coupled rolling average (RA); (3) ACWR, uncoupled RA; (4) ACWR, exponentially weighted moving average (EWMA).

Design: Descriptive epidemiology study.

Setting: This study is part of a randomized controlled trial on running injury prevention among recreational runners. Runners received a baseline questionnaire and a request to share global positioning system training data.

Patients or Other Participants: Runners who registered for running events (distances 10–42.195 km) in the Netherlands.

Main Outcome Measure(s): The primary outcome measure was the predefined significant increase in training load (weekly training loads ≥ 30% progression and ACWRs ≥ 1.5), based on training distance. Proportional Venn diagrams visualized the differences between the methods.

Results: A total of 430 participants (73.3% men; mean age = 44.3 ± 12.2 years) shared their global positioning system training data for a total of 22 839 training sessions. For the weekly training load, coupled RA, uncoupled RA, and EWMA method, respectively, 33.4% (95% CI = 32.8, 34.0), 16.2% (95% CI = 15.7, 16.6), 25.8% (95% CI = 25.3, 26.4), and 18.9% (95% CI = 18.4, 19.4) of the training sessions were classified as significant increases in training load. Of the training sessions with significant increases in training load, 43.0% from the weekly training load method were different than the coupled RA and EWMA methods. Training sessions with significant increases in training load based on the coupled RA method showed 100% overlap with the uncoupled RA and EWMA methods.

Conclusions: The difference in the change in training load measured by weekly training load and ACWR methods was high. To validate an appropriate measure of change in training load in runners, future research on the association between training loads and running-related injury risk is needed.

Key Words: injury prevention, running injury, global positioning systems, exponentially weighted moving average (EWMA)

Key Points

- This is the first study in which differences in methods used to measure change in training load (weekly training load and acute : chronic workload ratio methods) were investigated in recreational runners with the use of 22 839 global positioning system–based training sessions.
- Large differences between the weekly training load and acute : chronic workload ratio methods were found when calculating the change in training load, which may relate to the differences in each method's included training sessions.
- The complexity of optimal loading in running to avoid running-related injuries should be the subject of future research, as a better understanding will assist in the development of preventive tools for recreational runners.

Running is a time efficient, easily accessible, and relatively inexpensive activity.[1] Despite health benefits, running has a substantial risk of injury.[2] A recent systematic review (literature search up to June 2020) among middle- and long-distance runners reported an overall running-related injury (RRI) incidence and prevalence of 40% and 45%, respectively.[3] An RRI accounts for 48% of all reasons for running discontinuation.[4] To help people stay active and to work toward a healthy society, development of preventive interventions for RRIs is highly important.

Overuse injuries are estimated to account for 64% to 75% of all RRIs.[5,6] These injuries are characterized by a multifactorial aetiology.[6,7] It is assumed that the training load (the amount of training in a defined period) imposed by running plays an important role in the development of overuse injuries as a consequence of running too much too soon.[8] This significant change in training load may cause an imbalance between training and recovery, in which the training load exceeds runners' load capacity for adaptive tissue repair, especially if recovery time is inadequate.[7–9] To define the change in training load, accurate methods to collect training data need to be used. Training characteristics retrospectively collected from questionnaires might be inaccurate due to recall bias.[10] The use of global positioning systems (GPSs) might be a more accurate method to collect training data.[11,12] Collecting GPS data was recently also found to be feasible to estimate training load in runners.[13]

Traditionally, change in training load in running was expressed as the week-to-week training progression in running distance.[11,14,15] Runners who progressed their training distance by more than 30% seemed to be more vulnerable to sustaining an RRI.[15] In 2014, the acute : chronic workload ratio (ACWR) was launched to estimate change in training load, and this measure has been frequently used, especially in team sport populations.[16,17] An association between an increase in the ACWR and the risk of injury was identified in several competitive team sports, such as Australian football, rugby, cricket, and soccer, and ACWRs greater than 1.5 were considered high risk for sustaining an injury.[16,18,19] Though the use of the ACWR for training-load management and recommendations is the subject of discussion in literature, so far, only authors of a few studies have examined the ACWR in running populations, with conflicting results.[20–24]

A possible reason for the conflicting results is that the authors of these studies used different methods to calculate ACWRs. Possible methods for calculating the ACWR are (1) the coupled rolling average (RA) method, in which the acute workload (last 7 days) is divided by the chronic workload (last 28 days); (2) the uncoupled RA method, in which the acute workload is not included in the chronic workload; and (3) the exponentially weighted moving average (EWMA) method, in which a decreasing weight is assigned for load values that have been applied longer ago (see Supplemental Table 1, available online at https://dx.doi.org/10.4085/1062-6050-0430.23.S1).[25,26] Regardless of sport type, authors of most studies used the coupled RA method to calculate the ACWR.[18,27] However, the uncoupled RA method might be a better method since mathematical coupling of the ACWR is controversial, as it influences the chronic workloads and therefore the ACWR itself.[28] Compared with the RA methods, authors have suggested that the EWMA method is a more sensitive indicator to assess injury risk, while others have suggested that no differences exist between the RA and EWMA methods.[27,29–31] To examine the impact of change in training load on the risk for sustaining an RRI, it is first important to gain insight into the differences between the applied methods that are used to express change in training load in runners. Therefore, the aim of this study was to investigate differences between 4 methods when calculating a significant increase in training load in recreational runners: (1) weekly training load; (2) ACWR, coupled RA; (3) ACWR, uncoupled RA; and (4) ACWR, EWMA.

METHODS

Study Design

The current study was part of the Shaping up Prevention for Running Injuries in the Netherlands using Ten steps (SPRINT) study. The SPRINT study was a randomized controlled trial among recreational runners with a minimum follow-up of 3 months to investigate the effect of an online injury prevention program on the number of RRIs.[32] After participants completed the baseline questionnaire, follow-up questionnaires were sent 1 month before, 1 week before, and 1 month after the registered running event. Additionally, by the end of the follow-up period, all participants were asked to share their GPS training data. Because it was not possible for each platform to share GPS data of a specific timeframe, participants were asked to share all their GPS data up to the date of upload. The GPS training data within 6 months before the running event registered for were included in this study. A flowchart of the design is presented in Figure 1. The SPRINT study was funded by the Netherlands Organisation for Health Research and Development (ZonMW; Grant No. 50-53600-98-104). Medical ethics approval was obtained by the Medical Ethical Committee of the Erasmus MC Medical Center Rotterdam, the Netherlands (MEC-2019-0136).

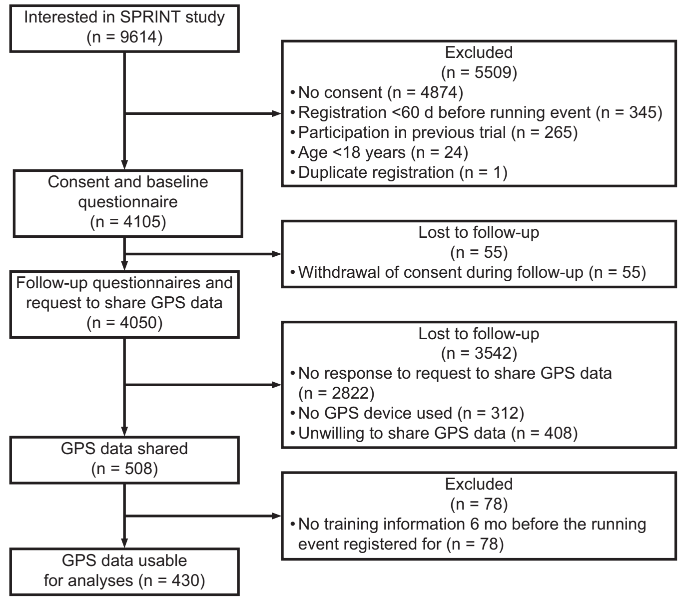

Figure 1. Flowchart of the participants.

Participants

Runners who registered for the DSW Bruggenloop Rotterdam 2019 (15 km), Nacht van Groningen 2020 (10, 16.1, and 21.1 km), NN CPC Loop The Hague 2020 (10 and 21.1 km), or NN Marathon Rotterdam 2020 (10.55 and 42.195 km) were invited to participate in the SPRINT study. Interested runners, aged 18 years or older, were asked to provide digital informed consent. Exclusion criteria were registration less than 60 days before the running event, no sufficient knowledge of the Dutch language, no access to internet and email, and participation in our previous trial on RRI prevention.[33] For the current study purpose, participants were excluded if they (1) did not share GPS training data or (2) shared GPS training data but did not include training data 6 months before the running event registered for.

Data Collection

In the baseline questionnaire, information on demographics (sex, age, weight, and height) was collected. Weight and height were used to calculate the body mass index. Information on training characteristics (average weekly training frequency, hours, distance [km], and running speed [min/km] over the last 3 months), running experience (years), RRI in the 12 months before baseline (yes/no), RRI at baseline (yes/no), use of a

GPS-enabled device or platform (yes/no), and distance of the registered running event was obtained. Based on the registered distance of the running event, participants were categorized into 10/10.55 km, 15/16.1 km, half marathon, and marathon. In the follow-up questionnaires, participants were asked if they sustained a new RRI since completing the previous questionnaire (yes/no). An *RRI* was defined as a self-reported injury of the muscles, joints, tendons or bones in the lower back or lower extremities (hip, groin, thigh, knee, leg, ankle, foot, and toes) that was caused by running (training or competition). The injury had to be severe enough to cause a reduction in running distance, speed, duration, or frequency for at least 7 days or 3 consecutive scheduled training sessions, or the consultation of a physician or other health professional had to be necessary.[34,35] At the end of follow-up, an email with a request to share GPS training data was sent to all participants. In this request, participants were asked to upload their GPS data through a personalized link to a cloud-based digital environment. This digital environment was especially developed for this study by MoveMetrics, a company specialized in data analysis for sport and health.[36] After uploading, the GPS data were automatically standardized and pseudonymized. Sensitive metadata (like user credentials) were automatically removed, and the GPS-position data were converted into relative distances. Accordingly, researchers downloaded the data through a password-protected link.

Training Load Analysis

Training load was calculated based on the distance of each running activity derived from GPS data within 6 months before the running event registered for. For each running session, the change in training load was calculated by the weekly training load, coupled RA, uncoupled RA, and EWMA method (see Supplemental Table 1). To begin the EWMA calculation, the distance of the first recorded running activity of the participants was used as the first training load value. To define the weekly training load, the week-to-week change in training load was divided into 1 of the following categories: (1) regression between 0% and 10%, (2) regression between 10% and 30%, (3) regression between 30% and 50%, (4) regression greater than or equal to 50%, (5) progression between 0% and 10%, (6) progression between 10% and 30%, (7) progression between 30% and 50%, or (8) progression greater than or equal to 50%.[15] Acute : chronic workload ratios (coupled RA method, uncoupled RA method, and EWMA) were categorized into (1) less than 0.8, (2) between 0.8 and 1.3, (3) between 1.3 and 1.5, (4) between 1.5 and 2.0, or (5) greater than or equal to 2.0.[16,27] If a participant did not train in the days used to calculate the denominator (the denominator was 0), it was not possible to calculate the workload of that training session. These training sessions were categorized into a *not available* group.

Outcome Measures

The primary outcome was the number of training sessions with a predefined significant increase in training load. Runners who train with a significant increase in training load are suspected to be at higher risk for sustaining an RRI.[15,16,18] A significant increase in training load was defined as greater than or equal to 30% progression.[11,15] For the ACWR methods, a significant increase in training load was defined as ACWRs greater than or equal to 1.5.[16,19]

Statistical Analyses

Descriptive statistics were used to describe all variables, expressed in frequency or mean ± SDs. Participants who shared GPS data eligible for analyses and participants who did not share GPS data were compared with independent sample *t* tests (continuous data), Mann-Whitney *U* tests (continuous data), and χ^2 tests (dichotomous data). Frequencies of the training sessions with 95% CIs were calculated for the predefined change in training load categories of the weekly training load, coupled RA, uncoupled RA, and EWMA method. Differences between training sessions with a significant increase in training load expressed in the weekly training load, coupled RA, and EWMA method were calculated. A proportional Venn diagram was used to visualize these differences with the use of the online software EulerAPE.[37] Additionally, differences between training sessions with a significant increase in training load expressed in coupled RA, uncoupled RA, and EWMA methods were calculated, and a second proportional Venn diagram was used to visualize these differences. All analyses were performed in SPSS Statistics Software (version 25; IBM Corp), and *P* values less than .05 were regarded as statistically significant.

RESULTS

Participants

Of the 9614 runners interested in participation in the SPRINT study, 4050 participants were included and consequently asked to share their GPS data (Figure 1). A total of 312 (7.7%) participants reported no use of a GPS device or platform. Of the remaining 3738 participants, 408 (10.9%) participants were unwilling to share GPS data, and 2822 participants did not respond to the request to share GPS data. A total of 508 (13.6%) participants shared GPS data. Of those, 78 (15.4%) participants were excluded because they did not share GPS data 6 months before the running event registered for. Therefore, GPS data of 430 participants were useable for analyses with a total of 22 839 training sessions. Compared with the participants who did not share (usable) GPS data, participants who shared GPS data were more often males (73.3% versus 62.3%, $P < .001$), on average older (44.3 ± 12.2 versus 42.0 ± 12.1 years, $P < .001$), with more running experience (10.9 ± 10.3 versus 10.2 ± 10.1 years, $P = .04$), trained at a higher weekly training distance (30.4 ± 22.5 versus 26.0 ± 22.6 km, $P < .001$), and were more often members of an athletic association (39.8% versus 28.7%, $P < .001$; Table 1). Furthermore, participants who shared GPS data more often reported an RRI during follow-up compared with the participants who did not share GPS data useable for analyses (46.3% versus 34.2%, $P < .001$).

Outcome Measures

Tables 2 and 3 show the number of training sessions within the predefined change in training load categories of the weekly training load method and ACWR methods (coupled RA, uncoupled RA, and EWMA). For the outcome weekly training load, a total of 33.4% (95% CI = 32.8, 34.0) of the training sessions were classified as significant increases in training load. For the coupled RA method, uncoupled RA method, and

Table 1. Baseline Characteristics of Participants Who Shared GPS Data Usable for Analyses

	GPS Data Shared[a]		
	Total (N = 4050)	Yes (N = 430)	No (N = 3620)
Demographic characteristics			
Sex (male)	2570 (63.5)	315 (73.3)	2255 (62.3)[b]
Age, y	42.3 ± 12.1	44.3 ± 12.2	42.0 ± 12.1[b]
Body mass index, kg/m^2	23.3 ± 2.6	23.0 ± 2.5	23.3 ± 2.6[b]
Training characteristics			
Running experience	10.3 ± 10.1	10.9 ± 10.3	10.2 ± 10.1[b]
Weekly training frequency	2.6 ± 1.3	2.8 ± 1.1	2.5 ± 1.3[b]
Weekly training, h	3.1 ± 2.8	3.2 ± 1.7	3.1 ± 2.9[b]
Weekly training distance, km	26.5 ± 22.7	30.4 ± 22.5	26.0 ± 22.6[b]
Running speed, min/km	5.8 ± 0.9	5.6 ± 0.7	5.8 ± 0.9[b]
Member of athletic association (yes)	1210 (29.9)	171 (39.8)	1039 (28.7)[b]
Use of training schedule (yes)	2636 (65.1)	300 (69.8)	2336 (64.5)[b]
Running events			
Distance registered for:			
10/10.55 km	894 (22.1)	56 (13.0)	838 (23.1)[b]
15/16.1 km	534 (13.2)	62 (14.4)	472 (13.0)
Half marathon	579 (14.3)	93 (21.6)	486 (13.4)[b]
Marathon	2043 (50.4)	219 (50.9)	1824 (50.4)
RRI			
RRI 12 mo before baseline (yes)	2000 (49.4)	225 (52.3)	1775 (49.0)
Reported RRI at baseline (yes)	763 (18.8)	75 (17.4)	688 (19.0)
RRI during follow-up (yes)	1436 (35.5)	199 (46.3)	1237 (34.2)[b]

Abbreviations: GPS, global positioning system; RRI, running-related injury.
[a] Categorical data are presented as No. (%) and continuous data as means ± SD.
[b] Statistically significant difference between responders and nonresponders ($P < .05$).

EWMA method, a total of respectively 16.2% (95% CI = 15.7, 16.6), 25.8% (95% CI = 25.3, 26.4), and 18.9% (95% CI = 18.4, 19.4) of the training sessions were classified as significant increases in training load. Figure 2A and Supplemental Table 2 present that 15.6% of the training sessions with a significant increase in training load showed an overlap between the coupled RA, weekly training load, and EWMA methods. A total of 43% of the training sessions with significant increases in training load based on the weekly training load method were different than the coupled RA and EWMA methods. Between the 3 ACWR methods (coupled RA, uncoupled RA, and EWMA), an overlap of 29.6% of training sessions with significant increases in training load was reported (Figure 2B and Supplemental Table 3). Training sessions with significant increases in training load based on the uncoupled RA method showed a difference of 23.6% with the coupled RA and EWMA methods, and 17.3% of the training sessions with significant increases in training load calculated by the EWMA method showed a difference with the coupled and uncoupled RA methods. Training sessions with significant increases in training load based on the coupled RA method showed 100% overlap with the uncoupled and EWMA methods.

Table 2. Number of Training Sessions per Category of the Weekly Training Load

Weekly Training Load[a]	No. (%)	95% CI
Weekly regression		
0%–10%	2196 (9.6)	9.2, 10.0
10%–30%	3328 (14.6)	14.1, 15.0
30%–50%	1837 (8.0)	7.7, 8.4
≥50%	1210 (5.3)	5.0, 5.6
Weekly progression		
0%–10%	2242 (9.8)	9.4, 10.2
10%–30%	3368 (14.7)	14.3, 15.2
30%–50%	2033 (8.9)	8.5, 9.3
≥50%	5589 (24.5)	23.9, 25.0
Not available	1036 (4.5)	4.3, 4.8

[a] All training loads are based on the distance of each training activity extracted from global positioning system data.

DISCUSSION

This is the first study in which differences in calculations of estimated training sessions with significant increases in training load were investigated between the weekly training load method and the ACWR methods in recreational runners. With the use of the weekly training load method, the percentage of training sessions with significant increases in training load was almost 2 times higher than the coupled RA and EWMA methods (33% versus 16% and 19%) and 1.5 times higher than the uncoupled RA method (33% versus 26%). Almost half of the training sessions with significant increases in training load calculated by the weekly training load method showed a difference with the coupled RA and EWMA methods. Only one-third of the training sessions with significant increases in training load showed an overlap between the coupled RA, uncoupled RA, and EWMA methods.

We categorized the change in training load of each training session and reported that 16% to 33% of the training sessions were classified as significant increases in training load. These percentages were higher than the percentages calculated in a recent study, in which the association between the ACWR and RRIs was described.[23] That study included 435 runners with a median follow-up time of 26 weeks and reported a total of 5% to 15% of the ACWRs higher than 1.5.[23] A reason for this difference might be that Nakaoka et al used questionnaires to calculate training load with retrospectively collected

Table 3. Number of Training Sessions for Each ACWR Method (Coupled, Uncoupled, and EWMA)[a]

	Coupled ACWR		Uncoupled ACWR		EWMA	
	No. (%)	95% CI	No. (%)	95% CI	No. (%)	95% CI
<0.8	3167 (13.9)	13.4, 14.3	3730 (16.3)	15.9, 16.8	781 (3.4)	3.2, 3.7
0.8–1.3	13 111 (57.4)	56.8, 58.0	10 192 (44.6)	44.0, 45.3	13 050 (57.1)	56.5, 57.8
1.3–1.5	2872 (12.6)	12.1, 13.0	2819 (12.3)	11.9, 12.8	4692 (20.5)	20.0, 21.1
1.5–2.0	2511 (11.0)	10.6, 11.4	3231 (14.1)	13.7, 14.6	3508 (15.4)	14.9, 15.8
≥2.0	1178 (5.2)	4.9, 5.5	2678 (11.7)	11.3, 12.1	808 (3.5)	3.3, 3.8
Not available	0 (0.0)	0.0, 0.0	189 (0.8)	0.7, 1.0	0 (0.0)	0.0, 0.0

Abbreviations: ACWR, acute : chronic workload ratio; EWMA, exponentially weighted moving average.
[a] All training loads are based on the distance of each training activity extracted from global positioning system data.

data, which might have caused recall bias.[23] They also calculated ACWRs with the use of biweekly cumulative distance of running sessions, which may have smoothed training load variations over time.[23]

In recent years, the assessment of change in training load in athletes has been studied widely. A possible reason for the growing interest was the creation and further detailing of the ACWR.[17,19,38] Despite the great interest, no consensus has been reached on the preferred method to calculate change in training load. Furthermore, the utility of the ACWR has prompted significant discourse in scientific literature mainly related to potential biased estimates of the ACWR.[20,39,40] We found that almost half of the training sessions with significant increases in training load calculated by the weekly training load showed no overlap with the ACWR methods (coupled RA and EWMA methods). A reason for this high difference is likely that the weekly training load method calculates change in training load based on the training sessions performed in 2 weeks rather than the 4 weeks used in the ACWR methods. By using training sessions over a longer period, small differences in training load will have less impact on the ACWR. Moreover, an actual difference in cutoffs appeared, as the week-to-week progression of 30% is lower than the 1.5 used for the ACWR, resulting in more training sessions when weekly progression exceeds the cutoff for a significant increase in training load. Therefore, the ACWR methods might be more sensitive in identifying change in training load spikes using repeated measurements. Furthermore, smaller differences were seen between the 3 ACWR methods than the difference between the weekly training load method and ACWR methods. However, 24% and 17% of the training sessions with significant increases in training load found in the uncoupled RA and EWMA methods, respectively, still showed a difference compared with the other methods. While these ACWR methods are frequently reported in the literature as 1 method, considerable differences between the different methods to calculate these ratios exist.

In our study, we used the distance of each running activity to calculate training loads. We used distance because it is an accurate and objective variable to collect from GPS training data in runners.[11,12] High variability exists in the variables used to calculate training load since the rate of change in load may be more problematic than the absolute load experienced by an athlete.[16] Therefore, external loads (ie, the amount of external work performed by the athlete measured by kilometers ran or duration of training session) and internal loads (ie, internal response factors within the biological system, measured by the subjective rate of perceived exertion [sRPE]) can be combined to calculate training load.[8] In our study, no information on internal loads was collected. However, no consensus on which variables need to be considered exists.[16] Future research is needed to validate an appropriate method to calculate training load in runners and to examine which internal and external variables must be used.

Authors of only a few studies examined the association between change in training load and RRI risk. Traditionally,

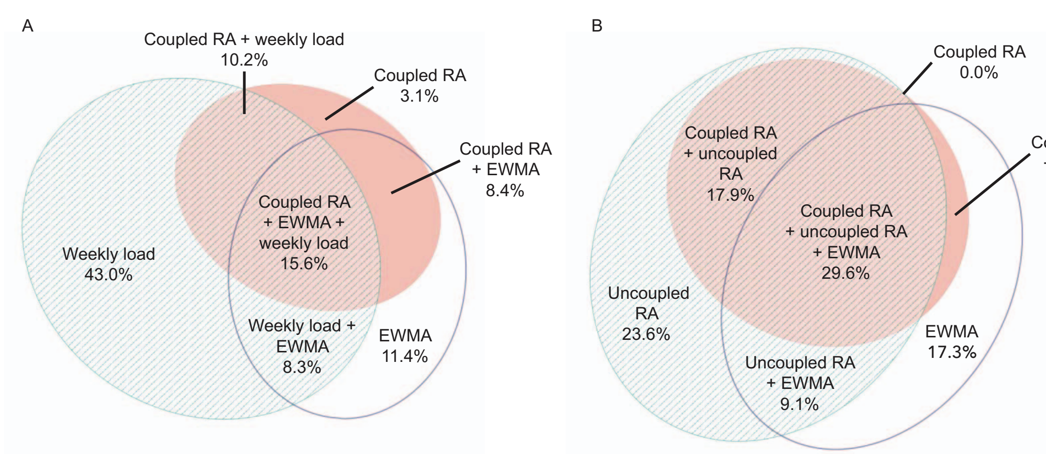

Figure 2. Proportional Venn diagram of training sessions with a significant increase in training load. A, Change in training load calculated by the weekly training load, coupled rolling average (RA), and exponentially weighted moving average (EWMA) methods (N = 9886). B, Change in training load calculated by the coupled RA, uncoupled RA, and EWMA methods (N = 7916). For the weekly training load, values ≥30% were regarded as a significant increase in training load.[15] For the RA and EWMA methods, values ≥1.5 were regarded as a significant increase in training load.[16,27]

runners have been advised not to increase their total training distance by more than 10% relative to the previous week.[41] However, a preventive randomized trial among novice runners found no effect of a graded 10%-rule training program on the number of RRIs.[14] Nielsen et al reported that runners who progressed their training distance by more than 30% seemed more vulnerable to sustain an RRI than runners who increased their running distance by less than 10%.[15] Authors who examined the association between the ACWR and running injury risk showed conflicting results.[21–24] Reasons for these conflicting results might be the differences in sample size, data collection (questionnaire or GPS data), and the methods used to calculate ACWRs. Dijkhuis et al calculated change in training load with the coupled RA method in a small study of 23 competitive runners with the use of questionnaires and expressed ACWRs as the combination of training duration and the sRPE.[21] They demonstrated that a fortnightly low increase of the ACWR (0.10–0.78) led to a 4.5-fold increase in injury risk, and a low increase (0.05–0.62) of the week-to-week ACWR difference between weeks 3 and 2 before an injury led to a 2.7-fold increase in injury risk.[21] Nakaoka et al calculated ACWRs with the use of a database composed of data from 3 studies in which questionnaires were used to collect the running distance and duration of 435 recreational runners and concluded that the higher the ACWR (uncoupled and coupled RA methods), the lower the risk of an RRI.[23] Also, no association was found between EWMA values and the risk for sustaining an RRI.[23] In another small study, Matos et al calculated training loads in 25 competitive male trail runners with the use of GPS data and calculated ACWRs for running duration, distance, and sRPE values separately.[22] They reported significant weekly increases in all ACWR measures in the weeks before the onset of an RRI.[22] In a recent study, Toresdahl et al calculated the number of days when the ACWR was greater than or equal to 1.3 or greater than or equal to 1.5 and showed that increases in training volume greater than or equal to 1.5 were associated with more injuries among runners training for a marathon.[24] The high variability of the previous studies makes it difficult to conclude if and how change in training load is associated with injury risk in runners. Therefore, future research on the complex relationship between training loads, the most sensitive method to calculate change in training load, and the risk for sustaining an RRI is needed.

A strength of this study was the large sample size of 430 participants who shared usable GPS training data with a total of 22 839 training sessions. To our knowledge, authors of only 1 other study collected this large amount of GPS training data to calculate change in training load in runners.[24] A limitation of this study was that participants who shared GPS data were more often males who had on average more running experience, were more often members of an athletic association, and more often used a training schedule compared with participants who did not share GPS data (Table 1). This could jeopardize the generalizability of this study. However, because our study purpose was to investigate differences in training load methods, this selective population was not expected to impact the study outcomes. Another limitation was that the ACWR is measured based on the training load of the previous 7 days and the previous 28 days per training session. Therefore, the first 27 days of data could not be used to calculate ACWRs. To calculate the change in training load of the same number of training sessions for the ACWR methods and weekly training load method, the first 27 days of data were removed for all methods. However, this decreased the amount of total data that we could use for calculating our outcome measure.

In conclusion, the difference in the calculated change in training load between the weekly training load method and ACWR methods (coupled ACWR and EWMA) was high. We found smaller differences between the 3 ACWR methods (coupled ACWR, uncoupled ACWR, and EWMA methods). To validate an appropriate measure of change in training load in runners, future research on the complex relationship between training loads, the most sensitive method to calculate change in training load, and the risk for sustaining an RRI is needed.

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SUPPLEMENTAL MATERIAL

Supplemental Table 1. Formulas and Definitions of the Methods Used to Calculate Change in Training Load[a]
Supplemental Table 2. Number of Training Sessions With a Significant Increase in Training Load Calculated by the Weekly Training Load, Coupled RA, and EWMA
Supplemental Table 3. Number of Training Sessions With a Significant Increase in Training Load Calculated by the Coupled RA, Uncoupled RA, and EWMA

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