Perceived Weekly Training Load and Soccer Specific Speed Performance

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ABSTRACT

*The study was done with an ultimate of unveiling how and to what extent perceived weekly training load (TL) correlate with linear sprinting speed, repeated sprinting ability (RSA) and Change-of-direction-speed (CODS). To this end, a correlational research design using bivariate and partial correlation was employed. Competitive soccer players (n=88) who were playing at the national league level (the third league level in Ethiopia) participated in the study. Internal load was measured using the rate of perceived exertion (RPE) scale for about five consecutive weeks. For this, each session load was calculated by multiplying the scale rated (the number which indicate the level of exertion) by the duration of the session. The specific finesses in question in the study as Linear speed and change-of-direction-speed was measured using 40m dash and 9-3-6-3-9 tests respectively. The 6*35m RSA testing method was used to measure the players` ability to produce the best possible sprinting over consecutive sprints with only a brief recovery time between the sprints. This was done for about five consecutive weeks. Thus, for each variable there were 440 observations. The study showed that linear sprinting speed had a small zero-order correlation (r (440) = -.292, p<.001) and non-significant partial correlation with TL. However, CODS has a moderate bivariate correlation (r (440) = -.350, p<.001) and a significant partial correlation (r (436) = -.162, p=.001). RSA average time had a significant moderate correlation with perceived training load (r (440) = -.317, p<.001. As that of linear sprinting speed, RSA has no significant partial correlation with perceived TL. Thus, it is concluded that, perceived TL can have a positive relationship with soccer specific speed performance parameters, though the relationship is highly dependent on moderating factors.*

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1. INTRODUCTION

Soccer is known for being one of the most demanding sports (Alghannam, 2013; Barnes, Archer, Hogg, Bush & Bradley, 2014). It is too demanding in terms of technical skill (Barnes et al., 2014). It requires the mastery of the most demanding skills which involve the coordination of eye-to-foot (Durate, Araujo, Vanda & Davids, 2012). The coordination commonly required in some multi-sprint team sports as handball and basketball is eye-to-hand coordination, which is relatively easy. Physically, contemporary soccer is well acknowledged that it is demanding or the players are highly taxed in aerobic and as well in anaerobic fitness (Bangsbo, 2014; Hoffman, Reed, Leiting, Chiang & Stone, 2014). Though the aerobic fitness is necessary to an extent, it is not that good in discriminating level of play or standard and success (Haddad et al., 2015; Johnston, Watsford, Pine & Spurrs, 2014; Schimpchen, Skorski, Nopp, Meyer, 2015; Tonnesen, Hem, Leirstein, Haugen & Seiler, 2013). It is only necessary to be developed to a certain level. However, the anaerobic fitness is the most important physical quality. It is one quality which is capable of discriminating different level of players. It is also capable of discriminating successful teams from unsuccessful teams, meaning that most successful teams showed to possess superior anaerobic qualities. This way, sprinting speed, agility, change-of-direction-speed (CODS), explosive power, strength and repeated sprinting ability (RSA) are the commonly observed anaerobic qualities in competitive soccer. Considering the invaluable role of speed and speed related qualities, a lot can be done. As part of seeking speed or speed related quality talent identification even should pay a due emphasis on speed ability (Dodd & Newans, 2018). A lot of scientific publications confirmed that speed is among the most critical fitness quality at any phase of the game (Faude et al., 2012). The action of defending or attacking situations can be handled effectively if the players possess good sprinting ability. Most of those world class players in the contemporary soccer are highly equipped with these qualities. Ronaldo C, Messi, L Neymar J. Mane S, Sterling R, or Mabpe K, are well known for their astonishing speed quality. Straight-line sprinting velocity, agility and repeated-sprint ability are physical fitness which is capable to distinguish groups from different performance levels (Haugen, Tønnessen, Hisdal & Seiler, 2014). Professional players have become faster over time, indicating that sprinting skills are becoming more and more important in modern soccer (Haugen et al., 2014). The so-called quality RSA is the ability of the players to produce the best possible sprinters over consecutive runs. It is a relevant fitness parameter, because players are required to have several sprints during a course of a match (Rivilla et al., 2019). As such, most decisive moments during match rely on the players' ability to produce repeated sprints (Girard, Mendez- Villanueva & Bishop, 2011). For example, scoring and assisting players during attacking moment are inherently expected to sprint (Faude, Koch, & Meyer, 2012). A lot of attacking moments are common within a 90-minute match play. Thus, the ability to produce quality sprint is most important to handle these situations. A lot of factors are shown to be contributing to linear speed, RSA and CODS performance. Linear sprinting speed, strength and explosive power are some of the contributing factors (Lopez-Segovia, Pareja-Blanco, Jimenez-Reyes & Gonzalez-Badillo, 2015; Dardouri et al., 2014). In addition to the anaerobic factors, aerobic fitness is shown to be one determining factor for RSA performance (da Silva, Gugliemo & Bishop, 2010). The ability to recover during the brief recoveries which are inherent (common) with most RSA test protocols is a significant limiting factor. The ability to refuel the muscle with the necessary substance which enables to produce good muscle contraction is one limiting factor with RSA. It is also dependent on the muscles ability to clear the metabolites which are limiting factors for the subsequent sprints. All these indicate how trainable RSA as a fitness element is. Thus, both aerobic and anaerobic kind of training can impact RSA performance to an extent (da Silva et al., 2010). Different training protocols (regimens) are studied and recommended to improve and maintain linear speed and RSA performance of soccer players (Beato, Bianchi, Coratella, Merlini & Drust, 2017; Cipryan, Tschakert & Hofmann, 2017; Negra et al., 2018). Additional trainings in addition to the common soccer specific training are suggested for speed or RSA to develop further and to be maintained (Beato et al., 2017). However, the basic question relies on how much TL is productive for speed and RSA? This is because that overload and under-load are associated with performance decline and increased risk of injury (Cross, William, Trewartha, Kemp & Stokes, 2016; Malone et al., 2018; Moreira et al., 2013). Therefore, the ultimate purpose of this study was to examine how perceived weekly TL relates with linear speed, RSA and CODS performance. Though adequate workload is seen as a prerequisite to improve player`s fitness (Malone et al., 2017; Malone et al., 2018), how much TL is optimal is not straightforward for practitioners. Thus, the relationship of TL with these crucial qualities is not that elucidated. Some of the studies done on the area showed inconsistent findings. Some claimed that higher training load and fitness are inversely related (Cross et al., 2016; Malone et al., 2017), while others associate TL with positive outcome (Brink, Nederhof, Visscher, Schniki & Lemmink, 2010; Gabbett, 2016). Basically, little is known about the impact of load imposed on players and the changes in fitness across a season (Haugen, 2018). Therefore, the study was done with a prime purpose of how perceived TL relates with linear sprinting speed, RSA and CODS.

Objective of the Study

The study was done with an ultimate of unveiling how and to what extent perceived weekly training load (TL) correlate with linear sprinting speed, repeated sprinting ability (RSA) and Change-of-direction-speed (CODS).

2. METHOD

A correlational research design with a bivariate and partial correlation analysis has been employed in the study. Competitive soccer players (n=88) who were playing at the third level of Ethiopian soccer league (National League) participated in the study. The study protocol involves the measurement of perceived weekly training load (TL), linear speed over 40m dash, RSA in 6*35m and CODS in the 9-3-6-3-9 test protocol weekly for about five consecutive weeks during the in-season.

Perceived Training Load (TL)

As one of the main variables with this investigation, load was measured on a daily basis. The continuous and extended use of RPE for measuring internal load is so recommended (Aughey et al., 2016). Generally, RPE training load quantification is more effective than HR-based methods to predict changes in performance in soccer players (Figueirdo, Moreira, Goncalves & Dourado, 2019), because RPE load measurement acknowledges individual capacity (Rago, Brito, Figueredo, Krustrup & Rebelo, 2019). For this, the players were rating their perceived exertion (load) with the Borg`s scale (Borg CR10) on daily basis (for each training session). Thus, players used any number on the scale to rate their exertion (perceived load) within 20-30 minutes after the session as described by Foster et al., (2001). Then this number was multiplied by the duration of the session in minutes. Thus, the product of the session-RPE and the duration of the training session were defined as the training load (TL). A rating of zero on the scale was associated with no effort (rest) and a rating of 10 considered the maximal effort and associated with the most stressful session. This way as a procedure each player`s Session- RPE was collected about 20-30 minutes after each session to ensure that the perceived exertion is referring to the whole session rather than the most recent exercise intensity.

While TL assessment via heart rate (HR) measures is well accepted in endurance sports, this method is questionable in team sports since the overall TL often comprised of workouts that do not include a significant cardiorespiratory component (e.g. strength or speed training) (Borresen, & Lambert, 2009). For this reason, the use of rating of perceived exertion (RPE) based method has emerged as a practical and valid method of estimating TL in team sports (Figueirdedo et al., 2019; Impellizzeri, Rampinini, Coutts, Sassi & Marcora, 2004). Recent studies even use RPE with elite soccer players (Brito, Hertzog & Nassis, 2016; Rago et al., 2019). Humans are equipped with the best monitoring tool (i.e., their brain) for perception of training, quantifying internal training load, expressing the feeling of negative adaptations to training, and impairment of psychophysiological processing in term of function since the brain integrates all the information from the periphery of the body and the state of the body homeostasis (Baron, Moullan, Deruelle & Noakes, 2009). Generally, the reliability and internal consistency of RPE as indicator of intensity is good despite any possible influence of any contributing factor (Haddad et al., 2015; Weston et al., 2015).

Before the beginning of data collection, the players were oriented and familiarized with the scale. In the procedure, the players were shown the scale and asked "how hard was your workout?" and they gave a single number on the scale which best expresses their level of exertion (perceived load).

3. TESTING METHOD AND PROCEDURE

1) 40-m Dash Linear Sprinting Speed

40-meter dash was the distance and the protocol to measure the sprinting speed of the players. Three trials were given for each player with an adequate recovery time of 7-9 minutes between the trials. The best time among the trials has been taken as a score for analysis. This has been done for five consecutive weeks. The 40-m dash linear speed test is useful to provide information about independent speed quality and also it is a commonly used testing method to assess linear speed of trained soccer players (Buchheit, Simpson, Peltola & Mendez-Villanueva, 2012).

2) Repeated sprinting ability (RSA)

The 6*35m RSA testing method was used to measure the players` ability to produce the best possible sprinting over consecutive sprints with only a brief recovery time between the sprints. The researcher used this specific RSA testing method following Bishop and colleagues (2011) and Bongers et al. (2015) recommendation. Here with this physical fitness quality, the aim was not only to measure how speedy were the players, but it was all about measuring the ability to produce the best possible sprint performance over a series of sprints in 35-m separated by short recovery periods of only 25-seconds. Therefore, the RAST (Running-based anaerobic sprint test), which involves 6*35m with 25 seconds recovery in between sprints was used. Because, it was such soccer specific RSA test (Zaggatto, Beck & Gabbatto, 2009).

3) CODS

Concerning which agility tests are the most valid for the planned agility of soccer players, Sporis et al. (2010) found that, sprint 9-3-6-3-9 m with backward and forward running (SBF) is among the most valid and reliable tests (i.e., α=0.949). As a result, this test was used in this research to measure planned agility performance of the players. The distance the player has to cover was 24m with forward sprinting and 6 m with backward running. Most sprints in soccer game are linear but the test that was used in this study better goes parallel with the point that the actions do not involve 90- or 180-degree sharp turn.

4. RESULT

Demographic Characteristics of the Participants

The demographic information includes chronological age, training age, weight and height of the players. The data was collected by measuring the attributes (height and weight) and by asking the players via questionnaire to self-report the exact time of their birth and when they start participating in soccer training (age and training age). Regarding the players demographics, table 1 summarizes the descriptive results.

Table 1

Descriptive Summary of Players Demographic Characteristics

	N	Minimum	Maximum	Mean	Std. Deviation
Age	88	18.00	30.00	22.25	2.27
Training Age	88	4.00	18.00	9.38	2.78
Weight	88	52.00	74.50	63.78	5.33
Height	88	150.00	185.00	172.90	6.28

The mean of the players` chronological age was M = 22.25 (SD = 2.27) years with a corresponding mean training age of M = 9.39 (SD = 2.78) years (table 1). In terms of their weight and height, the players` had a mean weight of M = 63.78 ± (SD = 5.33kg) and a mean height of M = 172.90 (SD = 6.28cm). Compared to their age variability, the players` had higher weight and height variability that is SD of 5.33 and 6.28, respectively.

The Relationship of Perceived TL with Soccer Specific Anaerobic Fitness Parameters

The correlation which is supposed to exist between perceived weekly TL and soccer specific fitness qualities is examined using bivariate (zero-order) and partial (first-order) correlation tests (table 2 and 3).

Table 2

The bivariate correlation of TL with Speed, RSA & CODS performance scores in seconds

		Speed	CODS	RSA Average
TL	Pearson Correlation	-.292**	-.350**	-.317**
	Sig. (2-tailed)	.000	.000	.000
	N	440	440	440

**. Correlation is significant at the 0.01 level (2-tailed).

Using a zero-order correlation, TL has such a significant relationship with linear speed over 40m dash and CODS score in 9-3-6-3-9 test as the correlation is r(440) = -.292, p<.001 and r(440) =

-.350, P<.001 respectively (table 2). The same way, RSA average time had a significant moderate level of relationship with TL (r (440) = -.317 respectively (table 2). The players who perceived and reported higher TL performed well in all the tests of linear speed, CODS and RSA, meaning that the higher the perceived load the less the time taken to cover the distance.

Table 3

The Partial Correlation of TL with Linear Speed, CODS and RSA

		Speed	CODS	RSA
TL	Correlation	.025	-.162	-.077
	Significance (2-tailed)	.604	.001	.109
	df	436	436	436

**. Correlation is significant at the 0.01 level (2-tailed).

The relationship of perceived weekly TL with that of linear speed, CODS and RSA performance was also examined using partial correlation. Here the effect of the moderating variables was controlled when each anaerobic fitness parameter association with TL is examined.

From the partial correlation test it was found that both linear speed and RSA do not have a significant correlation with perceived TL when the moderating variables are controlled. The correlation which was significant when the moderating variables were not controlled does not exist here when they are controlled. But the correlation between CODS and TL r (436) = -.162, p=.001 (table 3) is significant though it is smaller than the zero-order correlation r (440) = -.350, p<.001 versus r (436) = -.162, p=.001). Thus, the effect of the moderating variables (the moderating effect of one over the other) was greater.

The Interdependence among Speed, CODS and RSA Performance

These fitness qualities are generally believed to have a relationship as they all mainly rely on the anaerobic energy pathway and they involve explosive movements for a brief time. However, the exact relationship that they have with each other is not clear and consistent. The test protocols even are different enough. Here these fitness qualities are examined about how they relate each other and how significant and strong is their relationship.

Table 4

The correlation of Speed with CODS and RSA

		Linear Speed	CODS	RSA
Linear Speed	Pearson Correlation		.904**	.901**
	Sig. (2-tailed)		.000	.000
	N		88	88
CODS	Pearson Correlation	.904**		.872**
	Sig. (2-tailed)	.000		.000
	N	88		88

**. Correlation is significant at the 0.01 level (2-tailed).

The bivariate relationship between linear sprinting speed and CODS was significantly very strong r (86) =0.904, p<0.001 (table 4). The same thing is true that there is a strong positive relationship between linear speed and RSA (r (86) = .901, p<.001) and between CODS and RSA (r (86) = .872, p<.001).

5. DISCUSSION

The study was conducted aiming to identify the relationship of perceived TL with that of linear speed, RSA and CODS performance scores. So as to find out the real practical relationship of TL with RSA performance measures, both the zero-order correlation and partial correlation was examined.

As a matter of fact, the trainability of sheer speed or linear sprinting speed is limited. Genetic make-up and the dominant muscle fiber type, which is an endowed quality, is the greatest determining factor for sprinting performance. Training and other modifiable factors can take only a small portion of it. Linear speed, RSA CODS however, found to have a moderate level of inverse correlation with TL. This implies that higher perceived TL is associated with a decrease time to cover the distance and movement in the test. When players report higher perceived weekly TL, the total time they took to cover the 40m dash, 9-3-6-3-9 FB and the 6*35m test was lower.

Generally, TL is associated with increased linear sprinting speed, CODS and RSA performance of the players during the in-season. In parallel with this finding Malone et al. (2017) came up with the same result, which indicated the positive effect of higher TL during the in-season. This is because that higher TL might be a significant stimulus to impact fitness. Increased fitness can be associated with increased ability to tolerate even higher TL, which in turn improves sport specific fitness. This, in another way helps the players to be capable of withstanding the highest possible TL and can gain an advantage of realizing the highest possible adaptation. The effect of any training is on either aerobic capacity or anaerobic quality or on both simultaneously. Thus, the effect of higher

TL in this regard can potentially be substantial on both the aerobic and anaerobic segment. Since RSA performance can benefit from both aerobic (da Silva et al., 2010 and anaerobic adaptation (Ingebrigtsen et al., 2014; Wierike et al., 2014), the effect of higher TL can be too significant and so does the relationship. However RSA is more related with anaerobic quality and that is the reason for vertical jump and sprinting speed to be big factors for RSA (Ingebrigtsen et al., 2014; Kenney et al., 2015). Thus, the greater relationship of RSA with anaerobic qualities (less trainable relatively) make the relationship not to be large or very large.

However some findings come up with a negative relationship between TL and performance (Cross et al., 2016; Malone et al 2017). The reason for this is that these studies conducted on players who were having a congested schedule and highly competitive athletes. But this study was done with soccer players who were only having 1 match per week or in two weeks. They were not having any kind of additional tournament, or some other matches with national teams or regional teams. They were not susceptible to any congested fixture. Instead they may be playing fewer games per season than they are expected to have based on their maturity level (age). Thus, the relationship of higher training with a better linear sprinting, CODS and RSA performance is convincing and practically existing.

The relationship that TL had with linear speed, CODS or RSA performance parameters is highly dependent on other moderating factors. The relationship that each parameter has with one another highly impacts the nature of the relationship that they had with TL. For instance, linear sprinting speed and CODS are highly related physical qualities (Spittle et al., 2013). Moreover they both are dependent on maturity level of the players (Bishop et al., 2019; De Mascio et al., 2017; Selmi et al., 2018). The basic fact in relation with TL is that, the ability of players to tolerate TL highly depends on their maturity level. This means that, as maturity peaks the players' capacity to tolerate higher training load improves. Therefore, the effect of maturity to withstand higher TL and the subsequent adaptation for training exposure can immensely impact speed, RSA and CODS performance. Here with this study the small bivariate and non-significant partial correlation of TL with linear sprinting speed and RSA can however be accounted to the un-trainability of speed (i.e., it relies more on genetic make-up). The finding in this regard with this study otherwise is too convincing.

To an extent, CODS relies on some other qualities as perception, movement control, and techniques in relation with foot placement and stride adjustment (Spittle et al., 2013; Shepard et al., 2014; Young et al., 2015). These technical qualities are believed to be highly trainable through specifically designed training regimens. Still the effect of strength on CODS performance is highly acknowledged (Spittle et al., 2013), which can be improved through strength training. The finding with this study also goes in parallel with these findings. The moderate level of bivariate correlation and small level of partial correlation between perceived TL and CODS performance indicated the relative trainability of CODS than linear sprinting speed and RSA.

Recent findings on the matter confirmed that the effect of TL on RSA is of bidirectional. When training is extended and intensive the impact can be significant on the aerobic fitness and the ability to get rid-off performance limiting metabolites. This (aerobic fitness) is a significant factor for RSA as it can improve the ability of the muscle to recover between the sprints. Players with aerobic fitness showed a better recovery during the brief recovery times (da Silva et al., 2010). The other way that TL relates with RSA is that, the improvement of anaerobic qualities as strength, power and linear speed is transferable to RSA performance improvement (Azziz et al., 2007; Castagna et al., 2007; Lopez-Segovia et al., 2015; Dardouri et al., 2014). Therefore, the relationship of TL with the players RSA performance is persuasive.

6. CONCLUSION

Linear sprinting speed, CODS and RSA performance has a direct relationship with the level of TL players perceive. Higher TL is one important factor for the maintenance and improvement of these qualities during the in-season. CODS is such a trainable attribute of competitive soccer players than linear speed or RSA to an extent. The level of correlation that TL has with linear speed, CODS and RSA is not that negligible, because trained soccer players are resistant to change in performance. The small to moderate level of relationship between TL and linear speed, CODS or RSA is an indicator of how important to ensure the highest possible individual based TL to further improve and maintain RSA performance. CODS and RSA are not as training resistant as linear sprinting speed.

The association of CODS with the level of weekly TL is moderate. Though the effect of the moderating was controlled, the relationship was significantly existent. This means that change-of-direction-speed is relatively sensitive and responsive to training load soccer specific fitness quality.

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