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Is There a Difference in Muscle EMG Activity and Morphology Between Black and White People?

Beyaz ve Siyah Irk Arasında Kas EMG Aktivite Özellikleri ve Morfolojisi Açısından Fark Var mıdır?

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ABSTRACT

Objective: To measure differences in reaction time and morphology of the peroneus longus and tibialis anterior muscles between black and white people.

Materials and Methods: Twenty-five healthy recreational male athletes (12 black, 13 white) were enrolled in this study. Electromyographic activity parameters (reaction time, reaction duration and reaction magnitude) of the muscles were measured using an ankle supination tilting platform. There were four different supination conditions: (a) ankle neutral, 15° inversion (0015), (b) ankle neutral, 30° inversion (0030), (c) ankle 20° plantarflexion, 15° inversion (2015), and (d) ankle 20° plantarflexion, 30° inversion (2030). Morphology (pennation angle, fascicle length and muscle thickness) was evaluated by means of ultrasonographic measurements.

Results: Only the reaction duration of the tibialis anterior muscle in the 0015 ($p=0.030$) and 0030 ($p=0.039$) positions and the reaction magnitude of the peroneus longus ($p=0.046$) and tibialis anterior ($p=0.003$) muscles in the 0015 condition were significantly higher in white subjects. These parameters were not significantly different in 2015 and 2030 supination conditions ($p>0.05$). Neither peroneal nor tibial muscle latency were significantly different between ethnicities in any of the four supination conditions ($p>0.05$). Similarly, besides the different fascicle length values of the tibialis anterior muscle in the contracted condition ($p=0.011$), all other muscle morphological features (muscle thickness and pennation angle) of peroneus longus and tibialis anterior muscle were similar among the ethnicities ($p>0.05$).

Conclusion: The results of this study did not reveal differences in electromyographic activity or muscle morphology of the peroneus longus and tibialis anterior muscles between black and white people.

Key Words: Ethnic differences, muscle fascicle length, muscle pennation angle, peroneal reaction time, tibial reaction time

ÖZ

Amaç: Siyah ve beyaz ırk arasında peroneus longus ve tibialis anterior kaslarındaki reaksiyon zamanı ve morfolojisindeki farklılıkları araştırmak.

Gereç ve Yöntemler: Çalışmaya sağlıklı ve rekreasyonel düzeyde spor yapan 25 erkek denek katıldı (12 siyah ve 13 beyaz). Elektromiyografik aktivite parametreleri (reaksiyon zamanı, reaksiyon süresi ve reaksiyon büyüklüğü) ayak bileği burkulma platformu yardımı ile ölçüldü. Dört farklı burkulma simülasyonu yapıldı: (a) ayak bileği nötralde, 15° inversiyon (0015), (b) ayak bileği nötralde, 30° inversiyon (0030), (c) ayak bileği 20° plantar fleksiyonda, 15° inversiyon (2015), ve (d) ayak bileği 20° plantar fleksiyonda, 30° inversiyon (2030). Kas morfolojisi (pennasyon açısı, fasikül uzunluğu, kas kalınlığı) ultrasonografik ölçümler ile değerlendirildi.

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Bulgular: Sadece 0015 (p=0.030) ve 0030 (p=0.039) durumlarında tibialis anterior kasındaki reaksiyon süresi ve 0015 durumunda peroneus longus (p=0.046) ve tibialis anterior (p=0.003) kasındaki reaksiyon büyüklüğü beyaz ırkta anlamlı olarak daha fazla idi. Bu parametreler 2015 ve 2030 durumlarında anlamlı olarak farklı değildi (p>0.05). Bunun yanı sıra, dört burkulma durumunda da peroneal ve tibial kas reaksiyon süresi ırklar arasında farklı değildi (p>0.05). Benzer şekilde, maksimal kasılı durumdayken tibialis anterior kasındaki fasikül uzunluğu farklılığı dışında (p=0.011), peroneus longus ve tibialis anterior kaslarına ait tüm diğer kas morfolojisi özellikleri (kas kalınlığı ve pennasyon açısı) ırklar arasında benzerdi (p>0.05).

Sonuç: Bu çalışmanın sonuçları, genel olarak peroneus longus ve tibialis anterior kaslarında yapılan elektromiyografik aktivite ve kas morfolojisi değerlendirmeleri bakımından siyah ve beyaz ırklar arasında bir farklılığın olmadığına işaret etmektedir.

Anahtar Sözcükler: Irksal farklılık, kas fasikül uzunluğu, kas pennasyon açısı, peroneal reaksiyon zamanı, tibial reaksiyon zamanı

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INTRODUCTION

Ankle injuries are one of the most common injuries in competitive sports and recreational activities. More than 70% of ankle injuries in many sports are ankle sprains (1,2). Inversion sprains account for approximately 85% of ankle sprains (1,2). Possible contributing factors for ankle sprains are impaired proprioception (3,4), postural control (5,6), muscle strength (7,8), and prolonged peroneal reaction time (9-11). When the ankle is suddenly inverted, the peroneal and tibialis anterior muscles create a dynamic defense mechanism to protect against a lateral ankle sprain. The temporal latency between sudden inversion of the ankle and the first reflexive contraction of the peroneal or tibialis anterior muscles is defined as the reaction time of the peroneus longus or tibialis anterior muscle. Many studies have shown prolonged muscle reaction time in subjects with recurrent ankle sprains (9-13). On the other hand, it was stated that a longer peroneal reaction time may increase the risk of both primary and recurrent ankle inversion sprains (14).

Ankle sprain injuries have a peak incidence between 15 and 19 years of age (15). According to the vast majority of studies, the incidence of inversion sprains is not significantly different between female and male genders (15-17). Furthermore, since inversion sprains are frequently sustained during sports activities, they occur mostly in persons less than 50 years of age, but have been reported in elderly persons as well (18). In addition to these epidemiological data about ankle sprains, there are no known reports of differences in ankle sprain risk factors by ethnicity or race.

There are studies in the literature revealing variations in body composition and muscle mass between black and white people. It was previously shown that body composition and muscle mass may vary between black and white people (19-22). Hanson et al. (20) found a larger psoas major muscle size in black males than in white males. The results of the study by Ama et al. (23) indicated a higher percentage of type I muscle fiber in white males and a higher rate of type IIa muscle fiber and anaerobic enzyme activity in black males. There is also evidence of ethnic differences in cardiorespiratory fitness showing superior sprint or anaerobic capacity performances in black adults (24,25). On the other hand, Abe et al. (26) found greater muscle thickness of the biceps brachii, abdominal and upper portion of the quadriceps and hamstring muscles in blacks compared with whites, whereas fascicle length and pennation angle of the vastus lateralis, long head of the triceps and gastrocnemius medialis muscles were not significantly different between ethnicities.

Taking into account the fact that the amount of fast twitch skeletal type II muscle fibers is higher in blacks, we hypothesized that the reaction to sudden inversion perturbation in the peroneal or tibialis anterior muscles would also be different in blacks. In this sense, muscle reaction to sudden ankle inversion perturbation may represent differences between ethnicities. This topic has not been investigated before. Therefore, the primary aim of this study was to explore differences in peroneal and tibial muscle reaction properties (muscle latency, reaction magnitude and reaction time), which is one of the risk factors for ankle sprains. The secondary aim of this study was to explore the differences in the morphology of the peroneus longus and tibialis anterior muscles between black and white people.

MATERIALS and METHODS

Subjects

Twenty-five healthy recreational male athletes, including 12 black men (mean age, 24.0±3.4 yr; mean height, 176.1±5.8 cm; mean body mass, 72.6±12.2 kg; mean body mass index, 23.3±3.3 kg/m^2) and 13 white men (mean age, 24.2±2.3 yr; mean height, 177.1±5.7 cm; mean body mass, 72.3±8.0 kg; mean body mass index, 23.0±1.7 kg/m^2), were enrolled in this study. Inspected anthropometric features were not significantly different between groups ($p<0.05$). All of the 25 subjects enrolled in this study were regular participants in recreational sports, such as running, soccer, or basketball, which they played one to two times a week for durations of 30-60 min. Black subjects were born and lived in African countries such as Tanzania, Guinea-Bissau, Kenya, Kongo, Uganda and Ethiopia. White subjects were born and lived in Turkey.

Participants were excluded from the study if they met the following criteria: had or experienced an ankle sprain, low back- or lower extremity dysfunction, any ankle surgery or fracture or any occurrence of "giving way," complained of pain, swelling, or functional limitations in the ankles, or took part in any therapeutic exercise for the ankles within the preceding 12 months. All of the study participants had no mechanical ankle instability prior to participating in the study according to anterior drawer and talar tilt tests performed by the same clinician. Measurements were all performed on the dominant leg. To be consistent with previous research studies, the leg that the participant uses to naturally kick a ball was defined as the dominant leg (6,27). Afterwards, the subjects read and signed the informed consent form about the test procedures, and any possible risks and discomfort that might ensue that were approved by the University's Institutional Ethical Board for Protection of Human Subjects (Approval number: 2015-7/13).

Experimental Protocol

All testing protocols were performed on the same day. Muscle architecture evaluations of the peroneus longus and tibialis anterior muscles through ultrasound were performed at first. Subsequently, electromyographic (EMG) activity parameters were measured.

EMG Activity Measurements

EMG activity parameters (muscle latency time, muscle reaction duration and muscle reaction magnitude) recorded for the peroneus longus and tibialis anterior muscles via a portable 8-channel Muscle Tester™ device (ME6000, Mega Electronics, Kuopio, Finland) were measured using an ankle supination tilting platform. Bipolar pre-gelled Ag/AgCl surface electrodes (Covidien-Kendall™ electrodes with a 0.8 cm silver-silver chloride disks; Covidien LP, Mansfield, USA) were used to record EMG from these muscles. There were four different supination conditions: (a) ankle in neutral position and 15° inversion (0015), (b) ankle in neutral position and 30° inversion (0030), (c) ankle in 20° plantar flexion position and 15° inversion (2015), and (d) ankle in 20° plantar flexion position and 30° inversion (2030). A detailed description of the same custom-built trap door mechanism, subject positioning, skin preparation, electrode placement over the muscles of the peroneus longus and tibialis anterior, signal amplification, storage in the microcomputer, sampling of the analog EMG signal, testing procedure, and normalization of the EMG amplitude was published previously by Sekir et al. (28) and Keles et al. (29).

After testing, the raw EMG amplitudes (mV) from the data transmitted to a personal computer were calculated automatically using the ME6000 software (MegaWin v3.1, Mega Electronics). The stored raw EMG data were expressed by the software as absolute root mean square amplitude values (mVs). The criterion for the onset of EMG activity of the muscles during sudden ankle inversion was an increase in the signal to greater than twice the noise level. Similarly, offset of the EMG activity was determined when the EMG signal returned to the noise level (Figure 1).

The time interval between the moment of ankle inversion to the first EMG response was defined as the muscle latency time. The time interval between the first EMG response and the offset of the EMG activity was defined as the muscle reaction duration. Finally, the magnitude of the muscle reaction was obtained from the EMG activity amplitude between the onset and offset times (Figure 2). This value was normalized against the maximal voluntary contraction trial that yielded the highest peak torque value during the isometric ankle dorsiflexion and eversion contractions. Mean muscular magnitude for the peroneus longus and tibialis anterior muscles was expressed as the percentage (%MVC) of the amplitude values.

Ultrasound Measurements

Architecture parameters of the peroneus longus and tibialis anterior muscles were evaluated by an ultrasound (US) system (SonoScape Co. Ltd., Model S2, China) with a linear array probe (60 mm, 5-10 MHz) by the same physician. Muscle thickness, fascicle length and pennation angle were the outcome measures for the evaluation of muscle architecture. All subjects were in the supine position with knees extended and ankles in the neutral position. Measurements were obtained with muscles in the fully relaxed and maximally isometric contracted conditions. Images for the peroneus longus muscle were obtained distal to the caput fibula at the superior lateral side of the dominant leg where the muscle belly was palpable. Images for the tibialis anterior muscle, on the other hand, were obtained at the superior 2/3 part of the lower leg and 1 cm lateral to the anterior border of the tibia. The probe was held with a light touch, not to form any muscle deformation; in the longitudinal, sagittal plane parallel to muscle fibers direction during muscle architecture parameter evaluations.

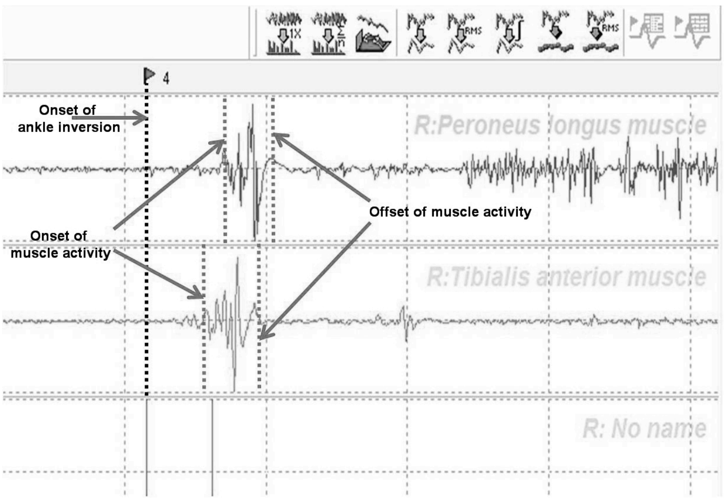

Figure 1. The cut-off levels of the EMG activity during ankle supination

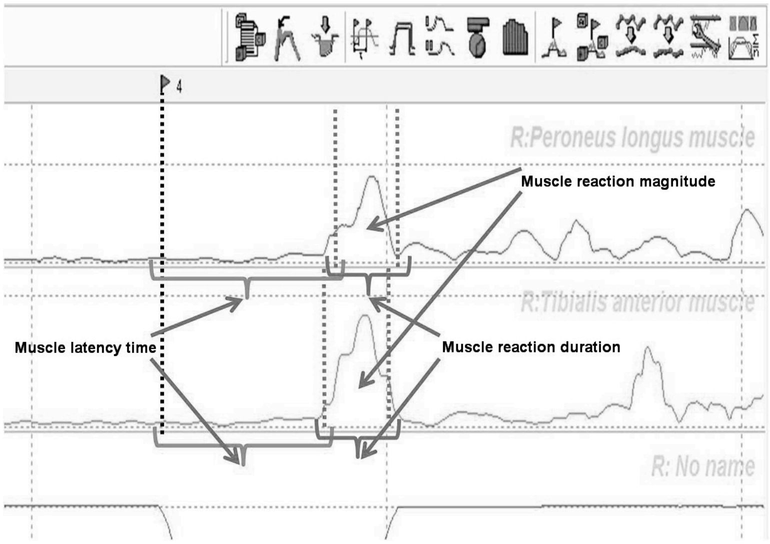

Figure 2. Measured EMG activity parameters during ankle supination.

Figure 3. Ultrasonographic imaging of the peroneus longus muscle demonstrating the measurement of muscle thickness, fascicle length, and pennation angle in **(a)** relaxed and **(b)** contracted condition.

Muscle thickness was determined as the distance between the superficial and deeper aponeurosis. Pennation angle was calculated from the insertion of the muscle fascicle to the aponeurosis. Finally, fascicle length was determined as the length of the fascicular path between the upper and deeper aponeurosis (Figure 3). When fascicles extended off the acquired image, then the panoramic mode of the software was used. The mean value of two measurements for each muscle architecture variable was calculated and was considered for statistical analysis. All the three measured US parameters were divided by the body mass index (BMI) of each subject, in the aim to provide standardization/normalization among subjects.

Statistical Analysis

Statistical analysis was performed using the SPSS v16.0 (SPSS Inc, Chicago, Illinois, USA) software. Means and standard errors of the mean were used to describe all variables. All tests were two-tailed, and the level of significance was set at $p<0.05$. Power analysis was performed based on reported values of other studies. According to the analysis, n1 and n2 group sample sizes of 12 would have 95% power to detect a mean difference of 8.0 and a SD of 3.4 at the 0.05 significance level (α). Statistically significant differences between the groups for the normally distributed and skewed data according to the Shapiro-Wilk test were analyzed using Student's t-test and Mann-Whitney U test, respectively.

RESULTS

Only the reaction duration of the tibialis anterior muscle in the 0015 (66.5 ms in white men and 46.5 ms in black men, p=0.030) and 0030 (52.2 ms in white men and 35.5 ms in black men, p=0.039) conditions and the reaction magnitude of the peroneus longus (30.4% in white men and 18.8% in black men, p=0.046) and tibialis anterior (11.9% in white men and 5.2% in black men, p=0.003) muscles in the 0015 condition were higher (p<0.05) in white subjects (Table 1 and 2).

Table 1. Muscle reaction duration in white and black subjects

Parameter	White	Black	p value
Peroneal			
PRD0015 (ms)	62.5 ± 7.3	52.4 ± 4.8	0.260
PRD0030 (ms)	48.2 ± 6.4	43.2 ± 5.8	0.568
PRD2015 (ms)	50.2 ± 7.3	47.3 ± 5.2	0.756
PRD2030 (ms)	54.5 ± 4.9	44.2 ± 5.4	0.167
Tibial			
TRD0015 (ms)	66.5 ± 5.6	46.5 ± 9.1‡	**0.030**
TRD0030 (ms)	52.2 ± 6.4	35.5 ± 3.9‡	**0.039**
TRD2015 (ms)	57.8 ± 5.5	46.1 ± 7.4	0.220
TRD2030 (ms)	57.2 ± 4.2	47.1 ± 5.4	0.154

PRD: Peroneal reaction duration; TRD: Tibial reaction duration; 0015: neutral, 15° inversion; 0030: neutral, 30° inversion; 2015: 20° plantarflexion, 15° inversion; 2030: 20° plantarflexion, 30° inversion. Results as Mean ± SEM; ‡: p<0.05 (between groups)

Table 2. Muscle reaction magnitude in white and black subjects

Parameter	White	Black	p value
Peroneal			
PRM0015 (%MVC)	30.4 ± 4.9	18.8 ± 2.2‡	**0.054**
PRM0030 (%MVC)	24.1 ± 4.8	18.4 ± 4.2	0.672
PRM2015 (%MVC)	19.8 ± 3.3	15.7 ± 2.0	0.395
PRM2030 (%MVC)	18.7 ± 3.0	14.6 ± 1.3	0.352
Tibial			
TRM0015 (%MVC)	11.9 ± 2.0	5.2 ± 0.9‡‡	**0.006**
TRM0030 (%MVC)	8.2 ± 1.6	5.3 ± 1.8	0.115
TRM2015 (%MVC)	10.1 ± 1.6	8.6 ± 1.5	0.335
TRM2030 (%MVC)	10.0 ± 1.8	7.2 ± 1.5	0.207

PRM: Peroneal reaction magnitude; TRM: Tibial reaction magnitude; 0015: neutral, 15° inversion; 0030: neutral, 30° inversion; 2015: 20° plantarflexion, 15° inversion; 2030: 20° plantarflexion, 30° inversion; MVC: Maximal voluntary contraction. Results as Mean ± SEM; ‡: p<0.05, ‡‡: p<0.01 (between groups)

These parameters were not significantly different between the 2015 and 2030 supination conditions (p>0.05). Additionally, no significant differences were found in peroneal or tibial muscle latency between both ethnicities in all four supination conditions (p>0.05, Table 3). Similarly, except for the different fascicle length values of the tibialis anterior muscle in the contracted condition (50.6 mm and 2.25 mm/BMI in white men and 41.9 mm and 1.78 mm/BMI in black men, p= 0.011 and 0.013, Table 4), all the other muscle morphological features (muscle thickness and pennation angle) of the peroneus longus and tibialis anterior muscle were similar between ethnicities (p>0.05, Table 5 and 6).

Table 3. Muscle latency time in white and black subjects

Parameter	White	Black	p value
Peroneal			
PLT0015 (ms)	99.5 ± 4.3	102.2 ± 5.9	0.716
PLT0030 (ms)	95.5 ± 4.0	93.1 ± 6.8	0.759
PLT2015 (ms)	90.2 ± 4.8	101.4 ± 5.5	0.135
PLT2030 (ms)	91.8 ± 4.8	103.3 ± 13.4	0.429
Tibial			
TLT0015 (ms)	101.6 ± 3.3	111.1 ± 7.3	0.258
TLT0030 (ms)	101.5 ± 4.9	91.9 ± 4.5	0.167
TLT2015 (ms)	93.5 ± 5.6	105.1 ± 8.3	0.262
TLT2030 (ms)	94.8 ± 4.9	95.2 ± 6.9	0.962

PLT: Peroneal latency time; TLT: Tibial latency time; 0015: neutral, 15° inversion; 0030: neutral, 30° inversion; 2015: 20° plantarflexion, 15° inversion; 2030: 20° plantarflexion, 30° inversion. Results as Mean ± SEM

Table 4. Muscle fascicle length in relaxed and contracted position in white and black subjects

Parameter	White	Black	p value
Relaxed			
Peroneus (mm)	42.4 ± 2.5	39.1 ± 2.3	0.345
Peroneus (mm/BMI)	1.83 ± 0.13	1.64 ± 0.10	0.267
Tibialis (mm)	78.0 ± 2.4	73.7 ± 3.4	0.313
Tibialis (mm/BMI)	3.39 ± 0.14	3.15 ± 0.17	0.287
Contracted			
Peroneus (mm)	27.9 ± 1.6	24.5 ± 1.7	0.153
Peroneus (mm/BMI)	1.21 ± 0.09	1.05 ± 0.08	0.198
Tibialis (mm)	50.6 ± 2.6	41.9 ± 1.8‡	**0.014**
Tibialis (mm/BMI)	2.25 ± 0.15	1.78 ± 0.08‡	**0.032**

BMI: Body mass index. Results as Mean ± SEM; ‡: p<0.05 (between groups)

DISCUSSION

On the basis of previous results that reported more type II muscle fibers in black individuals (23,24), with much faster contraction speeds, we hypothesized that muscle reaction features during ankle inversion perturbation would also be different between black and white ethnicities. Through this study, it is possible to stay on top of one of the risk factors for ankle inversion sprain in black and white people. However, the results of the presentstudy, in brief, revealed no meaningful differences in peroneus longus and tibialis anterior muscle reaction or morphological features between these ethnicities. The present study, to our knowledge, is the first trial to investigate differences in muscle latency time, muscle reaction duration and muscle reaction magnitude during ankle inversion perturbation between black and white people.

Table 5. Muscle thickness in relaxed and contracted position in white and black subjects

Parameter	White	Black	p value
Relaxed			
Peroneus (mm)	21.0 ± 0.8	21.9 ± 1.1	0.506
Peroneus (mm/BMI)	0.90 ± 0.04	0.93 ± 0.05	0.572
Tibialis (mm)	30.8 ± 0.7	31.1 ± 1.2	0.842
Tibialis (mm/BMI)	1.34 ± 0.04	1.33 ± 0.04	0.822
Contracted			
Peroneus (mm)	21.1 ± 0.9	21.7 ± 1.6	0.767
Peroneus (mm/BMI)	0.90 ± 0.04	0.93 ± 0.04	0.749
Tibialis (mm)	31.7 ± 0.5	30.9 ± 1.1	0.546
Tibialis (mm/BMI)	1.38 ± 0.04	1.32 ± 0.04	0.222

BMI: Body mass index. Results as Mean ± SEM

Table 6. Muscle pennation angle in relaxed and contracted position in white and black subjects

Parameter	White	Black	p value
Relaxed			
Peroneus (°)	12.4 ± 0.5	14.3 ± 1.2	0.174
Peroneus (°/BMI)	0.54 ± 0.03	0.63 ± 0.06	0.148
Tibialis (°)	10.9 ± 0.4	12.1 ± 0.7	0.139
Tibialis (°/BMI)	0.47 ± 0.03	0.54 ± 0.04	0.116
Contracted			
Peroneus (°)	18.3 ± 0.7	20.8 ± 1.6	0.175
Peroneus (°/BMI)	0.79 ± 0.03	0.93 ± 0.08	0.147
Tibialis (°)	18.0 ± 0.8	19.4 ± 0.8	0.228
Tibialis (°/BMI)	0.77 ± 0.03	0.87 ± 0.05	0.169

BMI: Body mass index. Results as Mean ± SEM

Muscle Reaction Time

It has been shown that muscle fiber types vary between ethnicities and that type II fibers are more prevalent in black subjects (23,24,30). It is well known that there are two skeletal muscle fiber types that differ based on their contractile and metabolic capacities. Type II muscle fibers possess much faster contraction speeds and lower oxidative enzyme activity (31). In a study conducted by Mero et al. (32), the athletes in the group named the "fast group" had 59% fast-twitch fibers, whereas these fibers were only 39% of fibers in the "slow group". Muscle fiber distribution and fiber area (% type II) correlated negatively with reaction time, meaning that type II fibers have shorter reaction times. In relation to this finding, the studies in the literature reflect about 200-250% higher contraction or reaction speed in type II muscle fibers than the type I ones (33,34,35). By looking at the faster speed of contraction in type II muscle fibers, it can be hypothesized that muscle reaction speed differences between ethnicities might also be present during sudden ankle inversion.

Prolonged reaction or latency times of the peroneal and tibialis anterior muscles following sudden ankle inversion have been shown to increase risk of ankle sprains (14). However, no study to date has investigated ethnical differences concerning peroneal or tibial muscle reaction features relationships with ankle inversion perturbation, in view of ankle inversion sprains.

The present study did not reveal differences for black people in muscle reaction time properties. Only reaction duration for the tibialis anterior muscle during inversion perturbation with the ankle in the neutral position was significantly shorter (46.5 vs. 66.5 ms for 0015, and 35.5 vs. 52.2 ms for 0030 test situations), and reaction magnitudes for the peroneus longus (18.8 vs. 30.4 %MVC) and tibialis anterior (5.2 vs. 11.9 %MVC) muscles during inversion perturbation to 15° of ankle inversion while the ankle was in the neutral position were significantly lower in blacks. All other muscle reaction duration and magnitude parameters, and especially muscle latency times were not significantly different in black subjects.

Muscle reaction time, which is the first muscle activity seen during sudden ankle inversion movement, is more important for prevention of ankle sprains. When this reaction time is short, then muscle reaction duration and reaction magnitude are important. Reaction time and reaction magnitude do not matter, as the reaction time was not different between groups. According to these results, it is possible to state that ankle inversion sprain features imply no differences between ethnicities, when at least reaction time measurement data are taken in consideration. For this reason, these results suggest that risk for ankle inversion sprain would not be different between black and white people.

Muscle Architecture

There are studies in the literature displaying muscle morphologic differences between white and black people. In one of these studies, Hanson et al. (20) investigated morphological differences in the psoas muscles during forensic autopsies of white and black male cadavers. Although the overall length of the psoas major muscle did not vary between white and black men, the results indicated that the width, thickness and circumference at the segmental levels from L1-L2 to L5-S1 in black males was approximately twice than those of the white males. Similarly, the psoas major muscle had four times greater cross-sectional area in black males than that in white males following calculations. Furthermore, the psoas minor muscle was present only in 9% of black males, in contrast to 87% presence in white males. The authors suggested that ethnic differences in the psoas muscles might have implications for hip flexor strength and race-specific incidence in low back injuries. In a further study by Hanson et al. (36), it was shown that mechanical properties of a single fascicle obtained from the iliopsoas tendon indicated stiffer and more failure-resistant collagen fascicles in African American males.

When muscle architecture is taken into consideration, only one study to date has investigated the differences in muscle architecture between black and white people. In this study, Abe at al. (26) aimed to determine whether there were differences in muscle thickness, pennation angle and fascicle length between black and white athletes. Particular muscles from the upper and lower extremity at 13 sites were evaluated with B-mode ultrasound. Muscle thicknesses of the abdomen, anterior part of the upper arm, upper parts of the quadriceps (30% proximal to the thigh) and hamstring (50% proximal to the thigh) muscles indicated larger values in black athletes, whereas no differences were present in the forearm, posterior part of the upper arm, lower leg, chest or subscapula. Furthermore, when some muscle groups were evaluated separately, muscle thickness was not found to be different in the long heads of the triceps, vastus lateralis and gastrocnemius medialis muscles. Similarly, pennation angle and fascicle length were also not different in these muscles between black and white athletes. Although muscles evaluated in our study were the peroneus longus and tibialis anterior muscles, not similar to the study by Abe et al. (26); the results of the present study are in agreement with that pennation angle and fascicle length (except fascicle length in the tibialis anterior during contraction) do not differ between black and white people.

Evaluation of muscle architecture during contraction will provide more insight into muscle functions than evaluation at rest. Therefore, muscle architecture was evaluated during maximal isometric contraction in the present study. Similar to studies evaluating during isometric (37) or isokinetic (38) contractions in white subjects; muscle fascicle length shortened and pennation angle increased during maximal isometric contraction both in black and white people, in the present study. However, fascicle length in the tibialis anterior muscle during maximal isometric contraction was shorter in black subjects, which is the unique result of the current study, while this difference was not present during rest.

Study Limitations

There were some limitations in this study. Although literature has shown that type II muscle fibers are more abundant in blacks than whites, we did not measure muscle fiber type in our subjects. Subjects included in the study might not have had fiber type differences; thus, the groups did not differ in terms of ethnicity. Other measures of proprioception such as joint position sense and kinesthesia were not assessed, which is another limitation of this study. It would be useful to investigate these variables, even though they were not intended for this study.

CONCLUSION

Overall, the results of this study indicate that there are no ethnic differences between white and black people in electromyographic activity or muscle morphology measures of the peroneus longus and tibialis anterior muscles.

Practical Applications

To our knowledge, this study was the first trial to investigate differences in muscle reaction properties during ankle inversion perturbation, between black and white people. Additionally, since no study to date has investigated muscle architecture during contraction between black and white people, it is appropriate that further studies should focus on this topic. Furthermore, these future evaluations should also focus on other muscle groups.

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