

Athletes and their Sensei's: did aging affect the lower limb kinematics in karate practitioners

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1. Introduction

Aging leads to a general decline in body functions that affects quality of life. Muscle function begins to slow the contraction from the 40 to 50 years and decreases muscle strength 1 to 1.5% per year after 60 years (Booth, Weeden, & Tseng, 1994; Vandervoort, 2002; Vandervoort & McComas, 1986). Older adults do less work for lower fast angular velocities (Power, et al., 2014), and less power for slow, moderate and fast angular velocities (Dalton, Power, Vandervoort, & Rice, 2012), than young adults. These losses increase as age increases. One factor that exacerbates these functional losses is the sedentary lifestyle, however, the physical exercise appears as an inversion factor, which cannot only reverse this decline but also promote an increase in functional capacity at the neuromuscular level. The athletic performance is seen as diminished in older adults, but in the case of martial arts, the karate Sensei's are the technical execution model. This leads us to question if in karate young adults have better performance than older adults? Which in many cases are their Sensei's. The aim of this study was to analyze the effects of the aging process in the kinematic and temporal structure of the frontal kick on veteran active karate practitioners.

2. Methodology

Thirty-three male black belt karate practitioners with more than 10 years of continuous practice volunteered to participate in the study. Two groups were formed: one with nine veteran karate practitioners aged more than 50 years old (VetK); and the other with 24 karate practitioners aged between 20 and 30 years old (YgK). All participants were in perfect health and without history of locomotors system disease, and signed an informed consent document.

For task execution, participants started from the typical karate static stance of *zenkutsu-dachi*, and execute the *mae-geri* (front-kick) was performed targeting a point at 90cm height in a vertical floor training bag, after a sound stimulus synchronized with the video record device. The video capture system record at a rate of 210 Hz to a video file, and analyzed with the software Ariel Performance Analysis System (APAS, Ariel Dynamics-2003). Each participant performed three repetitions of the *mae-geri* in the fastest and strongest way possible. For each variable, the mean value of the three kicks were used for analysis.

3. Results

The kinematic variables show that knee is the structure that holds most differences between young and veteran practitioners, both for linear and for angular variables. For linear kinematics, the young

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practitioners achieve higher values in linear velocity only for the knee marker, differing 0.30 m/s for veteran practitioners group ($p \leq .05$). Differences between groups in the linear acceleration were found for knee, hip and pelvis markers, differing respectively 11.56 m/s², 4.93 m/s² and 3.47 m/s² ($p \leq .001$).

In angular displacement, differences were found for the knee joint, with the young practitioners to make greater magnitudes of knee flexion ($p \leq .01$) and knee extension ($p \leq .01$), and therefore greater range of motion ($p \leq .001$) in this joint. In the maximum angular velocity, the group of young practitioners performed over 49 deg/s and 143.5 deg/s respectively for knee and hip joints, than veterans group. The maximum angular acceleration has significant lower magnitudes in the veterans group for ankle and hip joints ($p \leq .05$) than younger group.

For the temporal analysis, most results reveal that young practitioners perform the temporal events of kinematic variables before veterans group, with values that are between 3ms and 9ms.

4. Discussion and conclusion

The literature reports that aging leads to an overall decline in body functions, however exercise and sports appears as an inverse feature to this decline. The results of our study have outcomes that allow us to see the aging process and the effect of training. The aging process can be seen in kinematic variables, where linear and angular velocities and accelerations has lower magnitudes for veterans group when compared with younger group. The effect of training can be seen in the temporal structure of *mae-geri* kinematics, where veterans group shows a higher efficiency of task execution. Two reasons are pointed to prove that statement: first, because most peaks occur simultaneously between groups if we consider the contact time, and second, because the linear velocity and acceleration in the instant of contact are similar between groups. Specifically, the second reason shows the high efficiency that veterans have in the execution of *mae-geri*, because they don't need to spend that much energy to achieve the same magnitude of momentum of the foot in the contact.

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