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Impact of Gastrocnemius and Soleus muscle over calf muscle tightness in professional chefs

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Abstract
Background: Calf muscle tightness is a common musculoskeletal problem in occupations involving prolonged standing. Professional chefs are particularly at risk due to continuous weight-bearing activities, repetitive movements, and sustained postural demands. The gastrocnemius and soleus muscles, which together form the triceps surae complex, play an essential role in maintaining posture and ankle mobility. However, the relative contribution of these muscles to calf muscle tightness in professional chefs remains unclear.
Methodology: A cross-sectional study was conducted on 72 professional chefs. Calf muscle tightness was assessed using the Silfverskiöld test to evaluate gastrocnemius muscle tightness and the weight bearing lunge test to assess soleus muscle tightness. Both right and left lower limbs were evaluated. Data were collected and analysed to determine the prevalence of isolated gastrocnemius tightness, isolated soleus tightness, and mixed tightness involving both muscles.
Result: The Silfverskiöld test revealed gastrocnemius tightness in 58 right legs and 56 left legs. The weight bearing lunge test showed soleus tightness in 48 right legs and 50 left legs. Based on combined findings, mixed tightness involving both gastrocnemius and soleus muscles was most prevalent (47.2%), followed by isolated gastrocnemius tightness (33.3%) and isolated soleus tightness (19.4%). Bilateral involvement was commonly observed.
Conclusion: The study concludes that both gastrocnemius and soleus muscles significantly contribute to calf muscle tightness in professional chefs, with mixed tightness being the most common presentation. Prolonged standing and occupational demands are key contributing factors. Early assessment and appropriate physiotherapy interventions targeting both muscles are essential for effective management and prevention.

Keywords: Gastrocnemius, Soleus, calf muscle tightness, professional chefs, Silfverskiöld Test, Weight Bearing Lunge Test

Introduction
A chef is an incharge of the kitchen in restaurants or places where food is served. Chefs also have to order food or kitchen supplies and provide cost estimate to the employers. Professional chefs are open to a variety of learning involving college training and then working from the lowest position in the kitchen towards the top. The working processes in this profession still largely rely on human work and cannot be replaced by automation [1].
Furthermore, undertaking and completing several tasks in the kitchen including cooking for hours without enough rest and prolonged standing makes a chef vulnerable to develop musculoskeletal pain.[2] Most of these tasks involve static postures and repetitive movements that can lead a chef at a risk of developing musculoskeletal disorders risk [1].
Work-related musculoskeletal disorders are becoming highly prevalent particularly in chefs and other kitchen workers as their job involves repetitive movements and force full exertion resulting in pain. Kitchen workers including cooks are more susceptible to musculoskeletal symptoms because their job involves heavy lifting and repetitive motion of the upper limb, prolonged standing and forward leaning of the trunk [2].
The gastrocnemius and the soleus are strong plantar flexors of the foot at the ankle joint. Plantar flexion is very important in walking and running which is produced by the gastrocnemius and the soleus muscles. Ankle dorsiflexion range of motion from tight calf muscle has been linked to injuries such as Achilles tendonitis, gastrocnemius strains, and plantar fasciitis [3].
Calf muscle tightness and restricted dorsiflexion of the ankle joint are risk factors for many lower limb disorders, especially Achilles tendinosis [3]. The soleus is a broad flat muscle situated immediately in front of the gastrocnemius [4].
The gastrocnemius and soleus together form a muscular mass which is occasionally described as the Triceps surae; its tendon of insertion is the tendo calcaneus (Tendo Achillis), the common tendon of the gastrocnemius and soleus, is the thickest and strongest in the body [4]. The soleus muscle is located in the superficial posterior compartment of the lower limb, together with the gastrocnemius muscle and plantaris muscle [6]. Particularly in the hamstring and calf, which are made up of muscles that travel through more than two joints, muscle stiffness in the legs is usually noted [7].
As a result, it has an adverse effect on gait and balance and is accompanied by proprioceptive sensory issues. During walking, jumping, or ascending stairs, calf stiffness can make it difficult for the heel to push the ground appropriately. Reduced ROM of ankle for dorsiflexion due to calf tightness leads to difficulties in maintaining the center of mass in the weight-bearing posture [7].
Calf muscle tightness, particularly involving the gastrocnemius and soleus muscles, can adversely affect ankle dorsiflexion, gait mechanics, balance, and overall lower limb function. Professional chefs are frequently exposed to occupational risk factors such as prolonged standing, repetitive movements, and sustained postures,

which may contribute to the development of calf muscle tightness.

Although several studies have reported musculoskeletal problems among chefs, limited evidence is available regarding the specific involvement of the gastrocnemius and soleus muscles in calf muscle tightness within this occupational group. Therefore, the present study was undertaken to determine the impact of gastrocnemius and soleus muscles on calf muscle tightness in professional chefs. The findings of this study may help in the early identification and management of calf muscle tightness and contribute to the development of preventive physiotherapy strategies for professional chefs.

Methods

Ethical Statement

The study received approval from the Institutional Ethics Committee. It was conducted following the ethical guidelines of the Declaration of Helsinki (updated 2013) for medical research involving human subjects, as well as the 2017 National Ethical Guidelines for Biomedical and Health Research involving Human Participants from the Indian Council of Medical Research.

Design

A total of 72 samples were selected on the basis of inclusion criteria who were professional chefs. Subject were assessed for calf muscle tightness by using the Silfverskiöld test and the weight bearing lunge test. The result of tests was collected and analysed to find out impact of gastrocnemius and soleus muscle over calf muscle tightness in professional chefs.

Participants

Total 72 participants were chosen on the basis of inclusion criteria of the study the inclusion criteria for the study were professional chefs aged between 25 and 40 years, including both males and females, who were willing to participate and had been working for 8 hours and more. The analysis of study was done by using MS excels sheet.

Outcome Measure

1. Silfverskiold test
2. Weight-bearing lunge test

Procedure

Ethical Committee approval was obtained from the institutional ethical committee. Total 72 subject was screened as per inclusion and exclusion criteria. Subject was informed consent from in language understood by participants.

Written Consent was obtained from the subject. Procedure was explained the subject. At the starting of the study, demographic data was collected and Silfverskiold test and Weight-bearing lunge test was performed.

Data was collected. Statistical analysis was done by using descriptive analysis and result was obtained from after performing silfverskiold test and weight bearing lunge test.

Silfverskiold test [16]

The silfverskiold test differentiates gastrocnemius tightness from an achilles tendon contracture by evaluating ankle dorsiflexion with the knee extended and then flexed. It measures the dorsiflexion of the ankle joint with knee extended & flexed to 90 degrees. The test is considered positive when dorsiflexion at the ankle joint is greater with the knee flexed than extended. The test is performed with the patient seated or in supine. Two hands are utilized to perform the technique, with one hand neutralizing and locking the subtalar joint and the other stabilizing the talonavicular joint and forefoot in order to isolate the ankle joint motion. With the subtalar joint in neutral, forefoot is supinated, and foot is dorsiflexed with knee in full extension. Measurement is taken of the dorsiflexion range. Then the test is repeated with knee flexed at 90 degrees. Less dorsiflexion with a soft and spongy feel when the knee is extended, indicates a gastrocnemius contracture and equally limited dorsiflexion with the knee flexed and extended, points to either a soleal equinus or an osseous block.

Fig 1: Assessment of Silfverskiold test

Fig 2: Assessment of Silfverskiold test

Weight-bearing lunge test [14]

The Weight bearing lunge test is used to assess the dorsiflexion range of movement at the ankle joint. This test needs to be done against a wall. A standard tape measure (cm) is necessary. Participants are asked to place their foot in such a way that a imaginary line drawn through the heel and big toe are aligned on the tape measure on the floor. Furthermore, a vertical line is drawn on the wall in line with the tape measure. Participants are instructed to lunge forward until their knee touches the wall (vertical line). The heel is required to remain in contact with the floor at all times. The foot is moved away from the wall to the point where the knee can only make slight contact with the wall, while the heel remains in contact with the floor. This puts the ankle joint in maximal dorsiflexion. The leg not being tested can rest on the floor and participants are allowed to hold onto the wall for support. The maximum distance from the wall to the tip of the big toe is recorded. The distance is measured in centimeters (cm) with each centimeter corresponding to approximately 3.6° of ankle dorsiflexion.

Fig 3: Assessment of weight bearing lunge test

Data Analysis

The data was collected and analysed using descriptive statistics using percentage in MS Excel sheet.

Result

A Total of 72 participants were assessed for calf muscle tightness by using the Silfverskiöld test and the weight bearing lunge test.

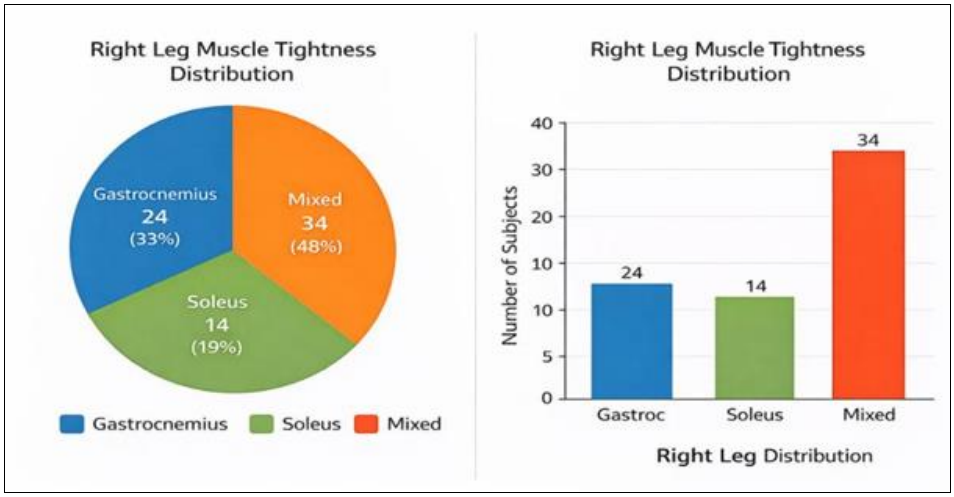

Chart 1: Leg wise distribution (Right leg)

Interpretation: The results showed that in the right leg, gastrocnemius tightness was observed in 24 participants (33.3%), soleus tightness in 14 participants (19.4%), and mixed tightness involving both muscles in 34 participants (47.2%).

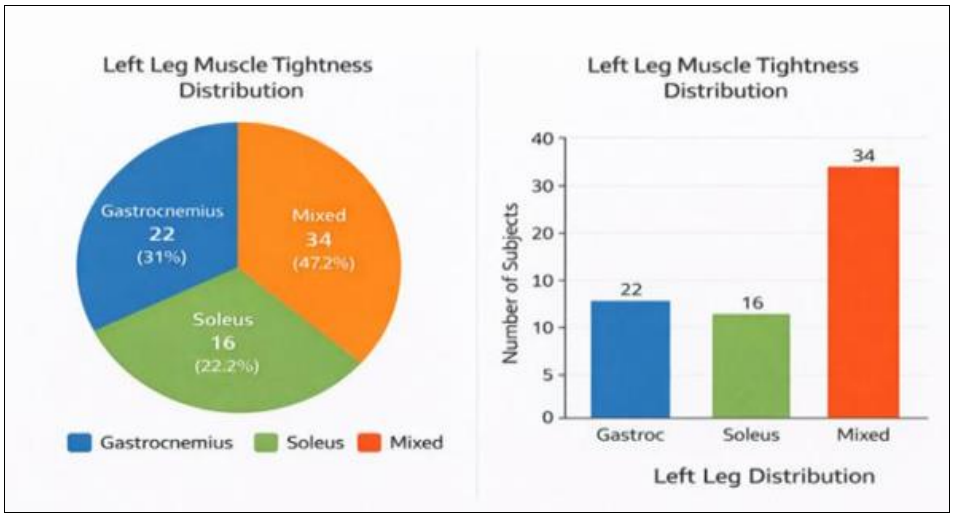

Chart 2: Leg wise distribution (Left leg)

Interpretation: Similarly, in the left leg, gastrocnemius tightness was found in 22 participants (30.6%), soleus tightness in 16 participants (22.2%), and mixed tightness in 34 participants (47.2%).

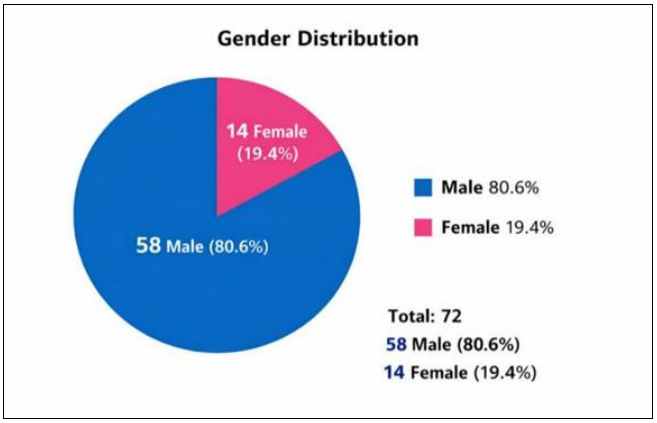

Chart 3: Gender wise distribution

Interpretation: The study consisted total 72 no. of professional chefs in which 58 male professional chefs (80.6 %) and 14 female professional chefs (19.4 %) were seen, this chart shows higher number of male chefs than female chefs.

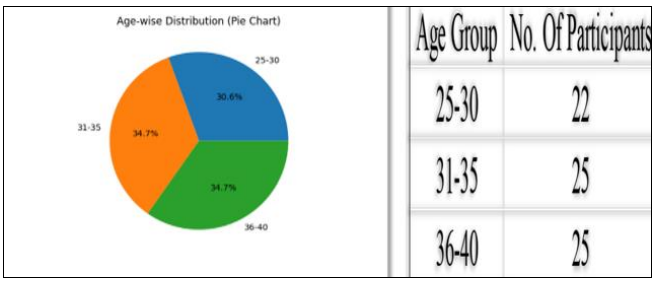

Chart 4: Age wise distribution

Interpretation: The study consists of total 72 participations among which majority of professional chefs (50 out of 72) fall in 30-40 years of age group, while 22 participants belong to the 25-30 age group.

Discussion

The present study was conducted to determine the impact of gastrocnemius and soleus muscles on calf muscle tightness among professional chefs. Professional chefs are required to stand for prolonged hours during cooking, food preparation, and kitchen management tasks. Prolonged standing leads to continuous loading of the triceps surae muscle complex (gastrocnemius and soleus), which may predispose individuals to muscle tightness, decreased flexibility, and altered ankle dorsiflexion.

Calf muscle tightness is quite common in those with tight hamstrings (gastrocnemius and soleus). Hamstring tightness could cause knee flexion to increase, which would lead to prolonged forefoot loading.7

In the present study, 72 professional chefs were assessed using the Silfverskiöld test and the Weight Bearing Lunge Test (WBLT). The Silfverskiöld test is widely used to differentiate gastrocnemius tightness by comparing ankle dorsiflexion in knee extension and knee flexion, while the WBLT evaluates soleus flexibility and functional ankle dorsiflexion under weightbearing conditions (Bennell *et al*., 1998) [14].

The results of the present study revealed that gastrocnemius tightness was observed in 58 right legs and 56 left legs, as assessed by the Silfverskiöld test. This indicates that a large proportion of professional chefs demonstrate reduced ankle dorsiflexion due to gastrocnemius muscle tightness. The gastrocnemius muscle crosses both the knee and ankle joints, making it more susceptible to shortening when the knee remains extended during prolonged standing activities (Neumann, 2017). Occupational activities that involve standing for long hours may lead to adaptive shortening of this muscle.

Similarly, the Weight Bearing Lunge Test showed soleus tightness in 48 right legs and 50 left legs, indicating that soleus muscle flexibility is also affected in professional chefs. The soleus muscle plays a major role in postural control and maintaining standing stability, and it remains continuously active during prolonged standing tasks. Continuous low-level contraction of the soleus muscle may lead to increased muscle stiffness and reduced flexibility over time (Kisner & Colby, 2018) [18].

Based on the combined findings of both tests, the present study found that mixed tightness involving both gastrocnemius and soleus muscles was most prevalent (47.2%), followed by isolated gastrocnemius tightness (33.3%) and isolated soleus tightness (19.4%). This suggests that occupational demands placed on professional chefs affect the entire triceps surae complex rather than a single muscle alone.

From a cellular physiology perspective, prolonged static muscle activity can lead to several adaptive changes within skeletal muscle fibres. Sustained muscle contraction results in increased cross-bridge formation between actin and myosin filaments, which may contribute to increased muscle stiffness (Guyton & Hall, 2021). Additionally, prolonged muscle loading can lead to reduced sarcomere length and increased connective tissue deposition, resulting in decreased muscle extensibility (Lieber & Fridén, 2000) [19].

At the cellular level, repetitive or sustained contraction can also increase intramuscular collagen content and extracellular matrix stiffness, which further contributes to muscle tightness and reduced range of motion. Changes in muscle spindle sensitivity and altered neuromuscular control may also occur, leading to increased muscle tone and resistance to stretch (Magnusson *et al*., 2008) [20].

The findings of the present study therefore suggest that prolonged standing and occupational workload in professional chefs may cause adaptive physiological changes within the gastrocnemius and soleus muscles, resulting in calf muscle tightness. Since both muscles are part of the triceps surae complex responsible for plantarflexion and postural stability, continuous activation may lead to fatigue and shortening of the muscle fibres.

Conclusion

The findings of the study demonstrated that gastrocnemius tightness was present in 58 right legs and 56 left legs, while soleus tightness was observed in 48 right legs and 50 left legs. When the results of both tests were analysed together, mixed tightness involving both gastrocnemius and soleus muscles was found to be the most prevalent (47.2%), followed by isolated gastrocnemius tightness (33.3%) and isolated soleus tightness (19.4%). These results suggest that professional chefs are more likely to develop combined tightness of both gastrocnemius and soleus muscles rather than tightness of a single muscle alone. This may be attributed to prolonged standing, repetitive lower limb loading, and sustained postural demands during occupational activities, which lead to adaptive changes in

the triceps surae muscle complex. Therefore, it can be concluded that occupational demands in professional chefs significantly contribute to calf muscle tightness, with mixed involvement of gastrocnemius and soleus muscles being the most common pattern.

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