Physical activity and Mediterranean diet based on olive tree phenolic compounds from two different geographical areas have protective effects on early osteoarthritis, muscle atrophy and hepatic steatosis

Summary

Osteoarthritis is a debilitating degenerative disease characterized by: 1) deterioration of articular cartilage, 2) inflammation of the synovium, 2) subchondral bone remodelling, and 3) stiffness and ultimately total joint disability (2). Given the complicated nature of disease progression and since cartilage is avascular and aneural, currently, there is no effective treatment for osteoarthritis (3, 4). Approaches involving functional foods represent an alternative for the management of disease progression. In this context, olive oil, a major constituent of the Mediterranean diet, and olive leaf extracts have shown beneficial effects, most likely due to their potent antioxidant and anti-inflammatory effects (5-7). Similarly regular physical activity is well-known to have beneficial effects on the musculoskeletal system, and has been shown to have protective effects on cartilage tissue (8, 9). Therefore, in this study the overall aim was to investigate the role of combinations of physical activity and extra-virgin olive oil on the protective effects on muscle and cartilage using a well-characterized model of murine osteoarthritis.

Key points and implications

A total of 48 rats were divided into six groups of eight animals per group for this study, which was performed over a 12 week period. The six groups consisted of: 1) control sedentary animals without operation, 2) sedentary animals which had undergone anterior cruciate ligament transection (ACLT; no physical activity controls), 3) physical activity controls (with ACLT); 4) physical activity and Sicilian extra-virgin olive oil (with ACLT), 5) physical activity and Tunisian extra-virgin olive oil (with ACLT), and 6) physical activity and olive-leaf extract-enriched Tunisian extra-virgin olive oil (with ACLT). In short, this was well-controlled experiment with an adequate number of animals in each group for statistical analysis. The physical activity consisted of regular treadmill (10/20 meters/min) for ten minutes a day, for five days per week. Supplementation of regular chow
was with 2.25g of either 1) Sicilian extra-virgin olive oil, 2) Tunisian extra-virgin olive oil, or 3) Tunisian extra-virgin olive oil that was enriched with a polyphenolic-rich olive leaf extract. Various histological and biochemical analyses were performed at two weeks and at the end of the 12 week study period. Firstly, as anticipated, body weight increased uniformly in all groups over the 12 week period, without significant differences between groups. Interestingly calorie consumption did fluctuate significantly between groups, with the highest consumption in group four, representing the animals undergoing regular physical activity and consuming a diet supplemented with Sicilian extra-virgin olive oil. In summary, histological and histomorphometic analyses indicated in general better articular cartilage preservation in the in the ACLT groups that had performed regular physical activity (group 3), and the groups that performed regular physical activity and consumed a diet enriched with extra-virgin olive oil (groups 4-6), compared to the ACLT group without intervention (group 2). Similarly, significant muscle hypertrophy was observed for all of the experimental groups (3-6), when compared to group two (ACLT with no physical activity control). Finally, liver steatosis was not observed in any of the groups. These findings corroborated with immunohistochemical and biochemical analyses which indicated a general increase in lubricin (lubricates the cartilage surface), and decrease in interleukin-6 (pro-inflammatory cytokine mediator) expression and plasma levels in the experimental groups (3-6), compared to group two (ACLT group without intervention). Overall, these findings highlight the importance of physical activity, and the added beneficial effects of supplementation with extra-virgin olive oil, in an experimental model of osteoarthritis. A particularly interesting observation, which will have very profound implications if it holds with further research, is that the best results were obtained with combinations of physical activity and supplementation with the Sicilian extra-virgin olive oil, compared to the other interventions.

Related publications
1. M. A. Szychlinska et al., Physical activity and Mediterranean diet based on olive tree phenolic compounds from two different geographical areas have protective effects on early osteoarthritis, muscle atrophy and hepatic steatosis. European journal of nutrition, (2018).