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LIST OF PUBLICATIONS

Study I Recreational football practice attenuates postprandial lipaemia in normal and overweight individuals. *European Journal of Applied Physiology*, 2018, 118(2):261-270.

Study II The effects of single versus three consecutive sessions of football training on postprandial lipaemia. *Sports Medicine Open*, 2019, 5(1): 38.doi:10.1186/s40798-0190212-1 .

Study III Postprandial lipaemia 10 and 34 hours after football training: Does training frequency effect the response? *PloS One* 2019, 14(7):e0218043.doi:10.1371/journal.pone.0218043

Abstracts

Background

It is well known that exercise can attenuate the postprandial lipaemic response, however, many of these exercise training intervention may not be representative of the exercise habits of millions of people. Moreover, despite the incessant flow of research, much of the worlds population are not active enough and have poor dietary habits. Football is the most popular sport played worldwide by people of different age, gender, training experience and pathological status. The last decade has seen an increase in research examining the health benefits of football, the focus of which has been on the long term effect. Understanding the short term and acute effect of football training would also prove insightful. Moreover, better understanding what happens when an exercise stimulus is withdrawn for a short period of time would also prove worthwhile, particularly as the exercise habits of many can often be inconsistent.

Aim

The overall aim of this thesis was to examine the effects of playing football and reduced activity on postprandial lipaemia in recreational players. The specific aims of the studies were:

Study I: To examine the effect of playing football on postprandial lipaemia in normal and overweight recreational players

Study II: To examine the effect of acute versus accumulated football training on postprandial lipaemia

Study III: To investigate the effect of football training frequency in response to a period of reduced activity on postprandial lipaemia.

Methods

In study I fifteen (7 normal weight, NW; age=32.3±6.0 (mean±SD) yrs, BMI = 22.8±3.4 kg/m² and 8 overweight, OW; age = 33.3±5.5yrs, BMI = 29.2±3.2 kg/m²) recreational football players were recruited. On the evening of day 1 participants played a 60-min 9-a-side football match (FOOT) or rested (control; CON) in a randomised counterbalanced cross-over design. Activity profile, heart rate and rate of perceived exertion were recorded.

In study 2 fifteen males performed either one (1FOOT; n= 7) or three 60-min football (3FOOT; n= 8) training sessions across an 8-day trial period. On day 1, a blood sample was collected at fasted (0 min) and 0.75, 2, 4, 6 h after a high fat meal. Participants were then randomly allocated to the 1FOOT (day 7) or 3FOOT (days 5, 6, 7) condition. On day 8, they repeated the high fat meal and blood sampling for the 6 hours following the meal. Postprandial total and incremental area under the curve (AUC, iAUC, respectively) were calculated.

In study III, eighteen males were randomly allocated to perform either 1 (n= 9; age=33.0 ± 5.0 yrs; body mass index=24.2 ± 3.6 kg/m²) or 3 consecutive 60-min 5 vs 5 football (n= 9; age=32.8 ± 5.2 yrs; body mass index=26.2 ± 4.1 kg/m²) sessions across a 5-day study period. They arrived to the laboratory 10 hrs and 34 hrs after the final training session and blood samples were collected at fasted (0 min) and 0.75, 2, 4, 6 hrs post a high fat load meal.

Results

For study I the postprandial TG iAUC was 31% lower in the normal weight group (ES=0.79) for the FOOT compared to CON trial and a discernible trend was shown for the overweight group (22 %; ES=0.51). We found the postprandial TG tAUC was 22 % and 28 % lower for the normal weight (ES=0.87) and overweight (ES=0.68) groups for football training, compared to the control.

For study 2 the postprandial triglyceride iAUC was 41% lower from pre to post measures for the 1FOOT ($p < 0.05$; ES= 1.02) and 15.7% lower for the 3FOOT (ns; ES= 0.41). Total triglyceride AUC was lower (26 %) post-training in the 3FOOT group only ($p < 0.01$; ES=1.23). In 3FOOT, insulin concentration was lower for post compared to pre measures at 0.75 h and 2 h ($p < 0.001$).

For study 3 there was no difference for postprandial TG incremental area under the curve from 10 to 34 hrs following either one single, or three consecutive sessions of football training. There was a non-significant increase for postprandial TG incremental area under the curve iAUC (14.2 %) and total AUC (9.1 %) between 10 and 34 hrs after the 1 football session. For the 3 session group, there was a non-significant decrease in postprandial TG iAUC (17.5 %) and AUC (2.7 %) from 10 to 34 hrs.

Conclusion

In this thesis we have shown:

- i) playing a 60 min football match can attenuate the postprandial TG response in normal weight individuals and also benefit overweight individuals;
- ii) A single bout of football exercise session lowered postprandial TG incremental area under the curve while performing 3 consecutive days of football training did not result in a greater attenuation.
- iii) There is no difference for postprandial TG measures between 10 and 34 hrs after the last football training bout. Also, performing three consecutive days of football training may offer no greater protective effect for postprandial TG before a period of reduced activity, compared to a single session.

Baggrund

Det er vist, at fysik aktivitet kan dæmpe det postprandiale lipid respons, men mange af de anvendte træningsinterventioner er ikke repræsentative for millioner af menneskers træningsvaner. Desuden har en stor del af verdens befolkning dårlige kostvaner og er ikke tilstrækkeligt aktive. Fodbold er den mest populære idrætsgren, og den spilles over hele verden af mennesker i forskellig alder, køn, træningserfaring og patologisk status. Det sidste årti har der været en stigning i forskningen der undersøger de sundhedsmæssige fordele ved fodbold, hvis fokus har været på den langsigtede effekt. At forstå den kortsigtede og akutte effekt af fodboldtræning er vigtigt. Desuden vil en bedre forståelse af, hvad der sker, når en træningsstimulus udebliver i en kort periode også være værdifuldt.

Formål

Det overordnede formål med denne afhandling var at undersøge effekten af at spille fodbold eller nedsat aktivitet på postprandial lipidprofil hos rekreative fodboldspillere. De specifikke formål med undersøgelse var:

Studie I: At undersøge effekten af at spille fodbold på postprandial lipider i normale og overvægtige rekreative spillere

Studie II: At undersøge effekten af akut versus akkumuleret fodboldkampe på lipidprofil efter et måltid

Studie III: At undersøge effekten af frekvensen af fodboldkampe efter en periode med nedsat aktivitet på postprandial lipideri.

Metoder

I studie I blev 7 normalvægtige (alder = $32,3 \pm 6,0$ år (gennemsnit \pm SD) år, BMI = $22,8 \pm 3,4$ kg / m²) og 8 overvægtige, (alder = $33,3 \pm 5,5$ år, BMI = $29,2 \pm 3,2$ kg/m²) rekreative

fodboldspillere rekrutteret. Om aftenen på dag 1 spillede deltagerne en 60-minutters fodboldkamp (FOD) eller hvilede (kontrol; KON) i et randomiseret krysover design. Aktivitetsprofil, pulsfrekvens og værdi for opfattet anstrengelse blev registreret.

I studie 2 udførte femten mænd enten en (1FOD; n = 7) eller tre (3FOD; n = 8) 60-minutters fodboldkampe i løber af en 8-dages. På dag 1 blev en blodprøve opsamlet ved faste (0 min) og 0,75, 2, 4 og 6 timer efter et måltid med højt fedtindhold. Deltagerne blev derefter tilfældigt inddelt i en gruppe der spiller kamp på dag 7 (1FOD) eller tre kampe på dag, 5, 6 og 7 (3FOD). På dag 8 gentog de måltidet med højt fedtindhold og der blev taget blodprøver i 6 timer efter måltidet. Postprandialt totalt areal og inkrementelt areal under kurven (henholdsvis AUC, iAUC) blev beregnet.

I studie 3 blev atten mænd tilfældigt fordelt til at udføre enten 1 (n = 9; alder = $33,0 \pm 5,0$ år; BMI = $24,2 \pm 3,6$ kg / m²) eller 3 på hinanden følgende 60-minutters fodboldkampe (n = 9 ; alder = $32,8 \pm 5,2$ år; BMI = $26,2 \pm 4,1$ kg / m²) over en 5-dages undersøgelsesperiode. De ankom til laboratoriet 10 timer og 34 timer efter den sidste kamp, og blodprøver blev opsamlet efter ed faste (0 min), og 0,75, 2, 4, 6 timer efter et måltid med højt fedtindhold.

Resultater

I studie I var den postprandiale TG iAUC 31% lavere i den normale vægtgruppe (ES = 0,79) for FOD sammenlignet med KON, og der var en tendens for gruppen med overvægt (22%; ES = 0,51). Den postprandiale triglycerider (TG) tAUC var 22% og 28% lavere for henholdsvis den normal vægtige (ES = 0,87) og overvægtige (ES = 0,68) gruppe i FOD sammenlignet med KON.

For studie 2 var den postprandiale triglycerid iAUC 41% lavere fra præ- til post-målinger for 1FOD (p <0,05; ES = 1,02) og 16% lavere for 3FOD (ns; ES = 0,41). Total triglycerid AUC var kun lavere (26%) efter kamp i 3FOD (p <0,01; ES = 1,23). I 3FOD var insulin koncentrationen ved 0,75 og 2 timer (p <0,001) lavere efter sammenlignet med før interventionen.

For studie 3 var der ingen forskel på det postprandiale TG-inkrementelle område under kurven efter 10 til 34 timer, hverken ved en enkelt eller tre på hinanden følgende fodboldkampe. Der var en ikke-signifikant stigning på det postprandiale TG-inkrementelle areal under kurven iAUC (14,2%) og den samlede AUC (9,1%) mellem 10 og 34 timer efter 1 fodboldkamp. For gruppen med 3 kampe var der et ikke-signifikant fald i postprandial TG iAUC (17,5%) og AUC (2,7%) fra 10 til 34 timer.

Konklusion

Denne afhandling har vist:

- i) at spille en 60-minutters fodboldkamp kan dæmpe det postprandiale TG-respons hos personer med normalvægt og også gavne overvægtige personer;
- ii) En enkelt fodboldkamp sænkede det postprandiale TG-inkrementelle område under kurven, mens 3 på hinanden følgende dage med fodboldkampe ikke resulterede i større dæmpning.
- iii) Der er ingen forskel for postprandial TG-målinger mellem 10 og 34 timer efter den sidste fodboldkamp. Således udførelse af tre kampe på tre hinanden følgende dage ser ikke ud til at give større beskyttende effekt for postprandial TG sammenlignet med en enkelt kamp.