Anabolic steroid use in male bodybuilders - implications upon cardio-metabolic health.

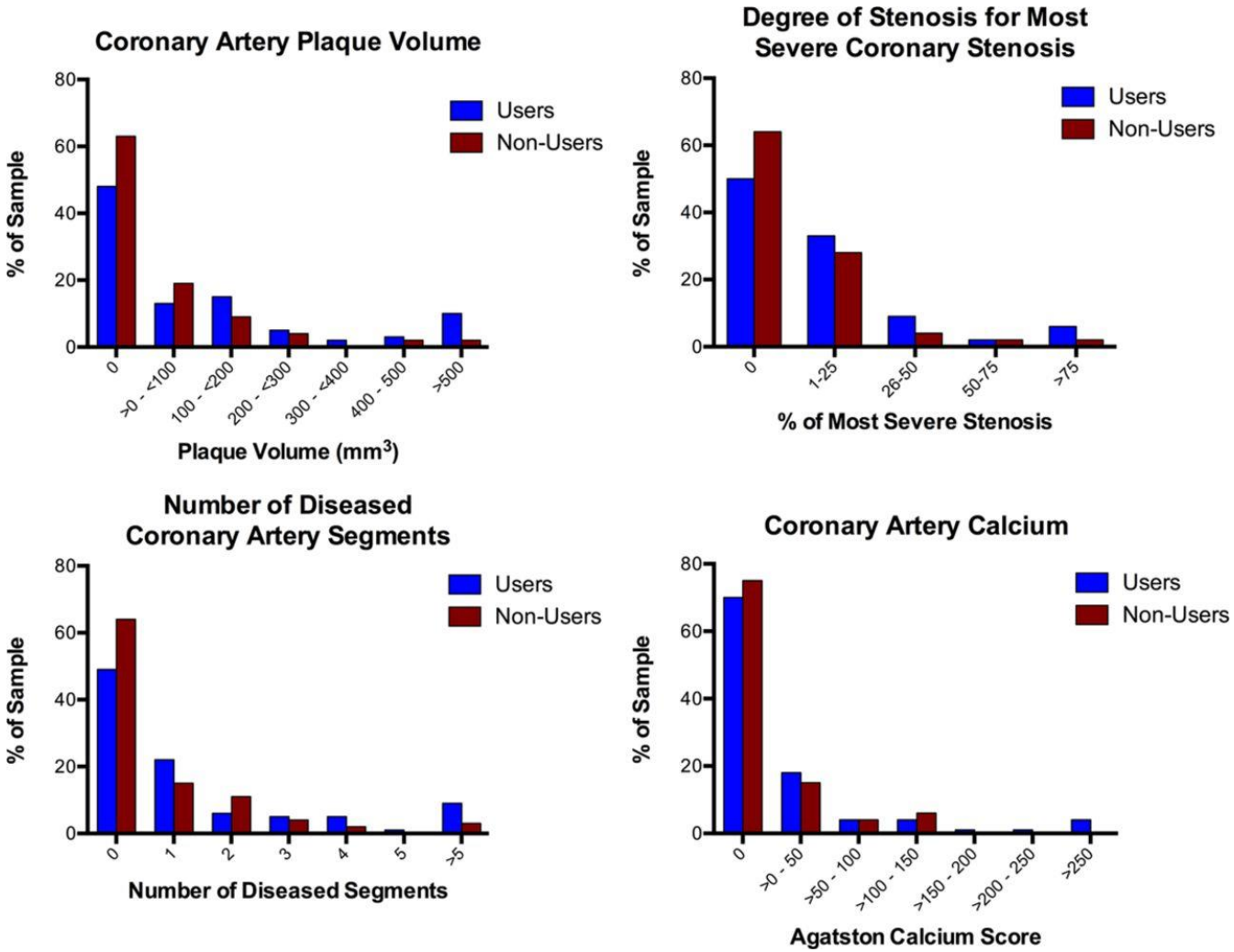
By Dr Ian G. Davies

Overview

- Cardiometabolic/Cardiovascular disease
- Lipids and lipoproteins
- The effect of anabolic androgenic steroids (AAS) on lipoproteins
- Putative mechanism of AAS
- The old and the new: enter lipoprotein-omics
- Aims and objectives of proposed study
- Methods
- Expected results
- Summary

Distribution of computed tomography coronary angiography measures in anabolic-androgenic *long-term* steroid users and nonusers.

N = 86 users, 54 non-users



Associated with long-term use

Aaron L. Baggish et al. Circulation. 2017;135:1991-2002

American Heart Association.

Cardiometabolic Health/Disease

Metabolic syndrome:

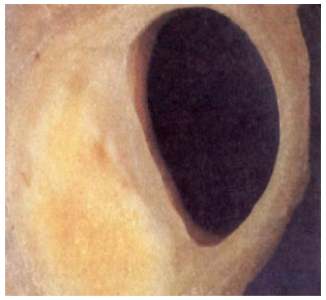
Hyperglycaemia, hyperinsulinaemia, **atherogenic dyslipidaemia**, T2d

Risk factors:

Age, gender, smoking, **LDL-cholesterol**, blood pressure

Drugs e.g. AAS

Cardiometabolic Disease



ASCVD

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erol, LDL, and LDL-C

Low-density lipoproteins cause atherosclerotic cardiovascular disease. 1. Evidence from genetic, epidemiologic, and clinical studies. A consensus statement from the European Atherosclerosis Society Consensus Panel

Brian A. Ference ✉, Henry N. Ginsberg, Ian Graham, Kausik K. Ray, Chri
Eric Bruckert, Robert A. Hegele, Ronald M. Krauss, Frederick J. Raal, Her
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European Heart Journal, Volume 38, Issue 32, 21 August 2017, Pages 24
https://doi.org/10.1093/eurheartj/ehx144
Published: 24 April 2017 **Article history** ▾

Abstract

European Heart Journ
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alerts

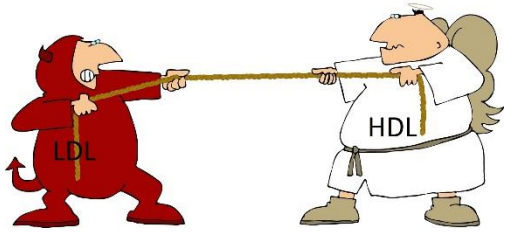
Lipid markers of cardiometabolic health

Traditional lipid profile	Athergoenic dyslipidaemia
Elevated total cholesterol	Elevated triglycerides
Elevated low density lipoprotein cholesterol (LDL-C)	Low high density lipoprotein cholesterol (HDL-C)
Low high density lipoprotein cholesterol (HDL-C)	Elevated **small, dense LDL**
Elevated triglycerides	**LDL particle number**

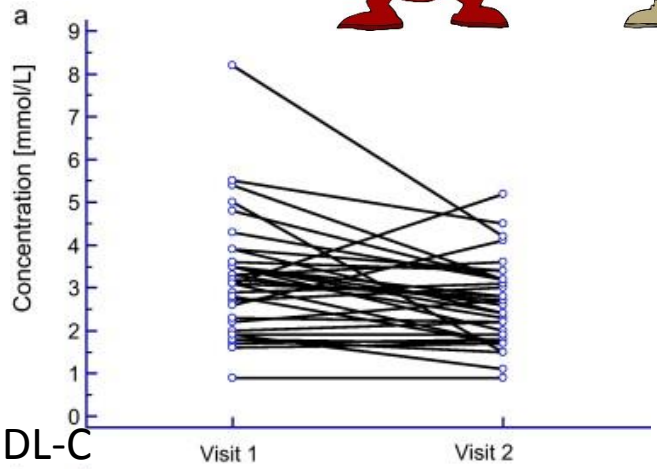
Lipoproteins and AAS

- LDL- cholesterol 20% ↑
- HDL-cholesterol 20-70% ↓

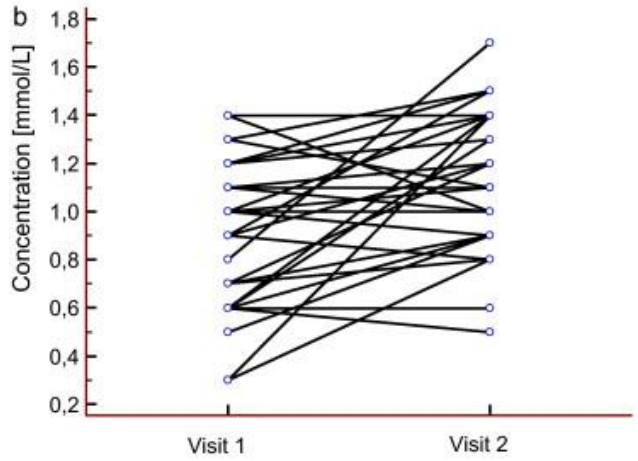
3 – 6 fold increase in CVD risk



LDL-C



HDL-C



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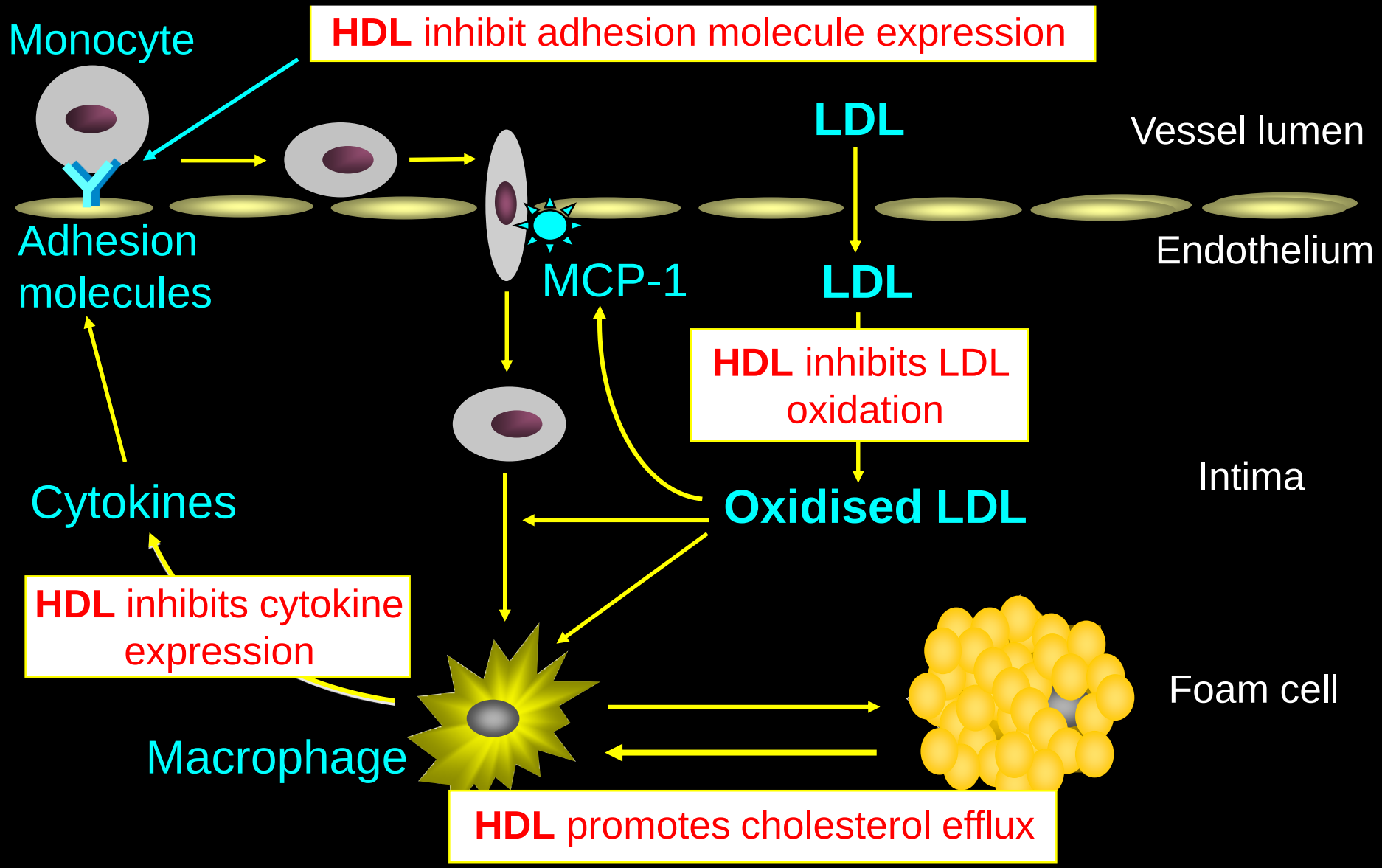
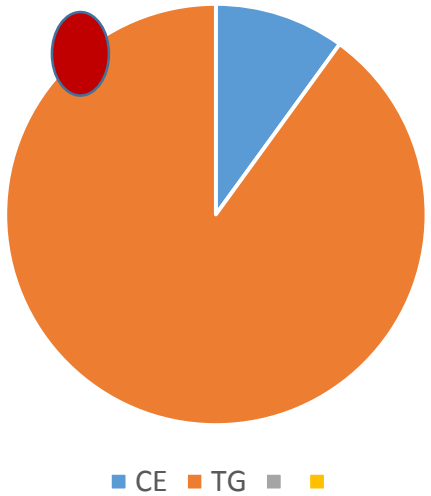
Achar et al., 2010; Gårevik et al., 2011

The role of LDL and HDL in atherosclerosis



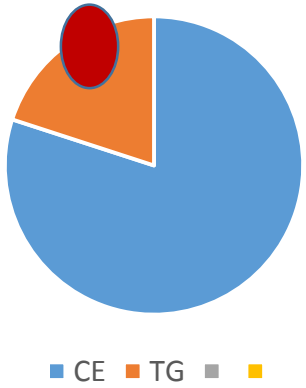
Lipoprotein structure and main function

VLDL



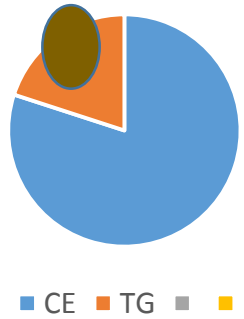
Transports triglycerides to adipose/muscle

LDL



Transports cholesterol to peripheral tissue and lesions

HDL



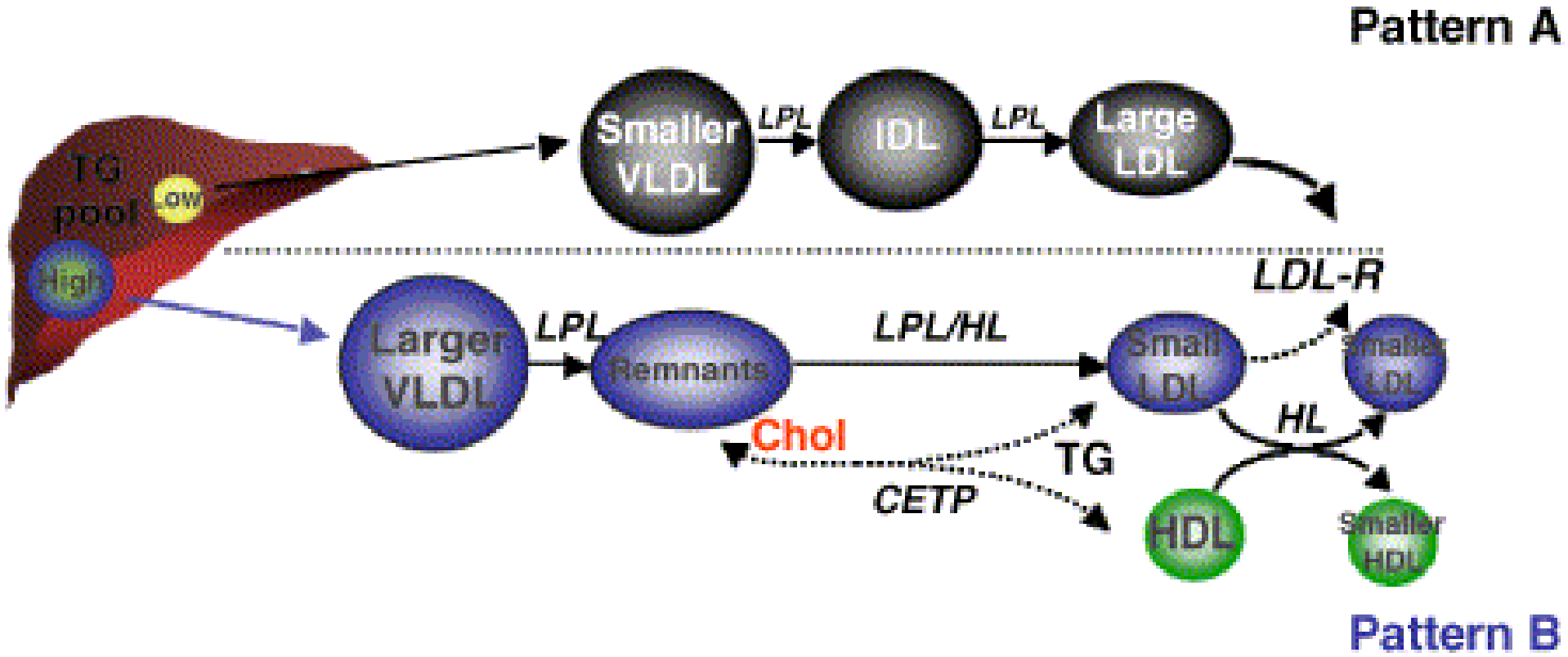
Transports cholesterol away from lesions to liver

Key:

Apo A-1

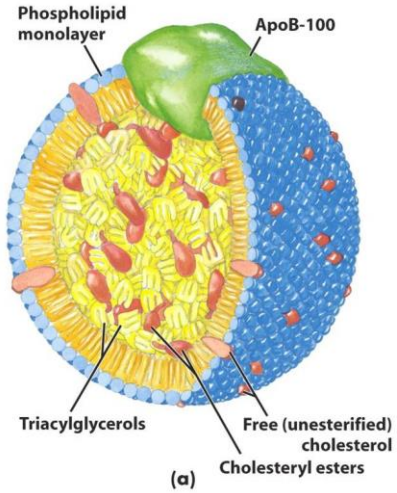
ApoB 100

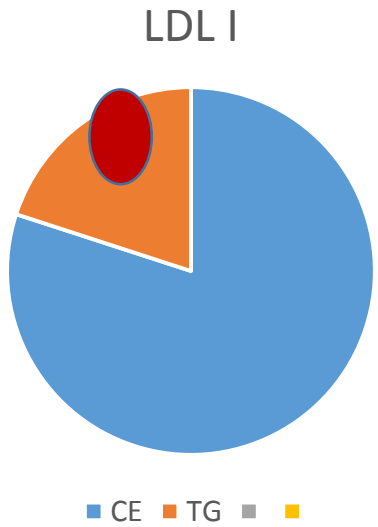
Hepatic lipase: a putative mechanism

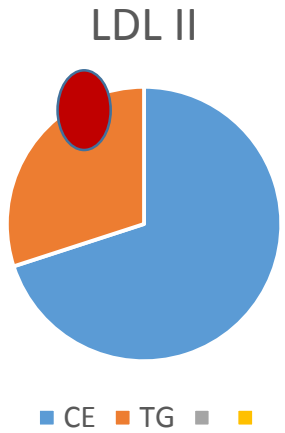


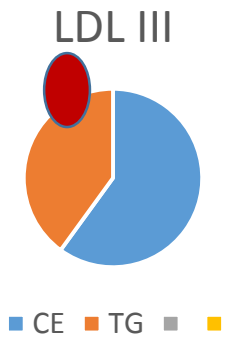
Baldo-Enzi et al, 1990

LDL, not one size fits all.
Small, dense LDL – small but deadly!





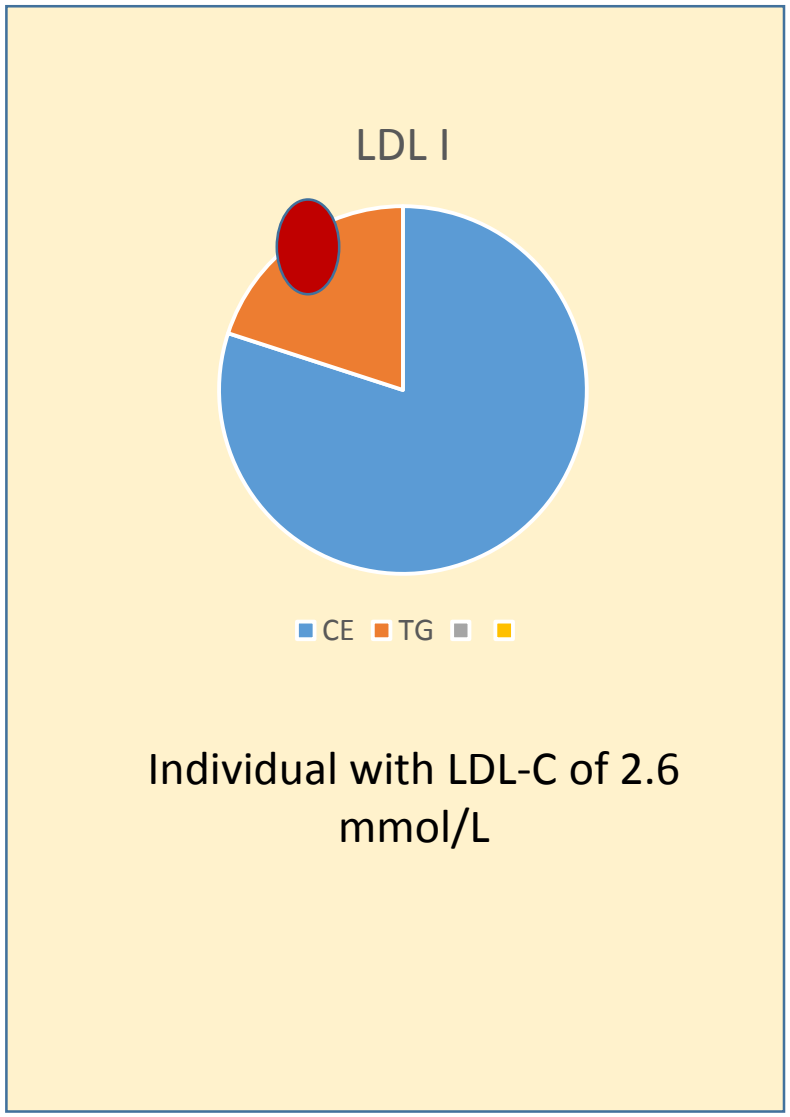




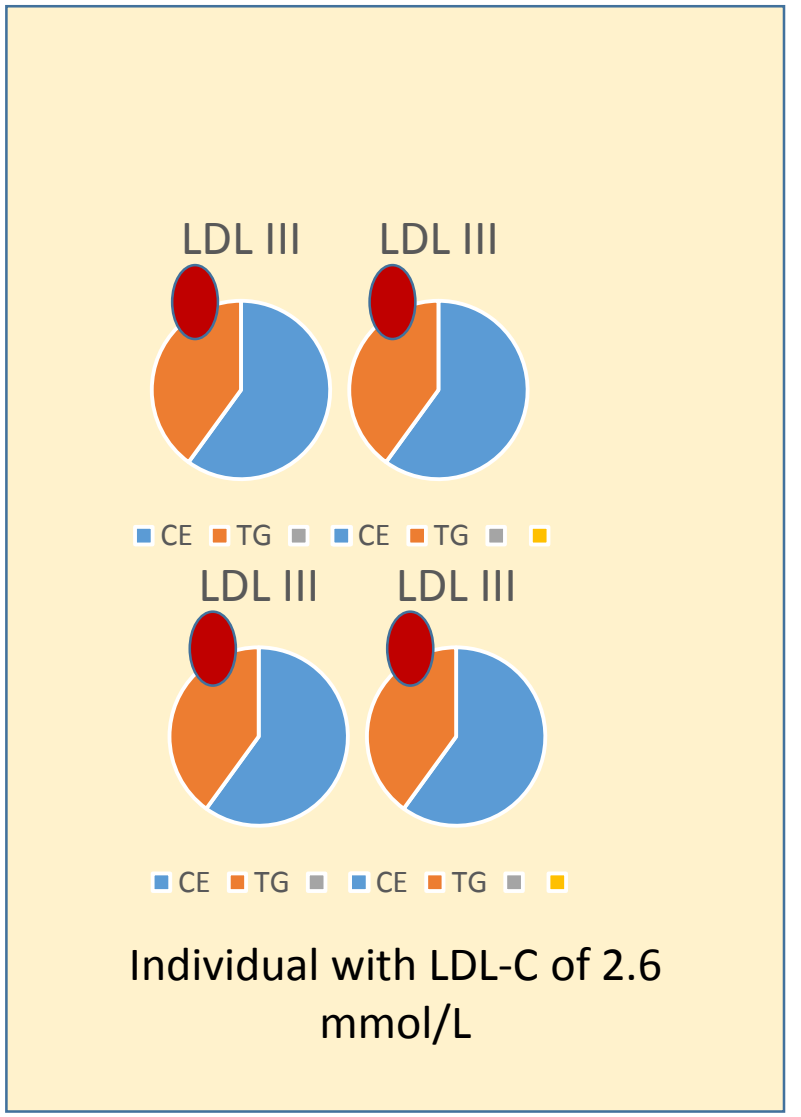
LDL particle decreasing in size, increasing in density, atherogenicity and number while losing cholesterol.

But does this not lower LDL-C?

LDL particle number can increase

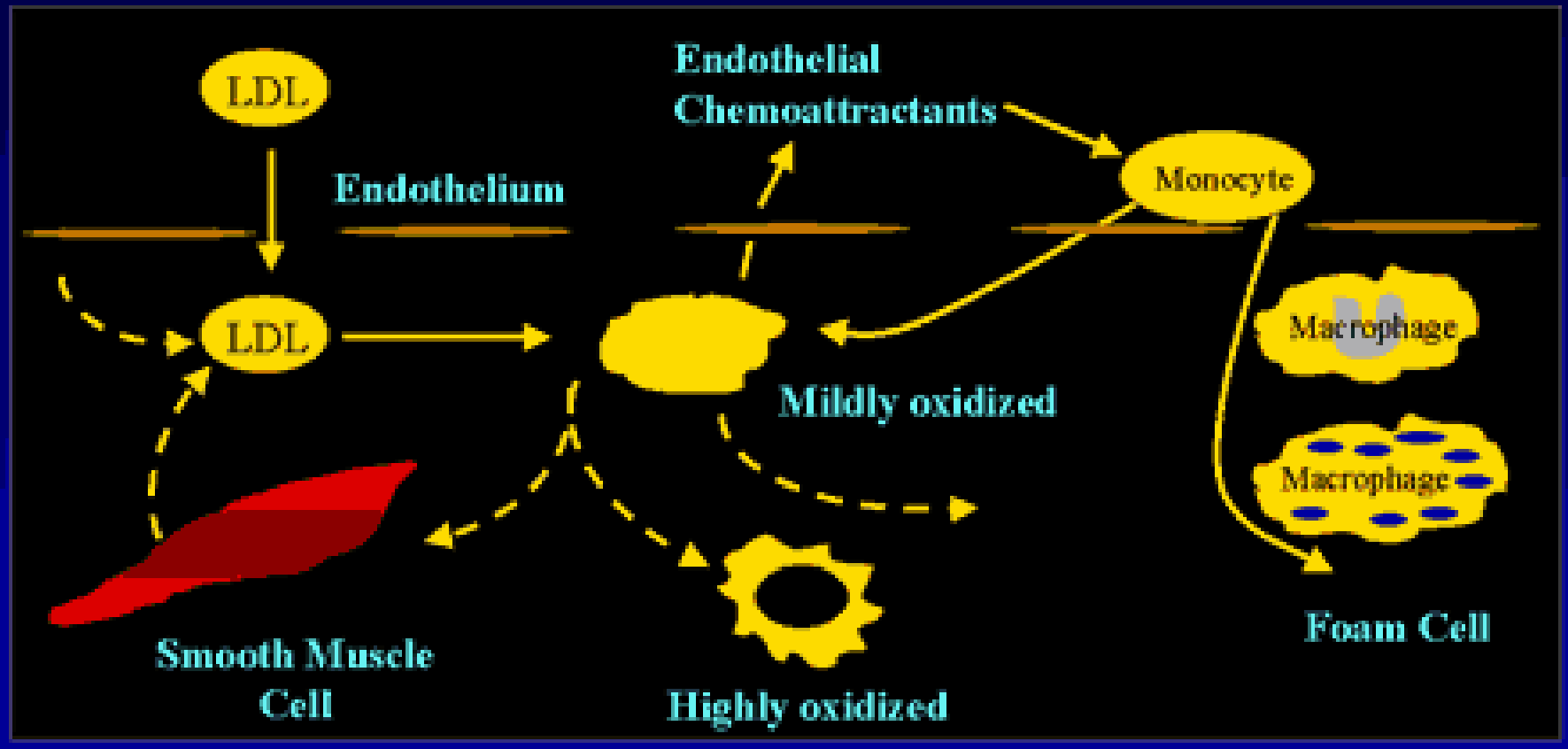


Individual with LDL-C of 2.6 mmol/L



Individual with LDL-C of 2.6 mmol/L

Atherogenicity of Small, Dense LDL



Evidence from in vitro studies suggests that large, buoyant LDL particles are more resistant to oxidative stress and small, dense LDL particles more susceptible to oxidation.

Clin Endocrinol (Oxf). 2017 Sep;87(3):249-256. doi: 10.1111/cen.13372. Epub 2017 Jun 8.

Insulin sensitivity in relation to fat distribution and plasma adipocytokines among abusers of anabolic androgenic steroids.

Rasmussen JJ[1,2], Schou M[2,3], Selmer C[1], Johansen ML[1,2], Gustafsson F[2,4], Frystyk J[5,6], Dela F[7,8], Faber J[1,2], Kistorp C[1,2].

Author information

Abstract

OBJECTIVE: Abuse of anabolic androgenic steroids (AAS) is prevalent among young men, but information regarding effects on insulin sensitivity and fat distribution is limited. The objective was to investigate insulin sensitivity in relation to fat distribution and adipocytokines among current and former AAS abusers compared with controls.

DESIGN: Cross-sectional study among men involved in recreational strength training. Current and former AAS abusers (n=37 and n=33) and controls (n=30) volunteered from the community.

METHODS: We assessed insulin sensitivity by Matsuda index (oral glucose tolerance test). Using overnight fasting blood samples, adiponectin and leptin were measured. Body composition and fat distribution, including visceral adipose tissue (VAT), were assessed by dual energy X-ray absorptiometry.

RESULTS: Current and former AAS abusers displayed lower Matsuda index than controls (%-difference (95%CI) from controls, -26% (-45; -1) and -39% (-55; -18)). Testosterone was markedly higher among current AAS abusers and subnormal among former AAS abusers compared with controls. Current AAS abusers displayed higher mean VAT than controls (388 (17) vs 293 (12) cm^3 , P<.001) whereas body fat %, adiponectin and leptin concentrations were lower. In contrast, former AAS abusers showed highest leptin concentrations and body fat %. Multivariate linear regressions identified VAT as independent predictor of lower Matsuda index among current AAS abusers compared with controls; while body fat % independently predicted lower Matsuda index among former AAS abusers.

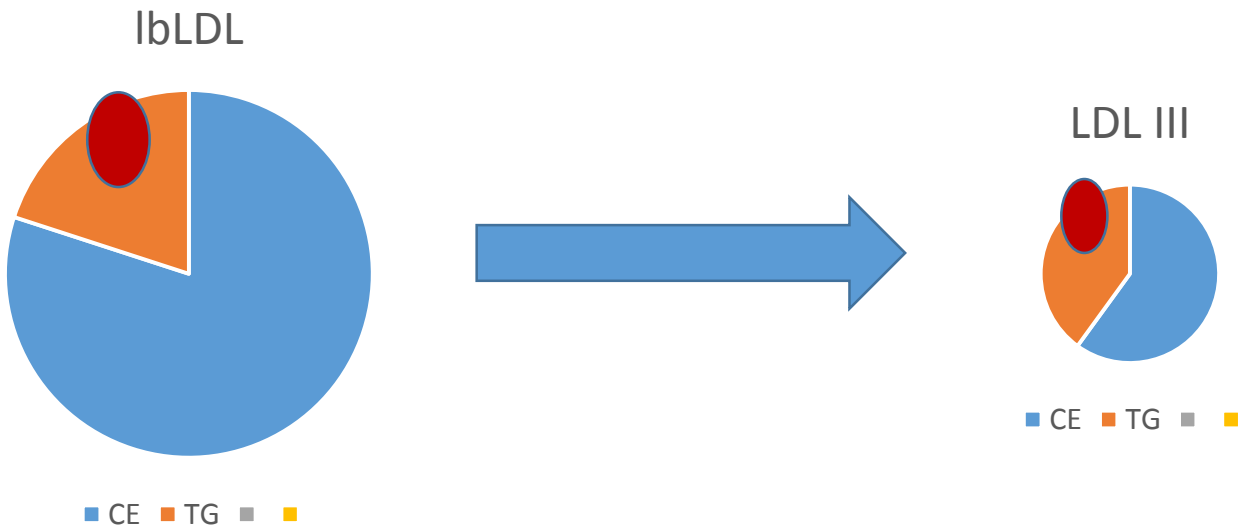
CONCLUSIONS: Both current and former AAS abusers displayed lower insulin sensitivity which could be mediated by higher VAT and total body fat %, respectively.

KEYWORDS: adipokines; androgens; glucose intolerance; insulin resistance; intra-abdominal fat

PMID: 28500659 DOI: 10.1111/cen.13372

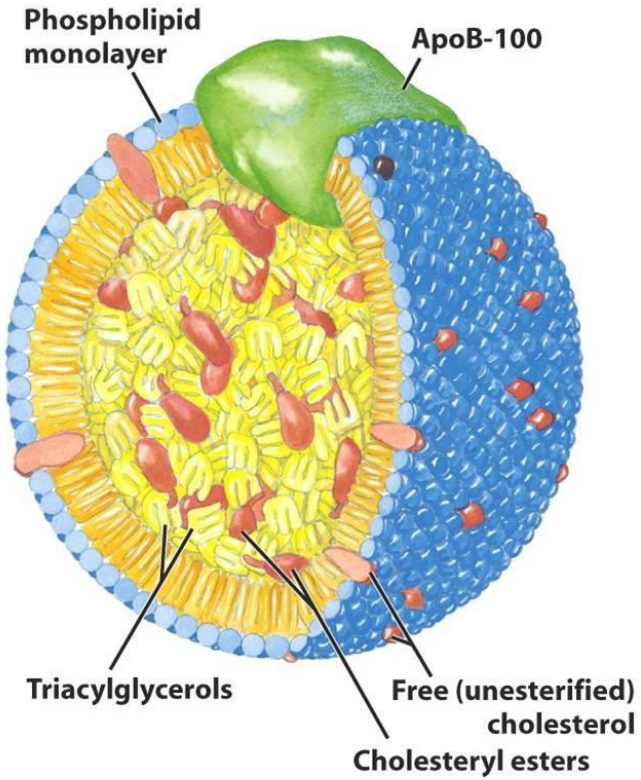
Research question number 1

Does AAS increase sdLDL?

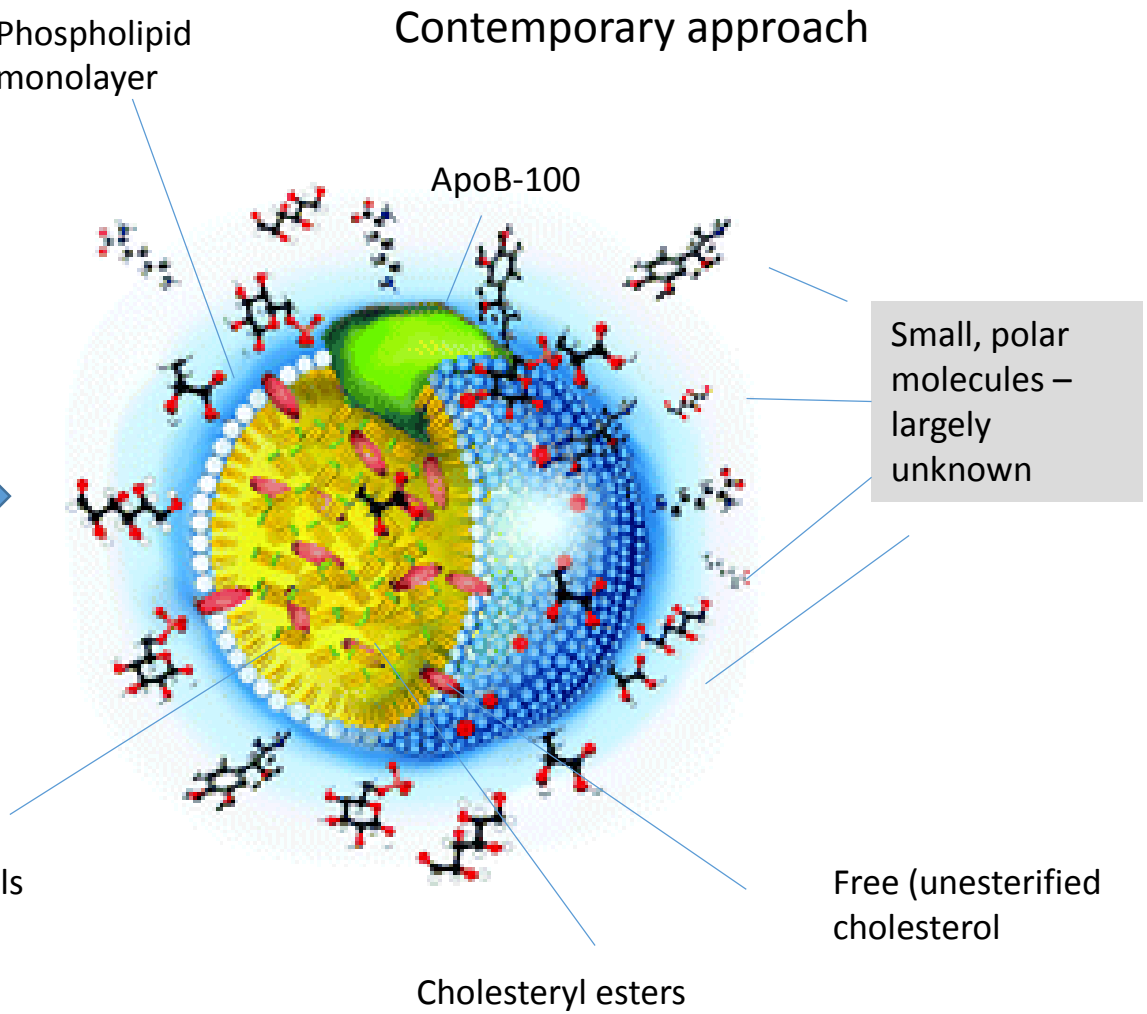


Lipoprotein-omics: small molecules, big questions!

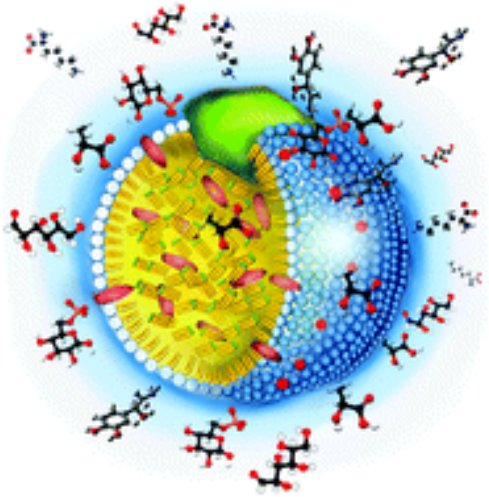
Traditional approach



Contemporary approach



Research questions number 2 & 3



What are these small molecules?

Are they different in AAS?

Aims and objectives

Aims: To use a ‘lipoprotein-omic’ approach to investigate small polar molecules associated with LDL subclasses in AAS use.

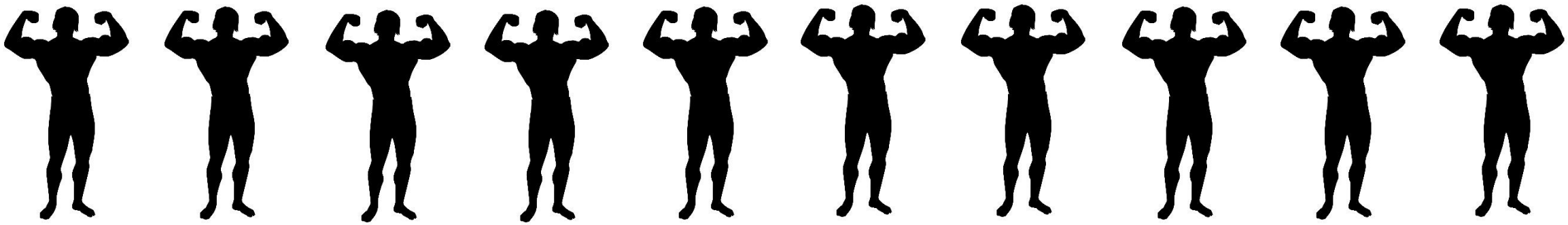
Hypothesis: AAS use will induce small, dense LDL and alter the small molecules covalently attached.

We will test these hypotheses by performing a proof of concept study consisting of the following objectives:-

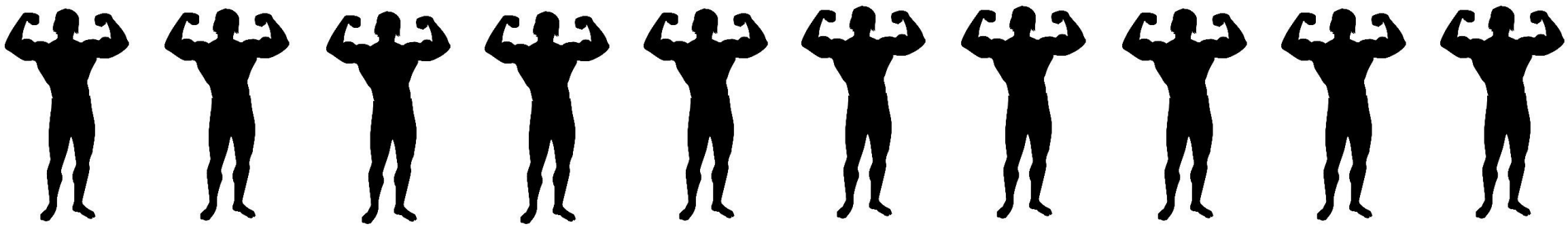
- 1. Prepare LDL subclasses from AAS & non-AAS Bodybuilders
- 2. Detect small polar molecule species contained in LDL subclasses

Sample

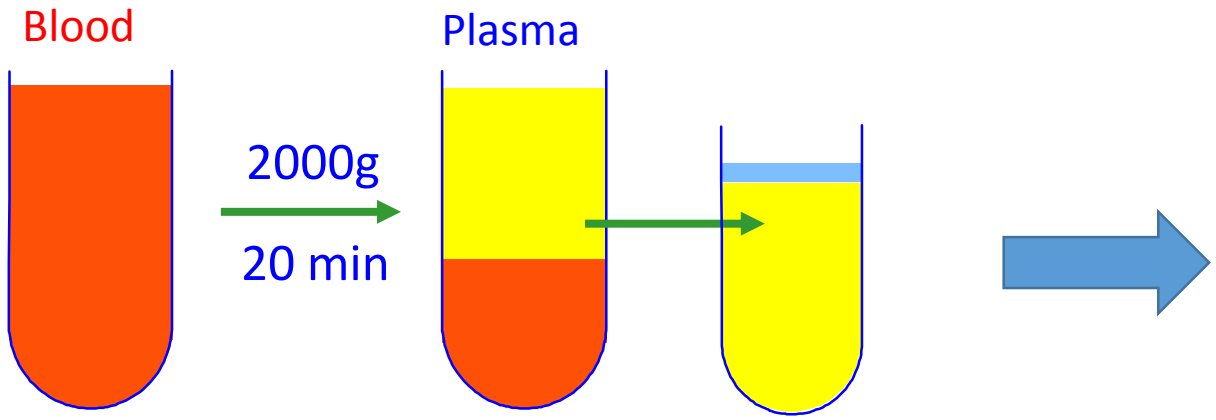
10 AAS-users (in cycle)

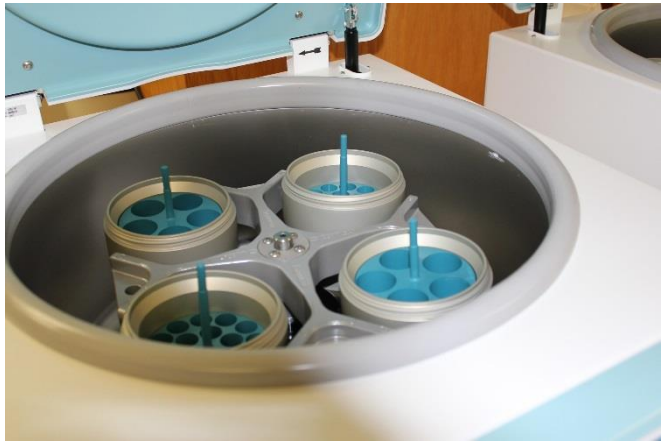


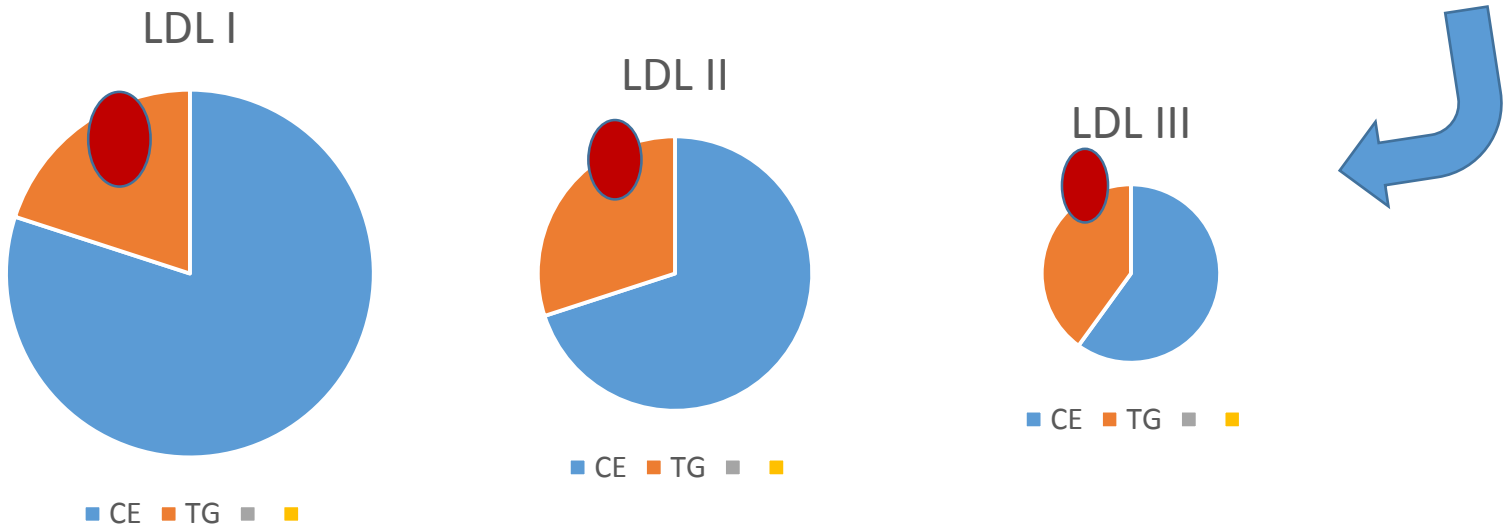
Vs. 10 non-users



Methods: Lipoprotein fractionation

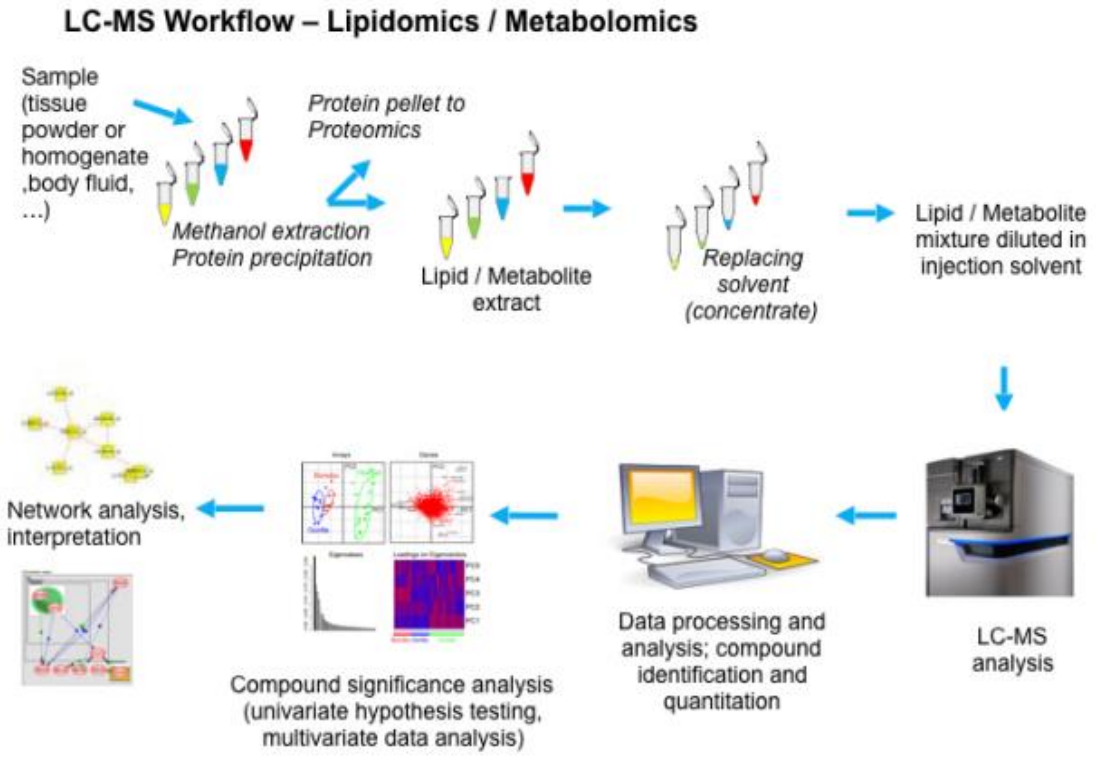






Davies et al., 2003

Methods



- Anthropometric (body composition) measurements
- 24 hour dietary recall survey
- Food frequency questionnaire
- Physical activity training log
- Steroid use interview (validated)

Expected results?

- Identification of small, polar molecules
- Involved in various biochemical pathways
- Enhance our knowledge of CM risk in AAS use

Summary

- Increased LDL-C and decreased HDL-C commonly observed in AAS use
- No evidence on LDL size
- No evidence on small, surface molecules
- Reveal new biomarkers associated with CM risk mechanisms
- Provide evidence for larger study
- Influence future interventions
- Provide HCP with information for patient care

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