Epidemiological relationships between physical activity, cardiorespiratory fitness and adiposity with cardiometabolic risk factors in youth

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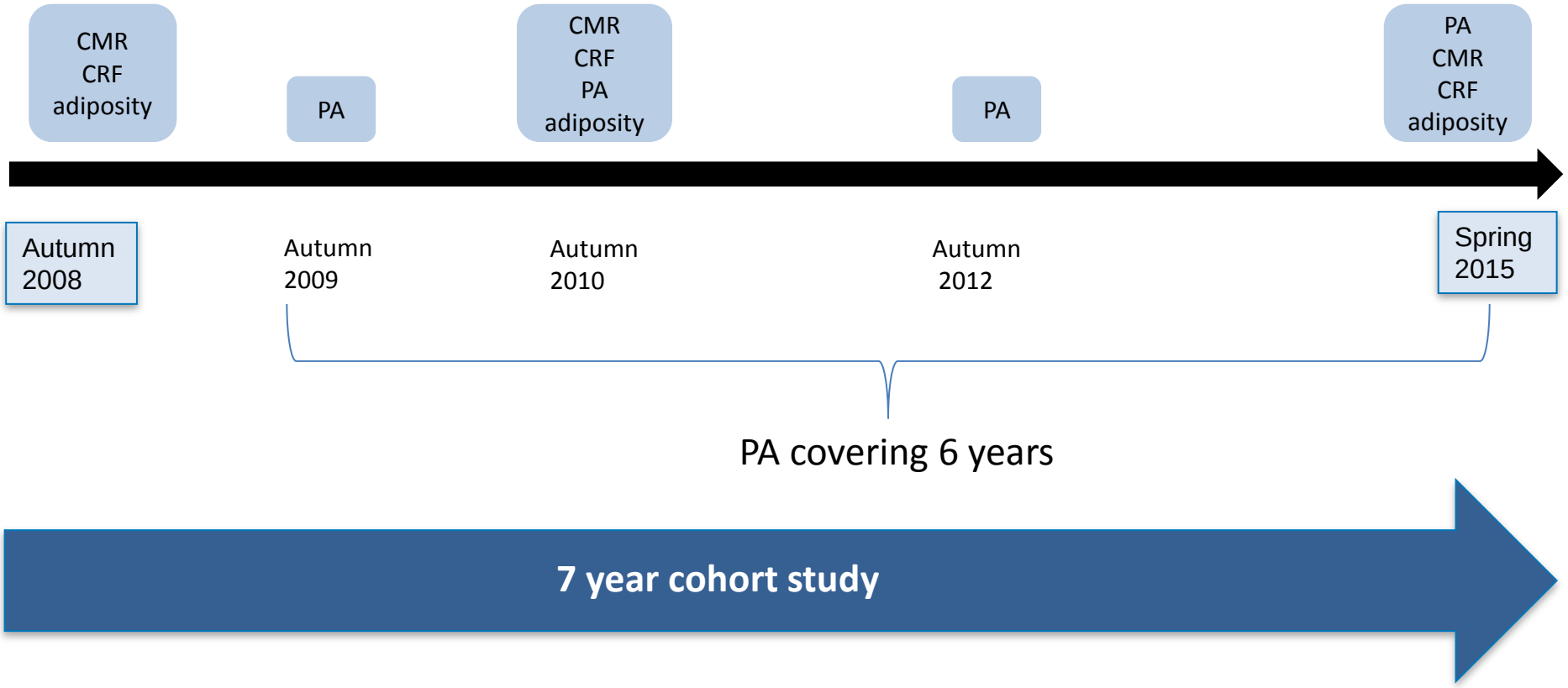
Purpose of presentation

- Present setting, scope of study and theoretical framework
- Methodological limitations
- Limitations in relation to interpretation of results

CHAMPS study-DK

Cardiometabolic risk factors (CMR) - clustered

Physical activity (PA)
Cardiorespiratory fitness (CRF)
Adiposity



Scope: Physical activity (public health) recommendations
Adults (composite of 10 studies)

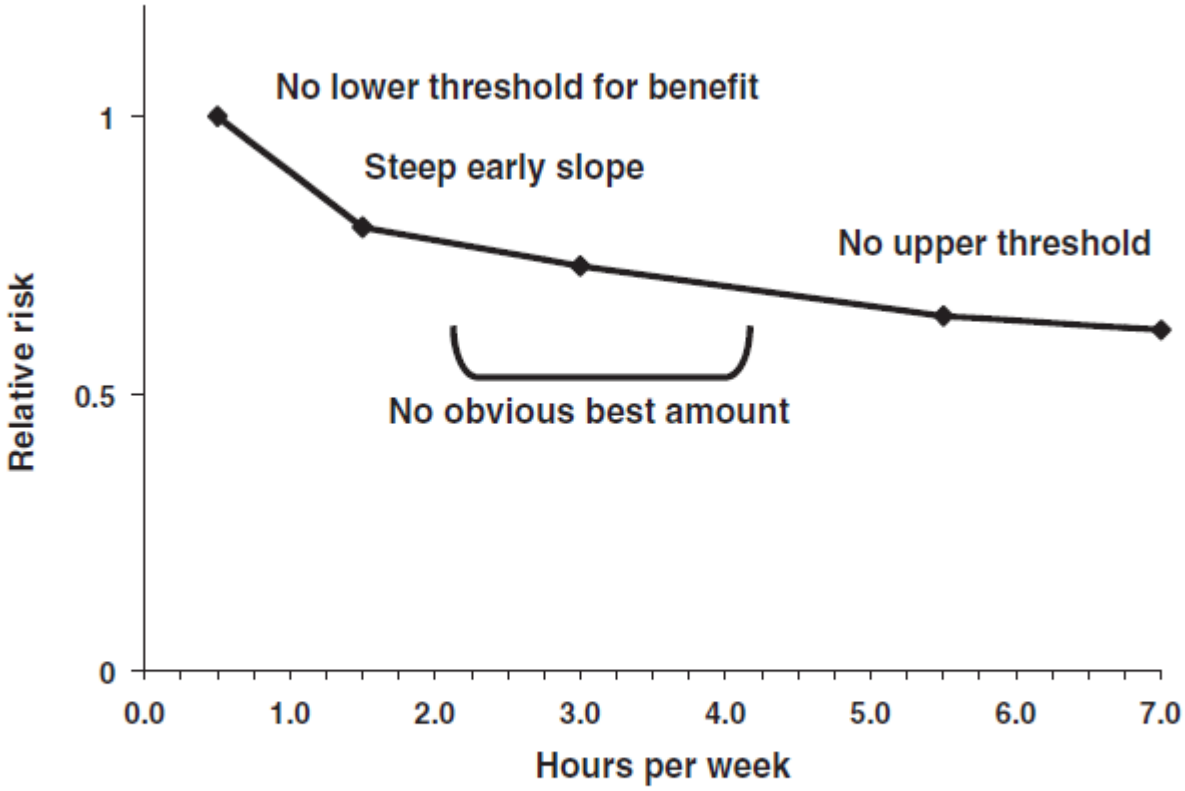


Figure 1

Risk of all-cause mortality by hours/week of moderate to vigorous physical activity. Adapted from Reference 71.

Powell et al (2011), adapted from: U.S. Department of Health and Human Services. These "2008 Physical Activity Guidelines for Americans" - Physical Activity Guidelines Advisory Committee Report

Table 1 U.S. Department of Health and Human Services physical activity recommendations [4]

Target group	Recommendation
Children and adolescents (aged 6-17)	Children and adolescents should do 1 hour (60 minutes) or more of physical activity every day. Most of the 1 hour or more a day should be either moderate- or vigorous-intensity aerobic physical activity. As part of their daily physical activity, children and adolescents should do vigorous-intensity activity on at least 3 days per week. They also should do muscle-strengthening and bone-strengthening activity on at least 3 days per week.

U.S. Department of Health and Human Services. These "2008 Physical Activity Guidelines for Americans" - Physical Activity Guidelines Advisory Committee Report

- A complementary approach might be to be specific about which type of phenotype is recommendable/should be avoided
  - Overweight?
  - High "average" physical activity? (i.e. low sedentary/?)
  - Engage in moderate-vigorous activity?
  - Have a high cardiorespiratory fitness?

Framework: associations?

A model c third variable (

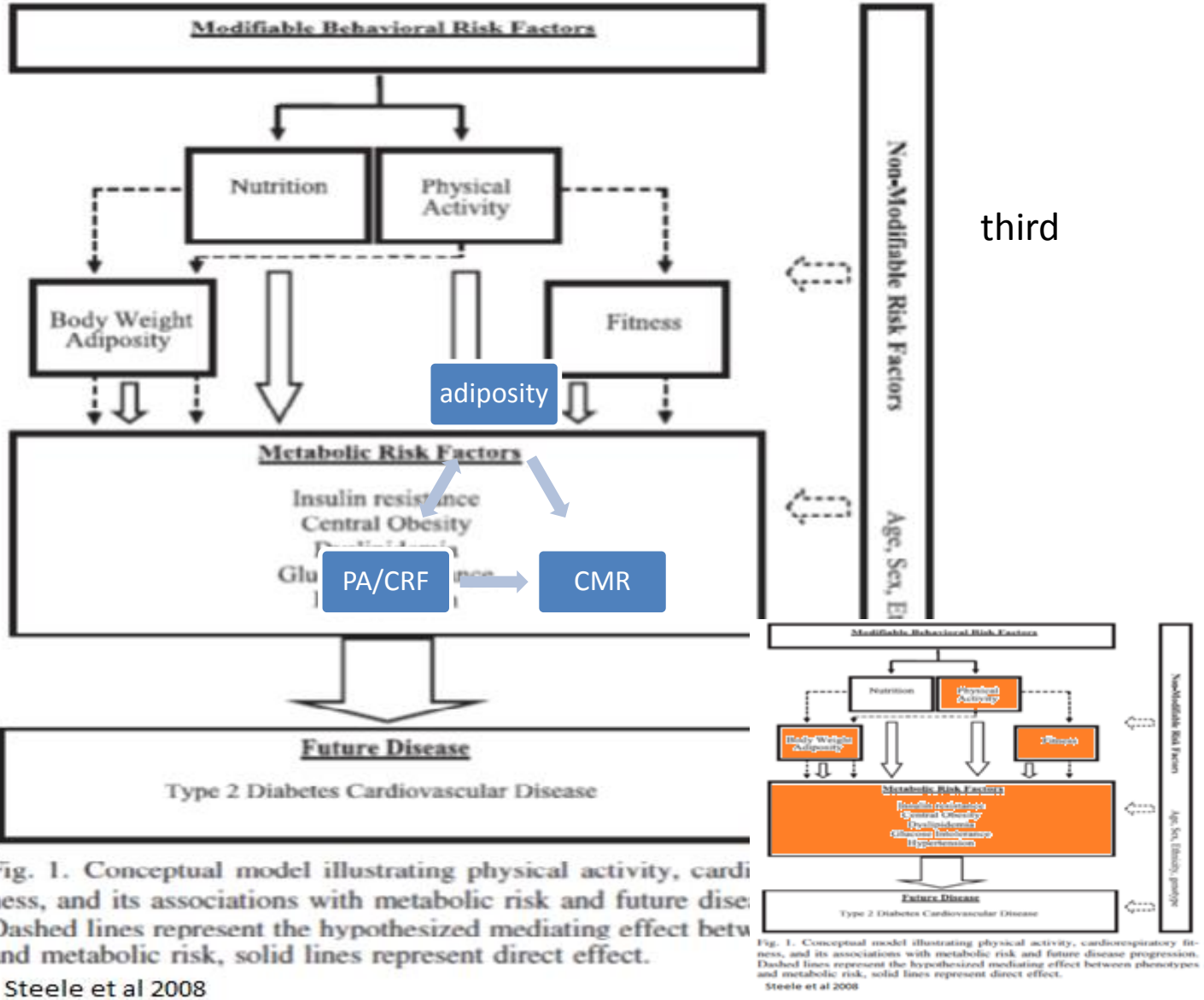
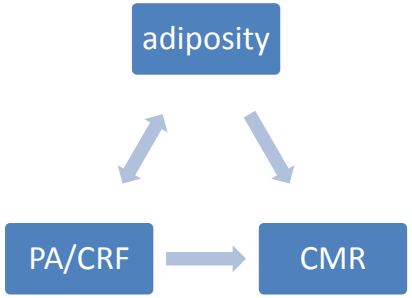


Fig. 1. Conceptual model illustrating physical activity, cardi
ness, and its associations with metabolic risk and future dise
Dashed lines represent the hypothesized mediating effect betw
and metabolic risk, solid lines represent direct effect.

Steele et al 2008



- **The literature strongly supports an association between physical activity, cardiorespiratory fitness and adiposity with cardiometabolic risk factors (cross-sectional)**

- Differences in CMR
  - +/- CRF
  - +/- adiposity (wc or BMI)
  - +/- adjustment for CRF or PA

- Confounded/mediated by adiposity?
  - CRF is attenuated or disappears (Eisenmann 2007 (BMI), Jago 2010 (BMI), Andersen 2011 (WC), Klakk 2014 (TBF%), Diez-Fernandez 2014 (BMI)
  - PA appears more robust (Brage 2004 (BMI/WC), Ekelund 2007 (WC), Jago 2008 (BMI, WC))

Average activity vs. MVPA?

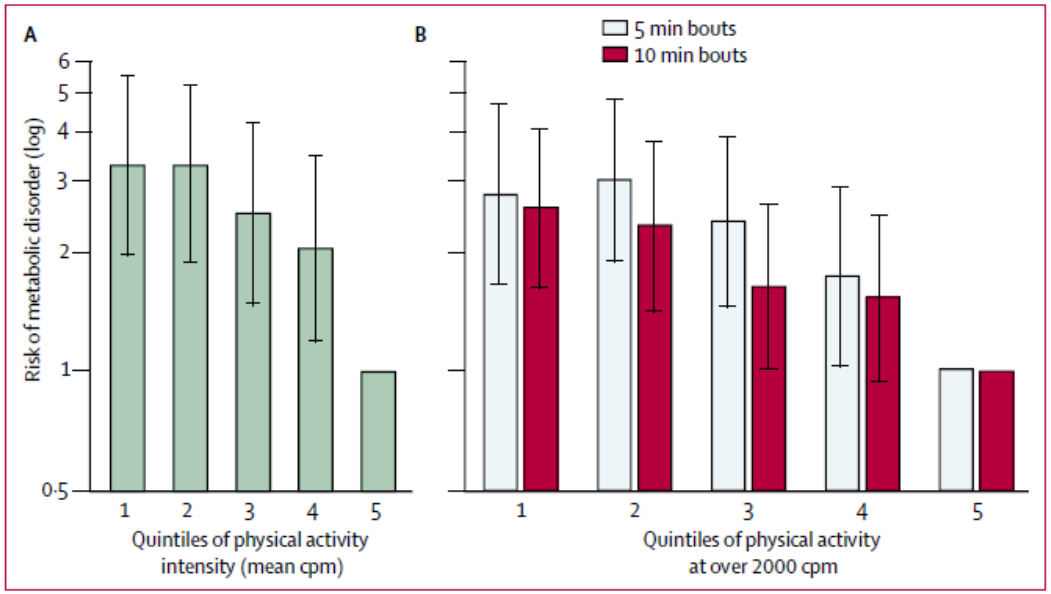
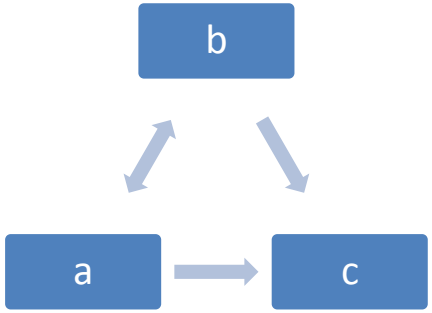


Figure 2: Odds ratios for clustered risk by quintiles of average physical activity intensity

Andersen 2006

Also reported by: Jago 2008, Ekelund 2007

What is lacking

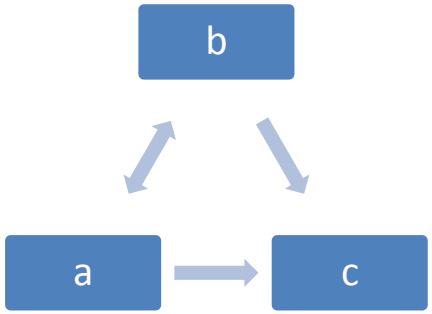


- **Longitudinal associations between PA and clustered CMR are not well studied in epidemiological designs**
  - Jago 2008 (significant association), Andersen 2011 (no association)
  - Single risk factors or obesity are more frequently studied (Riddoch 2009, White 2012, Ekelund 2012, Carson 2014)

- **Systematically investigate associations in terms of:**
  - mediation / confounding
  - Interaction

- **Investigation of physical activity in terms of intensity domains (i.e. MVPA, VPA) is less studied in relation to CMR than average activity levels**

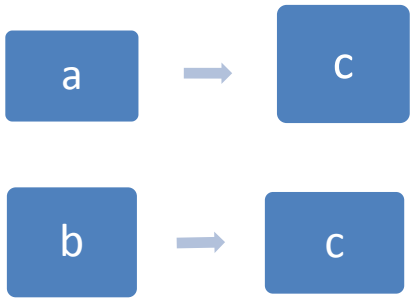
Framework: Methodology



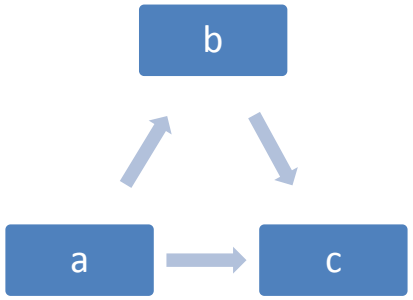
Mediator / confounder ?

Three models are constructed

Model 1 & 2:



Model 3



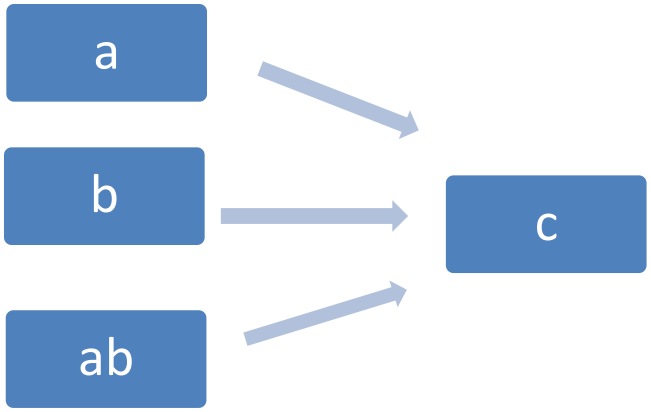
Conclusion from model 1 & 2 : a & b are both associated with c

Conclusion from model 3: a is associated with c = a-c association **statistically independent** of "holding b constant" (*"effect"* of a on c is **not** (completely) mediated (or confounded) by b)

Assumption: no measurement error

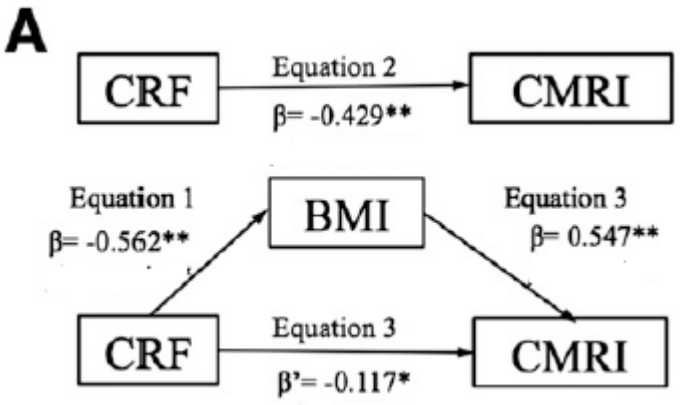
Methodology

Interaction?



Solution: Stratification on levels of b

Examples



Diez-Fernandez et al 2014

Indicates BMI is a strong mediator or confounder

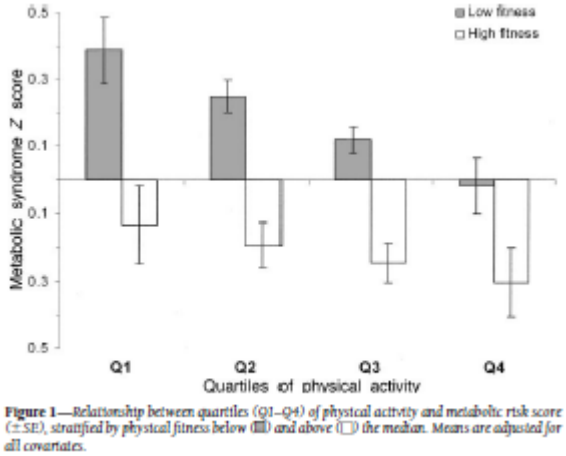


Figure 1.—Relationship between quartiles (Q1–Q4) of physical activity and metabolic risk score (± SE), stratified by physical fitness below (■) and above (□) the median. Means are adjusted for all covariates.

Brage et al 2004

Effect of low CRF or PA is "off-set" by the interaction

(some) Methodological limitations of PA assessment

- Regression dilution
  - ICC is a measure of the ratio of inter-individual variance to the total variance
  - ”True” beta = estimated beta / ICC
    - (Mattocks 2007: 0.51)

- PA during cycling
  - Match PA during cycling against criterion measure (heart rate)

(main) methodological considerations in relation to interpretation

It cannot be fully elucidated whether adiposity is confounding or mediating – but:

- Differences in attenuation between PA/CRF suggests different pathways = recommendations may be based on this
- Interaction is conceptually different from confounding = recommendations may be based on this

Measurement error in PA assessment

- Random error (regression dilution) – Mattocks 2007
  - Assumption behind ICC: all variation is due to measurement error
- Cycling

Measurement error in CRF

- Dependence on body weight (operationalization itself may be confounded by adiposity) – McMurray & Bugge 2011

One variable assessed with less error than the other…..