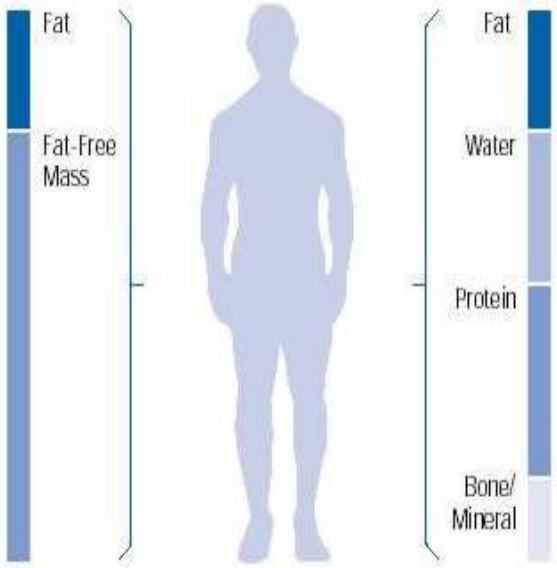
Diagnosing overweight & obesity by assessing *Body Composition* in Mauritius



Dr Sadhna Hunma

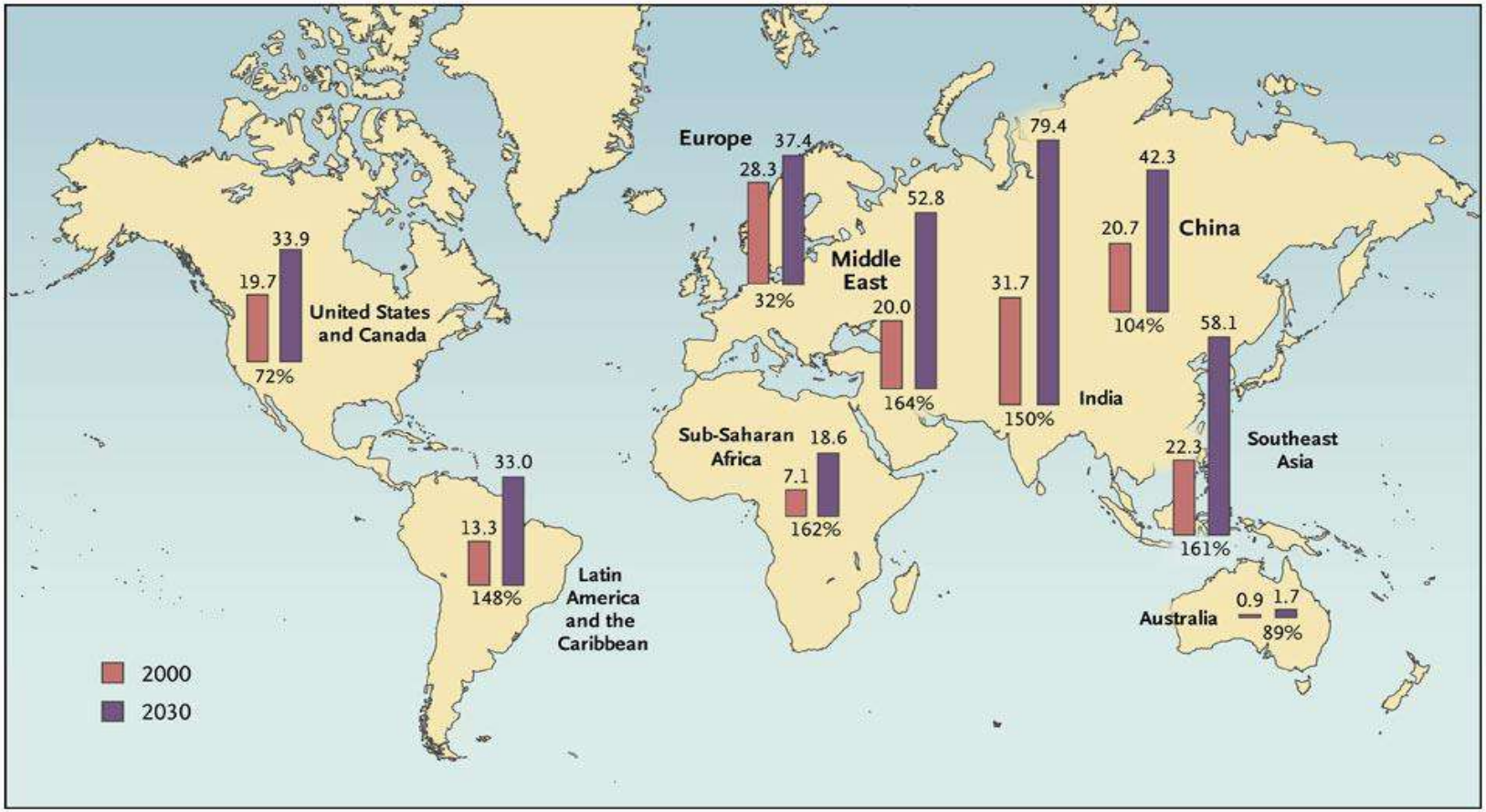
Body Composition & its relationship to Cardiometabolic Profile in healthy adult Mauritians of Indian & Creole Ethnicities

Dr Sadhna HUNMA
University of Fribourg, Department of Medicine
Switzerland

Thesis Supervisor : Prof A G Dulloo

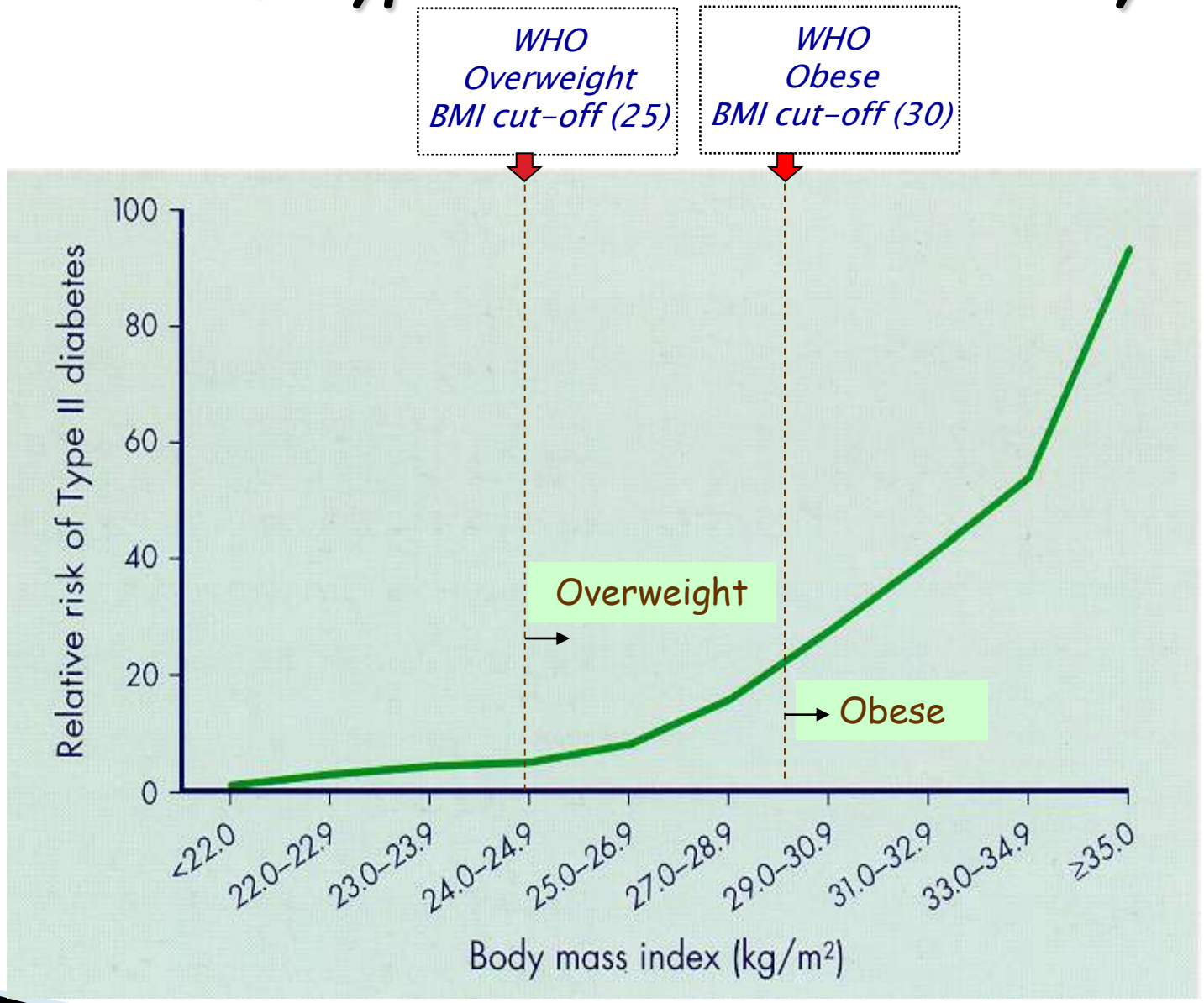
Rising Prevalence of Type 2 Diabetes Worldwide

From *Hossain et al. N Engl J Med 2007*



Millions of Cases of Diabetes in 2000
Projections for 2030
with Projected %Changes

Prevalence of Type 2 Diabetes is Obesity driven



Colditz GA et al. Ann Intern Med 1995;122:481-86

Rising Prevalence of Type 2 Diabetes Worldwide

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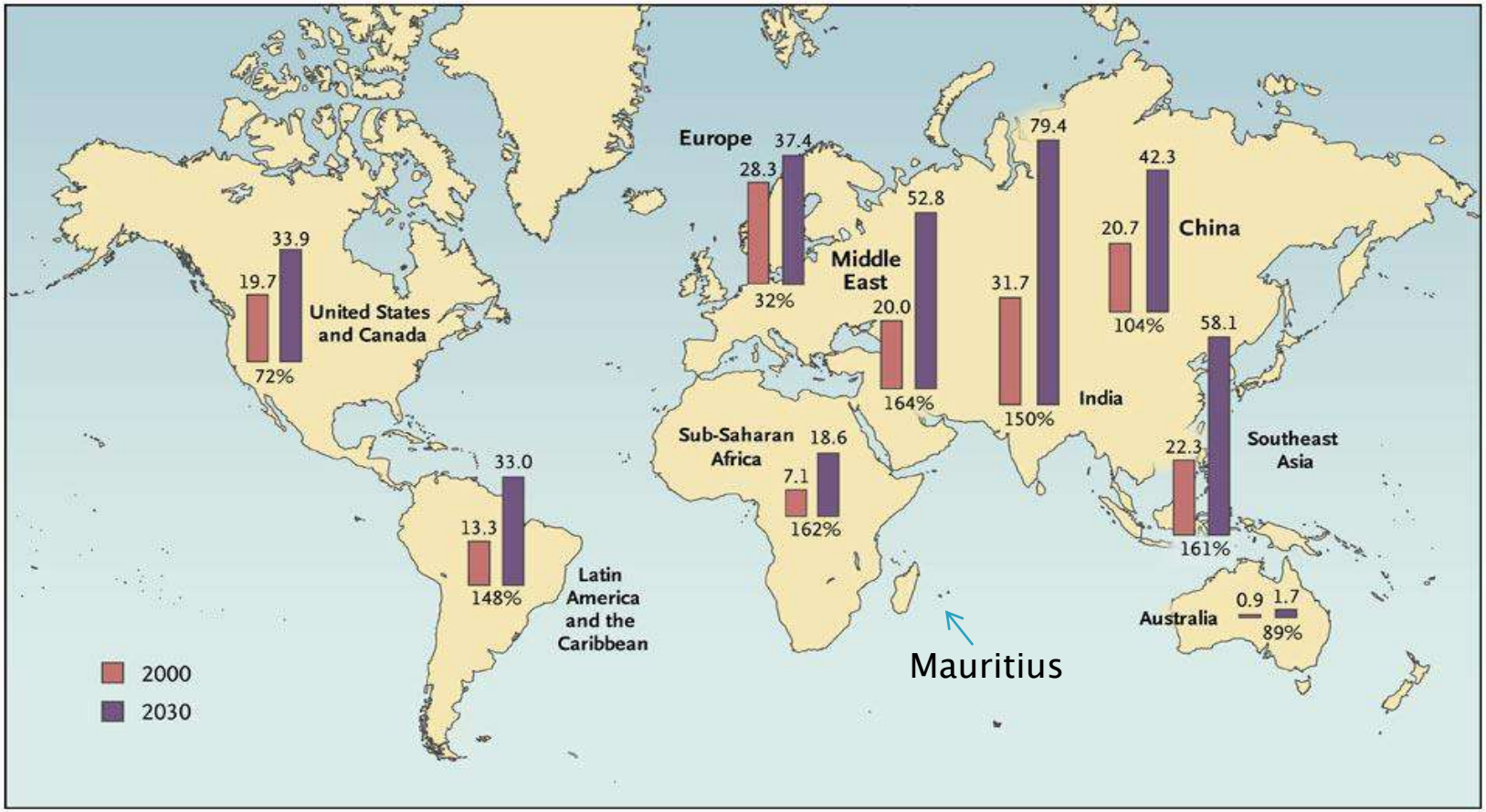

Millions of Cases of Diabetes in 2000
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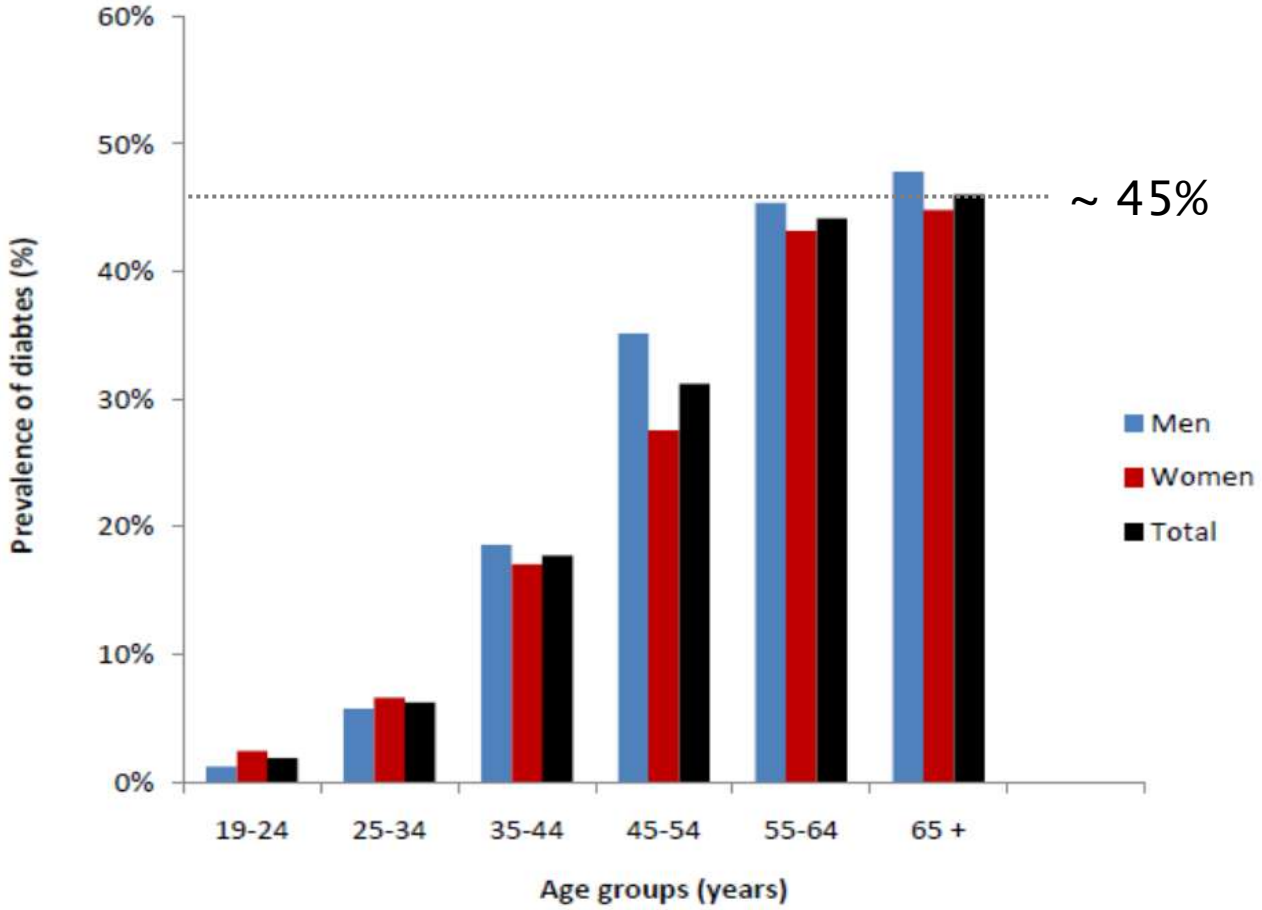
Baker IDI

Ministry of Health & Quality of Life

The Trends in Diabetes and Cardiovascular Disease Risk in Mauritius

The Mauritius Non Communicable Diseases Survey 2009



Prevalence high in all main ethnic groups

Mauritius: High prevalence of type 2 diabetes (T2D) & cardiovascular disease

- Mauritius: Population of 1.5 million

- Main Ethnic groups
  - 70% Indians (*south asian ancestry*)
  - 28% Creoles (African ancestry)
  - 2% Chinese (East mainland China ancestry)

- These 3 ethnic groups reflect ~ 2/3 of world population, *a microcosm of world epidemic*

since 1980's, many studies carried out in Mauritius by *World Health Organisation* (WHO):

Aims: towards better

Diagnosis/ pathogenesis/Early predictors

Some WHO publications based on research in Mauritius

- Dowse GK, Gareeboo H, Zimmet PZ, Alberti KG, Tuomilehto J, Fareed D, Brissonnette LG, Finch CF.
  High prevalence of NIDDM & impaired glucose tolerance in Indian, Creole, and Chinese Mauritians.
  Diabetes 1990; 39: 390–6

- Hodge AM, Dowse GK, Zimmet PZ, Collins VR.
  Prevalence and secular trends in obesity in Pacific and Indian Ocean island populations.
  Obes Res 1995; **3** (Suppl 2): 77s–87s.

- Soderberg S, Zimmet P, Tuomilehto J, de Courten M, Dowse GK, Chitson P, et al.
  Increasing prevalence of T2D mellitus in all ethnic groups in Mauritius.
  Diabet Med 2005;22: 61–8.

- Cameron AJ, Boyko EJ, Sicree RA, Zimmet PZ, Söderberg S, Alberti KG, Tuomilehto J, et al.
  Central obesity as a precursor to the metabolic syndrome in the AusDiab study and Mauritius.
  Obesity *(Silver Spring).* 2008;16: 2707–16.

- Nyamdorj R, Qiao Q, Söderberg S, Pitkäniemi J, Zimmet P, Shaw J, Alberti G, et al.
  Comparison of body mass index with waist circumference, waist-to-hip ratio, and waist-to-stature ratio. as a predictor of hypertension incidence in Mauritius.
  Hypertens 2008; 26: 866–70.

- Magliano DJ, Söderberg S, Zimmet PZ, Chen L, Joonas N, Kowlessur S,et al.
  Explaining the increase of diabetes prevalence and plasma glucose in Mauritius.
  Diabetes Care 2012; **35**: 87–91.

One major limitation:

Use of proxies of adiposity (BMI & WC) rather than body fat *per se*

Limitations of BMI and WC

- Misclassification across UW/NW/OW/OB because BMI does not distinguish between fat mass and lean mass
- Underdiagnosis of OW & OB patients at risk

Therefore we need a valid method to assess *body composition* (*Fat, FFM, %Fat, abdominal fat*)

Which body composition method to use?

Body Composition Methods

Capability of different body fat measurements to estimate total body fat and fat distribution

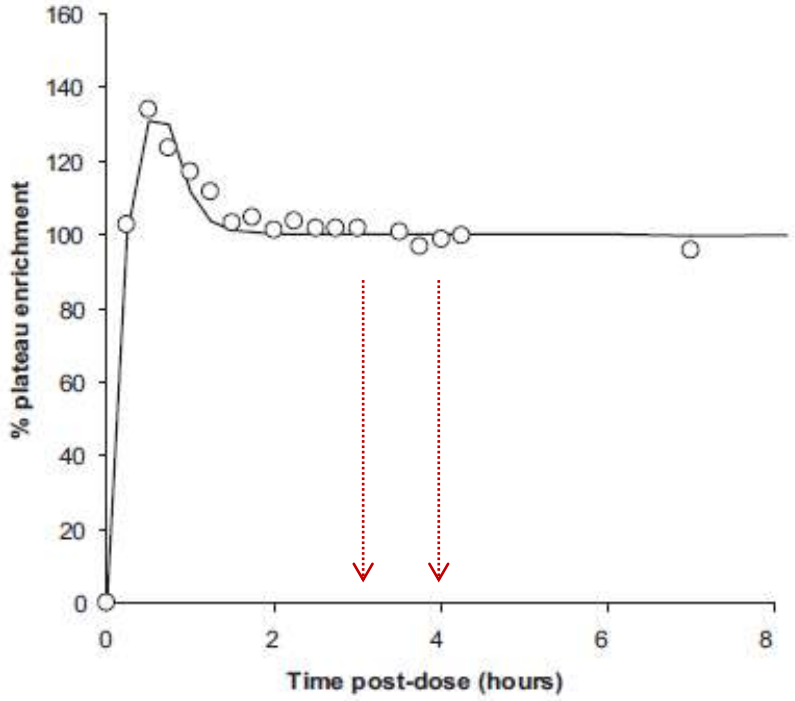
Snijder et al. Int J Epidemiol. 2006 Feb;35(1):83-92.

Method	Capability measuring total body fat	Capability measuring fat distribution	Applicability in large population studies
CT	Moderate	Very high	Low
MRI	High	Very high	Low
DXA	Very high	High	Moderate
Densitometry	Very high	Very low	Low
Dilution techniques D2O	High	Very low	Moderate
BIA (whole body)	Moderate	Very low	High
BIA-Abdo(*ViScan*)	Low	High	High
BMI	Moderate	Very low	Very high
WC, HC, WHR, SAD	Low	High	Very high
Skinfolds	Moderate	Moderate	High

- CT, computed tomography; MRI, magnetic resonance imaging; DXA, dual-energy X-ray absorptiometry; BIA, bioelectrical impedance analysis; BMI, body mass index; WC, waist circumference; HC, hip circumference; WHR, waist-to-hip ratio; SAD, sagittal abdominal diameter.

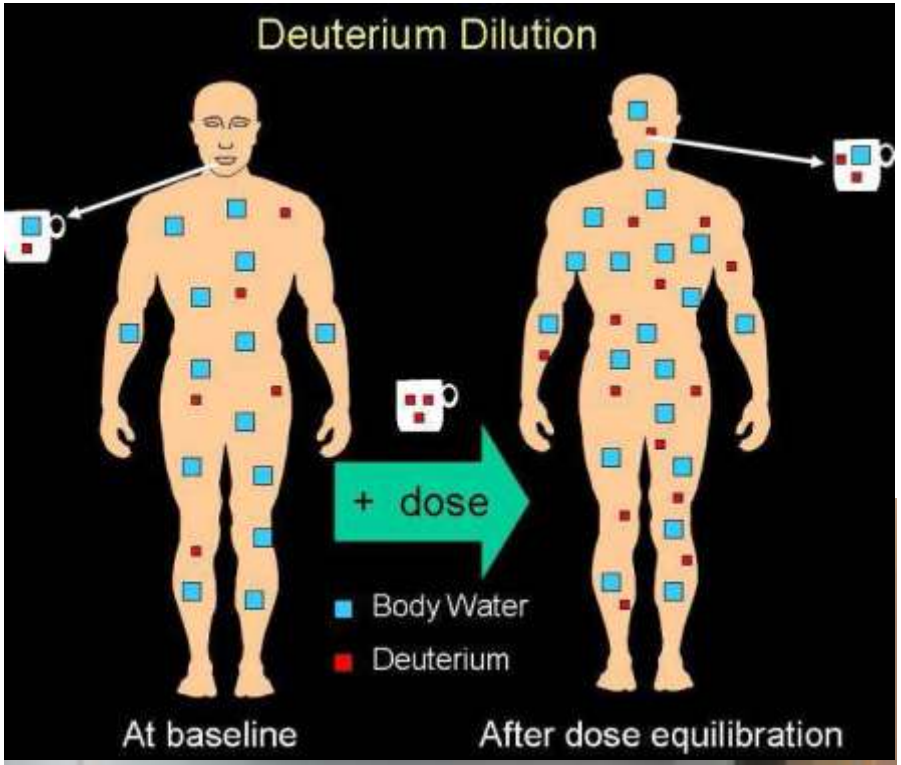
Principle of Deuterium oxide (D2O) dilution technique

Body water pool contains small amount of Deuterium (*collect baseline saliva*)



After dose equilibration 3-4 hrs: Enrichment which is amount of Deuterium in body water above that naturally present

Estimating total Body Water (TBW)



Conc of deuterium in saliva samples measured by FTIR

D2O technique (Two Component Technique : FM/FFM): Assumptions & Calculations

- D2O is distributed only in body water
- D2O is equally distributed in all body water compartments
- Rate of equilibration of D2O is rapid
- Neither D2O nor body water is lost during equilibration time

VD: Dilution space of D2O

TBW: Total body water

FFM: Fat free mass

- VD= Dose / Concentration
- TBW= VD/1.041
- FFM = TBW / 73%
- **Fat** mass= Body weight – FFM

BIA(Bioelectrical Impedance Analysis) : predictive techniques

BIA determines electrical impedance or opposition to flow of an electric current through body tissues ⇛Conductivity α total body water (TBW) ⇛ FFM
Fat mass = Body weight – FFM

BC-418 (BIA8)

8-contact electrodes
single frequency BIA

ViScan Abdominal fat analyser by BIA
+ estimates WC by IR

Subjects: recruitment criteria

- Healthy Men & Women of age 20-40 yrs of Indian & Creole ethnicities

- Non-regular smokers
- Non-regular alcohol consumers

- Non-pregnant & non-lactating mothers
- Non-athletes or engaged in heavy manual work

- No intense activities 15 hrs before the study
- Fasting state on study day (12-15 h overnight fast)

Subjects: Physical characteristics (n = 175)

	All	
	Men	**Women**
	N=87	*N=88*
Age *(y)*	**33.7**	**32.7**
	± 5.7	*± 6.5*
Weight *(kg)*	**77.7**	**62.4 *****
	± 15.7	*± 14.9*
Height *(m)*	**1.72**	**1.58*****
	± 0.07	*± 0.06*
BMI *(kg/m^2)*	**26.2**	**24.9**
	± 5.0	*± 5.3*
WC *(cm)*	**94.6**	**92.6**
	±12.3	*±12.6*

Aims of study

In young *disease-free* adult Mauritians

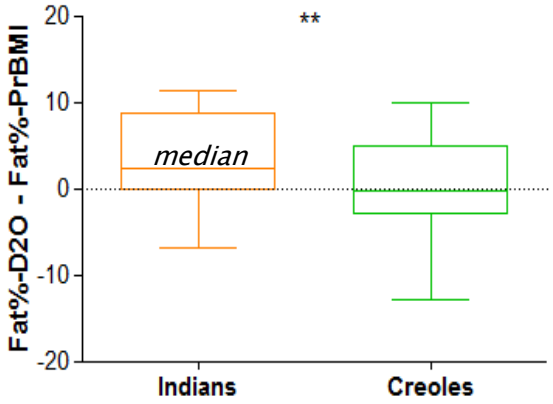
- Use of D2O dilution technique *as reference method*
  - to establish the BMI-body fat% relationship and
  - to investigate gender & ethnic differences (*Indian vs Creole*).
- Use of ViScan (abdominal/WC) analyser
  - to establish relationship between WC and abdominal fat%,
  - to investigate potential gender & ethnic differences
- Validate two field techniques (Bioimpedance BC-418 analysis system and the SKF technique) against D2O dilution reference technique for the assessment of total body fat%
- Evaluate the relationship between cardiometabolic signatures in relation to body composition, and according to gender & ethnicity.

Comparison of Fat% measured by D2O (Fat%-D2O) *versus* Fat% Predicted by BMI (Fat%-PrBMI)

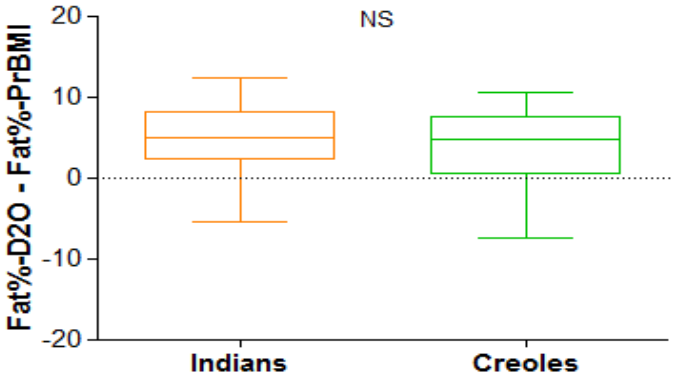
- *Deurenberg's equation* :
  Developed & Validated in Caucasians (using hydrodensitometry as reference.

%Fat=(1.2 x BMI)+(0.23 x age)-(10.8 x gender)-5.4

(males=1, females=0)

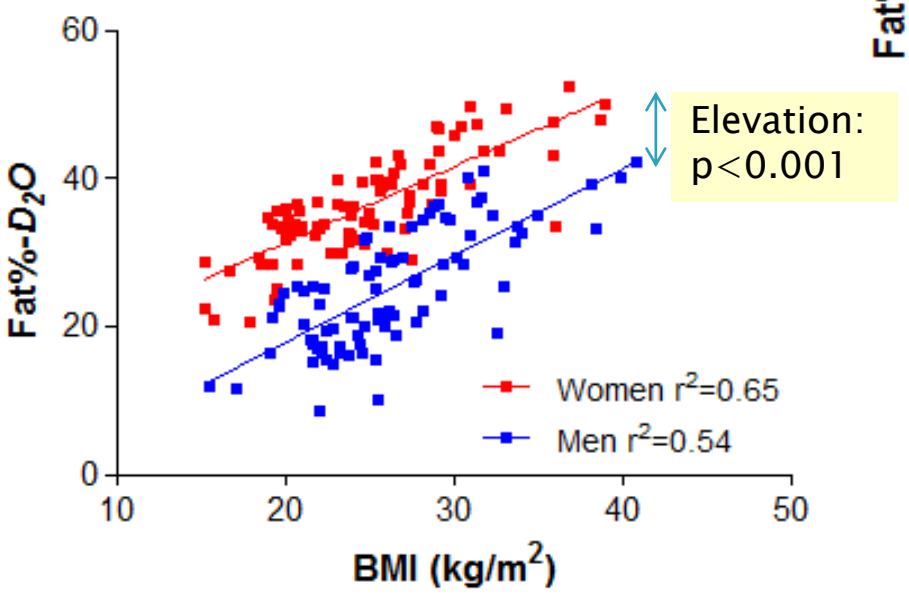


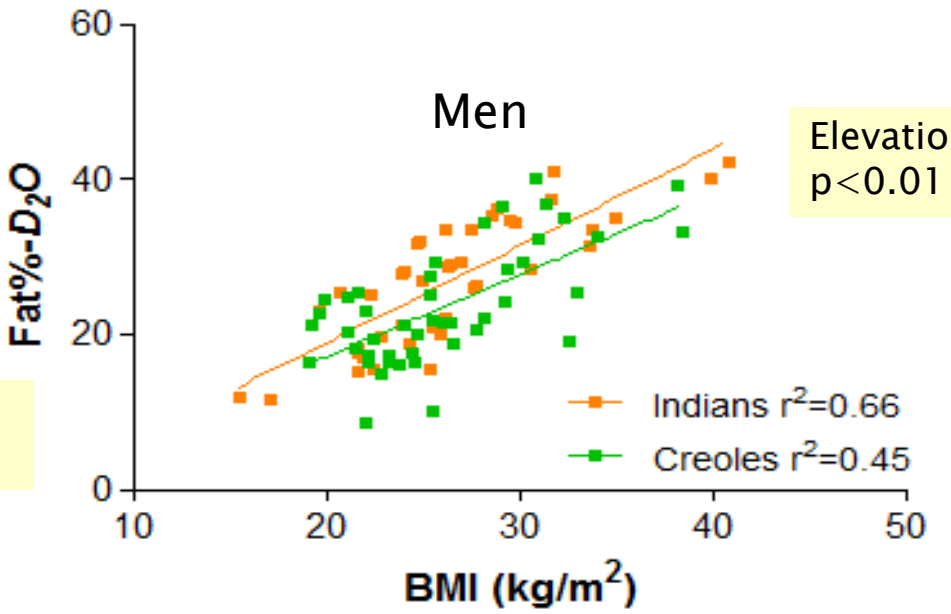
Men

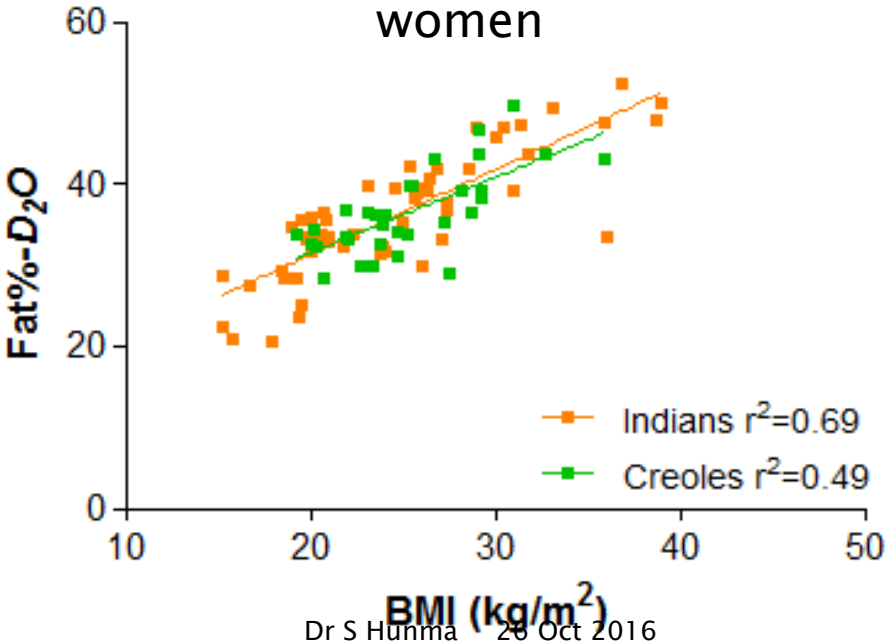


Women

Fat %–D2O *vs* BMI Relationship







Ethnic based equations

Men

- Indian %Fat = – 6.02 + (1.25 x BMI)
- Creole %Fat = – 4.01 + (1.06 x BMI)

Women

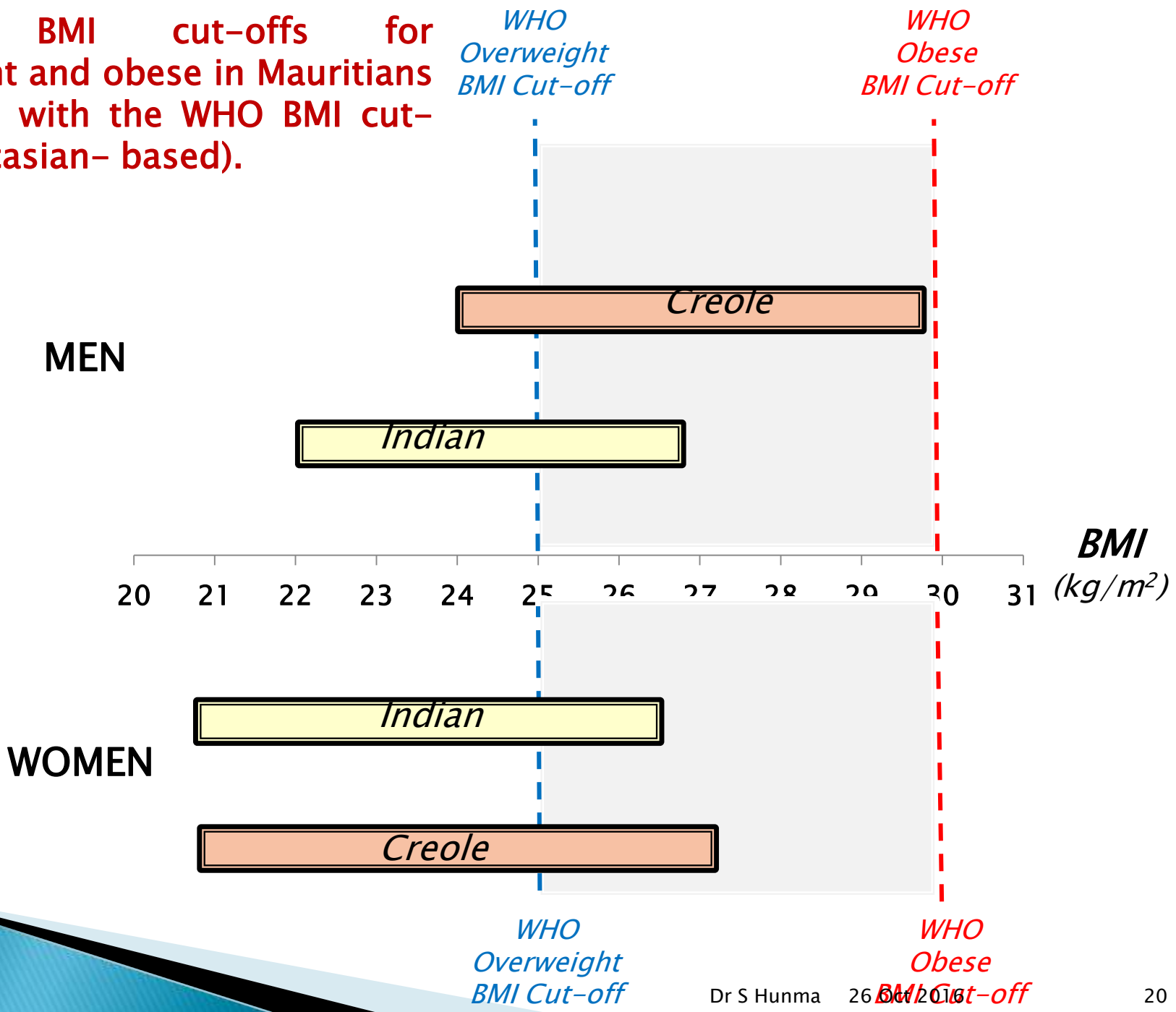
- Indian %Fat = 10.3 + (1.05 x BMI)
- Creole %Fat = 13.1 + (0.93 x BMI)

Estimations of new body fat% based on classic BMI cut off points & new ethnic specific cut offs

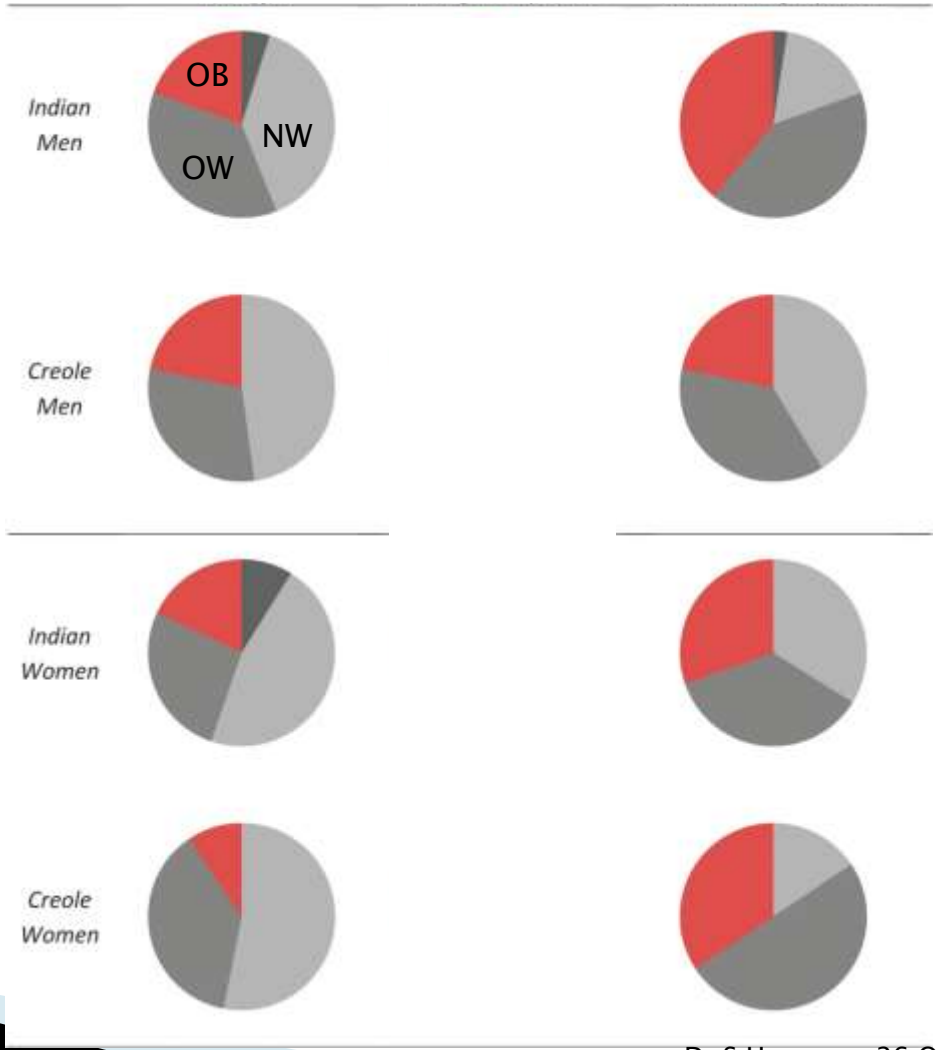
		Body fat (%)		
BMI cut-offs *(kg/m²)*	**Men**	***13.6 %***	***21.4 %***	***27.4 %***
		NW	*OW*	*OB*
	Caucasian	*> 18.5*	*> 25.0*	*> 30.0*
	Indian	> 15.7	> 22.0	> 26.8
	Creole	> 16.7	> 24.1	> 29.7
	Women	***24.4 %***	***32.2 %***	***38.2%***
		NW	*OW*	*OB*
	Caucasian	*> 18.5*	*> 25.0*	*> 30.0*
	Indian	> 13.4	> 20.8	> 26.5
	Creole	> 12.3	> 20.7	> 27.1

BMI cut-offs: Ethnic difference is *Gender specific*

Derived BMI cut-offs for overweight and obese in Mauritians compared with the WHO BMI cut-offs (Caucasian- based).



Proportions of Overweight (OW) & Obese (OB) based upon WHO (Caucasian-based) cut-offs *vs* Mauritian cut-offs for this cohort (n=175)



Conclusions of Body Composition (BC) study in Mauritius

- European cut offs of 25 & 30 kg/m2 valid only for Creole men (others had lower BMI cut offs)

- Gender-specific Ethnic differences in BC must be considered to avoid misclassification about adiposity & disease risks

Publication

- Body composition-derived BMI cut-offs for Overweight & Obesity in Indians & Creoles of Mauritius. *Int J Obes (Lond)* 2016 (*in press*)
- Sadhna Hunma, Harris Ramuth, Jennifer Miles Chan, Yves Schultz, Jean Pierre Montani, Noorjehan Joonas and AG Dulloo

THANK YOU !!