



# EL RETO DE LA OBESIDAD



C3

Un centro  
**TRANSVERSAL**  
para la unam

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# ¿Quién esta ayudando?

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Beda Espinosa FM UNAM  
Antonio Barajas FM UNAM  
Ricardo Martínez FM UNAM  
Alejandro Hernández FM UNAM  
Luís Flores FM UNAM  
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Katherine Stephens Santa Clara  
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Carolina Escobar, FM, UNAM  
Peter Gollwitzer, NYU  
Gabriele Oettingen, NYU

# ¿Porqué es importante?

## Obesity is one of the top three global social burdens generated by human beings

Estimated annual global direct economic impact and investment to mitigate selected global burdens, 2012<sup>1</sup>

GDP, \$ trillion



1 Based on 2010 disability-adjusted life years (DALY) data from the Global Burden of Disease database and 2012 economic indicators from the World Bank; excluding associated revenue or taxes; including lost productivity due to disability and death, direct cost, e.g., for health care, and direct investment to mitigate; GDP data on purchasing power parity basis.

2 Based on historical development between 1990 and 2010 of total global DALYs lost (Global Burden of Disease).

3 Includes military budget.

4 Includes functional illiteracy.

5 Includes associated crime and imprisonment.

6 Includes sexually transmitted diseases. Excludes unwanted pregnancies.

7 Excludes lost time to access clean water source.

SOURCE: Literature review; World Health Organization Global Burden of Disease database; McKinsey Global Institute analysis



# Porque esta en todas las partes

Reset zoom to world

Reset zoom to Europe

Percentage of adults with obesity *click countries for survey details and definitions*

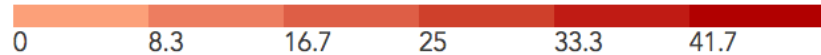
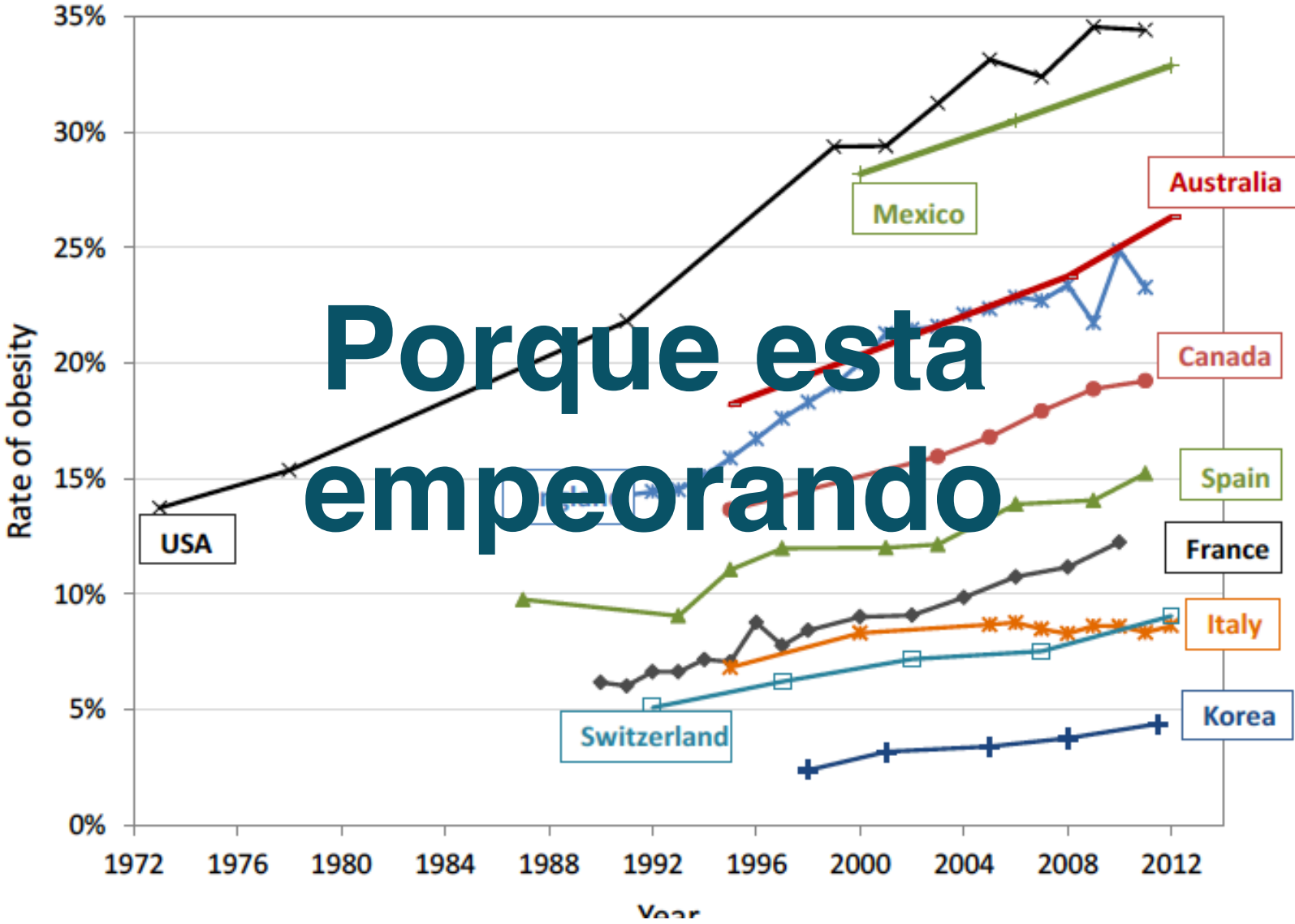


Figure 2. Obesity rates





Porque matará a

nuestros propios hijos

# ¿Qué estamos haciendo al respeto?

Estimates of Funding for Various Research, Condition, and

Disease Categories NIH

Research/Disease Areas	FY 2016 Actual (Dollars in millions)	2015 US Mortality	2015 US Prevalence (Standard deviation)
Cancer	5589.00	652,672	8.7% (0.20%)
Cardiovascular	2108.00	1,464,485	-
Chronic Obstructive Pulmonary Disease	97.00	292,471	6.2% (0.18%)
Diabetes 4/	1084.00	252,806	9.7% (0.22%)
Digestive Diseases	1745.00	-	-
Heart Disease	1289.00	1,202,319	11.7% (0.26%)
Heart Disease - Coronary Heart Disease	419.00	536,339	6.1% (0.17%)
Hypertension	224.00	427,631	27.0% (0.33%)
Inflammatory Bowel Disease	126.00	2,966	-
Obesity	965.00	39,590	30.0% (0.38%)
Stroke	308.00	234,867	-
	13,954	5,106,146	
% of total	17%	73%	
Physical Activity	392.00	-	-
Prevention	7566.00	-	-
Tobacco	299.00	-	-
Nutrition	1615.00	-	-
Basic Behavioral and Social Science	1804.00	-	-
Behavioral and Social Science	4137.00	-	-
	15,813		

**Con tanta inversión, esfuerzo,  
talento, investigación, experimento...**

**¿Porque es la amenaza mas costosa que  
enfrentamos?**

**¿Porque esta en todas las partes?**

**¿Porque esta empeorando?**

**¿Porque matará a nuestros propios hijos?**

# El Reto de la Obesidad

1. Multifactorialidad a múltiples escalas

Imagínense miles de hombres ciegos...

SNP FTO

Microbiome

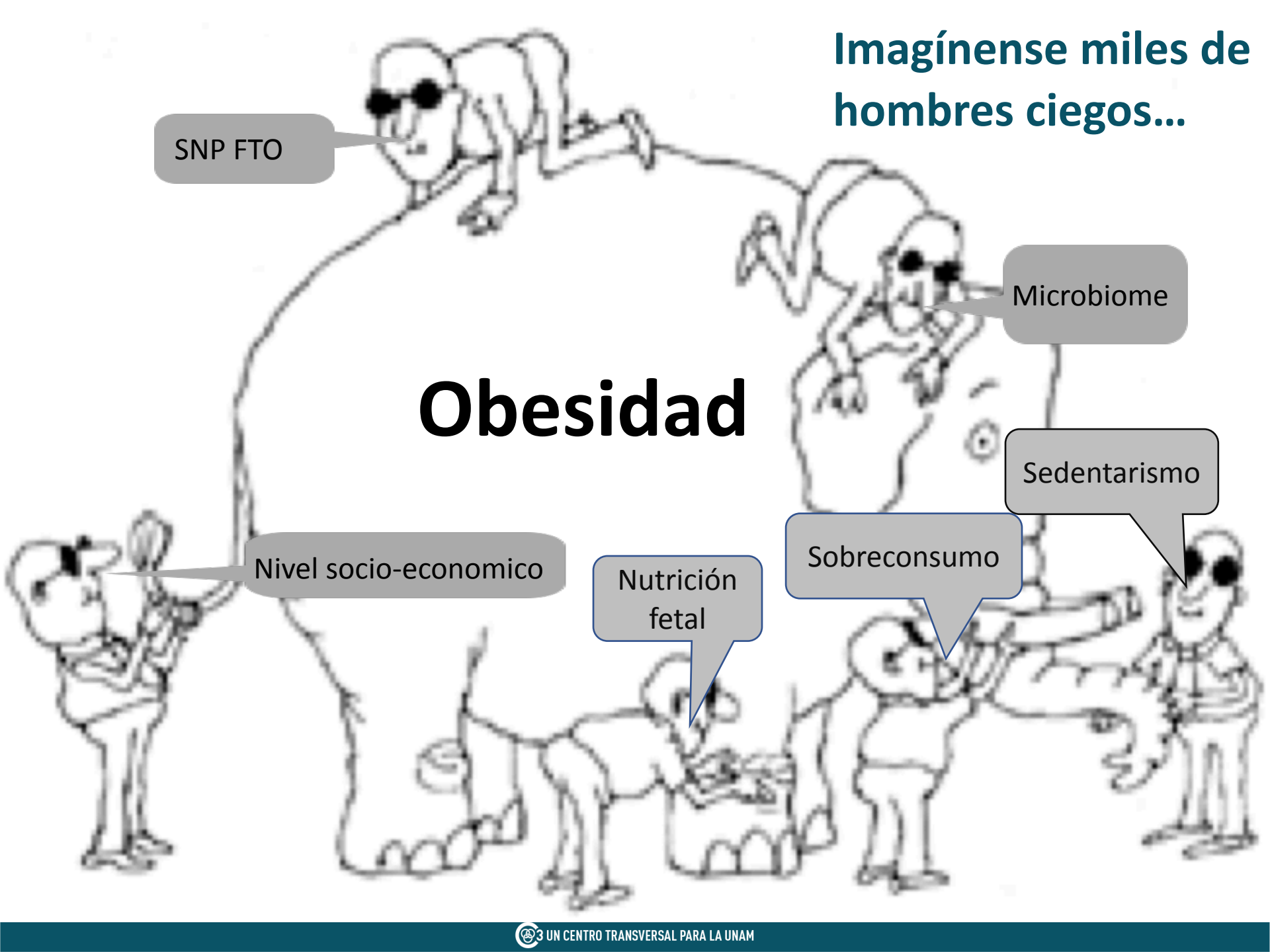
# Obesidad

Sedentarismo

Nivel socio-economico

Nutrición fetal

Sobreconsumo



Imagínense miles de hombres ciegos...

de diferentes disciplinas

# Obesidad

SNP FTO

Geneticista  
Bioinformático,...

Microbiome

Endocrinólogo,  
Bacteriólogo,...

Sedentarismo

Nivel socio-economico

Sociólogo  
Economista,...

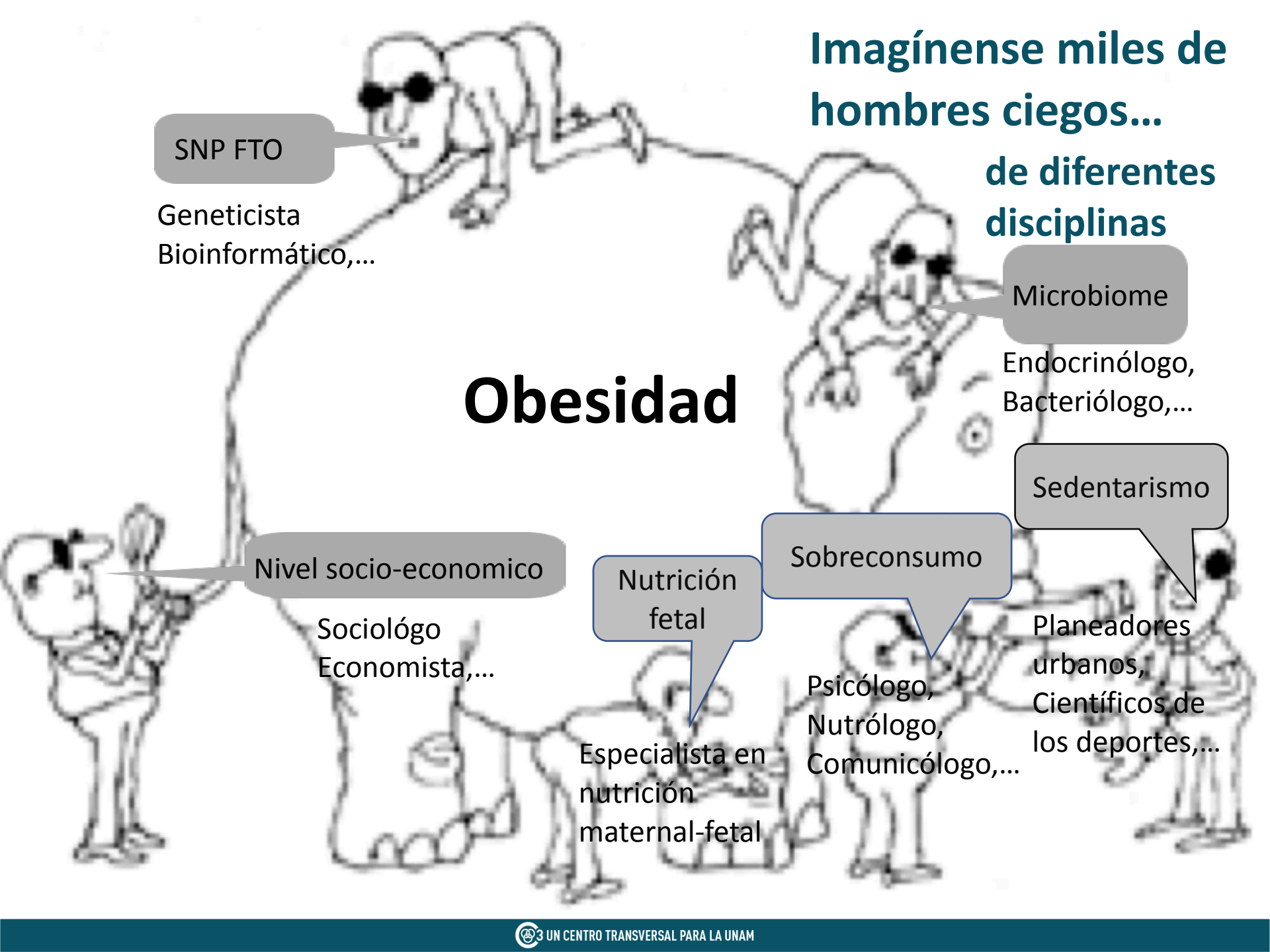
Nutrición fetal

Especialista en nutrición  
maternal-fetal

Sobreconsumo

Psicólogo,  
Nutrólogo,  
Comunicólogo,...

Planeadores urbanos,  
Científicos de los deportes,...



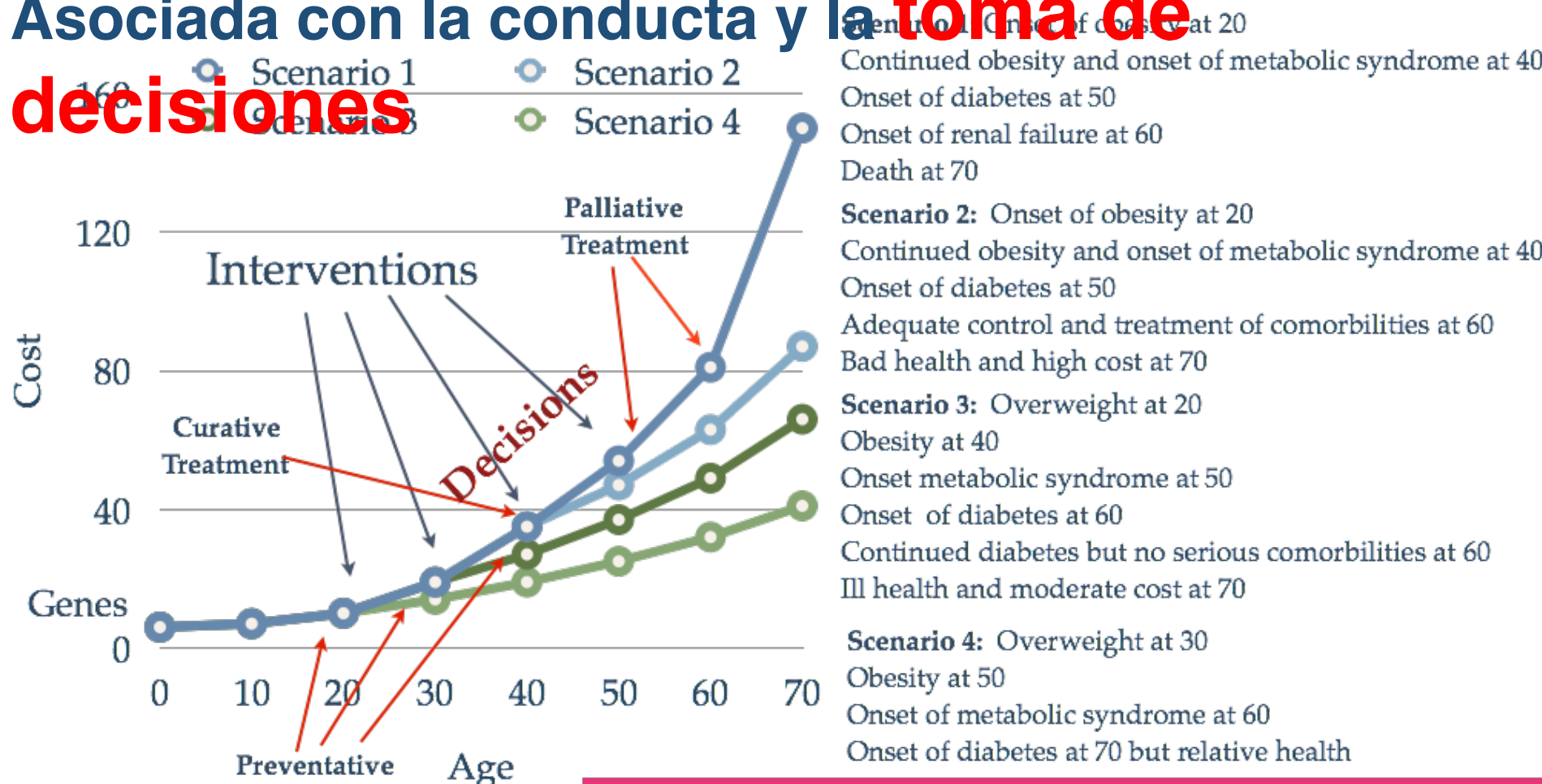


# El Reto de la Obesidad

2. Es una enfermedad principalmente de la “conducta”

# Obesidad (salud) es dinámica e adaptativo

Asociada con la conducta y la **toma de decisiones**



We want to predict and understand "histories"

# Algunas Decisiones Humanas



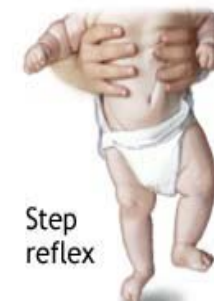
Tonic neck reflex



Grasp reflex



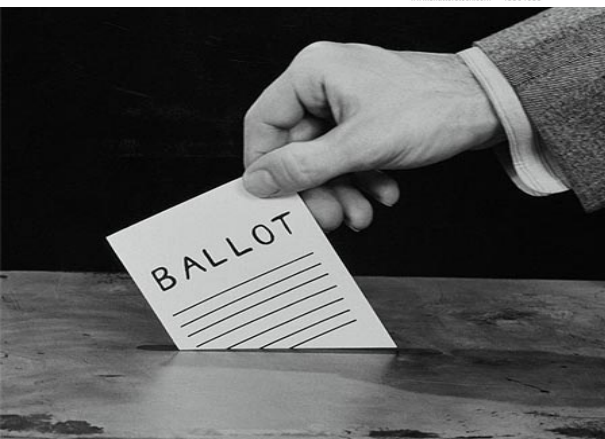
Step reflex



Crawl reflex



www.shutterstock.com - 48864685





# Tus Decisiones estan basadas en Predicciones y Dependenden de...

Que yo como  
Quien eres  
piensas

Tu heurística/algoritmo de predicción/decisión luego determina tu...

Comportamiento



# El Reto de la Obesidad

3. ¿Cómo se modela la “conducta”?

# ¿Qué es una “decisión”/predicción?

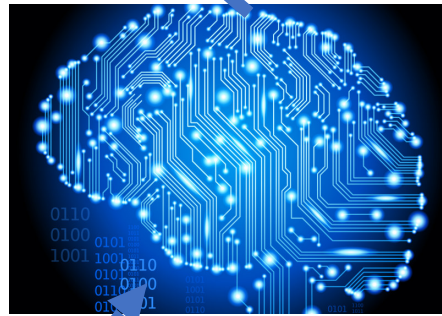
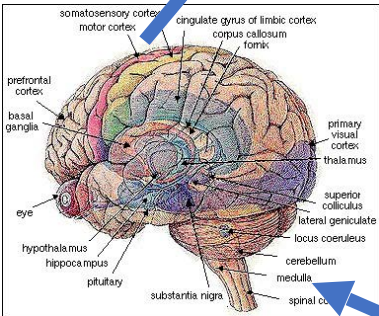
$$P(C | X(t))$$

Probabilidad que tomas la acción C dado el “mundo” o

Probabilidad que estas en el estado C dado el “mundo”

$X(t)$  = la información usada para tomar la decisión (predicción)

C es una acción (come/no come ejerce/no ejerce) o un estado (obeso/no obeso)



Se entiende esto pero no esto

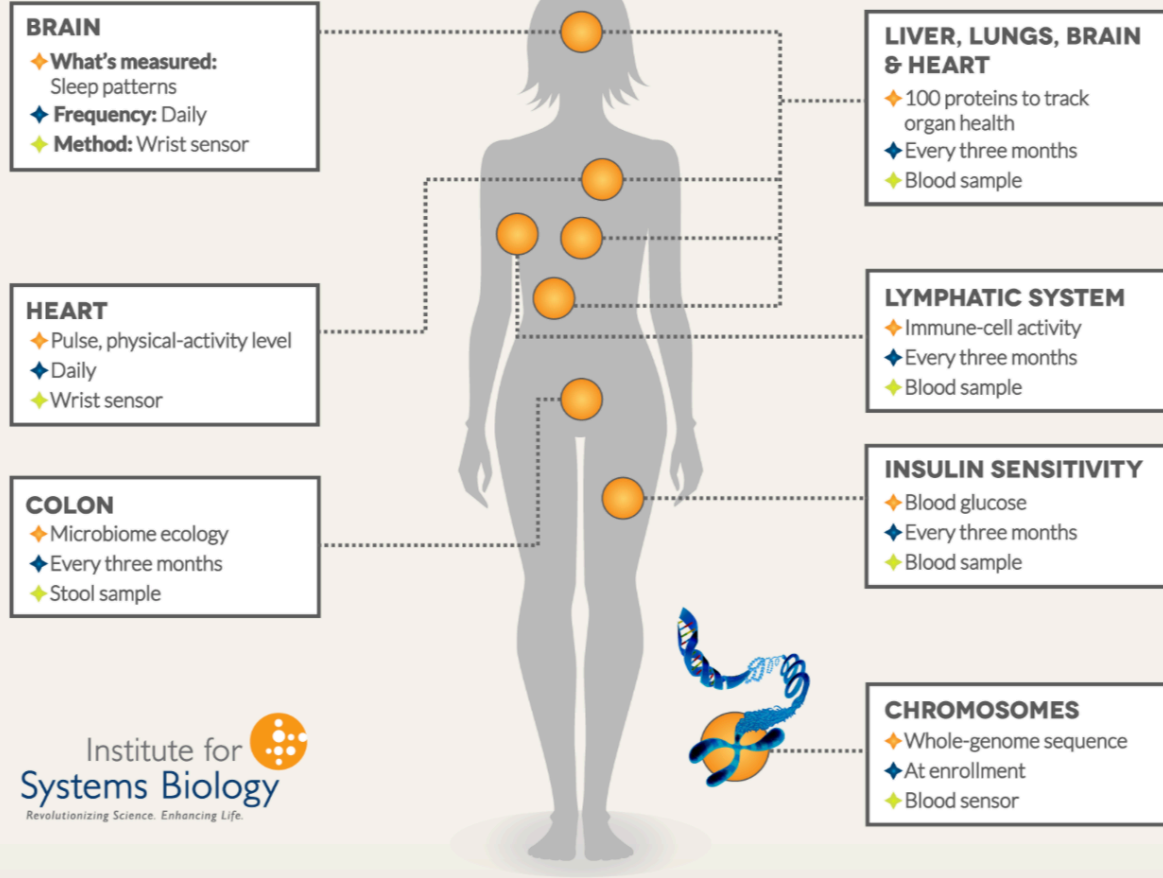
**¿Cómo se cuantifica cada factor?**

**¿Cómo se crea/entiende modelos predictivos y adaptativos naturales y artificiales?**

**Primero se necesita los datos...**

## AN EXAMINED LIFE

A longitudinal study will collect data at daily and three-month intervals, and allow personalized interventions -- such as changes in diet -- as the study proceeds.



# Ni siquiera los “ricos”





Imagínense miles de hombres ciegos...

Escolaridad

Propaganda de la industria alimentaria

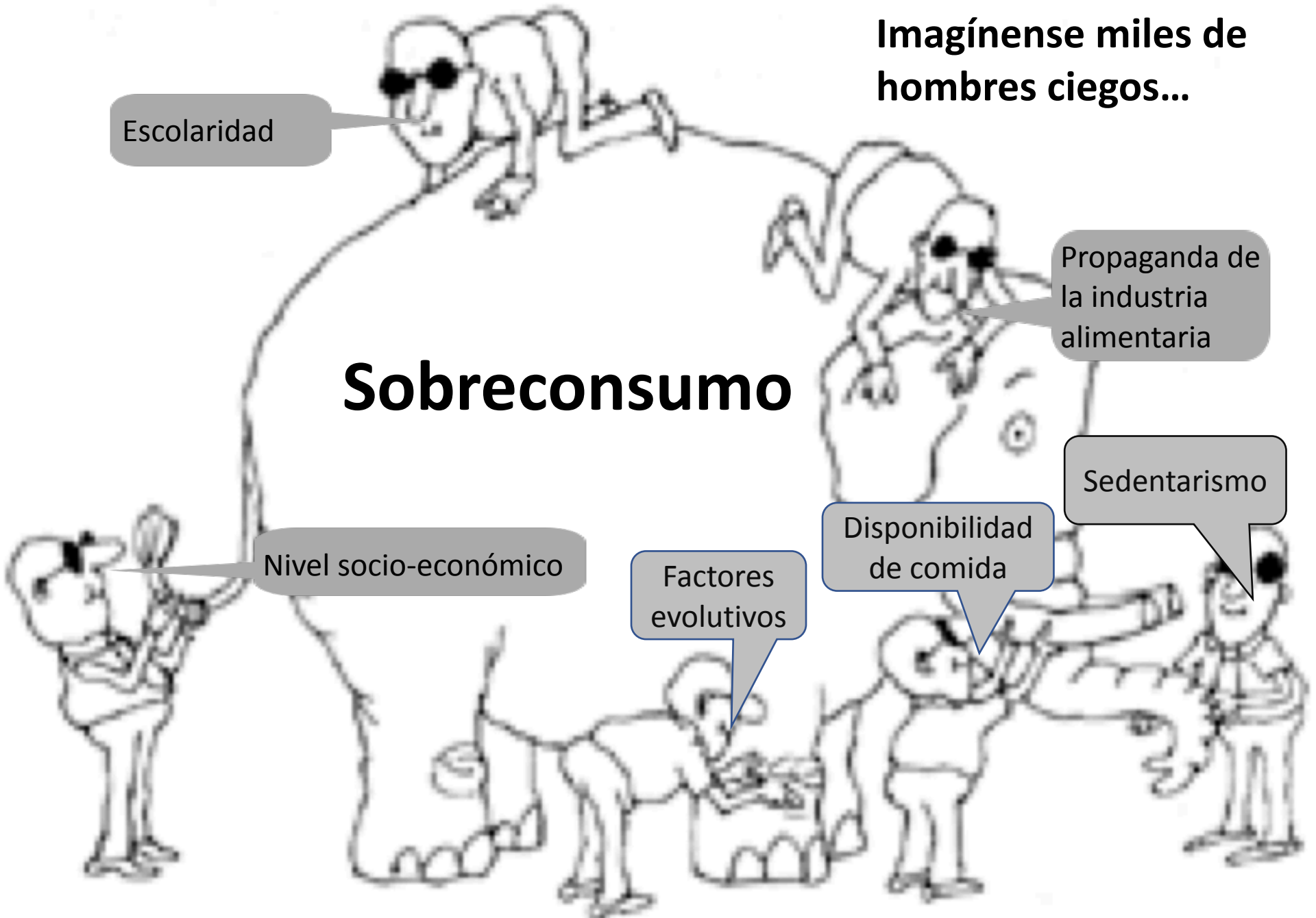
# Sobreconsumo

Sedentarismo

Disponibilidad de comida

Nivel socio-económico

Factores evolutivos



# ¿Qué hacemos?

**¡Intentar crear nuestra propia  
(mini) super base de datos!**

# Obesidad y Diabetes: Un enfoque desde la Ciencia de la Complejidad (CONACyT Fronteras, Redes y PAPIIT)

**Fase I: (03-05/2014) 1,076 académicos y no-académicos de 12 dependencias de la UNAM (ICN, IFC, FC, IB, II, IG, IF, IM, IIMAS)**

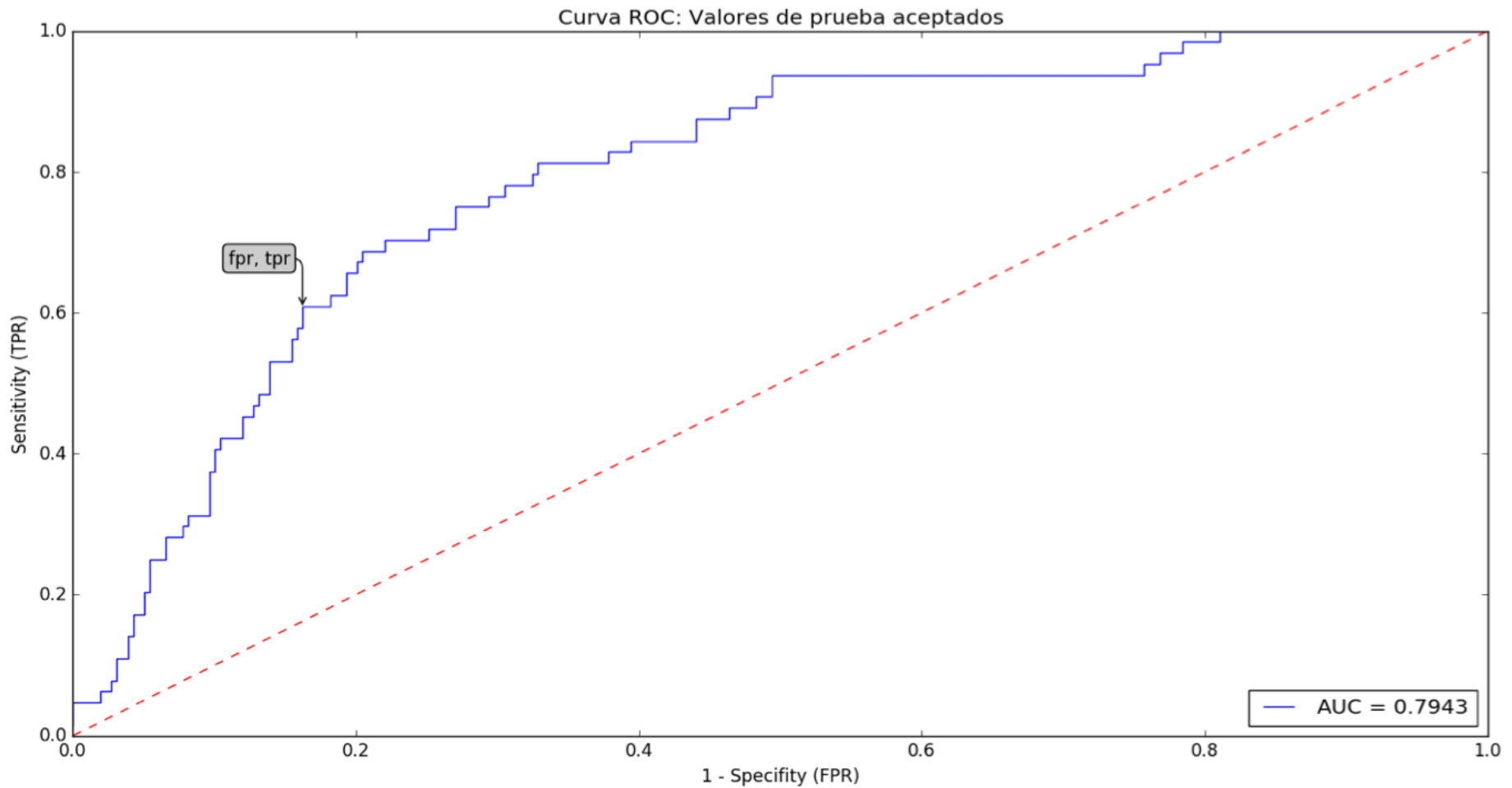
**2,524 variables** - Genetic, epidemiological, physiological,...

**Epidemiological:** Personal (81), Personal history (130), Family History (548), Self-health evaluation (226), Nutrition (220), Lifestyle (390), Health knowledge (293); **Genetic** (772); **Anthropometric and physiological** (49).

**Fase II: (03/2017) 282 estudiantes de carrera de la FM; (06/17) 400 trabajadores y profesores de la FM.** Agregando variables psicológicas. Involucramiento del ISSTE.

**Fase III: (08-10/2017) Seguimiento de los 1,076 de Fase I.** Otro análisis de sangre y agregando variables psicológicas, más variables fisiológicos en tiempo, un chip de 700,000 SNPs (INMEGEN) (se agradecerá la cooperación de las dependencias involucradas previamente – inicia de “programa” *PumaSalud* empezando con el ICN con estudios anuales)

**Fase IV: (2018) Extensión dentro de la UNAM a 5,000-10,000 más personas.** Vinculo con programa de Medico en tu Casa de la SEDESA

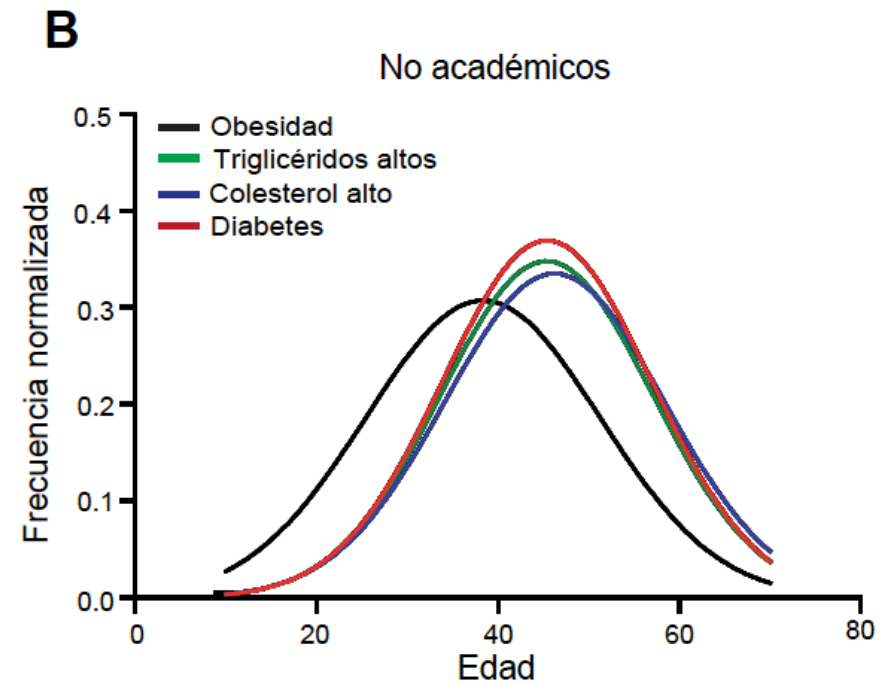
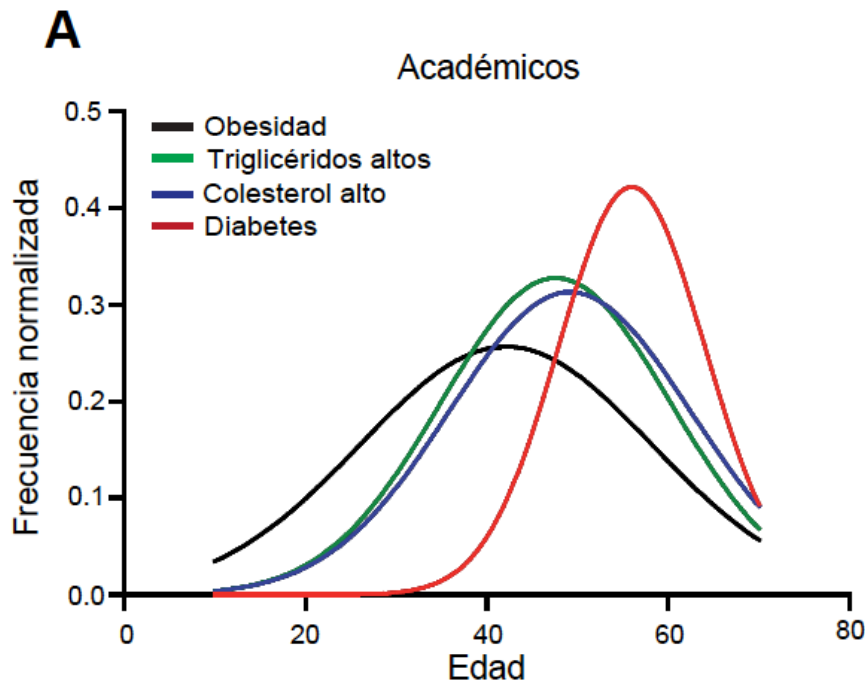


**= 42**

**Predictive model  
for obesity...**

# El Impacto de la Educación

Epsilon	# participantes	# obesos	Proporcion obesos	Grado de Estudios
4.24	105	40	38.10%	Carrera Técnica
3.53	141	47	33.33%	Secundaria
1.90	46	15	32.61%	Primaria
0.51	144	33	22.92%	Bachillerato
-1.66	301	52	17.28%	Licenciatura
-0.38	12	2	16.67%	Post-Doctorado
-3.00	182	22	12.09%	Maestria
-2.72	143	17	11.89%	Doctorado
-0.73	2	0	0.00%	Otro



**Inferencia: Los académicos van para revisiones médicas más rutinariamente  
¿Porqué?**

Pregunta	Epsilo	Score	N(C,X)	N(X)	P(C)	P(C X)
Sigues las recomendaciones de tu medico? - A veces	-1.06	-0.6	5	24	0.31	0.21
Sigues las recomendaciones de tu medico? - Normalmente	-4.18	-0.79	31	186	0.31	0.17
Sigues las recomendaciones de tu medico? - Casi siempre	-1.77	-0.35	42	171	0.31	0.25
Sigues las recomendaciones de tu medico? - Siempre	2.42	0.23	121	327	0.31	0.37
Sigues las recomendaciones de tu medico? - No se	2.25	0.21	132	364	0.31	0.36
Sigues las recomendaciones de tu medico? - No quizo responder	-0.94	-0.82	0	2	0.31	0

## Los académicos suelen seguir las recomendaciones de sus médicos ¿Porqué?

Pregunta	Epsilo	Score	N(C,X)	N(X)	P(C)	P(C X)
¿Cuanto comes- relativo a lo que crees recomendado? Mucho menos	0.41	-0.34	3	8	0.31	0.38
¿Cuanto comes- relativo a lo que crees recomendado? Mas de lo recomendado	-1.58	-0.36	32	131	0.31	0.24
¿Cuanto comes- relativo a lo que crees recomendado? Lo recomendado	3.08	0.29	141	369	0.31	0.38
¿Cuanto comes- relativo a lo que crees recomendado? Mas de lo recomendado	-0.58	-0.08	133	450	0.31	0.3
¿Cuanto comes- relativo a lo que crees recomendado? Mucho mas de lo recomendado	-1.92	-0.79	6	37	0.31	0.16
¿Cuanto comes- relativo a lo que crees recomendado? No se	-2.03	-0.59	16	79	0.31	0.2

## Los académicos suelen comer cantidades más “normales” ¿Porqué?

¡Y estos son nada mas que 2% de todas las variables!

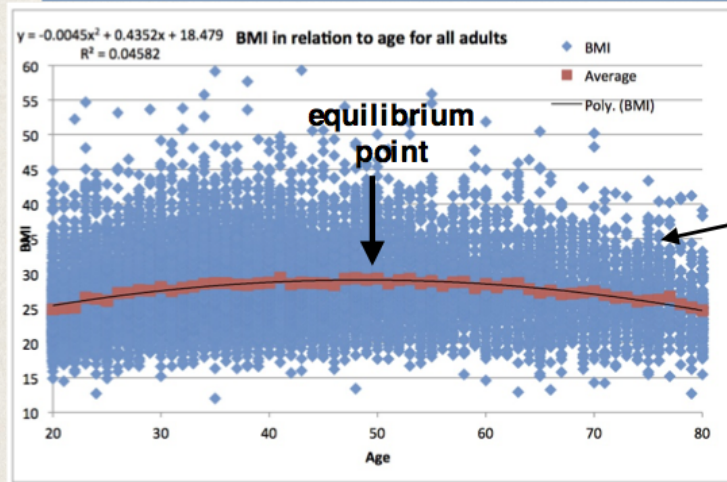


# Obesity - risk factors

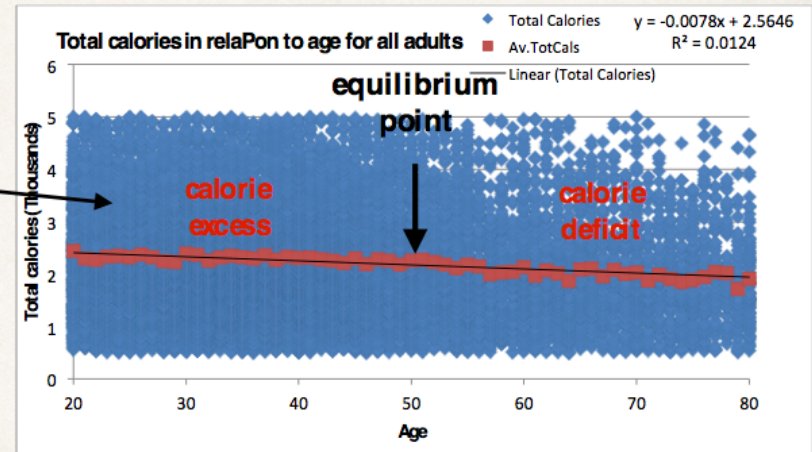
## What you do

You aren't what you eat you become what you eat

Epidemiological data from ENSANUT 2006

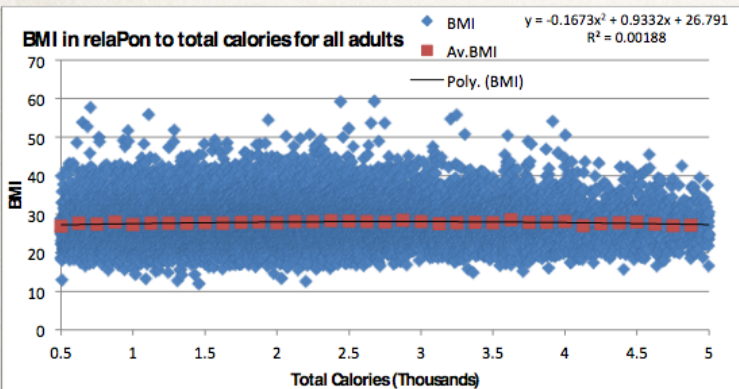


Its not "noise" its multifactoriality



We get fatter then we get thinner

We eat less the older we get



	Variable(s)	Unstd. B	Std. Error	t	f	R <sup>2</sup>	Sig	Lower	Upper
Moving Av.					29.236	0.343	0		
BMI Change	Constant	-1.954	0.362	-5.392			0	-2.68	-1.228
ALL	Total_Cals	0.904	0.167	5.407			0	0.569	1.239
	Variable(s)	Unstd. B	Std. Error	t	f	R <sup>2</sup>	Sig	Lower	Upper
Moving Av.					13.397	0.193	0.001		
BMI Change	Constant	-1.625	0.444	-3.656			0.001	-2.515	-0.734
Men	Total_Cals	0.724	0.198	3.66			0.001	0.328	1.121
	Variable(s)	Unstd. B	Std. Error	t	f	R <sup>2</sup>	Sig	Lower	Upper
Moving Av.					22.429	0.286	0		
BMI Change	Constant	-1.754	0.372	-4.711			0	-2.5	-1.008
Women	Total_Cals	0.833	0.176	4.736			0	0.481	1.185

Its the excess of calories that is the motor for obesity. The motor is more active at 20 and stops at 50 and then goes in reverse.

The obese eat as much as the thin



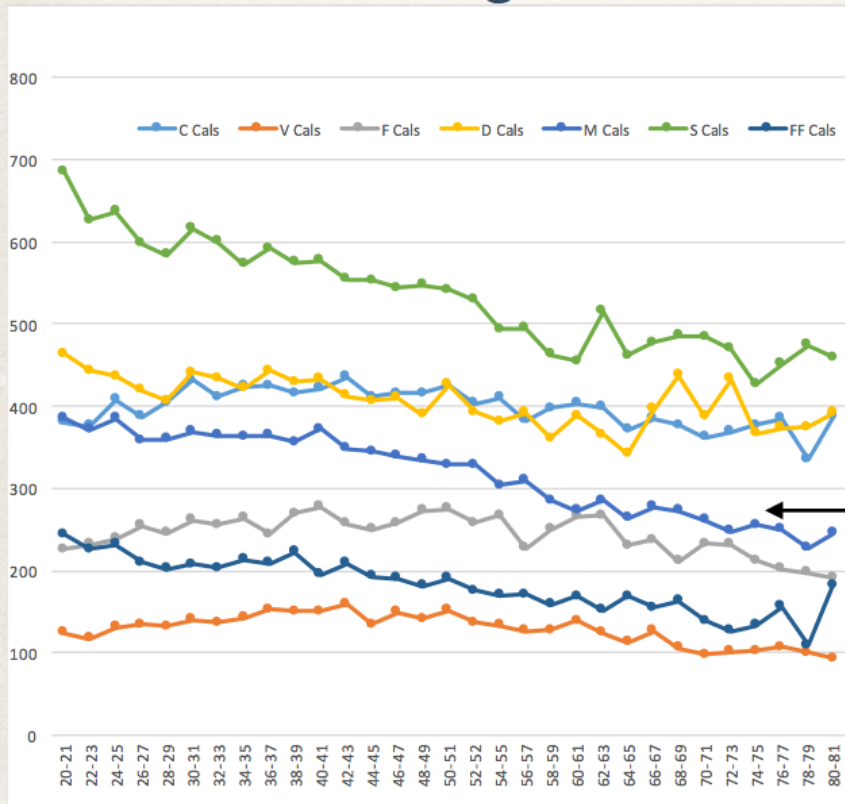


# Obesity - risk factors

## What you do

Epidemiological data from ENSANUT 2006

### The motor changes its fuel...



	Edad 20	Edad 50	Edad 80	Diff 50 20	Diff 80 20	Diff 80 50	Edad 20	Edad 50	Edad 80
S	650	540	460	16.92%	29.23%	14.81%	26.75%	23.38%	24.73%
FF	230	185	140	19.57%	39.13%	24.32%	9.47%	8.01%	7.53%
M	370	330	240	10.81%	35.14%	27.27%	15.23%	14.29%	12.90%
D	450	415	370	7.78%	17.78%	10.84%	18.52%	17.97%	19.89%
F	230	270	200	-17.39%	13.04%	25.93%	9.47%	11.69%	10.75%
V	120	150	90	-25.00%	25.00%	40.00%	4.94%	6.49%	4.84%
C	380	420	360	-10.53%	5.26%	14.29%	15.64%	18.18%	19.35%
	2430	2310	1860	4.94%	23.46%	19.48%			

The fuel mix at age 20 consists of 51.5% sugars, junk food and meat and 30% fruit, vegetables and cereals. At age 50 its 45.5% and 36.5%.

**Accelerated reduction in meat consumption in the aged**





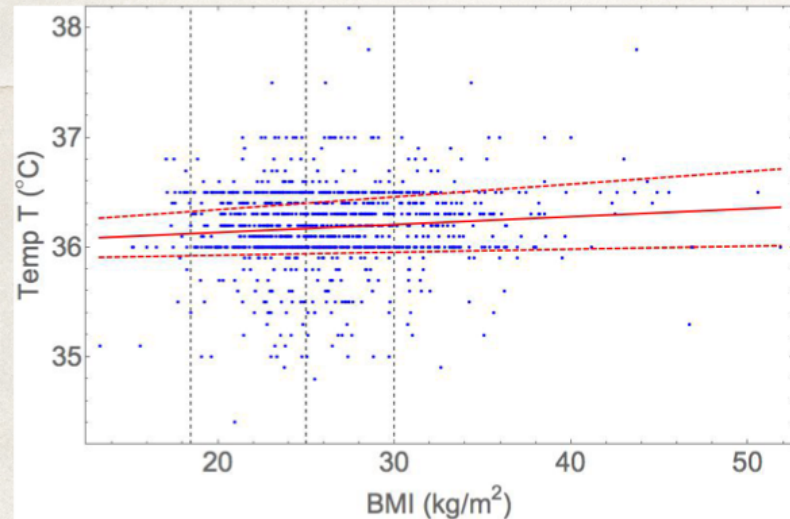
# Do you become what you eat?

The data shows an overconsumption of 200-300 Cals/ day at age 20-30. 8 Cal/ day is enough (naively through the famous/ infamous 3500 cal rule) to generate the observed increase in BMI.

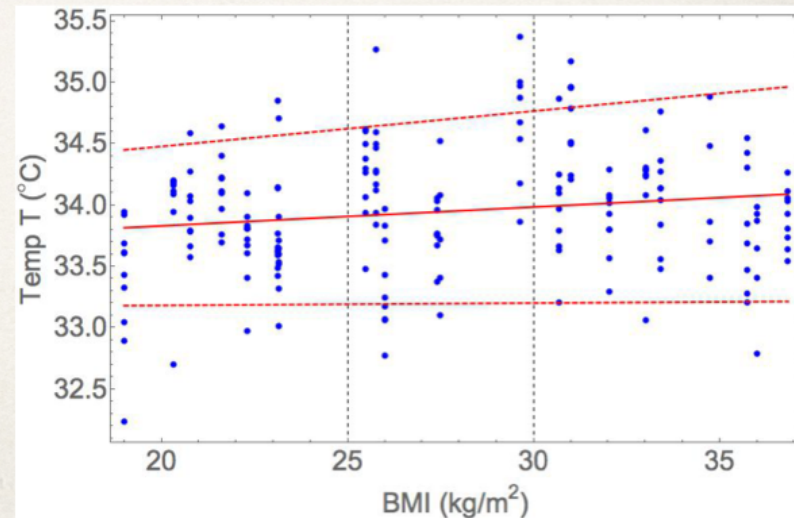
**Where do the other calories go?**

## Why aren't we even fatter?

Relation between temperature and BMI



	Study 1		Study 2	
	points	deciles	7-day mean	1-day mean
<b>slope</b>	0.0072	0.0067	0.0093	0.015
<b>intercept</b>	35.99	36.00	33.69	33.524
<b>Clslope</b>	0.0028	0.0024	-0.019	0.0019
	0.012	0.011	0.038	0.029
<b>Clintercept</b>	35.88	35.89	32.88	33.15
	36.11	36.12	34.51	33.90
<b>tslope</b>	3.18	3.56	0.68	2.25
<b>tintercept</b>	590.34	708.93	86.9	174.92
<b>F</b>	10.15	12.64	0.46	5.06
<b>p</b>	0.0015 (*)	0.0074 (*)	0.50	0.026 (*)
<b>R2</b>	0.0094	0.61	0.022	0.027



R. Fossion  
DH17



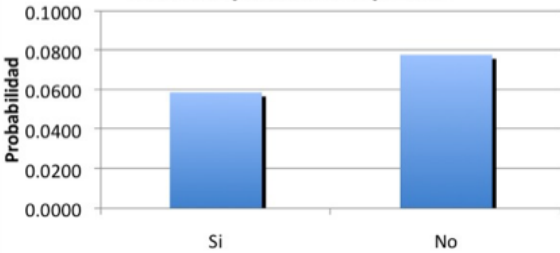
# Chronic disease - Risk factors



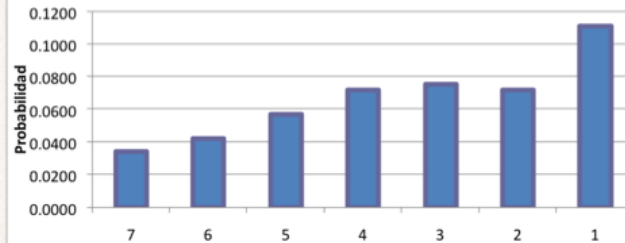
## What you do

## Exercise

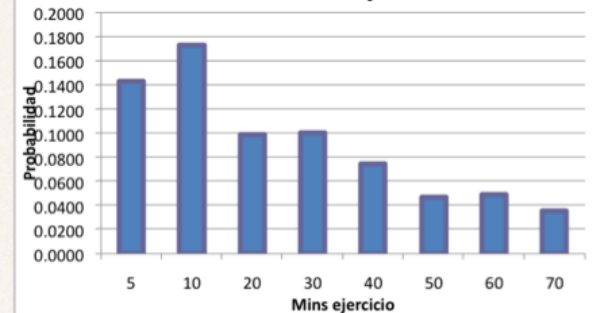
Gráfica de Probabilidad de Diabetes versus si practicas deportes



Gráfica de Probabilidad de diabetes versus Número de días de ejercicio por semana

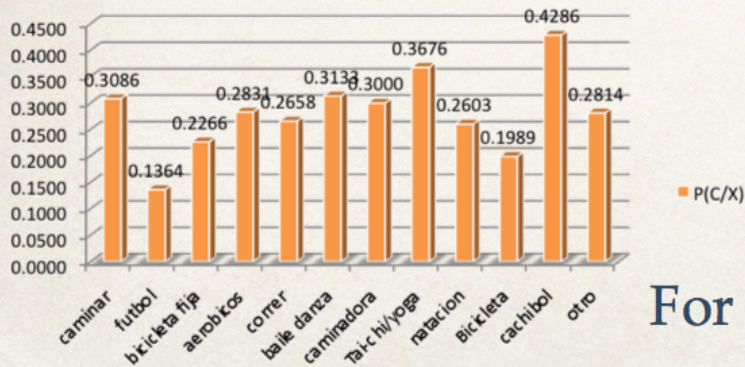


Gráfica de Probabilidad de diabetes versus mins de ejercicio

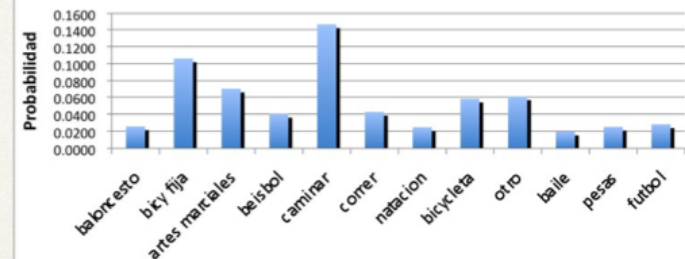


For men 20-59 de PREVENIMSS 2006

Tipo de ejercicio practicado vs probabilidad de tener diabetes P(C/X)



Gráfica de Probabilidad de Diabetes versus tipo de ejercicio



For seniors > 59

Is it riskier to walk than do nothing?





# Perception of weight and Cognitive Biases - What you think/feel

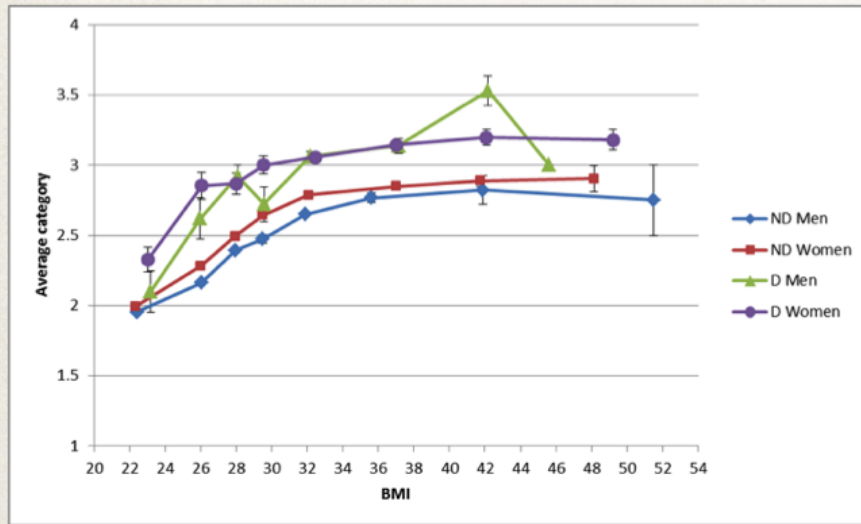
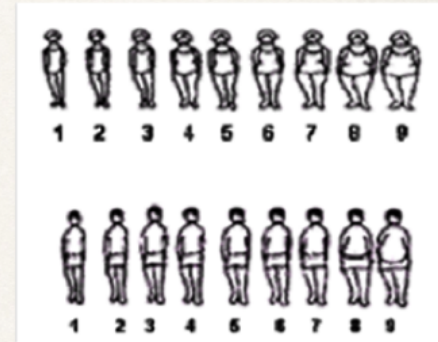


Figure 2. Comparison of non-diagnosed (ND) versus diagnosed (D) obese mean responses for the category self-perception question by gender.

Slopes in the linear range are 35-50% less than one would expect if people could gauge their weight accurately! The lobster in the pot syndrome



Self-serving bias  
Anchoring bias

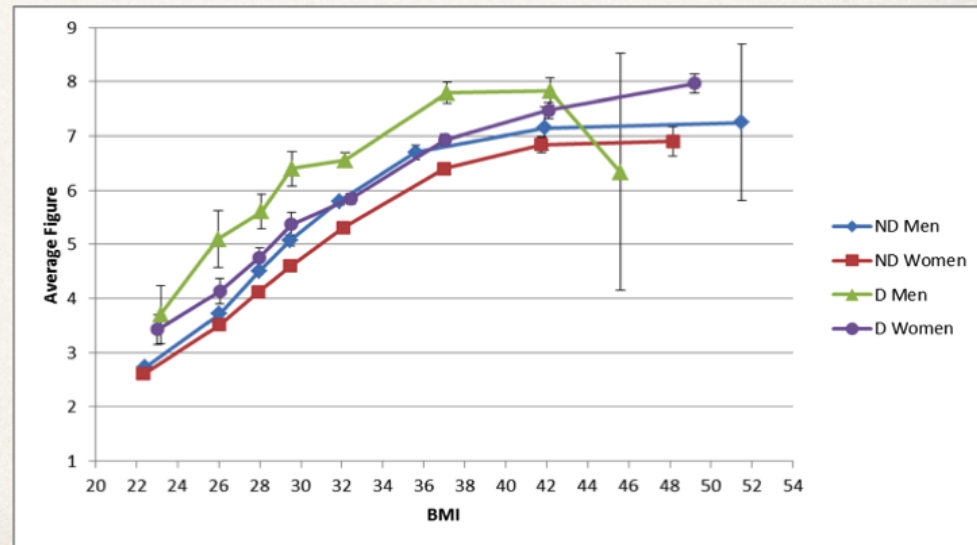


Figure 3. Comparison of non-diagnosed (ND) versus diagnosed (D) obese mean responses for the Stunkard figure rating scale question by gender.





# Obesity -risk factors

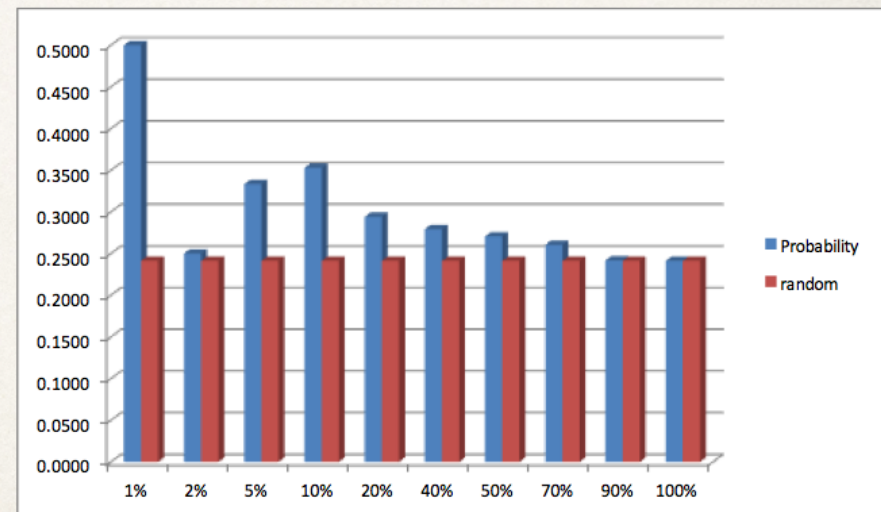
## Who you are - genes

772 SNPs considered  
Subsets with obesity,  
DM2, lipids, hepatic

Driver	Value	Epsilon	P(C X)	P(C)	N(X C)	N(X)	N(C)	NTotal
rs2943641_A	2	2.9391	0.6000	0.2169	6	10	123	567
rs2972146_C	2	2.9391	0.6000	0.2169	6	10	123	567
rs2943650_G	2	2.9391	0.6000	0.2169	6	10	123	567
rs12629908_A	2	2.6981	0.3116	0.2169	43	138	123	567
rs870347_C	2	2.2200	0.2914	0.2169	44	151	123	567
rs1407434_G	0	2.1617	0.2841	0.2169	50	176	123	567
rs972283_A	2	2.1543	0.3085	0.2169	29	94	123	567
rs10496971_C	2	1.9688	0.3011	0.2169	28	93	123	567
rs2241766_C	1	1.9472	0.2741	0.2169	54	197	123	567
rs10885122_A	2	1.9426	0.5000	0.2169	4	8	123	567
rs2986742_G	2	1.9121	0.4545	0.2169	5	11	123	567
rs1799884_A	2	-2.0385	0.0000	0.2169	0	15	123	567
rs3943253_A	2	-2.0502	0.1364	0.2169	15	110	123	567
rs4607517_A	2	-2.1053	0.0000	0.2169	0	16	123	567
rs4880436_A	2	-2.1388	0.0870	0.2169	4	46	123	567
rs174537_C	2	-2.1927	0.0851	0.2169	4	47	123	567
rs174546_G	2	-2.1927	0.0851	0.2169	4	47	123	567
rs174550_A	2	-2.1927	0.0851	0.2169	4	47	123	567
rs972283_A	0	-2.3181	0.1521	0.2169	33	217	123	567
rs2073821_A	2	-2.3502	0.1170	0.2169	11	94	123	567
rs1513181_G	2	-2.3605	0.1250	0.2169	14	112	123	567
rs2237895_A	2	-2.3836	0.1308	0.2169	17	130	123	567
rs7803075_G	2	-2.4635	0.0847	0.2169	5	59	123	567
rs896854_A	0	-2.5528	0.1398	0.2169	26	186	123	567
rs7809589_C	2	-2.5964	0.1231	0.2169	16	130	123	567
rs1111875_A	0	-3.2065	0.1211	0.2169	23	190	123	567

**obesity** (score = 0.904, predictive but scarce)

**obesity** (score = 0.105, not so predictive but common)



Doesn't give a good model on its own



# Questions

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1. What is the appropriate taxonomy of those “universal” tendencies in human physiology/ behaviour that are associated with the obesity pandemic?
2. What are the genetic/ epigenetic underpinnings of these “universal” tendencies?
3. What are the phenotypic variables that will most help to identify these tendencies? (Stop looking for only high signal to noise relations)
4. How have the consequences of those tendencies changed due to environmental changes (and how has the environment objectively changed?)
5. How do we quantify the effect of a given variable/ class of variables?
6. What is the impact of time horizon on a given variable (e.g., the difference between being obese for one year versus 20)
7. How do we disentangle the cause-effect relationships?
8. What is actionable? What factors are plastic and what is their degree of plasticity?

# EL RETO DE LA OBESIDAD

