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# The Health of the Amish and What we can learn

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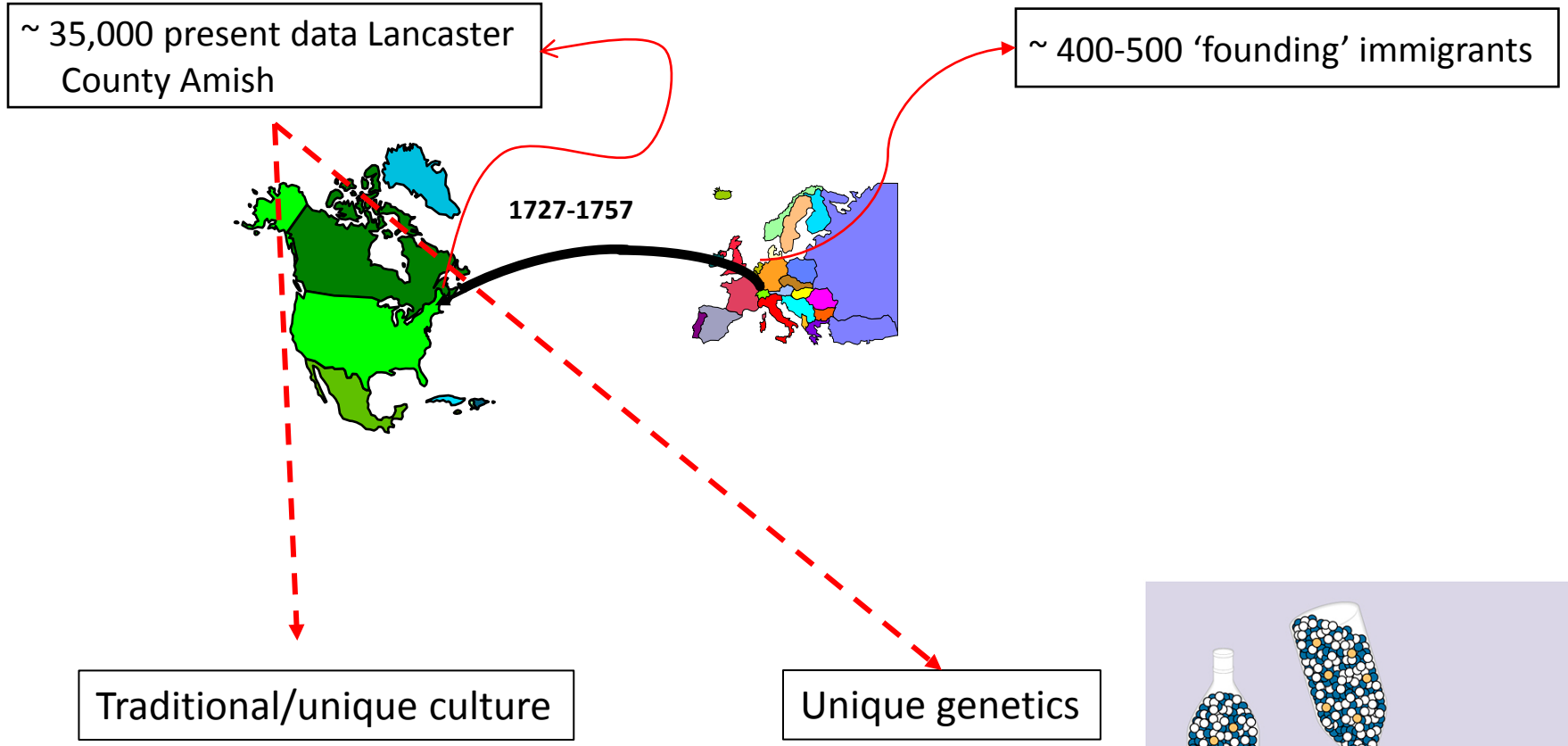
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# Disclosures

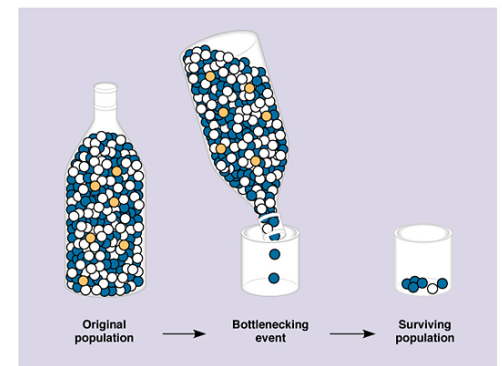
Some of the data presented funded in part by Regeneron Pharmaceuticals



# The Lancaster County Old Order Amish as a Genetic Isolate



- Less genetic diversity



## Some core characteristics of the Old Order Amish

- Adult baptism (anabaptist)
- Church, community, family
- Local governance through church districts
- 'Humble' lifestyle
- Education through 8<sup>th</sup> grade
- Excellent genealogical records
- Technological conservatism



# Amish lifestyle

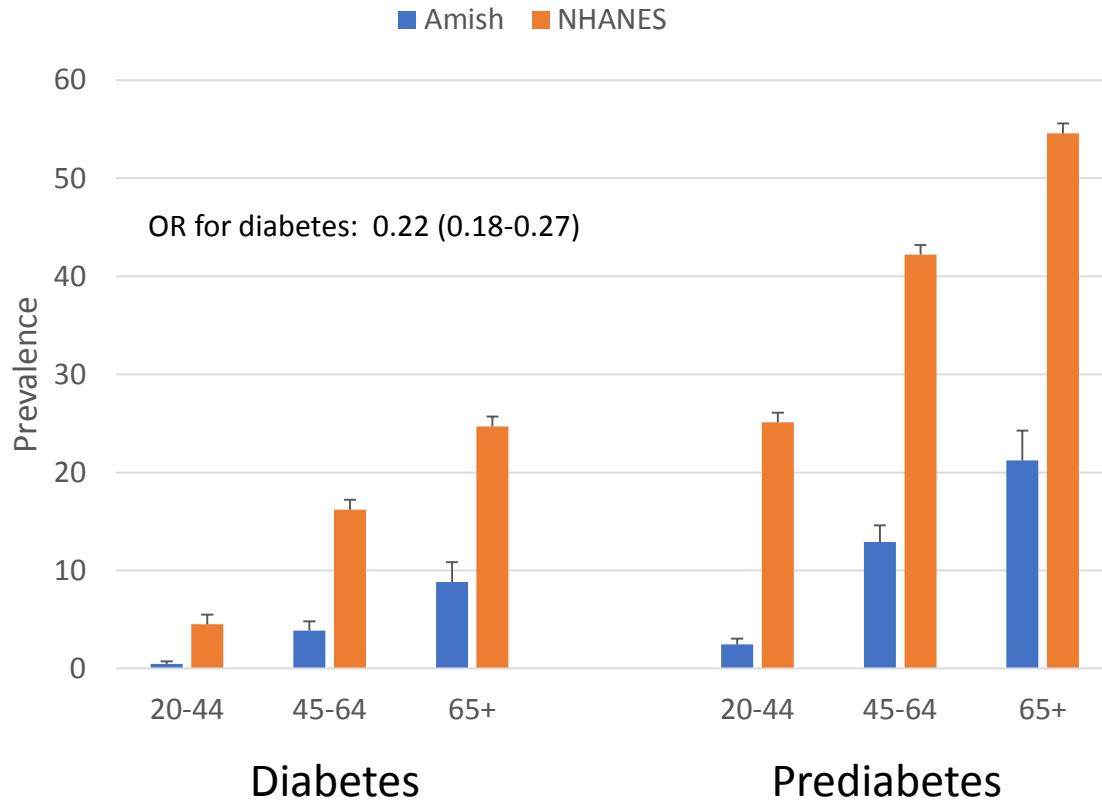


- High levels of physical activity
- High social cohesiveness
- Low smoking and alcohol consumption
- Home grown and prepared foods
- Limited access to health care systems

# The health of the Amish



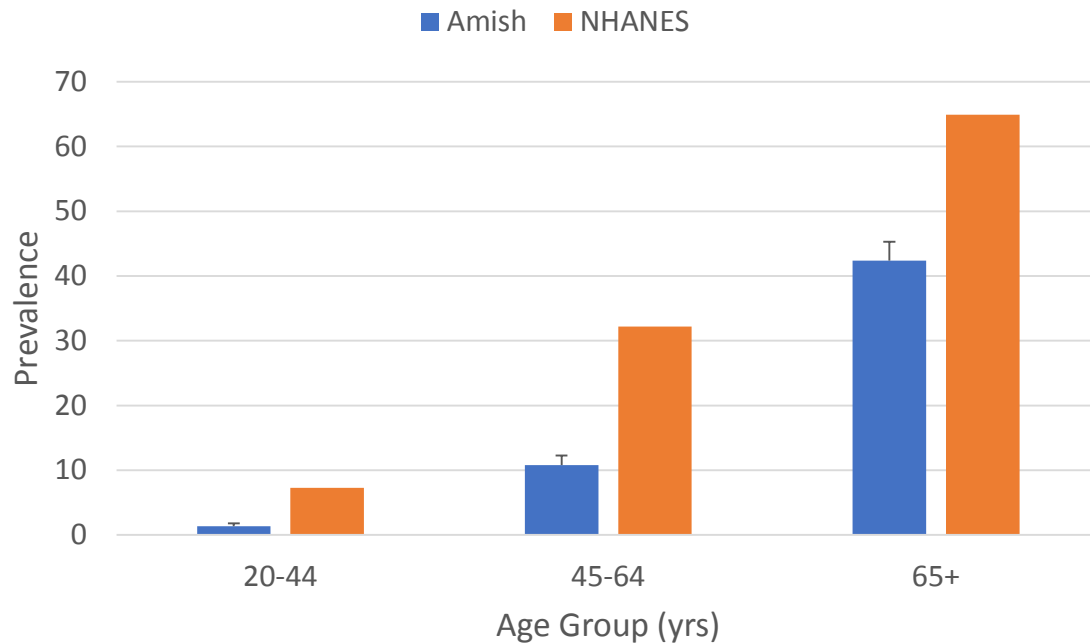
# Low prevalence of diabetes and prediabetes in the Amish



NHANES data (1988-2012) from Menke et al., 2015

Diabetes: FBG  $\geq$  126 or HbA1c  $\geq$  6.5 or medication use  
Pre-diabetes: 100  $\leq$  FBG  $\leq$  125 or 5.7  $\leq$  HbA1c  $\leq$  6.4

# Low prevalence of hypertension in the Amish

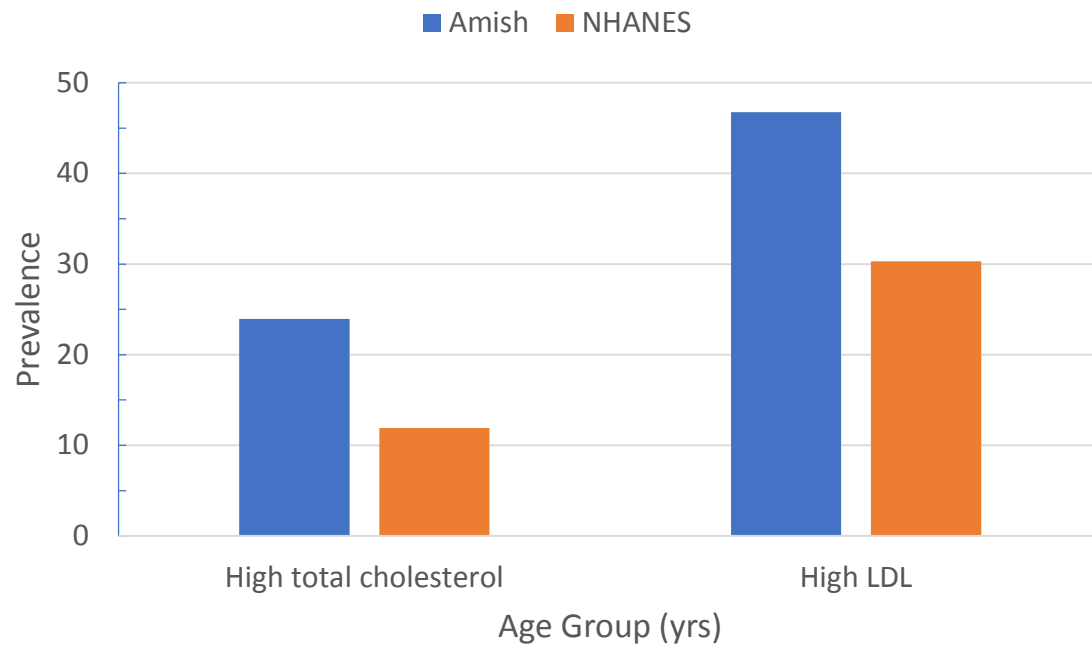


<sup>1</sup> NHANES data from Yoon et al., 2015

Hypertension: SBP  $\geq$  140 mmHg or DBP  $\geq$  90 mmHg or medication use



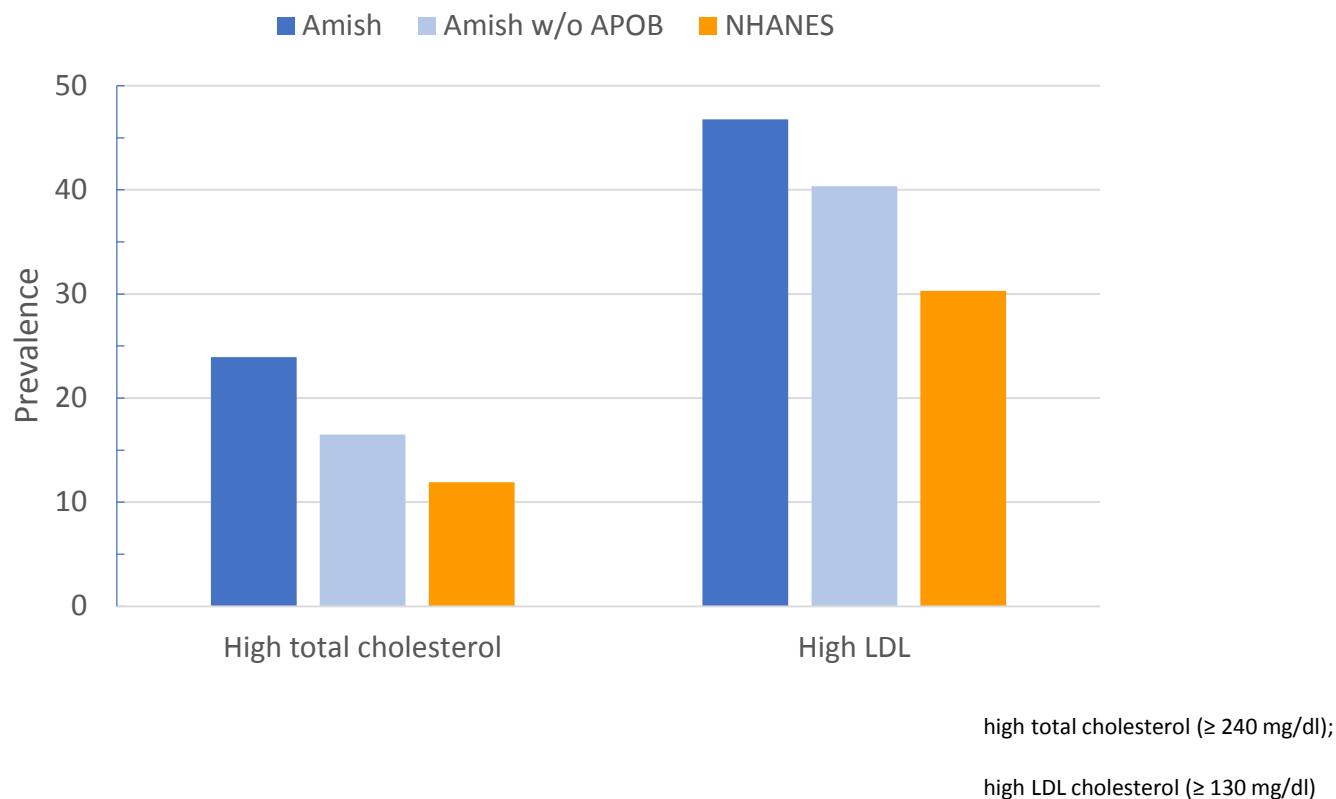
## Higher prevalence of total and LDL-cholesterol in the Amish, (age $\geq 20$ )



high total cholesterol ( $\geq 240$  mg/dl);

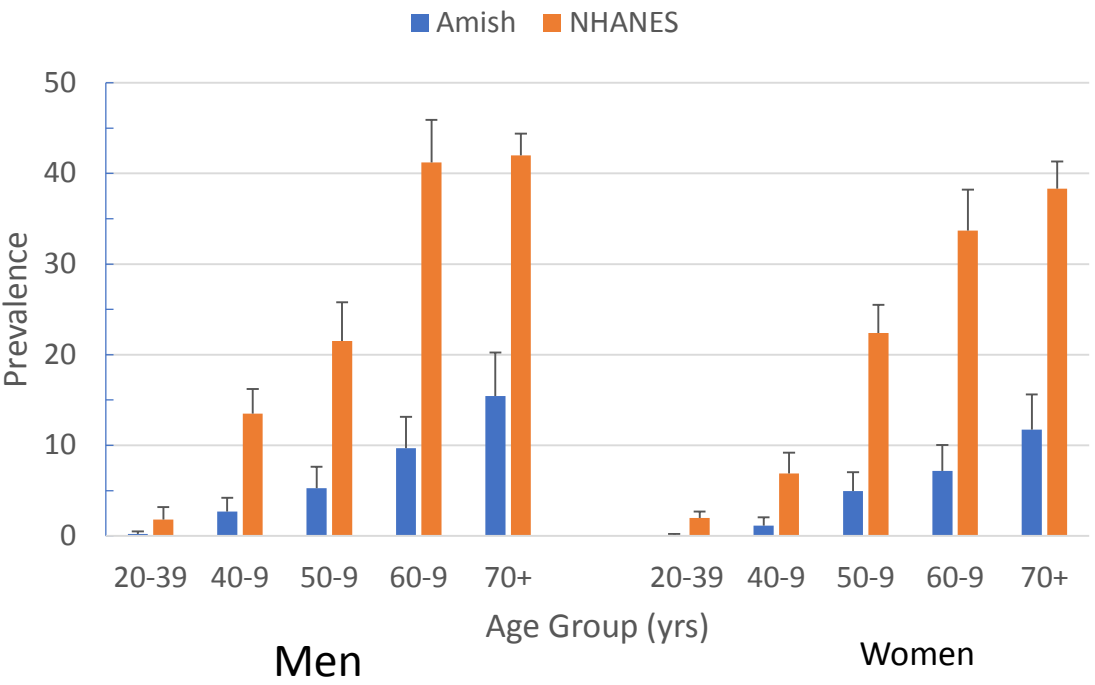
high LDL cholesterol ( $\geq 130$  mg/dl)

Higher prevalence of cholesterol in the Amish is partly due to an enrichment for LDL-raising mutations (e.g., *APOB* R3527Q)



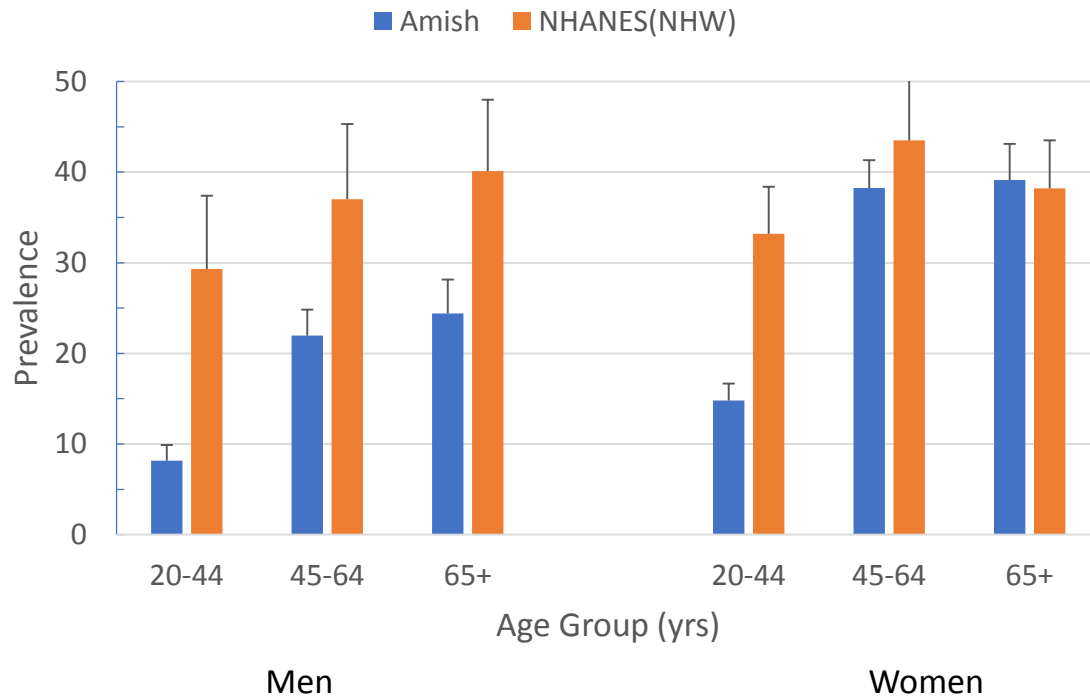
NHANES data from Benjamin et al., 2018

# Use of lipid-lowering medications in Amish vs NHANES, by age group and sex



NHANES data from Carroll et al., 2012

# Low prevalence of **obesity** in Amish men (but not women)



NHANES data from Flegal et al., 2016, NHWs

Obesity: BMI ≥ 30 kg/m²

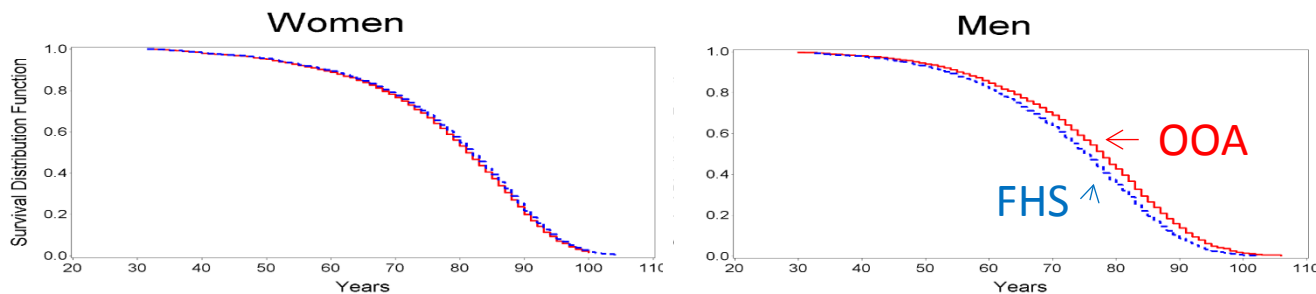
# Cardiovascular Risk Factors in Amish and non-Amish Caucasians

Compared to non-Amish Caucasians, Amish have:

- Less diabetes and less hypertension
- Lower BMI (men only)
- Higher LDL-C; but ↓ TG
- Much less Rx medication use:
- Less smoking: (20% of Amish men)
- Higher physical activity

Hsueh et al, Diab Care 2000; 23:595;  
Bielak et al., Atherosclerosis 2008; 196:888;  
Mitchell et al., Am Heart J 2008; 155:823.

Lifespan in Amish vs than Framingham Heart Study: (cohorts born 1886 - 1922)



Mitchell et al., PLoS One 2012; 7:e51560.

# A Common Variant Associated with BMI and Predisposes to Child and Adult Obesity

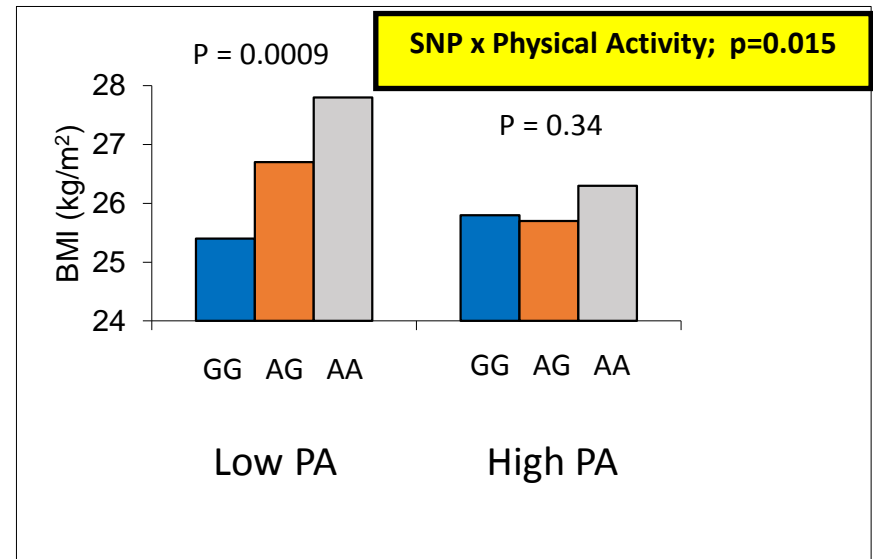
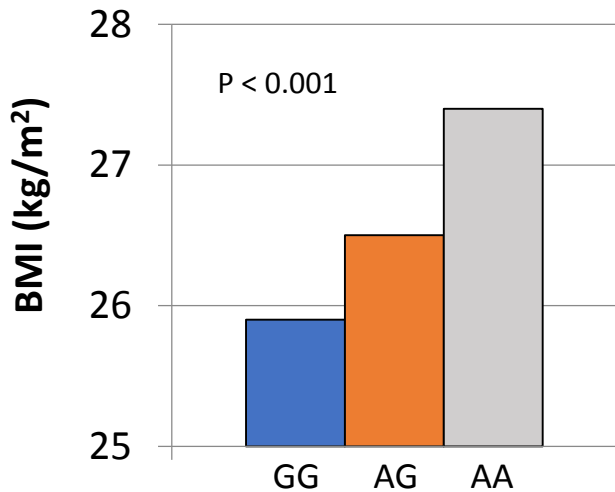
Effect size:  
 ~ 0.4 kg/m<sup>2</sup>;  
 MAF: 0.39

Frayling, SCIENCE VOL 316 11 MAY 2007

Does high physical activity blunt the effect of the *FTO* risk allele on BMI?

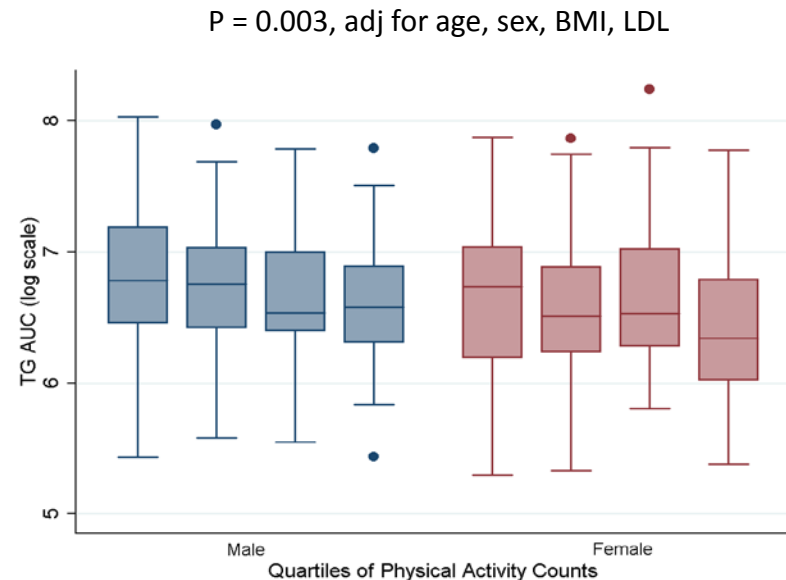


Association of *FTO* rs1861868 with BMI in the Amish



# High 'usual' levels of physical activity blunt the TG response following a high fat meal

- Nonfasting TGs associated with incident CHD (post-prandial inflammation and endothelial dysfunction?)
- Standardized oral fat tolerance test administered (n = 671 subjs)
- TG excursions measured over 6 hrs
- 7-day physical activity by accelerometer



# Gender differences in first and secondhand smoke exposure, spirometric lung function and cardiometabolic health in the old order Amish: A novel population without female smoking

**Robert M. Reed**<sup>1\*</sup>, PLOS ONE | March 31, 2017

- 34% of Amish men reported ever smoking (esp. cigars)
- Ever smoking associated with lower lung function, higher heart rate
- Secondary smoking associated (in men) with higher BMI, higher fasting glucose, lower heart rate.





# Summary and Conclusions

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- Amish are one of the fastest growing population groups in the U.S.
- Across multiple indices, Amish adults have lower disease rates compared to other non-Hispanic whites in the U.S.
  - Less diabetes, obesity, and hypertension
- Exploration of lifestyle differences can provide insights into improving the nation's health
  - Physical activity
  - Other lifestyle factors (social cohesiveness, family support, diet, etc.)



# Amish Investigators at Maryland

Alan Shuldiner

Brackie Mitchell

Toni Pollin

Jeff O'Connell

Liz Streeten

Jim Perry

Patrick McArdle

May Montasser

Christy Chang

Norann Zaghloul

Kathy Ryan

Simeon Taylor

Amber Beitelshoes

Josh Lewis

Coleen Damcott

Da-Wei Gong

Mao Fu

Hui Xu

Brady Gaynor

Melanie Daue

Nanette Steinle

Teo Postolache

Elliot Hong



# Amish Research Clinic

- **Support staff-**

- RNs, Amish liaisons, lab tech, driver, admin

- **Recruiting visits**

- Home visits: ~400-500/month
- Wellness study: ~70-80/mon
- Mobile van

- **Testing done**

- Fat biopsies, OGTT, IVGTT,
- metabolic studies (TrueOne 2400 cart), lipoprotein turnover studies
- platelet functional studies
- Anthropometry
- Imaging/ultrasound:



# The End

