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HEALTHCARE

MEASURING CHANGES IN LIPID AND BLOOD GLUCOSE VALUES IN PRUDENTIAL'S HEALTH & WELLNESS PROGRAM

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INTRODUCTION

- Prudential Financial, Inc., a financial services company, offers a variety of financial products and services related to life insurance, annuities, retirement plans, mutual funds, investment management, and real estate
- Prudential Financial's Health and Wellness Program offers a variety of programs and services, including fitness centers, wellness classes, an on-site clinic, HRAs, preventive health screenings, health coaching, employee assistance programs (EAPs), and child and adult care services
- This study assessed the accuracy of employee self-reporting and the impact of fitness center use and disease management program participation in relation to lipid and blood glucose values.

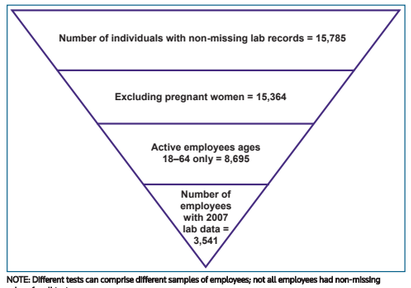
BACKGROUND

- Most people accurately recall their levels of glucose/cholesterol.[1,2]
  - Pearson's correlations for total cholesterol and high-density lipoprotein for self-reported and measured values were 0.54 and 0.63, respectively.
- People exhibit declining recall accuracy when asked to report results of biometric health risk screenings taken previously, especially with longer follow-up intervals.[3]
  - Accuracy was 47.6 percent, 34.2 percent, and 31.3 percent for the one-, three-, and six-month follow-up groups.
- Professional athletes had more desirable lipid values (total cholesterol, LDL and triglycerides lower and HDL higher) compared to male sedentary controls.[4]
- Disease management programs can be effective at lowering cholesterol levels.[5,6]

RESEARCH QUESTIONS

1. Employee awareness and accuracy
   - How well do employees recall their lipid and blood glucose values when asked about them on a health risk assessment offered up to one year after a laboratory screening?
2. Fitness center users versus sedentary employees
   - Do fitness center users have better lipid and blood glucose values compared to sedentary employees?
3. Longitudinal cohort analysis
   - How have lipid and blood glucose values changed for Prudential Financial employees from 2005–2007 and from 2005–2008?
   - How do lipid and blood glucose values differ between DM participants and non-participants over three- and four-year periods?

Figure 1: Final Sample Size Based on Inclusion/Exclusion Criteria for 2007 Data



NOTE: Different tests can comprise different samples of employees; not all employees had non-missing values for all tests.

Table 1: Overall Study Sample Demographics—2007*

Demographics	N = 3,541
Female (%)	57%
Race/ethnicity (%)	
Asian	8%
African-American	12%
Hispanic/Latino	5%
White	75%
Other	0%
Average age (SD)	44 years (10.0)

***Note:** 2007 was chosen because all the analyses include 2007 data. Average annual salary was not included because of its sensitive nature.

METHODS AND RESULTS

Research Question 1—Analyses

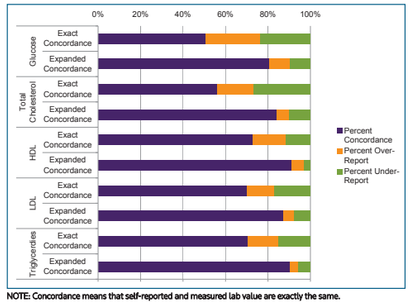
- Difference scores were created by subtracting the HRA value from the measured value. Measured value was considered the "gold standard."
- Repeated measures t-test determined the statistical significance of difference between self-reported and measured values.
- Pearson's correlation coefficients were calculated to determine the strength of the relationship between self-reported and measured values.
- Percentage concordance was used to measure the number of employees who were accurate.
  - "Exact concordance" meant self-reported values exactly matched measured values.
  - "Over-report"' meant HRA values were larger than measured values.
  - "Under-report" meant HRA values were less than measured values.
- Additionally, exact concordance was relaxed to include +/-0.5 standard deviation from the measured value.

Table 2: Statistical Comparison of Self-Reported and Measured Lipid/Blood Glucose Values

Screening Test	N	Average Self-Reported Value (mg/dL)	Average Measured Value (mg/dL)	Standard Deviation of Measured Values	Difference (Measured Self-Report)	*P* Value	Average Length Between Measured and Self-Reported Values (Days and Range)	Pearson's Correlation
Total cholesterol	1,099	187.8	190.0	36.0	2.2	0.0002	132 (0, 365)	0.8502
HDL	786	57.1	56.3	15.5	-0.8	0.0002	123 (0, 365)	0.9228
LDL	794	108.9	110.2	30.4	1.3	0.0414	124 (0, 365)	0.8349
Triglycerides	741	117.4	120.3	83.1	2.9	0.0827	122 (0, 365)	0.8397
Blood glucose	272	100.7	101.5	26.8	0.8	0.5452	143 (0, 365)	0.6243
With self-reported diabetes	31	137.6	149.8	75.0	12.3	0.1277	209 (65, 353)	0.3755
Without self-reported diabetes	241	96.0	96.2	15.0	0.2	0.4771	181 (0, 365)	0.4373

- Numbers in red indicate statistical significance at $p<0.05$.
- The average difference between persons with diabetes and persons without diabetes was statistically significant, $p<0.001$. The average length of time between self-reported and measured values was 9.4478 days.
- Of those with blood glucose data, according to HRA responses, 84.9 percent (231) were fasting.

Figure 2: Concordance, Over- and Under-Reporting of Lipid and Blood Glucose Values



NOTE: Concordance means that self-reported and measured lab value are exactly the same.

Research Question 2—Analyses

- Self-reported and measured lipid values for fitness center users compared to non-users were analyzed using regression techniques.
- Regression analyses controlled for age, gender, race, and annual salary (all 2007 measures).

Table 3: Comparison of Ordinary Least Square (OLS) Model Results for Regression-Adjusted Self-Reported and Measured Lipid and Blood Glucose Values for Fitness Center Users and Sedentary People

Screening Test	Values	Fitness Center Users N	Fitness Center Users Adjusted Value (mg/dL)	Sedentary People N	Sedentary People Adjusted Value (mg/dL)	*P* Value
Total cholesterol	Measured	152	212.0	94	209.3	0.5525
	Self-reported	152	205.2	94	204.0	0.7983
HDL	Measured	105	59.9	58	52.5	0.0016
	Self-reported	105	59.9	58	52.0	0.0005
LDL	Measured	110	123.5	57	119.2	0.3681
	Self-reported	110	121.6	57	120.5	0.8368
Triglycerides	Measured	111	150.0	62	168.5	0.0669
	Self-reported	111	150.7	62	166.9	0.1232

Numbers in red indicate statistical significance at $p<0.05$.

Research Question 3—Methods and Analyses

- Additional inclusion/exclusion criteria
  - Three or four years of laboratory data (2005–2007 or 2005–2008)
  - Active employee for all years in the sample
- Measures used
  - 2005–2008 laboratory data from and the On-Site Clinic
  - No HRA data used in these analyses
- Analyses
  - Three- and four-year trend across all employees
  - Three-year trend, DM participants compared to non-participants
    - Diabetes, coronary artery disease, and chronic heart failure only
    - DM participants had to participate during at least one out of the three years in the above programs for inclusion in the cohort.
    - Participation in any year was considered participation across all years.

Table 4: Three-Year Cohort Trends: OLS Model Results for Regression-Adjusted Mean Lipid Values

	N	Adjusted Average Value (mg/dL) 2005	2006	2007	1-Year Difference (2006–2005)	*P* Value	2-Year Difference (2007–2005)	*P* Value
Total cholesterol	624	207.4	203.7	202.0	-3.7	0.0025	-5.4	<0.0001
HDL	582	132.8	129.3	127.9	-3.5	0.0019	-4.9	<0.0001
LDL	612	49.6	49.1	49.9	-0.47	0.1064	0.3	0.4022
Triglycerides	620	136.6	132.0	128.2	-4.6	0.1480	-8.4	0.0074

Numbers in red indicate statistical significance at $p<0.05$.

Table 5: Three-Year Cohort Trends Stratified by Disease Management Participation: OLS Model Results for Regression-Adjusted Mean Values

Screening Test	Disease Management Status	N	Adjusted Average Value (mg/dL) 2005	2006	2007	1-Year Difference (2006–2005)	Difference in Differences *P* Value	2-Year Difference (2007–2005)	Difference in Differences *P* Value
Total cholesterol	Participant	127	198.4	186.4	186.1	-12.0	0.0017	-12.3	0.0170
	Non-participant	496	208.8	207.0	204.7	-1.8		-4.0	
HDL	Participant	115	124.3	113.5	113.1	-10.8	0.0041	-11.2	0.0164
	Non-participant	467	134.1	132.2	130.8	-1.9		-3.3	
LDL	Participant	122	46.5	46.5	46.6	0.0	0.4587	0.1	0.8469
	Non-participant	490	50.2	49.6	50.4	-0.2		0.2	
Triglycerides	Participant	124	153.7	139.7	138.7	-14.0	0.1287	-15.0	0.2980
	Non-participant	496	133.0	130.9	126.6	-2.1		-6.4	

Numbers in red indicate statistical significance at $p<0.05$.

Table 6: Four-Year Cohort Trends: OLS Model Results for Regression-Adjusted Mean Lipid Values

Screening Test	N	Adjusted Average Value (mg/dL) 2005	2006	2007	2008	Difference (2008–2005)	*P* Value
Total cholesterol	431	206.8	203.6	201.2	197.9	-8.9	<0.0001
HDL	422	48.7	48.3	48.8	50.0	1.3	0.0084
LDL	401	131.9	129.7	127.3	122.4	-9.5	<0.0001
Triglycerides	428	137.2	132.0	130.4	130.1	-7.1	0.0573

Numbers in red indicate statistical significance at $p<0.05$.

- Self-reported versus measured values
  - Self-reported and measured values were significantly different for total cholesterol, HDL, and LDL.
  - Over half of the sample accurately reported total cholesterol, HDL, LDL, and triglycerides.
  - When concordance was expanded, over 80 percent of participants accurately reported their lipid and blood glucose values.
- After controlling for gender, race, age, and annual salary, HDL levels were significantly higher for fitness center users compared to sedentary employees.
- Measured lab values of cohort participants significantly decreased for total cholesterol, LDL, and triglycerides over a three-year period. After four years, decreases in total cholesterol and LDL remained significant and HDL values significantly increased.
- Percentage at high risk also decreased over time ($p<0.05$).
- Disease Management participants showed greater significant reductions in total cholesterol and LDL values compared with non-participants.

LIMITATIONS

- Employees enrolled in medical plans other than the primary plan or screened at an offsite facility (i.e., other than Prudential Financial's two main lab vendors) were excluded.
- The small sample size may not be representative of Prudential Financial's population.
- Recall bias may have occurred for self-reported measures
- Lack of additional information about employees including use of prescription medication (such as statins), diet, weight, and amount of physical activity, prior lipid values.
- Given the small numbers of participants in the DM program, participation was collapsed across all years. Changes in lipid values may be the result of other factors prior to DM participation.

CONCLUSIONS

- In general, participants accurately reported their lipid and blood glucose values—especially when definition of agreement was relaxed.
- Fitness center users had significantly higher HDL levels compared to sedentary employees.
  - This corroborates clinical evidence, now evidenced in a real-life corporate setting.
  - It is still undetermined whether use of the fitness center improves HDL levels or whether fitness center users are healthier and have higher HDL levels to begin with.
- Lipid values significantly decreased for a cohort of employees over three and four years.
- DM participants showed significant reductions in total cholesterol and LDL values, but causality between DM participation and lower lipid values could not be determined.

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