

Changes in Weight, BMI, and Waist Circumference after 2 Years in Respondents with or at Risk for Metabolic Disease: Study to Help Improve Early evaluation and management of risk factors Leading to Diabetes (SHIELD)

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BACKGROUND

- 50 million US adults aged 40-74 years currently have prediabetes, 20 million US adults have diabetes mellitus and projections indicate that diabetes will affect 300 million people globally by 2025^{1,2}
- The increasing prevalence of T2DM is directly related to an increasing rise in the prevalence of obesity and physical inactivity
 - Excessive body fat may result in adipocyte hypertrophy and/or visceral adipose tissue accumulation (adiposopathy), which results in multiple metabolic and immune derangements contributing to T2DM^{3,4}
 - An estimated 97 million US adults are overweight or obese⁵, and obesity and its metabolic complications have been characterized as epidemics⁶
- There are two commonly held concepts regarding the relationship between weight gain and metabolic diseases
 - Weight gain in genetically and/or environmentally predisposed individuals directly contributes to metabolic diseases such as T2DM
 - Patients with metabolic diseases are simply more likely to gain weight

OBJECTIVE

- Evaluate whether T2DM respondents had significantly greater weight gain over 2 years compared with respondents with hypertension (HTN) or dyslipidemia (DYS) or none of these conditions

METHODS

STUDY DESIGN

- Data was derived from the **Study to Help Improve Early** evaluation and management of risk factors **Leading to Diabetes** (SHIELD), a 5-year population-based survey conducted to better understand the risk for the development of diabetes, as well as disease burden
 - Based upon a screening questionnaire mailed to 200,000 nationally representative households (part of the TNS NFO consumer household panel), responses for 211,097 adults from 127,420 households (64% response rate) were obtained
 - A 64-item survey was sent to 22,001 selected individuals derived from the screening respondents. Since 2004, sequential ("longitudinal") SHIELD surveys have captured self-reported information on health status, attitudes and behaviors, quality of life and anthropometry from this representative sample of the US population
- This investigation is a longitudinal analysis of the relation between T2DM and other cardiometabolic risk groups for change in weight, BMI, and waist circumference among SHIELD respondents

STUDY POPULATION

- Respondents were categorized as having T2DM, hypertension, or dyslipidemia based upon self-report of having been told by a doctor, nurse or other healthcare professional that they have the condition
 - T2DM was defined as a diagnosis of type 2 diabetes and age of onset >21 years of age
 - HTN was defined as a diagnosis of high blood pressure/hypertension
 - DYS was defined as a diagnosis of cholesterol problems
- T2DM respondents were stratified based on whether they had or had not been treated with insulin, TZD or SU (anti-diabetes drugs known to increase body weight)

STUDY MEASURES

- Changes in anthropometric measures were assessed over 2 years (change from baseline survey to Year 2 survey)
 - BMI was weight/height² in kg/m²
 - Weight in pounds
 - Waist circumference was measured in inches at the navel level with a standard tape measure (included with instructions in the survey) while the respondent was standing
- Changes in anthropometric variables were assessed among respondents with T2DM, HTN alone, DYS alone, and those without T2DM, HTN, or DYS
- The use of anti-diabetes drug was determined by a review of the self-reported prescription medications listed on the survey forms

STUDY ANALYSIS

- All T2DM respondents were included in the analysis even if they were not currently on anti-diabetes drugs. They were stratified by whether they had a history of insulin, TZD or SU use
- Differences across groups were assessed with two-sided t-tests for pairwise comparisons
- Multivariate linear regression models assessed differences in change between disease groups, adjusted for age, gender, race, education, income, and baseline anthropometry

RESULTS

Table 1. Baseline characteristics of SHIELD survey respondents

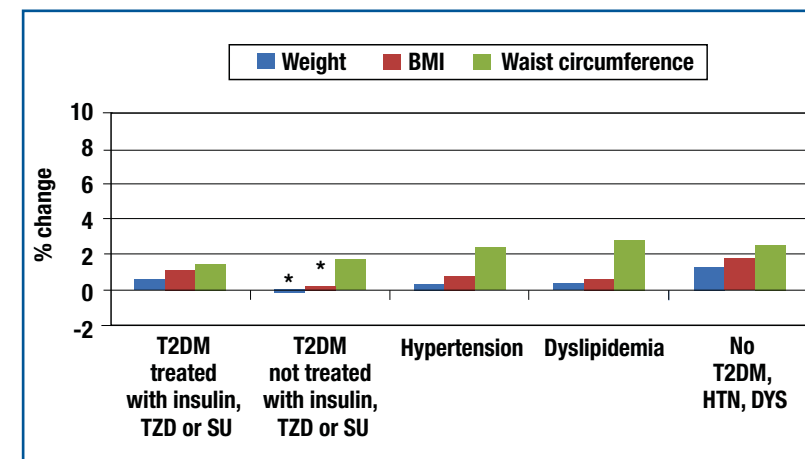
Characteristics	T2DM treated with insulin, TZD, or SU (N=1609)	T2DM not treated with insulin, TZD, or SU (N=626)	HTN only (N=755)	DYS only (N=1145)	No T2DM, HTN or DYS (N=1957)
Age, years, mean (SD)	61.2 (12.1)	60.2 (12.9)	59.2 (14.4)	56.1 (14.4)*	47.8 (15.8)*
Women, %	61	63	63	62	65
Race, % white	85	86	86	91	88
Education, % with some college or higher	63	66	68	72*	74*
Income, % <\$35,000/yr	57*	50	47	40*	39*
Baseline weight, pounds, mean (SD)	217 (56)*	206 (53)	201 (56)	186 (45)*	179 (48)*
Baseline BMI, kg/m ² , mean (SD)	34.5 (8.6)*	32.8 (8.1)	31.8 (7.6)*	29.3 (6.4)*	28.1 (6.8)*
Waist circumference, inches, mean (SD)	44.3 (7.5)*	42.6 (7.7)	41.1 (7.8)*	39.0 (6.9)*	37.5 (7.9)*

*p<0.02 for comparison with T2DM respondents not treated with insulin, TZD, or SU

- T2DM respondents were significantly older than respondents with DYS or with none of the 3 conditions (p<0.0001)
- Significantly fewer T2DM respondents had some college education and a greater proportion had lower income, compared with respondents with DYS and those with none of the conditions (p<0.01)
- Baseline BMI and waist circumference measures were significantly higher in the T2DM respondents, compared with respondents with HTN alone, DYS alone, or none of these conditions (p<0.02)
- Baseline weight was significantly higher in the T2DM respondents, compared with respondents with DYS alone or none of these conditions (p<0.02)
- There were 2985 respondents with HTN and no T2DM (75% also had dyslipidemia), and there were 3376 respondents with DYS and no T2DM (66% also had hypertension)

RESULTS (Continued)

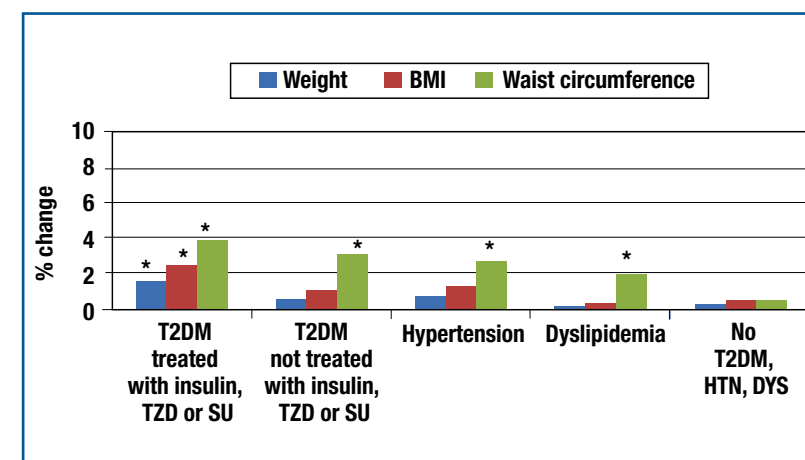
Figure 1. Percent change over 2 years (unadjusted) in weight, BMI, and waist circumference among different disease groups



*p<0.05; T2DM not treated with insulin, TZDs, or SU had significantly less change in weight and BMI than respondents with no T2DM, HTN, or DYS

- Percent change in weight, BMI, and waist circumference was not significantly different among respondents with T2DM not treated with insulin, TZDs, or SU versus HTN alone versus DYS alone
- T2DM not treated with insulin, TZDs, or SU had statistically significantly less change (but not clinically meaningful difference) in weight and BMI than respondents with no T2DM, HTN, or DYS
- For those with HTN and no T2DM (n=2985) and those with DYS and no T2DM (n=3376), the change in weight, BMI, or waist circumference was not different from T2DM not treated with insulin, TZDs, or SU

Figure 2. Adjusted percent change over 2 years in weight, BMI, and waist circumference among different disease groups



No T2DM, HTN, or DYS is the reference group for the regression model
*p<0.0001; adjusted for age, gender, race, income, education and baseline anthropometry; Respondents with no T2DM, HTN, or DYS had significantly less change in waist circumference compared with other disease groups

RESULTS (Continued)

Adjusted Percent Weight Change:

- Respondents with T2DM who were not treated with insulin, TZDs, or SU had similar change in weight, compared with respondents with no T2DM, HTN, or DYS, after adjusting for baseline weight and patient characteristics
- Respondents with HTN alone or DYS alone also had similar weight change, compared with respondents who had no T2DM, HTN, or DYS after adjustment
- Age, gender, and baseline weight were significant predictors of weight change over 2 years

Adjusted Percent BMI Change:

- Respondents with T2DM who were not treated with insulin, TZDs, or SU had similar change in BMI, compared with respondents with no T2DM, HTN, or DYS, after adjusting for baseline BMI and patient characteristics
- Respondents with HTN alone or DYS alone also had similar BMI change, compared with respondents who had no T2DM, HTN, or DYS after adjustment
- Age, graduate degree, and baseline BMI were significant predictors of BMI change over 2 years

Adjusted Percent Waist Circumference Change:

- T2DM respondents, regardless of treatment had significantly greater change in waist circumference, compared with respondents with no T2DM, HTN, or DYS, after adjusting for baseline waist circumference and patient characteristics
- Respondents with T2DM and not treated with insulin, TZDs, or SU, HTN alone or DYS alone had similar changes in waist circumference
- Adjusted change in waist circumference was significantly less than unadjusted mean change in the no T2DM, HTN, or DYS group largely because of controlling for baseline waist circumference, which was less than other groups

LIMITATIONS

- Weight, height, and waist circumference were self-reported and not validated by clinical measure due to the survey approach
- Household panels, like the SHIELD study, tend to under-represent the very wealthy and very poor segments of the population and do not include military or institutionalized individuals
- Patients with T2DM had higher baseline weight, BMI and waist circumference, suggesting the possibility that their predisposition to increases in body fat had already been realized

SUMMARY

- Respondents with metabolic disease (T2DM) and those at risk for metabolic disease did not differ in a clinically meaningful way in regard to changes in weight, BMI, or waist circumference after 2 years
- Baseline weight, BMI, and waist circumference were higher among T2DM respondents, but changes in these parameters were not different, compared with respondents with HTN alone or DYS alone
- When adjusted for age, gender, race, income, education, and baseline anthropometry, patients with metabolic disease may be more likely to increase their waist circumference

CONCLUSIONS

- Respondents with metabolic disease (T2DM) may not differ from other individuals in their predisposition toward increasing either the amount or central distribution of body fat
- We hypothesize that it is the pathogenic effects of adipose tissue (adiposopathy), within the individual, that contribute to the expression of metabolic diseases

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LIST OF ABBREVIATIONS

BMI	Body mass index
DYS	Dyslipidemia
HTN	Hypertension
SHIELD	Study to Help Improve Early evaluation and management of risk factors Leading to Diabetes
SU	Sulfonylurea agents
T2DM	Type 2 diabetes mellitus
TNS NFO	Taylor Nelson Sofres National Family Opinion
TZD	Thiazolidinediones

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