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Household expenditures on dietary supplements sold for weight loss, muscle building, and sexual function: Disproportionate burden by gender and income

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ABSTRACT

Dietary supplements sold for weight loss (WL), muscle building (MB), and sexual function (SF) are not medically recommended. They have been shown to be ineffective in many cases and pose serious health risks to consumers due to adulteration with banned substances, prescription pharmaceuticals, and other dangerous chemicals. Yet no prior research has investigated how these products may disproportionately burden individuals and families by gender and socioeconomic position across households. We investigated household (HH) cost burden of dietary supplements sold for WL, MB, and SF in a cross-sectional study using data from 60,538 U.S. households (HH) in 2012 Nielsen/IRi National Consumer Panel, calculating annual HH expenditures on WL, MB, and SF supplements and expenditures as proportions of total annual HH income. We examined sociodemographic patterns in HH expenditures using Wald tests of mean differences across subgroups. Among HH with any expenditures on WL, MB, or SF supplements, annual HH first and ninth expenditure deciles were, respectively: WL $5.99, $145.36; MB $6.99, $141.93; and SF $4.98, $88.52. Conditional on any purchases of the products, female-male-headed HH spent more on WL supplements and male-headed HH spend more on MB and SF supplements compared to other HH types (p-values < 0.01). High-income ($30,000 < annual income < $100,000), compared to low-income (annual income < $30,000) HH, spent more on all three supplements types (p-values < 0.01); however, proportional to income, low-income HH spent 2–4 times more than high-income HH on WL and MB supplements (p-values < 0.01). Dietary supplements sold for WL, MB, and SF disproportionately burden HH by income and gender.

1. Introduction

The dietary supplement industry in the United States is a growing, multi-billion dollar industry. Dietary supplements, which include vitamins, minerals, herbs, and amino acids, are widely used by adults and children of all ages. In fact, Americans spent an estimated $36.7 billion on dietary supplements in 2014 (Anonymous, 2015). Dietary supplements sold for weight loss, muscle building, and sexual function are commonly used. Americans spent $2 billion in 2015 on dietary supplements for weight loss (Anonymous, 2014), which is among the most common reasons for dietary supplement use (Bailey et al., 2013). Americans spent $2.6 billion on muscle-building products in 2015 (McKenna, 2015). There is also a substantial market for dietary supplements promising enhanced sexual function. Recently, one manufacturer was found to produce over one million capsules per month of a supplement sold for sexual functioning, netting more than $2 million dollars in three years. The global sexual-function supplement industry likely generates tens of millions, if not billions, of dollars yearly (Canham, 2011; Cohen and Venhuis, 2013; Szalavitz, 2013).

Despite their widespread use, dietary supplements for weight loss, muscle building, and sexual function are not medically recommended and have been shown to be ineffective in many cases (Steffen et al., 2007; Roerig et al., 2003; Blanck et al., 2007) and to pose serious health risks to consumers due to adulteration with banned substances, prescription pharmaceuticals, and other dangerous chemicals (U.S. Food and Drug Administration, 2017; U.S. Food and Drug Administration, 2010; Cui et al., 2015). In fact, the U.S. Food and Drug Administration has been well aware of this heightened risk for many years, and in 2010 issued a special warning to consumers regarding supplements sold for weight loss, muscle building, and sexual function as being more likely than other supplements to be deceptively marketed and tainted with toxic ingredients (U.S. Food and Drug Administration, 2010). Effects with adverse health consequences can include for weight-loss supplements: chronic diarrhea and constipation, dehydration, hypokalemia, metabolic acidosis, and other electrolyte imbalances, cardiac arrhythmia, hemorrhagic and ischemic stroke, hepatic and renal

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failure; (Steffen et al., 2007; Roerig et al., 2003; Schneider, 2003; Copeland, 1994; Tozzi et al., 2006; Vanderperren et al., 2005; Crow, 2005) for muscle-building supplements: infertility, testicular cancer, stunted growth, coronary artery disease, pulmonary embolism; (Liyanage and Kodali, 2014; Li et al., 2015) and for sexual-function supplements: changes in blood pressure, hypomania, insomnia, anxiety, irritability, nausea, headaches, loss of consciousness, seizures (Cohen and Venhuis, 2013; Corazza et al., 2014).

With the serious health risks of dietary supplements sold for weight loss, muscle building, and sexual function well-documented, there is concern that economic costs of these products may disproportionately burden individuals and families by gender and socioeconomic position. A recent national study found 21% of women and 10% of men had used weight-loss supplements at some point in their lives, with women ages 18–34 years having the highest rate of past year use at 17%, affecting many millions of Americans (Blanck et al., 2007). A different study assessing use of muscle-building products among adolescents found that 35% of boys had used protein powder in the past year and 11% had used other products including dietary supplements sold for muscle-building. On the other hand, 21% of girls had used protein powder in the past year and 6% had used other products including supplements sold for muscle-building (Eisenberg et al., 2012).

In the U.S. nationally representative National Health and Nutrition Examination Survey, Kakinami and colleagues found that compared to adults in high-income households, those in low-to-middle income households were more likely to use weight-loss strategies in the past year inconsistent with medical recommendations, such using as non-prescription diet pills, which are likely to include dietary supplements, as they comprise the vast majority of over-the-counter diet pills on the U.S. market (Kakinami et al., 2014). In another nationally representative study of U.S. adults, Pillitteri and colleagues similarly found that among adults who had ever attempted to lose weight, those in low-to-middle income households were more likely than those in higher-income households to use dietary supplements for weight loss (42% vs. 30%) (Pillitteri et al., 2008). They also found in this same sample that adults with high school or less education were more likely than those with at least some college education to use dietary supplements for weight loss (38% vs. 31%) and found higher use among African American (49%) and Latino (42%) adults compared to white adults (31%) (Pillitteri et al., 2008). We are not aware of any studies assessing the association between income and dietary supplement use for muscle building or sexual function.

Given these gaps in the literature, the objectives of our study were to estimate the proportion of household income in the United States spent on dietary supplements sold for weight loss, muscle building, and sexual function as related to gender of household head and household annual income.

2. Methods

The primary data source, from which information on U.S. household purchases of dietary supplements was aggregated, was the observational 2012 Nielsen/IRi National Consumer Panel (NCP) (Nielsen/IRi, 2012). The dataset, administered by the Kilts Center at the University of Chicago, is a sample of >60,000 U.S. households that in 2012 were asked to provide complete information on household purchases labeled with a scannable universal product codes (UPC). The NCP draws from all U.S. states and major metropolitan areas, which allowed us to produce national-level projections using NCP-calculated projection factors. The NCP database includes no identifiable information; therefore, this study is not considered human subjects research.

To augment information on dietary supplements listed in the NCP as having been purchased by participating households, we collected data on products with packaging and advertising making claims in at least one of three categories: weight loss, muscle building, or sexual function. To identify these characteristics, we conducted web searches by UPC, product brand, and product description, registering whether each product included each claim. The collected product claims data were merged into the NCP at the product level by matching collected UPCs with those recorded in the NCP database, at the product level. Then, all purchases for each household, as identified in the UPC merge, were aggregated according to the relevant measure, e.g., sum for total expenditure or an indicator value for any expenditure. This was done separately for each claim-type category. The analytic sample consisted of 60,538 households, which is all households included in the 2012 panel year.

The primary measure of interest is household-level expenditures within each product category during 2012. As described below, we also analyzed this measure across household types according to the gender(s) of the household head(s) and annual household income. There were 15,796 households reporting a female head only, 6112 reporting a male head only, and 38,630 reporting a female and male head. In addition, 13,470 households reported earning less than $30,000 in the prior tax year and 47,068 households reported earning more than $30,000 in the prior tax year.

Household-level expenditures were summarized in two ways. Whether or not a household purchased a product in a particular category (e.g., weight loss, muscle building, or sexual function) were coded as 1 or 0, so the estimated means represent percent of households reporting any purchases. Statistics that report conditional expenditure are calculated as mean values, conditional on a household having made any purchases of a product in one of the three dietary supplement categories under study (i.e., weight loss, muscle building, or sexual function). Thus, conditional estimates were based on the subset of the household population that purchased at least one product in a category. In addition, household expenditure greater than or equal to $250 on weight-loss (N = 659), muscle-building (N = 362), or sexual-function (N = 27) products were considered outliers and removed for relevant product type.

To prepare for estimates of a household's income share that was spent on products in each category, household income was imputed as the midpoint of the reported household income category. Recorded income category increments ranged from $3000 (for low income categories) to $20,000 (for high income categories), and the highest income category in the NCP database was $100,000 or more. Because the highest income category did not have a midpoint, households in this category (N = 9039) were excluded from income share estimates.

All analyses were cross-sectional, and statistics are reported in both weighted and unweighted estimates. Weighted estimates were constructed using projection factors provided by NCP, where the primary sampling unit was the household-year, and the sample was stratified by markets and census regions. We examined differences in weighted estimates using Wald tests. Some of the difference estimates may not satisfy the normality assumption of the Wald test; therefore, we also report results using unweighted estimates and corresponding nonparametric Wilcoxon-Mann-Whitney tests that the samples are drawn from the from the same population.

As sensitivity analyses, we compared findings from analytic sample when outliers were removed, as described above, to findings when outliers were retained. Associations were not qualitatively different; therefore, results presented are based on the analytic sample exclusive of outliers.

3. Results

Table 1 presents estimates of the percent of households purchasing any products, and household expenditures conditional on any purchases, for each of the three supplement categories and each household head type. Among households with any expenditures on weight- loss, muscle-building, or sexual-function supplements, annual households first and ninth expenditure deciles were: weight loss $5.99 and $145.36; muscle building $6.99 and $141.93; and sexual function $4.98 and $88.52. In Fig. 1, panels A–C present the monthly expenditure