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## Spillovers of health education at school on parents' physical activity

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# Spillovers of Health Education at School on Parents' Physical Activity

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## Abstract

To prevent modern health conditions like obesity, cancer, cardiovascular illness, and diabetes, which have reached epidemic-like proportions in recent decades, many health experts argue that students should receive Health Education (HED) at school. Although this type of education aims mainly to improve children's health profiles, it might affect other family members as well. This paper exploits state HED reforms as quasi-natural experiments to estimate the causal impact of HED received by children on their parents' physical activity. We use data from the Panel Study of Income Dynamics (PSID) for the period 1999-2005 merged with data on state HED reforms from the National Association of State Boards of Education (NASBE) Health Policy Database, and the 2000 and 2006 School Health Policies and Programs Study (SHPSS). To identify the spillover effects of HED requirements on parents' behavior we use a "differences-in-differences-in-differences" (DDD) methodology in which we allow for different types of treatments. We find a positive effect of HED reforms at the elementary school on the probability of parents doing light physical activity. Introducing major changes in HED increases the probability of fathers engaging in physical activity by 12.4 percentage points, while this probability for mothers does not seem to be affected. We find evidence of two channels that may drive these spillovers. We conclude that the gender specialization of parents in childcare activities, as well as information sharing between children and parents, may play a role in generating these indirect effects and in turn, in shaping healthy lifestyles within the household.

**JEL Classification:** I12, I18, I28, C21.

**Keywords:** physical activity; healthy lifestyles; indirect treatment effects; health education; triple differences.

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# 1 Introduction

Non-communicable diseases such as obesity, cancer, cardiovascular conditions, and diabetes have reached epidemic-like proportions in recent decades.<sup>1</sup> Physical inactivity is one of the most important risk factors for these diseases (WHO, 2003). As a result, prevention increasingly involves changes in lifestyles, such as introducing the practice of regular physical activity in order to reduce risk factors (Kenkel, 2000). In the US, physically active individuals save an estimated US\$ 500 per year in health care costs according to 1998 data (WHO, 2003).

Interactions within the family may crucially affect the “production” of healthy lifestyles. As Kenkel (2000) points out, the family is often identified as the unit of production of preventive practices. Previous literature on intra-household health decisions has focused on the interactions between spouses (e.g., Clark and Etile (2006)). As well, the literature on inter-generational transmission of characteristics such as health, ability, education or income, has focused on the effects that parents’ decisions can have on children’s behaviors and outcomes. However, little research has been done to evaluate the impact of children on parents’ decisions, in particular on healthy lifestyle choices.<sup>2</sup>

Schools can play a fundamental role in providing children with information about healthy lifestyles and health decisions, which may complement what they learn at home. At school, the knowledge about health is transferred to children through the implementation of specific curricular modules, often known as Health Education (HED).<sup>3</sup> There is evidence indicating that HED consisting for instance of physical education, nutrition or sexual education is actually effective in directly improving the health profiles of children.<sup>4</sup> However, it may be the case that parents are as well affected by the education about preventive health care that their children acquire at school. Moreover, the indirect effect of HED on parents may in turn enhance the effectiveness of HED delivered in the school setting in changing children’s health behaviors.

The first goal of this paper is to assess the existence of spillover effects of Health Education received by children at elementary school on their parents.<sup>5</sup> We exploit the quasi-experiment provided by the changes in the state-level HED requirements in elementary schools implemented between the school years 1999/2000 and 2005/2006 in the US to quantify the effects of these programs on parents’ physical activity. Thus, the focus is on a policy that does not imply any transfer of resources to children -the targeted individuals- but instead provides them with new information. A second goal of this paper is to discuss the plausible channels through which children receiving HED at schools may affect the probability that their parents engage in physical activity.

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<sup>1</sup>See Burkhauser et al. (2009) for a detailed examination of US obesity trends in the period 1966-2006.

<sup>2</sup>One exception is Kuziemko (2011), who analyzes the effect of children on parents’ education.

<sup>3</sup>According to the Centers for Disease Control and Prevention (CDC) “*Health Education is a planned, sequential, and developmentally appropriate instruction about Health Education designed to protect, promote, and enhance health literacy, attitudes, skills, and well-being*” (Kann et al., 2007).

<sup>4</sup>As stated by WHO (1999), there are several reasons for promoting healthy behaviors through schools. Schools are an efficient way to reach school-age children and their families in an organized way and students spend a great portion of their time in schools, where education and health programs can reach them at influential stages in their lives.

<sup>5</sup>HED in middle and high school levels is not mandatory. Moreover, as shown later, the channels we emphasize as drivers of the spillovers of HED inside the family include information transmission between parents and children, and role-modeling, both of which are more present in the interaction of parents with younger kids (in elementary education) than in the interaction with adolescents (in middle or high education). These reasons motivate the focus of the analysis on children in elementary schools.

To identify the spillover effects of HED policies, we use a “differences-in-differences-in-differences” (DDD) strategy, exploiting not only the time series and cross-state variation, but also within-state variation. The variation within states makes possible controlling for state-specific time trends that can be correlated with the change in HED policies. We are able to exploit the third difference because within each state there are individuals who were exposed to the treatment and others who were not.<sup>6</sup> The data we use is from the Panel Study of Income Dynamics (PSID) for the period 1999-2005, merged with data on state HED reforms from the State School Healthy Policy Database of the National Association of State Boards of Education (NASBE), and the 2000 and 2006 surveys of the School Health Policies and Programs Study (SHPPS).

Our results show evidence of a positive effect of HED received by children in elementary schools on their fathers’ probability of engaging in physical activity. Introducing major reforms in HED in elementary schools makes a father exposed to this policy 12.4 percentage points more likely to be physically active than a comparable father not affected by the policy. We do not find evidence that the policy under analysis affects the decision of mothers to engage in physical activity.

We explore the channels behind these results, and find two non-exclusive explanations. First, we argue that a “role model” channel may explain the differential impact according to parent gender. In effect, the roles that mothers and fathers play for their children in the activities they usually do together are important for this result. Parents usually spend more time with their children doing gendered activities, such as physical activity in the case of fathers. Therefore, the promotion of healthy behaviors at school is more likely to have an effect on the behavior of fathers than that of mothers. Second, we find evidence consistent with an “information sharing” channel. We analyze the differential impact of HED reforms on individuals with low and high education and find a greater effect on individuals with lower education. The existence of spillovers of HED on parents’ lifestyles indicates that the interaction between children and parents plays a role in the formation of healthy lifestyles within the household, which must be taken into account to properly design policy interventions aimed at increasing the adoption of healthy lifestyles in a given community.

We perform a number of robustness checks that support the causality of the link between HED received by children in elementary schools and the probability of their fathers engaging in physical activity. First, we show that HED reforms do not affect outcomes that are not related to health behaviors, such as labor force participation. Second, we perform a “placebo” test on adults that were not exposed to the potential indirect effect of HED. The test shows that the placebo treatment group is not affected by the HED reforms, indicating that our results are not driven by other shocks contemporaneous to HED changes that systematically affected parents in the treatment group. Finally, we show that our results are also robust to alternative definitions of the control group.

This work is related to two strands of literature. First, to the literature on policy evaluation trying to measure the spillover effects of policy interventions on non-targeted individuals, also known as Indirect Treatment Effects (ITE). There are a small number of works in the economic literature assessing the existence of spillovers on non-targeted individuals within the household that present reliable results by using neat identification methodologies. One example is Bhattacharya et al. (2006), who analyze the effects of the School Breakfast Pro-

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<sup>6</sup>We show in Section 3 that there are remarkable differences in the pre-treatment trends in the outcomes of experimental versus non-experimental states, indicating that the implementation of HED policies is correlated with the behavior of the outcome of interest, which makes the use of a DDD estimator crucial here.

gram (SBP) in the US on not only targeted children but also on adult (non-targeted) family members. They find that the SBP improves the quality of diets even for family members who were not directly exposed to the program. The explanation for family spillover effects in this work is that the particular program reduces family budgetary constraints, freeing resources that may be redirected towards other household members. In contrast, we explore family spillovers occurring for non-budgetary reasons.<sup>7, 8</sup>

The second strand of literature related to our work consists of recent research evaluating the direct impact of particular aspects of health education at the school level on students' health outcomes and behaviors. Cawley et al. (2007) find positive effects of physical education requirements on the amount of time high school students engage in physical exercise, although they do not find any impact on Body Mass Index (BMI) or the probability of students being overweight. Also, McGeary (2009) assesses the effects of state-level nutrition education program funding on the BMI, the probability of obesity, and the probability of above normal weight.<sup>9</sup> Her results suggest that this funding is associated with reductions in BMI and in the probability of an individual having an above-normal BMI. Moreover, Dupas (2011) finds that sexual education reduced the incidence of teen pregnancy in a randomized controlled trial in Kenya.<sup>10</sup> In other words, there is suggestive evidence indicating that HED does have direct effects on children, even though this is not necessarily required to generate indirect effects, given the type of mechanisms that we emphasize (see Section 4.1) as the drivers of the family spillovers.

## 2 Health Education Policies in the US

In the 1970s and 80s, research studies showed that healthy kids did better in school and scored higher on achievement tests. As a consequence, some states started to develop and implement HED programs in public schools. In the 1990s, many educators called for the creation of a set of national health education standards that states could use as a template. In 1995, the National Committee for Health Education Standards created national health education standards with K-12 benchmarks covering several content areas of health. In 1998, the Congress urged the Centers for Disease Control and Prevention (CDC) to "expand its support of coordinated health education programs in schools" (Wyatt and Novak, 2000).

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<sup>7</sup>Harre and Coveney (2000) and Nandha and Krishnamoorthy (2007) analyze two interventions explicitly designed to induce school-age children to affect their families and other community members' health behaviors. Harre and Coveney (2000) evaluate two pilot studies implemented in a school in New Zealand that taught children about burns and scalds hazards, and encouraged changes to the home environment and family practices through a take-home exercise. Nandha and Krishnamoorthy (2007) describe the role and effectiveness of school-based HED for social mobilization to promote the use of a fortified salt in an Indian district where lymphatic filariasis is endemic. Regrettably, neither of these case studies is able to state causality since the interventions were not randomly assigned and affected few individuals.

<sup>8</sup>There are also some works in this literature evaluating external effects at the community level instead of the family level. Some examples are Angelucci and Giorgi (2009), Lalive and Cattaneo (2006), and Miguel and Kremer (2004).

<sup>9</sup>This funding is allocated to public-school systems, public-health clinics, as well as public-service announcements and advertisements. McGeary's analysis goes beyond the effects of education at school, and therefore she computes the estimates for the entire population in each state.

<sup>10</sup>Also, Kahn et al. (2002), Salmon et al. (2007) and van Sluijs et al. (2007) summarize the results of several interventions aimed at evaluating the effectiveness of HED programs in changing children's physical activity, and they all conclude that the interventions reviewed provide inconclusive evidence because of various limitations regarding the validity of the randomization procedures, the short duration of follow-ups, the lack of precision of the physical activity outcome measures, etc.

As Kahn et al. (2002) explain, “*HED classes that provide information and skills related to decision making are usually multicomponent, with the curriculum typically addressing physical activity, nutrition, smoking, and cardiovascular disease. HED classes, taught in elementary, middle, or high schools, are designed to effect behavior change through personal and behavioral factors that provide students with the skills they need for rational decision making*”.

State HED programs are typically characterized by two dimensions. The first is the health education curricula indicating the health related topics schools are *required* to teach. Panel A of Table 1 lists the topics included as potential HED requirements. We focus in these five topics because all of them may affect the knowledge about the benefits of being physically active.<sup>11</sup>

The second dimension is specific regulations to guarantee and strengthen the effective and coordinated implementation of health education in schools. We broadly refer to these regulations as *enforcements*. Panel B of Table 1 describes the three specific state requirements enforcing HED we focus on.<sup>12</sup>

Table 1: HED Programs

<b>A) Curricula: Topics covered</b>
1) Alcohol- or Other Drug-Use Prevention
2) Emotional and Mental Health
3) Nutrition and Dietary Behavior
4) Physical Activity and Fitness
5) Tobacco-Use Prevention
<b>B) Enforcements</b>
1) State requires districts or schools to follow national or state health education standards or guidelines
2) State requires students in elementary school to be tested on health topics
3) State requires each school to have a HED coordinator

In the period 1994 and 1999 school health policies at the state level generally remained unchanged, but important changes were detected between 1999 and 2005.<sup>13</sup> During this period, states either implemented HED programs for the first time or expanded one or both dimensions of pre-existing programs.

## 2.1 Databases for HED programs: NASBE and SHPPS

The information we use to define which states have HED programs and the degree of development of such programs -i.e., which topics were required and which enforcements were mandatory at different points in time- comes from two complementary sources: the NASBE

<sup>11</sup>Table 7 in the Appendix shows other topics that could potentially be included in an elementary school HED curriculum, but we do not take them into consideration because they are more related to sex education.

<sup>12</sup>The full list of potential requirements is shown in Table 7 in the Appendix.

<sup>13</sup>See Kann et al. (2001) and Kann et al. (2007) for more details on these changes in policies.

State School Health Policy Database and the School Health Policies and Programs Study (SHPPS).

The NASBE Database is a comprehensive set of laws and policies related to health issues at schools of all states in the US. It began in 1998 and is maintained with support from the Division of Adolescent and School Health (DASH) of the CDC. The database contains brief descriptions of laws, legal codes, rules, regulations, administrative orders, mandates, standards, resolutions, and other written means of exercising authority. While authoritative binding policies are the primary focus of the database, it also includes guidance documents and other non-binding materials that provide a detailed picture of a state's school health policies and activities.

The NASBE Database was designed to build upon the SHPPS, conducted by the CDC every 6 years since 1994. SHPPS is a nationwide survey that gathers detailed and comparable information about the characteristics of HED programs at the state level across elementary, middle, and high schools.<sup>14</sup> While SHPPS collects state policy information by means of survey questionnaires that are completed by state education agency personnel, the NASBE Database provides the legal support for the policies reported in SHPPS.

Having the exact date of the change in the policy at each state would allow us to know in each year under analysis which states changed the HED programs and which didn't. Regrettably, the information of the year in which the reforms were implemented is incomplete in the NASBE Database and non-existent in the SHPPS. However, using the information provided by both sources we can recover the characteristics of the existing HED program in each state in 1999 and 2005. With this information we classified each state as either an "*Experimental State*", if the state changed the HED program between 1999 and 2005, or as a "*Non-Experimental State*", if no changes were introduced in the state HED program during the period. Tables 8 and 9 in the Appendix give a detailed description of HED programs in all states in 1999 and 2005.

In the NASBE Database and in the SHPPS surveys we found that HED policies across states are highly heterogeneous, not only in terms of whether the state has implemented a HED program, but also regarding the scope and effectiveness in the implementation of such programs. Accordingly, we divided the non-experimental and experimental states into several groups. The non-experimental states are those states that did not change their HED policies between 1999 and 2005. We classified the non-experimental states into two groups: (1) States without HED programs in 1999 and 2005; (2) States with HED programs implemented by 1999, and without changes in 2005. We name groups (1) and (2) *S1* and *S2*, respectively.

The experimental states are those that introduced any HED reforms between 1999 and 2005. There are three types of treatments (policies) that define three types of experimental states. Group *S3* are states that, while having some topics in their HED curricula in 1999, did not introduce changes in those topics by 2005, but introduced some reforms in enforcements. Group *S4* are states that, while having some topics required in 1999, increased the number of topics required by 2005, without introducing changes in enforcements. We consider that these two policies involve only minor changes in the already implemented HED programs, so in what follows we refer to these groups of states as "*Moderate changes A*" and "*Moderate changes B*", respectively. Finally, we include in the group *S5* those states that for the first

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<sup>14</sup>SHPPS also gathers information about health-related programs at the district, school, and classroom levels. SHPPS analyzes seven components, one of which is the HED component. The remaining seven components are physical education and activity, health services, mental health and social services, nutrition services, a healthy and safe school environment, and faculty and staff health promotion.

time introduced required topics at state level in their HED programs by 2005. We consider this policy to be a deep reform in HED, so we refer to group  $S_5$  as “Major changes”. Some of the states introduced topics for the first time by 2005, while they did not make changes in enforcements, as were the cases of Arkansas and Florida. New Mexico and Wyoming introduced topics as mandatory by 2005, and simultaneously strengthened their HED policies by introducing new enforcements. In Texas, all districts had a non-mandatory HED program in 1999 designed and implemented following district rules. By the academic year 2001/2002 Texas implemented a coordinated HED program, and in 2004 the State Board of Education required all public schools in the state to have all HED topics in curriculum.

### 3 Identification Strategy and Data

Our goal is to identify the spillover effects of elementary school HED policies implemented in certain states (the “experimental states”) on the behavior of parents of elementary school-age children (the treatment group). Identifying this effect requires, as stated in Gruber (1994), controlling for any systematic shocks to the parents’ outcome behavior in the experimental states that are correlated with, but not due to, changes in HED policies. To do so, we use a “differences-in-differences-in-differences” (DDD) approach that allows us to exploit the variation of HED policies across time (time dimension), across states (geographical dimension), and across different groups of individuals residing in the same state (individual dimension). That is, we compare the treatment individuals in experimental states to a set of control individuals in those same states and we measure the change in the treatments’ relative outcome, relative to those of states that did not change HED policies. The identifying assumption requires that there is no contemporaneous shock affecting the relative outcome of the treatment group in the same state-year as the change in the HED policy.

We use a DDD identification strategy instead of the more commonly used “difference-in-differences” (DD) because it does not require the common trend assumption for treatment and control groups. We consider that this assumption will most likely be violated given the characteristics of the policy we are analyzing. In particular, the DD estimator of the spillover effects of HED policies on parents will be biased if the states that increased their HED requirements between 1999 and 2005 were those where health indicators and health habits were deteriorating more rapidly. Section 3.3 provides evidence supporting this hypothesis.

The population under analysis includes adults who have children living with them. Let  $y_{it}$  be the outcome of interest for individual  $i$  at time  $t$ . The specification for the outcome is

$$\begin{aligned} y_{it} = & \beta_0 + \beta_1 \tau_t + \beta_2 elem_i + \beta_3 S_i \\ & + \beta_4 (elem_i \times \tau_t) + \beta_5 (S_i \times \tau_t) + \beta_6 (elem_i \times S_i) \\ & + \beta_7 (\tau_t \times elem_i \times S_i) + u_{it}, \end{aligned} \tag{1}$$

where  $i = 1 \dots N$  indexes individuals, and  $t = 0, 1$  indexes time (0=before the policy change, 1999; 1=after the policy change, 2005).  $\tau_t$  is a dummy variable, equal to one in 2005, so it captures a nationwide time trend in the outcome;  $elem_i$  is a dummy variable that takes the value one if individual  $i$  has at least one child of elementary-school-age, reflecting a group fixed effect in the outcome; and  $S_i$  is a dummy variable equal to one if individual  $i$  resides in an experimental state, that is, a state where the HED policy has changed between 1999 and 2005, allowing for an experimental-state fixed effect in the outcome. Moreover, the outcome

may present differential time trends: (1) between parents of elementary school-age children versus parents of children of other ages and (2) between individuals living in experimental states and those living in non-experimental states.  $(elem_i \times \tau_t)$  and  $(S_i \times \tau_t)$  are the group-trend and the experimental state-trend respectively. Since parents of elementary school-age children in experimental states may have a different outcome than parents of children below and above elementary school age also living in experimental states, we include the group-state fixed effect captured by the interaction  $(elem_i \times S_i)$ . Finally, the triple interaction  $(\tau_t \times elem_i \times S_i)$  is equal to one only for treated individuals in the after-policy-change time period: these are the parents of elementary school-age children residing in experimental states in 2005. The treatment effect for individual  $i$  is  $\beta_{7i}$ , and the average treatment effect on the treated (which we call Indirect Average Treatment effect on the Treated, IATT, because we are estimating the indirect effect of HED policies) is  $\mathbb{E}(\beta_{7i}|elem_i = 1, S_i = 1)$ .

### 3.1 Database

We analyze the impact of HED policies on the behavior of adults who have children attending elementary school using data from two sources. We complement the information on HED policies obtained from the NASBE Database and the SHPPS, with the information on individuals obtained from the Panel Study of Income Dynamics (PSID).

The PSID is a nationally representative longitudinal survey of individuals in the US (men, women, and children) and the family units in which they reside. In 1999, the PSID has expanded the set of health-related questions for the heads of family units and spouses, gathering information on health status, health behaviors, health insurance, and health care expenditures. We concentrate on the indirect effect of HED policies on levels of physical activity, a health behavior reported in this survey. The PSID also provides detailed information about family income, as well as family composition and demographic variables, including age of family members, race, marital status, employment status and education. The PSID covers all states.

We base our analysis on the PSID survey years 1999 and 2005, using 1999 as the pre-reform period. We use these two waves as two repeated cross-sections, rather than as a panel. The DDD design we apply to identify the effect of interest does not require the use of a panel, but the identification is improved by the availability of longitudinal data.

Our final sample consists of 10,663 observations that include parents of children living with them, who participated in the 1999 and/or 2005 PSID. It is worth noting that for most of the individuals we also have her/his spouse or partner in the sample. Given the way in which the PSID is designed, for some of the individuals we also have another relative in the sample, for instance siblings.

Besides the PSID, there are other household and individual surveys containing information about health lifestyles. However, these surveys do not include all the variables we require to conduct our analysis for the years in which we can identify HED policy changes.<sup>15</sup>

Considering the heterogeneity in HED policies across states described in the previous Section, we modify the specification in equation (1) to introduce the classification of states, and to allow for differential effects of the policy across different types of treatment

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<sup>15</sup>In the National Health Interview Survey (NHIS) and the National Health and Nutrition Examination Survey (NHANES) the public-use data files do not include the state identifiers. In the Behavioral Risk Factor Surveillance System (BRFSS) the information on the age of children is incomplete. Finally, there are important limitations in the information about adult's physical activity recorded in the National Longitudinal Survey of Youth 1979 (NLSY79).

$$\begin{aligned}
y_{it} = & \beta_0 + \beta_1 \tau_t + \beta_2 elem_i + \sum_{k=2}^5 \beta_{3,k} Sk_i \\
& + \beta_4 (elem_i \times \tau_t) + \sum_{k=2}^5 \beta_{5,k} (Sk_i \times \tau_t) + \sum_{k=2}^5 \beta_{6,k} (elem_i \times Sk_i) \\
& + \sum_{k=3}^5 \beta_{7,k} (\tau_t \times elem_i \times Sk_i) + u_{it},
\end{aligned} \tag{2}$$

where, as before,  $i = 1 \dots N$  indexes individuals, and  $t = 0, 1$  indexes time (0=before policy, 1999; 1=after policy, 2005), and now  $k = 1, \dots, 5$  indexes state groups.<sup>16</sup>

In our setting, treated individuals, those exposed to changes in HED policies, are adults who reside in an experimental state, and who have elementary school-age children (6-10). The PSID does not provide information on whether a child is attending elementary school. However, it provides information on the age of children, allowing us to determine if individuals have school-age children.<sup>17</sup>

The control group consists of individuals who were unaffected by changes in state HED requirements; it includes adults who have elementary school-age children (6-10) living in states that did not change HED policies, that is, living in states that either did not implement HED policies or that, while having HED requirements in 1999, did not introduce any reform during the period. Furthermore, to control for possible correlation of state HED policies with unmeasured state trends in health and health behaviors, we use a sample of adults who have children living with them but not of elementary school-age as a within-state comparison group. We group the non-treated individuals in three different control groups. We include in the Treatment-Non-Experimental group (Control 1) individuals with elementary school-age children residing in non-experimental states. The Control-Experimental group (Control 2) includes individuals with children not of elementary school-age residing in experimental states. Finally, in the Control-Non-Experimental group (Control 3) we include individuals with children above and below elementary school age residing in non-experimental states.

In view of the longitudinal nature of most part of the sample, and the classification of the states, in all regressions we compute standard errors clustered at the state level. Note that our empirical model includes time, group of individuals (treated vs. control), state, and group-state fixed effects, as well as the group-trend and the experimental state-trend.

In the final sample, we do not include states for which the sample size was lower than 13 observations in the four groups identified by the survey year and the condition of having children of elementary school-age.<sup>18</sup> The information available in the NASBE database and SHPPS surveys regarding HED in the District of Columbia, Minnesota, and New Hampshire was not conclusive, so we could not classify these states and, consequently do not include them in our sample. To check that the exclusion of the selected states does not drive our

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<sup>16</sup>  $S_1$  is the group of reference.

<sup>17</sup> Note that the dropout rate in elementary school is very low in the US. Therefore, by knowing the age of the children we are able to know whether the child is attending elementary education.

<sup>18</sup> For example, Idaho has only 10 individuals that answered the 2005 survey, and who have children not of elementary school-age. Hence, Idaho was not included in the sample. States excluded from our database due to small sample size are Alaska, Delaware, Hawaii, Idaho, Maine, Montana, Nevada, New Mexico, North Dakota, Oklahoma, Rhode Island, South Dakota, Vermont, West Virginia, and Wyoming.

results we estimate the effect of interest including the states with small sample size and the results are comparable. Table 2 presents the aforementioned state classifications and the sample sizes for the states included in the sample.<sup>19</sup>

Table 2: States classification by changes in HED requirements between 1999 and 2005.

Group		Type of policy	Num. of states	Num. of Obs.
Non- Experimental	<i>S</i> 1	Does not have HED in '99 and '05	2	707
	<i>S</i> 2	Existing HED in '99 remains unchanged in '05	18	6,417
Experimental	<i>S</i> 3	Moderate changes A	5	1,099
	<i>S</i> 4	Moderate changes B	5	1,156
	<i>S</i> 5	Major changes	3	1,284
Total			33	10,663

*Source:* NASBE State School Health Policy Database, SHPSS surveys, and PSID database. The number of observations is the number of individuals in each group of states.

### 3.2 The outcome variable

Our outcome variable is light physical activity. PSID respondents are asked about their physical activity habits through two questions, the first about how often they do light physical activity and the second about the frequency of these activities (daily, weekly, monthly or annually). Based on these two questions we construct a binary variable that reflects whether an individual reports engaging in light physical activity at least once a week.<sup>20</sup>

In what follows, the outcome variable is

$$y_i = \begin{cases} 1 & \text{if } i \text{ does light physical activity at least once a week,} \\ 0 & \text{otherwise.} \end{cases}$$

The two graphs in the left panel in Figure 1 show the proportion of physically active individuals by gender in 1999 and 2005 for the treated and control groups. We observe a downward trend in all groups for both genders. In particular for the treated groups, the proportion of physically active individuals goes down by 7 percentage points for males, and by 12 percentage points for females. This simple Before-After estimator tells us that HED policies have had a negative impact on the outcome of interest. However, these estimates are obviously biased given that the average of the outcome variable in the three control groups also has a downward trend.

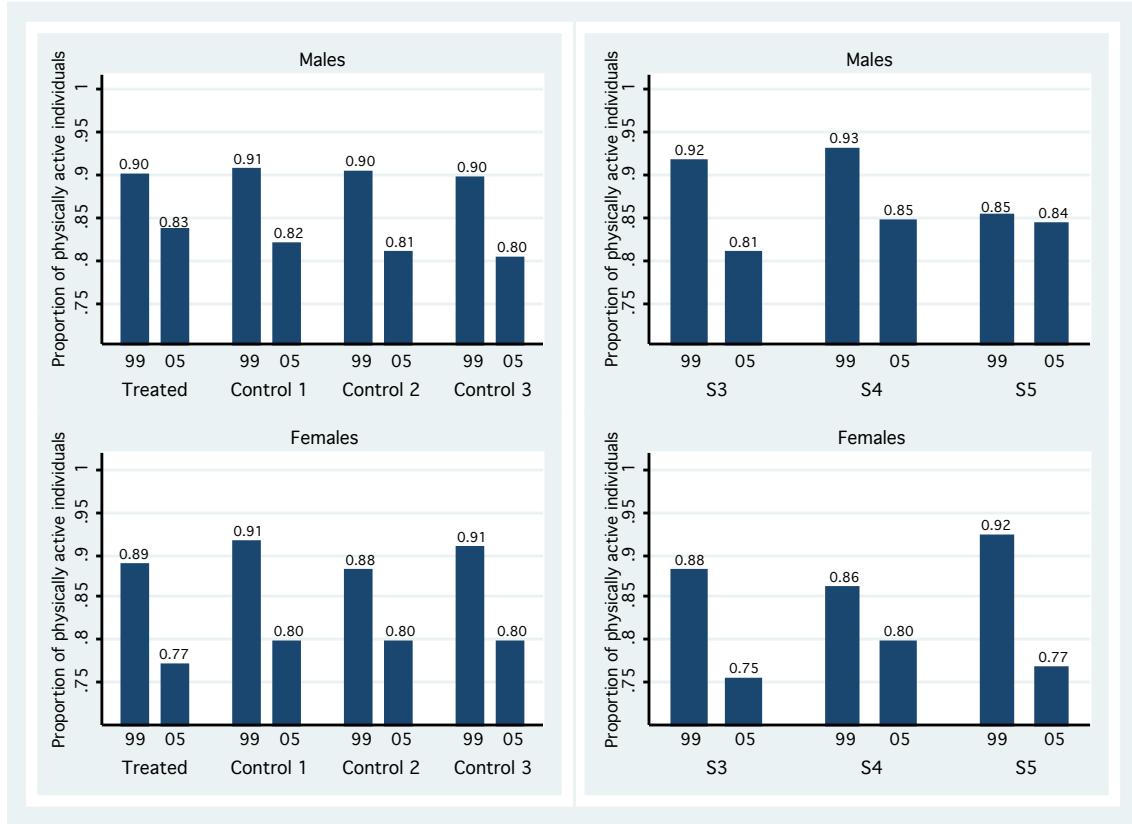
Exploring gender differences, we can see that females in the Treatment-Experimental group (Treated) present a larger drop in the proportion of physically active individuals than

<sup>19</sup>The complete list of states in each group, and the number of observations in each state are reported in Table 10 in the Appendix.

<sup>20</sup>One limitation to using the number of times per week of light physical activity directly as our outcome variable is that there is no information in the PSID about the amount of time (minutes, hours) individuals spend each time they do physical activity. For example, in our database an individual that reports doing light physical activity three times per week is not necessarily doing more light physical activity than an individual that reports one session per week. This makes it very difficult to compare individuals who are physically active. To overcome this problem, we use the binary outcome variable.

that observed for males in the same group. This suggests the need to take gender differences into account when estimating the effect of HED policies.

Figure 1: Proportion of physically active individuals by treated/control groups (left panel), and treated individuals by treatment groups (right panel), and by gender, in 1999 and 2005.



*Notes:* **Treated:** individuals with elementary school-age children in experimental states. **Control 1:** individuals with elementary school-age children in non-experimental states. **Control 2:** individuals without elementary school-age children in experimental states. **Control 3:** individuals without elementary school-age children in non-experimental states. The type of policies corresponding to the groups of states  $S_k$  are as follows. **S3:** Moderate changes A; **S4:** Moderate changes B; **S5:** Major changes. Source: PSID.

As we discussed above, the implementation and modification of HED policies between 1999 and 2005 were not homogeneous across states. Therefore, we can expect differences in the temporal evolution of the outcome of interest for treated individuals across the three groups of experimental states. The two graphs in the right panel in Figure 1 show the proportion of physically active treated individuals, by gender and by group of experimental states. In the first graph we see that in states belonging to group  $S_5$ , the states that introduced major HED changes, the downward trend in the proportion of physically active males is substantially smaller than the corresponding downward trend in groups  $S_3$  and  $S_4$ , the groups of states that introduced moderate HED changes. Moreover, the reduction in the proportion of physically active males in the group  $S_5$  is lower than the fall in all three control groups. This relatively moderate downward trend for treated males in  $S_5$  experimental states suggests a positive

effect of HED policies on the outcome variable, although it does not seem to be the case for females.

### 3.3 Pre-treatment trends in experimental and non experimental states

To explore the possibility that the DD common trends assumption for treatment and control groups absent the policy is not satisfied in our case, we looked at health indicators of the population of adults with children below 18 years of age for pre-treatment periods (1994-1998), using data from the Behavioral Risk Factor Surveillance System (BRFSS).<sup>21</sup> As shown in Table 3, the proportion of individuals at risk because of overweight or obesity has increased more rapidly in experimental states than in non-experimental states. As well, between 1994 and 1998 the proportion of individuals with sedentary lifestyles has increased more in experimental than in non-experimental states. Therefore, the different trends in the outcomes of experimental versus non-experimental states indicate that the implementation of HED policies is correlated with the evolution of the outcome of interest, which makes the use of a DDD estimator crucial here.

Table 3: Lack of common trends between experimental and non-experimental states.

Year	Obesity 1 (%)		Obesity 2 (%)		Sedentary lifestyle (%)	
	Non-exper. states	Exper. states	Non-exper. states	Exper. states	Non-exper. states	Exper. states
1994	33,1 (22824)	32,8 (13693)	28,3 (22824)	28,4 (13693)	59,5 (22824)	56,9 (13693)
1996	35,7 (24612)	35,6 (16470)	30,7 (24612)	31,5 (16470)	59,0 (24612)	59,4 (16470)
1998	36,9 (29052)	39,8 (20767)	32,4 (29052)	34,9 (20767)	57,0 (29052)	59,1 (20767)
Var. % ('94-'98)	11,6%	21,3%	14,4%	22,7%	-4,2%	4,0%

*Source:* BRFSS 1994, 1996, and 1998. Sample sizes in parentheses. *Definitions:* **Obesity 1 (%)**: Percentage of population (with children under 18 years old) at risk for obesity (greater than 120% of weight for height percent median). **Obesity 2 (%)**: Percentage of population (with children under 18 years old) at risk for overweight based on BMI. At risk defined as: >27.8 for males and >27.3 for females. **Sedentary lifestyle (%)**: Percentage of population (with children under 18 years old) at risk for sedentary lifestyle (sedentary or irregular physical activity profile).

### 3.4 Allowing for covariates and gender differences

In Table 4 we report average values and standard errors of the outcome variable, and other demographic and socioeconomic characteristics for treated and control individuals in 1999 and 2005.

For each group, we find evidence of statistically significant differences in some observable characteristics between 1999 and 2005, although most of these differences vanished when we compute differences in trends between treated and control individuals (reported in column

<sup>21</sup>Note that we made use of this other dataset to evaluate the pre-treatment trends because the PSID does not contain information on health issues for this period of time.

(7)). These differences may produce changes in the observed proportion of physically active individuals between 1999 and 2005 that are not a consequence of changes in HED programs. To avoid a biased estimation of the effect of interest, we use a regression framework that allows us to control for temporal differences in observable characteristics between treated and control individuals.

Given the existence of different time trends on the frequency of light physical activity between females and males observed in Figure 1, in the model that we estimate we include interactions of all the parameters related to the identification of the HED effect with a gender dummy.

The outcome equation with interactions by gender and with covariates has the following form

$$\begin{aligned}
y_{it} = & \beta_0 + \beta_1 \tau_t + \beta_2 elem_i + \sum_{k=2}^5 \beta_{3,k} Sk_i + \beta_4 female_i \\
& + \beta_5 (\tau_t \times female_i) + \beta_6 (elem_i \times female_i) + \sum_{k=2}^5 \beta_{7,k} (Sk_i \times female_i) \\
& + \beta_8 (elem_i \times \tau_t) + \beta_9 (elem_i \times \tau_t \times female_i) \\
& + \sum_{k=2}^5 \beta_{10,k} (Sk_i \times \tau_t) + \sum_{k=2}^5 \beta_{11,k} (Sk_i \times \tau_t \times female_i) \\
& + \sum_{k=2}^5 \beta_{12,k} (Sk_i \times elem_i) + \sum_{k=2}^5 \beta_{13,k} (Sk_i \times elem_i \times female_i) + \\
& \sum_{k=3}^5 \beta_{14,k} (Sk_i \times elem_i \times \tau_t) + \sum_{k=3}^5 \beta_{15,k} (Sk_i \times elem_i \times \tau_t \times female_i) + \beta_{16} X_{it} + u_{it},
\end{aligned} \tag{3}$$

where  $i = 1...N$  indexes individuals,  $t = 0, 1$  indexes time (0=before policy, 1999; 1=after policy, 2005), and  $k = 1, \dots, 5$  indexes state groups.<sup>22</sup>

The DDD estimates in this model are the estimates of  $\beta_{14,k}$  for males, and  $\beta_{14,k} + \beta_{15,k}$  for females. If the parameter  $\beta_{15,k}$  is significantly different from zero, there is evidence of a different impact of HED policies between fathers and mothers.  $X_{it}$  is a set of observable individual characteristics including age, race, marital status, number of children, children of high-school-age, education level, employment status, full-time/part-time employment, per capita family labor income, and state dummies.

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<sup>22</sup> S1 is the group of reference.

Table 4: Descriptive statistics: All individuals in the sample.

	Treated individuals			Control individuals			Control vs Treated (7)=(6)-(3)
	1999 (1)	2005 (2)	Difference (3)	1999 (4)	2005 (5)	Difference (6)	
Proportion of physically active parents	0.89 (0.31)	0.80 (0.40)	-0.1***	0.90 (0.30)	0.80 (0.40)	-0.1***	-0.01
Frequency of light physical activity (times per week)	4.31 (3.09)	3.82 (3.26)	-0.49***	4.37 (3.09)	3.75 (3.23)	-0.62***	-0.13
Body Mass Index	27.11 (5.77)	27.59 (5.67)	0.48	26.53 (5.30)	27.74 (5.96)	1.21***	0.73**
Proportion with Health condition that limits daily activity	0.11 (0.32)	0.14 (0.35)	0.03*	0.14 (0.34)	0.17 (0.37)	0.03***	0
Proportion of Female	0.56 (0.50)	0.57 (0.50)	0.01	0.55 (0.50)	0.57 (0.50)	0.02*	0.01
Age	36.13 (6.34)	36.15 (6.84)	0.02	37.17 (8.25)	39.46 (9.92)	2.29***	2.28***
Years of Education completed	13.01 (2.38)	13.22 (2.25)	0.21*	12.79 (2.74)	13.05 (2.49)	0.26***	0.05
Num. of Children	2.62 (1.33)	2.58 (1.26)	-0.04	2.34 (1.25)	2.31 (1.20)	-0.03	0.01
Num. of Children of elementary school-age	1.26 (0.50)	1.28 (0.52)	0.03	0.45 (0.72)	0.31 (0.60)	-0.14***	-0.16***
Proportion of White	0.53 (0.50)	0.50 (0.50)	-0.03	0.56 (0.50)	0.54 (0.50)	-0.02*	0.01
Proportion of Married	0.77 (0.42)	0.75 (0.43)	-0.02	0.78 (0.42)	0.76 (0.43)	-0.02**	0
Proportion of Unemployed	0.04 (0.21)	0.04 (0.19)	0.00	0.03 (0.17)	0.04 (0.19)	0.01**	0.01
Proportion of Retired	0.00 (0.04)	0.00 (0.05)	0.00	0.00 (0.07)	0.01 (0.10)	0.01***	0
Proportion of Disabled	0.01 (0.12)	0.02 (0.14)	0.00	0.02 (0.14)	0.03 (0.17)	0.01***	0.01
Proportion of Full time workers	0.74 (0.44)	0.70 (0.46)	-0.03	0.77 (0.42)	0.73 (0.44)	-0.03***	0
Labor income per capita	13,621 (16,916)	17,723 (28,353)	4,102***	14,878 (15,911)	19,765 (29,240)	4,887***	0.76
Sample size	679	661		4,061	5,262		

Notes: Standard errors reported in parentheses below the corresponding average or proportion. Stars in columns (3) and (6) show statistical significance of differences in mean (continuous variables and variables with more than 12 categories) or proportion (dummy variables) of the referred variable, between years 1999 and 2005. Stars in column (7) show statistical significance of differences in mean. Significance levels: \* = 10%; \*\* = 5%; \*\*\* = 1%.

## 4 IATT estimates

Table 5 shows the IATT for the three types of treatment, by gender, obtained using a linear probability model.<sup>23</sup> We present results for two models, one set of results obtained without covariates and other set of results from models that include covariates. The “DD” columns present the IATT estimates obtained with a difference-in-difference identification strategy. In this case, we compare parents of children in elementary school before and after of the policy change (time dimension), across experimental and non-experimental states (geographical dimension). The “DDD” columns present the IATT estimates obtained with the difference-in-difference-in-difference estimator.

Table 5: IATT by type of treatment, and by gender.

Group of experimental states	Without covariates				With covariates			
	Male		Female		Male		Female	
	DD (1)	DDD (2)	DD (3)	DDD (4)	DD (5)	DDD (6)	DD (7)	DDD (8)
<b>S3:</b> Moderate changes A	-0.021 (0.037)	-0.025 (0.044)	-0.012 (0.057)	-0.041 (0.065)	-0.018 (0.032)	-0.009 (0.049)	-0.014 (0.058)	-0.039 (0.061)
<b>S4:</b> Moderate changes B	0.004 (0.045)	-0.051 (0.062)	0.050 (0.049)	0.019 (0.087)	0.014 (0.043)	-0.033 (0.065)	0.055 (0.045)	0.025 (0.084)
<b>S5:</b> Major changes	<b>0.078***</b> (0.021)	<b>0.138***</b> (0.041)	-0.039 (0.044)	-0.063 (0.040)	<b>0.071***</b> (0.025)	<b>0.124***</b> (0.038)	-0.026 (0.049)	-0.056 (0.049)
Sample size	1,752	4,698	2,268	5,965	1,752	4,698	2,268	5,965

*Notes:* Robust standard errors reported in parenthesis clustered at the state level. All columns estimated using a linear probability model. The regressions in columns (5) to (8) include the following covariates: age, race, gender, marital status, number of children, children of high school-age, education level, employment status, full-time/part-time employment, and total family income level. Significance levels: \* = 10%; \*\* = 5%; \*\*\* = 1%.

We first discuss the results obtained with the non-parametric “DD” and “DDD” estimators, that is, using models without covariates. These results are presented in Columns (1) to (4) of Table 5. With the “DD” estimator we obtain a significant and positive effect of major HED reforms on the probability of fathers doing physical activity, as it can be seen in Column (1), but it seems to be no effect on mothers. Additionally, minor reforms in HED programs do not affect parents physical activity. However, the DD estimate could be downwardly biased because, as we showed with the data from the BRFSS in Section 3.3, the policy changes occurred in those states where health outcomes and health behaviors were deteriorating more rapidly.

The non-parametric DDD estimator, reported in Column (2) of Table 5, indicates that there is a 13.8 percentage points significant increase in the relative proportion of physically active fathers of elementary school-age children, compared to the change in the relative pro-

<sup>23</sup>A complete report of the model estimated to obtain the results in columns (5) to (8) can be found in Table (11) in the Appendix.

portion of physically active fathers with no elementary school-age children. This statistically significant DDD estimate provides evidence on the existence of spillovers of HED on the physical activity of fathers.

The interpretation of the estimated IATT can be clarified by looking at the averages of the estimated outcomes in Table 6. Let's consider the results for treated fathers residing in the group of states *S5*. On average, the estimated percentage of physically active fathers in the pre-treatment period, 1999, is 85.1%. In 2005, after major changes in HED programs, we estimate that 84.3% of fathers were engaged in light physical activity. Nevertheless, if HED programs had not been subject to profound changes in this group of states, we estimate that only 70.5% of fathers of elementary school-age children would have engaged in light physical activity in 2005. In other words, due to the major changes in HED programs, the percentage of physically active fathers fell from 85.1% to 84.3%, instead of falling to 70.5% had HED not been modified. The effect of major reforms on HED was to soften the declining trend in the proportion of physically active fathers.

Table 6: DDD estimator without covariates: IATT and averages of the estimated outcomes for treated individuals, by type of treatment and gender.

Group of experimental states	IATT	Estimated Average Outcomes for Treated Individuals		
		Post-treatment period		Pre-treatment period
		with treatment	without treatment	without treatment
<b>S3:</b> Moderate change A	Male	-0.025	0.810	0.834
	Female	-0.041	0.754	0.795
<b>S4:</b> Moderate change B	Male	-0.051	0.848	0.899
	Female	0.019	0.796	0.778
<b>S5:</b> Major change	Male	<b>0.138</b>	<b>0.843</b>	<b>0.705</b>
	Female	-0.063	0.767	0.830
				0.851
				0.922

*Notes:* IATT and estimated outcomes obtained using a DDD estimator and a linear probability model without including covariates. Each cell contains the estimated proportion of physically active individuals. Pre-treatment period is 1999, and post-treatment period is 2005. The IATT is obtained as the estimated average outcome in the post-treatment period under treatment minus the missing counterfactual, that is, the estimated average outcome in the post-treatment period without treatment.

In Section 3.4 we show that there are some differences in observable characteristics between treated and control individuals. Hence, we consider that the proper results are those obtained with the model that includes covariates (reported in Columns (5) to (8) of Table 5).<sup>24</sup> The “DD” estimates (Column (5)) shows that a noteworthy change in the HED program (*S5* group of states) increases the probability of fathers doing physical activity in 7.1 percentage points. Since the “DD” estimator is likely to be downward biased, this estimate is a lower bound of the real effect under analysis. Using the “DDD” estimator (reported in Column (7)) we find evidence that the probability of fathers affected by this policy change doing physical activity is 12.4 percentage points higher than that of fathers not affected by

<sup>24</sup>In Table 13 (in Section 7 in the Appendix) we present descriptive statistics for men in the group of states *S5*.

the policy. The effect on the probability of mothers engaging in light physical activity is never statistically significant, but the signs are the opposite to those found for fathers. The estimated effects are not statistically significant for males and females residing in the group of states *S3* and *S4*. These results suggest that moderate changes in HED programs do not produce indirect effects.

We conclude that there are positive spillovers of introducing major changes in existing HED programs on the probability of fathers engaging in light physical activity, while for mothers we do not find a statistically significant effect of these reforms.

#### 4.1 Plausible explanations for our results

We can think of two channels to explain our results. When children start receiving HED at school their parents are confronted with two new sets of factors that might potentially affect their health-related behaviors. First, parents may optimally react to HED in schools by complementing this education with the incorporation of healthy lifestyles into their own daily activities. We refer to this potential channel as “role modeling”. On the other hand, there is the effect of the arrival of new information that the child receives at the school. In particular, parents are confronted with knowledge that the child brings to the household from the health education curricula given at the school, and they may adjust their health behaviors in response to it. We refer to this potential channel as “information sharing”. In what follows we provide evidence of the existence of both channels.

##### 4.1.1 Role models

Parents may do more physical exercise in response to the knowledge children acquire via HED, not because they were not already aware of the benefits of exercising but because they want to complement the instruction received by the child so as to form the desired healthy lifestyle in the child.

The estimates from the model interacting the policies with a dummy variable for gender provide some insights on the operation of the “role model” channel. Parents usually spend more time with their children doing gendered activities. Figure 2 in the Appendix shows some evidence on this respect with data from the American Time Use Survey (ATUS). Women spend roughly twice as much time in childcare as do men, a pattern which holds true for all subgroups and for almost all types of childcare, except for “Recreational” childcare. This type of childcare activity includes playing games with children, playing outdoors with children, attending a child’s sporting event or dance recital, going to the zoo with children, taking walks with children, etc. In the case of “Recreational” childcare, mothers allocate relatively less of their time with children than do fathers. Thus, this is evidence that fathers are more likely to do stereotypically male activities with their children, among them physical activity. Accordingly, the impact of HED reforms on physical activity is more likely to appear for fathers rather than for mothers.

For the policy to have an impact on parents’ behaviors, it is necessary that they do have some time available to assign to the practice of physical activity, or to have the possibility of reallocating time across different activities. Following this idea, one could argue that single parents, that face a higher time constraint, will not be able to react to the policy, while those who are living at home with their partners may find it easier.<sup>25</sup> To contrast this hypothesis,

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<sup>25</sup>Also, as results from ATUS show, mothers seem to have a full childcare schedule, while fathers may have

we estimate the differential effect of HED reforms between single and couple parents. In the group of states  $S5$ , we found a significant and positive effect of HED reforms on couple fathers (estimate 0.13 and standard error 0.04) and no effect on single fathers (estimate 0.07 and standard error 0.07). There is no effect on single or couple mothers, or on parents residing in states  $S3$  and  $S4$ .

#### 4.1.2 Information sharing between children and parents

Individuals with a lower stock of information are expected to be more affected by HED changes. We explore the existence of the information-sharing channel by analyzing the differential impact of HED reforms on individuals with low and high education levels. Since lower levels of education are related to less knowledge about health (Kenkel, 1991; Tinsley, 2003), we expect to obtain a greater effect of HED reforms on individuals with lower levels of education.

To explore differential effects of the policy by education level, we estimate the model interacted with a dummy variable equal one if the individual finished high school, and zero otherwise. The IATT for males in the group of states  $S5$  are the following: 0.437 (standard error 0.117) for low educated males who didn't finish high school; and 0.034 (standard error 0.037) for males who did finish high school. According to these results, the policy has a higher effect on low educated fathers relative to high educated fathers.

## 5 Robustness

### 5.1 Validity of the identifying assumption

Our identifying assumption requires that, in the absence of HED reforms, state specific trends of the proportion of parents physically active in the treatment group (those with elementary school-age children) is the same as that of parents in the control group (those with children below or above elementary school-age). This assumption will be violated if there is a shock contemporaneous to HED reforms that systematically affects the relative outcome of parents of elementary school-age children.

In order to check the robustness of our identifying assumption we perform two tests. First, we estimate the effect of the HED reform on the labor force participation of parents. Labor participation is a decision that should be not affected by the policy under analysis. If HED changes are not the only shock that affects the relative outcomes of treated versus control individuals between 1999 and 2005, we may observe that the labor force participation among individuals in the treatment group changes relative to that of individuals in the control group. Using the DDD estimator and a linear probability model we obtain an estimate of the effect of HED on labor force participation equal to 0.035 (standard error: 0.048) for fathers and 0.029 (standard error: 0.032) for mothers. The two estimates tell us that between 1999 and 2005 there were no significant changes in the relative decision of participating in the labor market of treated and control parents. This constitutes evidence that there was no other labor market related shock systematically affecting the relative outcomes of treated and control parents between 1999 and 2005.<sup>26</sup>

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some possibility of increasing the time their spend with their children.

<sup>26</sup>We also perform this test for the group of states  $S3$  and  $S4$  and results and conclusions are similar to

Second, we estimate the effect of HED reforms in elementary school on individuals that are not likely to be affected by such reforms: the group of adults without children. If there had been no other shock contemporaneous to the HED reforms, the outcome of adults without children relative to the control group should remain unchanged between 1999 and 2005. To perform this test, we include in the “placebo” treatment group only individuals without children. The control group includes parents of high school-age children and kinder-age children. If our identification strategy is correct, we should find no effect of HED reforms on the “placebo” treated individuals. Using linear probability models, we estimate that the effect of HED on the “placebo” treated males is -0.007 (standard error: 0.047), and the effect on the “placebo” females is -0.034 (standard error: 0.027). Reassuringly, the estimated coefficients are smaller (in absolute value) than those in the baseline model and not significantly different from zero.<sup>27</sup>

## 5.2 Sensitivity analysis

Parents in the treatment group, that is parents of elementary school-age children, may also have other children below and/or above elementary school age. In order to have individuals in the control group comparable to those in the treatment group in the same state, we consider that the appropriate group of control individuals should include parents of children of ages below and above elementary school age. Nevertheless, to determine whether our results are sensitive to this definition, we perform two tests. First, we use parents with at least one child below elementary-school-age as non-treatment individuals. The estimated effect of HED on the probability of being physically active is 0.10 (standard error: 0.048) for fathers, and -0.012 (standard error: 0.04) for mothers.

Second, we use parents with at least one child above elementary-school-age as non-treatment individuals. The estimated effect of HED on the probability of being physically active is 0.14 (standard error: 0.037) for fathers, and -0.083 (standard error: 0.069) for mothers. Since the estimates of the effects of HED reforms on the group of states  $S5$  are very similar to those obtained with the baseline model, we conclude that the results are not sensitive to the definition of the control group.<sup>28</sup>

## 6 Conclusion

We find evidence for positive spillovers of HED imparted in elementary schools on the probability of parents engaging in light physical activity. However, our results suggest that fathers and not mothers are those affected by the HED reforms. We also analyze the differential impact of HED reforms on fathers and mothers as a way to explore the nature of the channels driving the spillovers.

We argue that a “role model” channel can explain the differential impact on fathers and mothers. The idea is based on the different role models that mothers and fathers play for their children. Parents usually spend more time with their children doing gendered activities. Since physical activity can be included in the group of typically-male activities, the effect of promoting the advantages of doing physical activity is more likely to appear for fathers

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those obtained with the group of states  $S5$ .

<sup>27</sup>Idem footnote 26.

<sup>28</sup>Idem footnote 26.

rather than for mothers. We also explore the existence of a second channel driving our results -the “information sharing” channel- by analyzing the differential impact of HED reforms on individuals with lower and higher education levels, and obtain the expected greater effect on less educated individuals.

Our results also highlight the importance of clearly distinguishing the existence of several dimensions in the implementation of a policy. In our case, it is important for policy evaluation to consider the two dimensions in HED reforms, changes in topics and enforcements, as well as the distinction between “Moderate changes” and “Major changes” in HED requirements. Our main result shows spillovers only in states that carried out profound reforms in their HED programs.

Spillovers of HED on parents’ lifestyles indicate that the interaction between children and parents plays a role in the formation of healthy lifestyles within the household. Therefore, taking these spillovers into account is important in the cost-benefit analysis of health education in schools. In addition, the conclusion that implementing minor reforms in existing HED programs is not enough to obtain spillovers at the family level helps to properly design policy interventions aimed at increasing the adoption of healthy lifestyles.

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# Appendix

Table 7: HED topics and enforcements. Full list.

<b>Topics List</b>
1) <i>Alcohol- or Other Drug-Use Prevention</i>
2) <i>Emotional and Mental Health</i>
3) <i>Nutrition and Dietary Behavior</i>
4) <i>Physical Activity and Fitness</i>
5) <i>Tobacco-Use Prevention</i>
6) Human immunodeficiency virus (HIV) prevention
7) Accident or injury prevention
8) Sexually transmitted disease (STD) prevention
9) Pregnancy prevention
10) Suicide prevention
11) Violence prevention, for example bullying, fighting, or homicide

<b>Enforcements List</b>
1) <i>State requires districts or schools to follow national or state health education standards or guidelines</i>
2) <i>State requires students in elementary school to be tested on health topics</i>
3) <i>State requires each school to have a HED coordinator</i>
4) State uses staff development for HED teachers to improve compliance with HED standards or guidelines
5) State uses written reports from districts or schools to document compliance with HED standards or guidelines
6) State provides a list of one or more recommended elementary school HED curricula
7) State provides a chart describing the scope and sequence of instruction for elementary school HED
8) State provides lesson plans or learning activities for elementary school HED
9) State provides plans for how to assess or evaluate students in elementary school HED
10) State adopts a policy stating that newly hired staff who teach HED at the elementary school level will have undergraduate or graduate training in HED
11) State offers certification, licensure, or endorsement to teach HED
12) State adopts a policy stating that teachers will earn continuing education credits on HED topics to maintain state certification, licensure, or endorsement to teach HED

*Notes:* The topics and enforcements considered for the analysis are in italics.

Table 8: HED programs: health topics required, by state and year.

State	1999					2005				
	topic 1	topic 2	topic 3	topic 4	topic 5	topic 1	topic 2	topic 3	topic 4	topic 5
Alabama	yes									
Alaska	no									
Arizona	no									
Arkansas	no	no	no	no	no	yes	no	yes	yes	yes
California	yes									
Colorado	no									
Connecticut	yes									
Delaware	yes									
District of Columbia	yes									
Florida	no	no	no	no	no	yes	yes	yes	yes	yes
Georgia	yes	yes	yes	no	yes	yes	yes	yes	yes	yes
Hawaii	yes									
Idaho	yes									
Illinois	yes									
Indiana	yes									
Iowa	yes									
Kansas	.	.	.	.	.	.	.	.	.	.
Kentucky	yes									
Louisiana	yes	no	no	no	yes	yes	yes	yes	yes	yes
Maine	yes	yes	yes	no	yes	yes	yes	yes	yes	yes
Maryland	yes									
Massachusetts	yes									
Michigan	yes									
Minnesota	.	.	.	.	.	.	.	.	.	.
Mississippi	no									
Missouri	yes									
Montana	yes									
Nebraska	yes	no	no	no	yes	yes	no	yes	yes	yes
Nevada	yes									
New Hampshire	.	.	.	.	.	yes	yes	yes	yes	yes
New Jersey	yes	no	no	yes	yes	yes	no	yes	yes	yes
New Mexico	no	no	no	no	no	yes	yes	yes	yes	yes
New York	yes									
North Carolina	yes									
North Dakota	yes	no	no	no	yes	yes	no	no	yes	yes
Ohio	yes	no	yes	yes	yes	yes	no	yes	yes	yes
Oklahoma	no									
Oregon	yes	no	no	no	yes	yes	no	no	no	yes
Pennsylvania	yes									
Rhode Island	yes									
South Carolina	yes									
South Dakota	no									
Tennessee	yes									
Texas	.	.	.	.	.	yes	yes	yes	yes	yes
Utah	yes									
Vermont	yes									
Virginia	yes									
Washington	yes	no	yes							
West Virginia	yes	no	yes	yes	yes	yes	no	yes	yes	yes
Wisconsin	yes									
Wyoming	no	no	no	no	no	no	yes	no	no	no

Source: NASBE Database and School Health Policies and Programs Study (SHPPS).

*Notes:* The data contained in this table was constructed cross-checking the information from both sources, and in most of the cases survey information from SHPPS coincides with the legal information summarized in NASBE. In those cases in which there is no coincidence, we rely on NASBE information only. In few cases NASBE does not provide complete information -i.e., cases in which the regulations contained in NASBE are not informative about the characteristics of the policy the state implements-, then we rely on SHPPS. Missing values indicate that the information cannot be recovered from any of the two sources.

**Topic 1:**Alcohol or other drug-use prevention; **Topic 2:** Emotional and mental health; **Topic 3:** Nutrition and dietary behavior; **Topic 4:** Physical activity and fitness; **Topic 5:** Tobacco-Use prevention.

Table 9: HED programs: enforcements required, by state and year.

State	1999			2005		
	enf 1	enf 2	enf 3	enf 1	enf 2	enf 3
Alabama	yes	no	no	yes	no	yes
Alaska	no	no	no	no	no	no
Arizona	yes	no	no	yes	no	no
Arkansas	yes	no	no	yes	no	no
California	no	no	no	no	no	no
Colorado	no	no	no	no	no	no
Connecticut	no	no	no	no	no	no
Delaware	yes	no	yes	yes	no	yes
District of Columbia	.	.	.	.	.	.
Florida	yes	no	no	yes	no	no
Georgia	yes	no	no	yes	no	no
Hawaii	yes	no	no	yes	no	no
Idaho	no	no	no	no	no	no
Illinois	yes	no	no	yes	no	no
Indiana	yes	no	no	yes	no	no
Iowa	no	no	no	no	no	no
Kansas	.	.	.	.	.	.
Kentucky	no	yes	no	yes	yes	no
Louisiana	yes	no	no	yes	no	no
Maine	yes	yes	no	yes	yes	no
Maryland	yes	no	no	yes	no	no
Massachusetts	yes	no	no	yes	no	no
Michigan	yes	no	no	yes	no	no
Minnesota	.	.	.	.	.	.
Mississippi	no	no	no	no	no	no
Missouri	yes	yes	no	yes	yes	no
Montana	yes	no	no	yes	no	no
Nebraska	no	no	no	no	no	no
Nevada	yes	no	no	yes	no	no
New Hampshire	.	.	.	yes	.	.
New Jersey	.	.	.	yes	.	.
New Mexico	no	.	.	yes	.	.
New York	no	.	.	no	.	.
north Carolina	yes	no	no	yes	no	no
north Dakota	no	no	no	no	no	no
Ohio	.	.	.	.	.	.
Oklahoma	no	no	no	no	no	no
Oregon	no	no	no	yes	no	no
Pennsylvania	yes	.	.	yes	.	.
Rhode Island	yes	yes	no	yes	yes	yes
South Carolina	yes	no	no	yes	yes	no
South Dakota	no	no	no	no	no	no
Tennessee	yes	no	no	yes	no	no
Texas	no	no	no	yes	no	no
Utah	yes	no	no	yes	yes	no
Vermont	yes	no	no	yes	yes	no
Virginia	yes	no	no	yes	no	no
Washington	yes	yes	no	yes	yes	no
West Virginia	yes	no	no	yes	no	no
Wisconsin	no	no	no	no	no	no
Wyoming	no	no	no	yes	no	no

Source: NASBE Database and School Health Policies and Programs Study (SHPPS).

*Notes:* The data contained in this table was constructed cross-checking the information from both sources, and in most of the cases survey information from SHPPS coincides with the legal information summarized in NASBE. In those cases in which there is no coincidence, we rely on NASBE information only. In few cases NASBE does not provide complete information -i.e., cases in which the regulations contained in NASBE are not informative about the characteristics of the policy the state implements-, then we rely on SHPPS. Missing values indicate that the information cannot be recovered from any of the two sources.

Enforcement 1: State requires districts or schools to follow national or state health education standards or guidelines.

Enforcement 2: State requires students in elementary school to be tested on health topics.

Enforcement 3: State requires each school to have a HED coordinator.

Table 10: States classified by groups  $S_k$ .

NON-EXPERIMENTAL		EXPERIMENTAL	
State	# of obs.	State	# of obs.
<b>S1</b>		<b>S3</b>	
Alaska	14	Alabama	138
Colorado	246	Kentucky	169
Mississippi	521	Oregon	208
Oklahoma	62	Rhode Island	10
South Dakota	59	South Carolina	564
		Utah	100
<b>S2</b>		Vermont	7
Arizona	178		
California	1,218	<b>S4</b>	
Connecticut	79	Georgia	414
Delaware	14	Louisiana	209
Hawaii	4	Maine	30
Idaho	25	Nebraska	106
Illinois	397	New Jersey	336
Indiana	363	North Dakota	16
Iowa	264	Washington	218
Kansas	81		
Maryland	450	<b>S5</b>	
Massachusetts	258	Arkansas	278
Michigan	613	Florida	450
Missouri	340	New Mexico	16
Montana	13	Texas	691
Nevada	72	Wyoming	18
New York	493		
North Carolina	605		
Ohio	505		
Pennsylvania	476		
Tennessee	238		
Virginia	373		
West Virginia	24		
Wisconsin	183		

*Notes:* We do not include the District of Columbia, Minnesota, and New Hampshire since the information regarding HED policies for these states is not precise in terms of when HED was implemented, making impossible their classification.

Table 11: Linear Probability Model: Probability of doing light physical activity at least once a week.

Number of obs= 10,663 R-squared=0.0796  
 (Std. Err. adjusted for 33 clusters at state level)

Variable	Coefficient	(Std. Err.)	Variable	Coefficient	(Std. Err.)
$\tau$	-0.042***	(0.015)	married	0.016	(0.015)
elem	0.035	(0.021)	widowed	-0.059	(0.042)
S2	-0.03	(0.025)	separated	0.007	(0.019)
S3	0.014	(0.035)	divorced	-0.015	(0.023)
S4	-0.008	(0.032)	fulltime	-0.017**	(0.008)
S5	-0.006	(0.024)	nchildren	0.005	(0.004)
$elem \times \tau$	-0.015	(0.031)	pclabinc	0.009***	(0.002)
$S2 \times \tau$	-0.043*	(0.021)	on leave	-0.028	(0.026)
$S3 \times \tau$	-0.051	(0.033)	unemployed	-0.023	(0.031)
$S4 \times \tau$	0.009	(0.048)	retired	-0.074	(0.049)
$S5 \times \tau$	-0.092***	(0.032)	disabled	-0.203***	(0.027)
$S2 \times elem$	-0.011	(0.015)	housekeeper	0.005	(0.018)
$S3 \times elem$	-0.01	(0.029)	student	0.053	(0.033)
$S4 \times elem$	-0.011	(0.031)	stated3	-0.054***	(0.005)
$S5 \times elem$	-0.087**	(0.038)	stated5	0.033***	(0.007)
$S3 \times elem \times \tau$	-0.009	(0.049)	stated7	-0.031***	(0.006)
$S4 \times elem \times \tau$	-0.033	(0.065)	stated10	-0.026***	(0.004)
$S5 \times elem \times \tau$	0.124***	(0.038)	stated11	-0.034***	(0.009)
$\tau \times female$	-0.024**	(0.011)	stated14	-0.006	(0.004)
$elem \times female$	0.039**	(0.018)	stated15	0.005	(0.004)
$S2 \times female$	0.044	(0.030)	stated16	0.012**	(0.005)
$S3 \times female$	0.021	(0.041)	stated18	-0.043***	(0.012)
$S4 \times female$	0.027	(0.035)	stated21	0.003	(0.006)
$S5 \times female$	-0.015	(0.030)	stated22	-0.041***	(0.006)
$elem \times \tau \times female$	-0.005	(0.030)	stated23	-0.007	(0.004)
$S2 \times \tau \times female$	0.002	(0.012)	stated25	-0.069***	(0.005)
$S3 \times \tau \times female$	0.041	(0.029)	stated26	0.006	(0.004)
$S4 \times \tau \times female$	-0.017	(0.036)	stated31	-0.059***	(0.010)
$S5 \times \tau \times female$	0.083*	(0.045)	stated33	-0.032***	(0.005)
$S2 \times elem \times female$	-0.056***	(0.012)	stated34	0.003	(0.006)
$S3 \times elem \times female$	-0.065	(0.043)	stated36	0.003	(0.005)
$S4 \times elem \times female$	-0.104**	(0.045)	stated38	-0.033**	(0.013)
$S5 \times elem \times female$	0.074**	(0.028)	stated39	-0.027***	(0.004)
$S3 \times elem \times \tau \times female$	-0.03	(0.093)	stated41	-0.064***	(0.012)
$S4 \times elem \times \tau \times female$	0.059	(0.076)	stated43	0.024***	(0.005)
$S5 \times elem \times \tau \times female$	-0.181**	(0.072)	stated44	-0.006	(0.004)
jhs	0.016**	(0.007)	stated47	-0.018***	(0.005)
gender	-0.023	(0.025)	stated48	-0.034***	(0.009)
age	-0.001	(0.003)	stated50	0.057***	(0.004)
$age^2$	0	0.000	Intercept	0.657***	(0.071)
white	0.083***	(0.010)			
edu	0.014***	(0.002)			

Notes: Significance levels: \* = 10%; \*\* = 5%; \*\*\* = 1%.

Description of variables in Table 12

Table 12: Description of variables in Table 11.

Name	Description
<i>tau</i>	time fixed effect
<i>elem</i>	group of parent's of elementary school-age children fixed effect (group fixed effect)
<i>Sk</i>	groups of states $k$ fixed effect (region fixed effect)
$elem \times \tau$	group time trend control (group-time interaction)
$Sk \times \tau$	group of states' time trend control (region-time interaction)
$Sk \times elem$	region-group interaction
$Sk \times elem \times \tau$	triple interaction (region-group-time interaction)
<i>jhs</i>	dummy variable equal to one if the individual has at least one children of junior-high-school age
<i>age</i>	age in years
<i>white</i>	white race dummy
<i>edu</i>	year of education completed
<i>married</i>	married or permanently cohabiting dummy
<i>widowed</i>	widowed dummy
<i>separated</i>	separated dummy
<i>divorced</i>	legally divorced dummy
<i>fulltime</i>	equal to one if the individual works less than 36 hours a week during the last year
<i>nchildren</i>	number of children (all ages)
<i>pclabinc</i>	per-capita family labor income in dollars
<i>onleave</i>	only temporarily laid off, sick leave or maternity leave dummy
<i>unemployed</i>	looking for work, unemployed dummy
<i>retired</i>	retired dummy
<i>disabled</i>	permanently or temporarily disabled dummy
<i>housekeeper</i>	housekeeper dummy
<i>student</i>	student dummy
<i>stated#</i>	state # dummy.

## 7 Descriptive statistics for males in the group of states S5

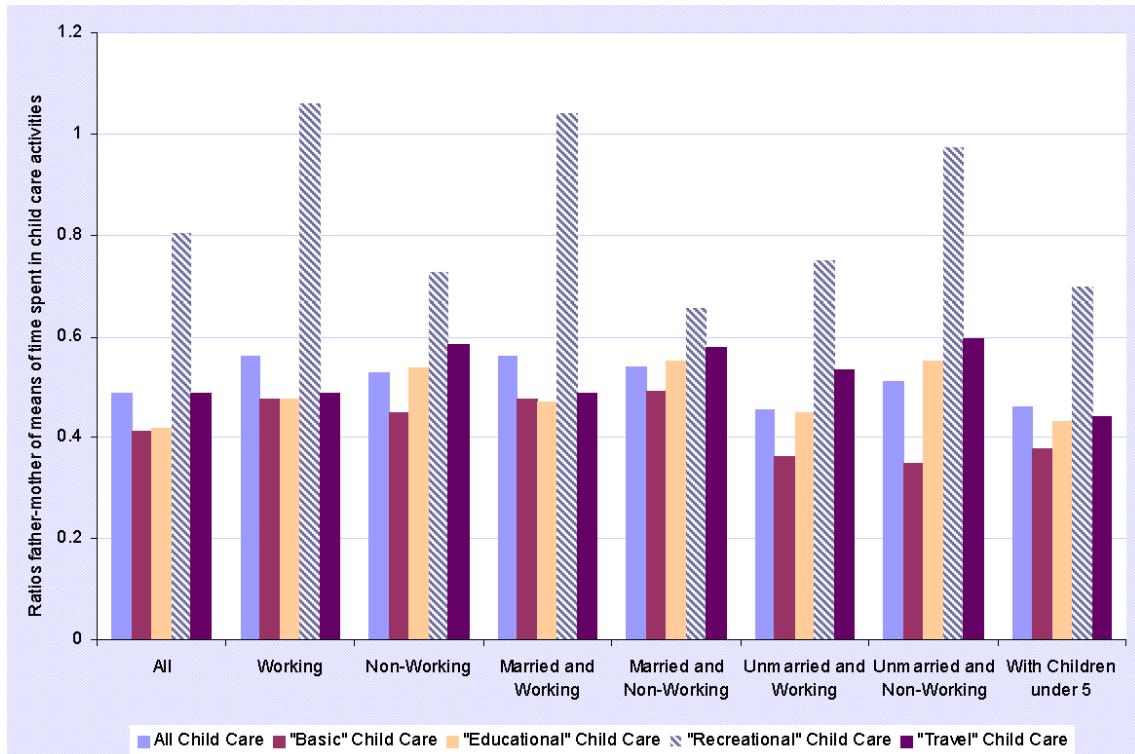
Although we control for differences in observable characteristics between treated and control individuals when we compute the IATT, we want to explore whether in the control groups there are individuals similar enough to the treated individuals. In Table 13, we compare treated individuals (columns (1) to (3)) with individuals who have children of elementary school-age living in non-experimental states (columns (4) to (6)), and with individuals living in the same group of states (S5) whose children are not of elementary school-age (columns (8) to (10)). Results of test of differences in columns (7) and (11) show that by comparing the treated individuals with the group of individuals who have children of elementary school-age living in non-experimental states (Control Between) or with the group of individuals living in the same group of states (S5) whose children are not of elementary school-age (Control Within), we can control for differences in observables. Hence, we are confident that individuals in the control group and the treated individuals are very much alike in observable characteristics, and the effect of the policy is not capturing differences in observed variables such as the age.

Table 13: Descriptive statistics: treated and selected control groups, males in group of states S5, S1, and S2.

	Treated individuals			Control Between			Control B		Control Within			Control W	
	1999 (1)	2005 (2)	Diff. (3)	1999 (4)	2005 (5)	Diff. (6)	vs Treated (7)=(6)-(3)	1999 (8)	2005 (9)	Diff. (10)	vs Treated (11)=(10)-(3)		
Proportion of physically active parents	0.85 (0.36)	0.84 (0.37)	-0.01	0.91 (0.29)	0.82 (0.38)	-0.09***	-0.08	0.92 (0.27)	0.77 (0.42)	-0.15***	-0.14**		
Frequency of light physical activity (times per week)	3.79 (3.07)	4.07 (3.53)	0.28	4.34 (3.13)	3.89 (3.27)	-0.45**	-0.73	4.49 (2.92)	3.62 (3.43)	-0.86***	-1.14**		
Age	37.36 (6.27)	37.22 (6.42)	-0.13	38.36 (6.65)	37.61 (7.44)	-0.76*	-0.62	37.20 (8.48)	40.65 (10.61)	3.45***	3.59***		
Years of Education completed	12.78 (2.73)	13.34 (2.38)	0.56	12.32 (3.12)	12.87 (2.76)	0.55***	-0.01	13.23 (2.57)	13.09 (2.54)	-0.14	-0.7		
Num. of Children	2.60 (1.38)	2.43 (1.20)	-0.18	2.74 (1.36)	2.60 (1.17)	-0.14*	0.04	1.99 (1.03)	2.15 (1.37)	0.16	0.33		
Num. of Children of elementary school-age	1.23 (0.49)	1.25 (0.48)	0.02	1.34 (0.58)	1.27 (0.53)	-0.07**	-0.09	0.00 (0.00)	0.00 (0.00)	0	-0.02		
Proportion of White	0.53 (0.50)	0.56 (0.50)	0.03	0.55 (0.50)	0.52 (0.50)	-0.03	-0.06	0.62 (0.49)	0.56 (0.50)	-0.06	-0.09		
Proportion of Married	0.88 (0.33)	0.85 (0.36)	-0.03	0.85 (0.35)	0.85 (0.36)	0.00	0.03	0.88 (0.32)	0.86 (0.35)	-0.02	0.01		
Proportion of unemployed	0.05 (0.22)	0.04 (0.19)	-0.01	0.04 (0.20)	0.05 (0.21)	0.01	0.02	0.01 (0.12)	0.05 (0.23)	0.04**	0.05		
Proportion of Retired	0.00 (0.00)	0.00 (0.00)	0.00	0.00 (0.07)	0.00 (0.06)	0.00	0	0.00 (0.00)	0.00 (0.00)	0	0		
Proportion of Disabled	0.02 (0.14)	0.02 (0.14)	0.00	0.02 (0.15)	0.03 (0.16)	0.01	0.01	0.01 (0.12)	0.04 (0.20)	0.03	0.03		
Proportion of Full time workers	0.92 (0.27)	0.87 (0.34)	-0.05	0.91 (0.28)	0.90 (0.30)	-0.02	0.03	0.97 (0.16)	0.90 (0.30)	-0.07***	-0.02		
Labor income per capita	14,434 (12,050)	24,938 (50,724)	10,503**	14,891 (13,786)	17,332 (14,205)	2,440***	-8,063	19,134 (26,468)	21,944 (17,910)	2,811	-7,693		
Sample size	101	108		606	563			147	201				

Notes: **Treated**: males living in group of states *S5* that have children of elementary school-age. **Control between**: males living in group of states *S1* or *S2*, that is in non-experimental states, who have children of elementary school-age. **Control within**: males living in group of states *S5* whose children are not of elementary school-age. Standard errors reported in parentheses below the corresponding average or proportion. Stars in columns (3), (6), and (10) show statistical significance of differences in mean (continuous variables and variables with more than 12 categories) or proportion (dummy variables) of the referred variable, between years 1999 and 2005. Stars in columns (7) and (11) show statistical significance of differences in mean. Significance levels: \* = 10%; \*\* = 5%; \*\*\* = 1%.

Figure 2: Ratios father-mother of means of time spent in childcare activities (hours per week), by demographic subgroups.



Source: Ratios computed using data in Table 1 in Guryan et al. (2008) based on the 2003-2006 waves of the American Time Use Survey (ATUS). Childcare activities are classified into: “Basic” childcare (breast feeding, rocking a child to sleep, general feeding, changing diapers, providing medical care to child, grooming child, etc.); “Educational” childcare (reading to children, teaching children, helping children with homework, attending meetings at a child’s school, etc.); “Recreational” childcare (playing games with children, playing outdoors with children, attending a child’s sporting event or dance recital, going to the zoo with children, taking walks with children, etc.); “Travel” childcare (any travel related to any of the three other categories of childcare). Samples include all individuals between the ages of 21 and 55 (inclusive) who had time diaries summing to a complete day and at least one child under the age of 18.