Obesity and Health Care Expenditures of Americans with Intellectual and Developmental Disabilities

 $\mathbf{B}\mathbf{Y}$

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DISSERTATION

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LIST OF ABBREVIATIONS

ACS	American Community Survey
AHRQ	Agency for Healthcare Research and Quality
BMI	Body Mass Index
CAPI	Computer-Assisted Personal Interview
СРІ	Consumer Price Index
DD	Developmental Disabilities
ER	Emergency Room
FPL	Federal Poverty Line
GLM	General Linear Model
HCBS	Home and Community-Based Services
ННС	Home Health Care
ID	Intellectual Disability
IDD	Intellectual and Developmental Disabilities
MEPS	Medical Expenditure Panel Survey
MEPS-HC	Medical Household Component
MR	Mental Retardation (Intellectual Disability)
MSA	Metropolitan Statistical Area
NHIS	National Health Interview Survey
OLS	Ordinary Least Squares
PSU	Primary Sampling Unit
TPM	Two-Part Model

SUMMARY

It is estimated that 4.6 to 7.2 million Americans have intellectual and developmental disabilities (IDD) (Office of the Surgeon General, 2002). The 2002 U.S. Surgeon General report stated that Americans with IDD experience poorer health status and more difficulties in affording appropriate health care compared with other populations. Research has shown that Americans with IDD are especially at risk for obesity, which is a major driver of health care expenditures in the general population. However, health care expenditures studies on Americans with IDD using nationally representative samples are rare, and the role of obesity has not been specifically examined. Mapping and understanding the key determinants of health care expenditures is vital for policymakers and stakeholders of this population. Thus, the proposed dissertation will seek to develop and test models of health care expenditures among Americans with IDD using obesity as the primary focus of the analysis.

Many existing national health data systems do not separately identify IDD as a subpopulation and therefore cannot be used to study obesity, health care expenditures, and IDD at the same time. An innovative approach was proposed in the present study. By linking two datasets – Medical Expenditure Panel Survey (MEPS) and National Health Interview Survey (NHIS), individuals with IDD were identified from a nationally representative sample. Health care expenditures were assessed and the hypothesis that obesity drives up health care expenditures in the IDD population was tested. The outcomes of the present study will add to the emerging body of literature on IDD and health disparities and provide information for policymaking and program-developing efforts.

I. INTRODUCTION

A. Background

"[T]here is a segment of our population that too often is left behind as we work to achieve better health for our citizens." (Office of the Surgeon General, 2002, p. iii) In Closing the Gap, the U.S. Surgeon General (2002) highlighted the multitude of health-related challenges faced by Americans with intellectual and related developmental disabilities (IDD). Today, the IDD population consists of 4.6 to 7.2 million Americans (Morstad, 2012). Americans with IDD are consistently reported to have poorer health than other Americans (Cooper, Melville, & Morrison, 2004; Morin, Mérineau-Côté, Ouellette-Kuntz, Tassé, & Kerr, 2012; U.S. Public Health Service, 2001). The IDD population is more likely to have skin conditions (Krahn, Hammond, & Turner, 2006), oral health problems (Morgan et al., 2012), thyroid disorders (Kapell, Nightingale, Rodriguez, & Lee, 1998), epilepsy, gastrointestinal problems, cardiovascular disease (Draheim, 2006), osteoporosis, musculoskeletal problems (Cooper et al., 2004), respiratory problems (McCarthy & O'Hara, 2011), phobias, depression (Turk, Khattran, Kerry, Corney, & Painter, 2011; Webb & Stanton, 2005), and be more overweight and obese (Melville et al., 2008; Rimmer & Yamaki, 2006; Rimmer, Yamaki, Davis, Wang, & Vogel, 2011; Stancliffe et al., 2011). Additionally, there is a consensus that while the observed health disparities are numerous, still many more health problems remain undiagnosed or underdiagnosed, such as vision/hearing impairments, dental caries and cancer (McCarthy & O'Hara, 2011; Morin et al., 2012). Many of those health problems can be attributed to inadequate health care.

With the rising cost of health care in America, it is important to examine health care expenditures by Americans with IDD. However, existing research is scarce, especially for those

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who live in the community. Studies have showed that individuals with IDD tend to live in poorer financial and social conditions compared to their counterparts without IDD (Emerson, 2003, 2007). This can translate to more hazardous living environments, more difficulties in obtaining quality health insurance, and the lack of social support such as transportation for physician visits. The net effect is greater unmet health care needs (McCarthy & O'Hara, 2011; Morgan et al., 2012; Reichard & Stolzle, 2011). Those unmet needs further expose individuals with IDD to more health problems, which might lead to higher health care spending later on. Inadequate health insurance coverage can also result in greater out of pocket expenses on visits and medications: families affected by disabilities are more likely to be in poverty and thus more sensitive to these out-of-pocket expenses (Lukemeyer, Meyers, & Smeeding, 2000). However, the number of existing studies on IDD and health care expenditures is limited and program development and policy-making largely occurs in the absence of hard data. Therefore, the first aim of the present study was to bridge this gap and report the extent, use, source of payment, and other characteristics of health care expenditures of community-living Americans with IDD.

One of the most significant health disparities in the population of people with IDD is obesity (Hsieh, Rimmer, & Heller, 2013; Rimmer & Yamaki, 2006; Rimmer, Yamaki, Lowry, Wang, & Vogel, 2010). Defined as having a Body Mass Index (BMI) of 30 or higher, obesity is a major driver of health care expenditures in the general population (Bach Xuan, Nair, Kuhle, Ohinmaa, & Veugelers, 2013; Karpur & Bruyère, 2012). Many conditions closely associated with obesity -- heart disease, cancer, hypertension, diabetes and hyperlipidemia, are also among the most expensive in terms of health care (Andreyeva, Sturm, & Ringel, 2004; Finkelstein, Trogdon, Cohen, & Dietz, 2009; Wolf & Colditz, 1998). However, the relationship between obesity and health care expenditures in the IDD population has not been examined and may present unique challenges. Thus, the second and primary aim of the present study is to statistically model health care expenditures of Americans with IDD and determine whether obesity is a significant predictor of costs.

To achieve the two aims, I adapted the widely-used Andersen model (Andersen & Newman, 2005) to identify relevant variables to be included in the analysis. Small sample size and difficulty of identification are frequently cited as reasons for limiting the use of the Andersen model in IDD research. This study provided an opportunity to apply the Andersen model using a larger, nationally representative IDD sample.

B. <u>Statement of Problem and Research Questions</u>

To summarize, the three key issues identified in the current literature were:

- There is very little knowledge about the characteristics of health care expenditures of noninstitutionalized Americans with IDD;
- 2. There are considerable difficulties with identifying respondents with IDD in national health survey datasets; and
- 3. There are no studies examining obesity in the context of health care expenditures and IDD, even though there are consensus that community-living Americans with IDD are at higher risk of being obese compared with the general population.

The need for better collection and reporting of IDD health care data was highlighted in Office of Surgeon General's *Closing the Gap* report (2002). Specifically, in *Goal 2: Increase Knowledge and Understanding of Health and Mental Retardation: Data collection*, the Surgeon General urged researchers to "[i]dentify and evaluate existing data on health and MR (mental retardation). Add MR to population-based data collection on health status, health risks, health services utilization, and health care costs" (Office of the Surgeon General, 2002, p. 5). It is difficult to identify respondents with IDD in existing national health survey datasets. IDD identification is typically not included in national level statistics programs (Krahn, Fox, Campbell, Ramon, & Jesien, 2010). In addition, many national surveys such as the American Community Survey (ACS) use a functional limitation approach to disability identification (Brault & United States Census Bureau, 2012). In the ACS, disabilities are categorized into six types of function: hearing difficulty, vision difficulty, cognitive difficulty, ambulatory difficulty, self-care difficulty and independent living difficulty (Brault, 2009). However, there are no follow up questions to indicate whether IDD underlies the cognitive, self-care or independent living difficulties. As such, this approach is unable to differentiate between difficulties caused by IDD, aging-related conditions (e.g., Alzheimer's disease), or brain injury (Krahn et al., 2010). The ACS and similar surveys cannot be used to study IDD research questions.

It is well documented that individuals with IDD are on average more overweight and obese than their counterparts without IDD (Melville et al., 2008; Rimmer & Yamaki, 2006; Rimmer et al., 2011; Stancliffe et al., 2011). Most estimates made during in the past decade put obesity rates among adults with IDD between 32% and 38% (Harris, Rosenberg, Jangda, O'Brien, & Gallagher, 2003; Rimmer & Yamaki, 2006; Yamaki, 2005), compared with the general population at around 32%. Obesity and related conditions such as heart disease, cancer, hypertension, diabetes and hyperlipidemia, are also known to be associated with increased health care expenditures (Andreyeva et al., 2004; Finkelstein et al., 2009; Wolf & Colditz, 1998). However, to date there have not been any studies on the intersection of IDD, obesity and health care expenditures.

The study asked the following research questions.

- 1. What were the obesity rates over the 2002-2011 period for noninstitutionalized Americans with IDD?
- 2. How did noninstitutionalized obese and non-obese Americans with IDD compare on total health care expenditures, costs by types of services, and sources of payment?
- 3. What impact did obesity status have on estimated annual health care expenditures for noninstitutionalized Americans with IDD?

C. Significance

The findings of the present study provide a first look at the health care utilization and expenditures among noninstitutionalized Americans with IDD. Application of the Andersen model in a nationally representative sample serves could serve as foundation for more sophisticated models of future IDD health care expenditures research. Finally, the identification of the status and needs of noninstitutionalized Americans with IDD in the health care market should help inform health services policymaking efforts. Even though the present study does not fully map out the mechanisms and determinants of health care expenditures of noninstitutionalized Americans with IDD, it marks an important first step towards understanding obesity's financial impact on health care spending for Americans with IDD.

II. LITERATURE REVIEW

A. Intellectual and Developmental Disability and Health Disparities

1. Intellectual and developmental disability

Intellectual Disability (ID) is a disability characterized by "significant limitations both in intellectual functioning and in adaptive behavior, which covers many everyday social and practical skills" (Schalock et al., 2010, p. 1). Developmental Disability (DD) refers to disabilities that originate before age 22, are expected to continue indefinitely, and substantially restrict the individual's functioning in several major life activities (Developmental Disabilities Assistance and Bill of Rights Act, 2000). Intellectual and Developmental Disability (IDD) is a term that covers a wider range of conditions such as ID, autism spectrum disorders, epilepsy, cerebral palsy, developmental delay, and fetal alcohol syndrome, which translate to about 15% of children between ages 3-17 (The Arc, 2012).

While the majority of Americans with IDD have always lived in community settings, due to deinstitutionalization, even more Americans with IDD are now living in the community (Parish & Saville, 2006). Health services research consistently finds that community living is associated with lack of preventive care and lack of convenient access to a doctor (Morgan et al., 2012). Life expectancy for people with ID, though it has increased over the years, is still about 15 years shorter than the general population (Janicki, Dalton, Henderson, & Davidson, 1999; McCarthy & O'Hara, 2011). Health disparities are even larger for people who are aging with IDD (Robinson, Dauenhauer, Bishop, & Baxter, 2012).

A great deal of research has been conducted on health and IDD, consistently finding people with IDD in poorer health than their peers without IDD (Cooper et al., 2004; Morin et al., 2012; U.S. Public Health Service, 2001). The U.S. Surgeon General's report, entitled *Closing the*

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Gap: a National Blue-Print for Improving the Health of Individuals with Mental Retardation, documented the great health disparities experienced by people with IDD (U.S. Public Health Service, 2001). These include skin conditions (Krahn et al., 2006), oral health problems (Morgan et al., 2012), thyroid disorders (Kapell et al., 1998), epilepsy, gastrointestinal problems, cardiovascular disease (Draheim, 2006), osteoporosis, musculoskeletal problems (Cooper et al., 2004), respiratory problems (McCarthy & O'Hara, 2011), phobias, and depression (Turk et al., 2011; Webb & Stanton, 2005). Severe or profound IDD is linked with higher risks of cardiovascular diseases, pneumonia, visual/hearing impairments, and cancer compared with people with mild IDD (Krahn et al., 2006; Morin et al., 2012; Patja, Eero, & Iivanainen, 2001). The disparities in the health status of people with IDD are well documented. As the "cascade of disparities" (Krahn et al., 2006) continues to evolve, it is essential to study and understand the complex interactions between multiple factors that coalesce in the poorer health of people with IDD.

2. **Obesity and other health disparities**

Conceptually, overweight and obesity refers to "abnormal or excessive fat accumulation that may impair health" (World Health Organization, 2014, p. 1). Operationally, obesity is conventionally defined as having a BMI of 30 or higher in adults, and having a body mass index (BMI) at or above 95th percentile for appropriate age group in children (Centers for Disease Control and Prevention, 2010a; National Institutes of Health, 1998). BMI is a commonly used weight-for-height measure, defined as weight in kilograms divided by the square of their height in meters. In 1980, about 15% of adults and 7% of children in the U.S. were obese (Centers for Disease Control and Prevention, 2010b, 2011a); as of year 2014, more than one in three adults (34.9%) and approximately one in six children (17.0%) were obese (Ogden, Carroll,

Kit, & Flegal, 2012a, 2013, 2014). Although the increase in obesity prevalence has been attributed to complex interplays between genetic, physiological, behavioral, environmental, cultural, and socioeconomic factors, the most important causes are considered to be dietary and behavioral (Office of the Surgeon General, Office of Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, & National Institutes of Health, 2001). As such, obesity is one of the leading *preventable* causes of death for the United States. To address this challenge, in 2001, the Office of Surgeon General issued a Call to Action report that spurred many prevention and intervention efforts that followed, including First Lady Michelle Obama's "Let's Move" campaign (Wojcicki & Heyman, 2010). Eleven years later after the Surgeon General report, there were no significant increases in obesity prevalence in either the adult or children general population (Ogden, Carroll, Kit, & Flegal, 2012b), suggesting a halt or at least slowdown of the increase in obesity prevalence. However, the overall obesity prevalence still remains at a very high level.

Obesity is significantly more prevalent in people with disabilities, racial/ethnic minorities, and low-income families (Centers for Disease Control and Prevention, 2011b; NCBDDD Atlanta, 2013; Nosek et al., 2008). Research generally finds that both youths and adults with IDD have higher levels of obesity compared with their counterparts without IDD (Melville et al., 2008; Rimmer & Yamaki, 2006; Rimmer et al., 2010). Barnes, Howie, McDermott, and Mann (2013), using objectively measured data, found almost eight in ten participants with ID were overweight or obese. The higher prevalence rates have been attributed to poor diet, physical inactivity, smoking, and genetic factors, e.g., Down Syndrome (Draheim, Williams, & McCubbin, 2002a; Frey, 2004; Messent, Cooke, & Long, 1998; Robertson et al., 2000; Temple, Frey, & Stanish, 2006). Existing research suggests other important predictors of obesity in relation to IDD. Emerson (2005) suggested that gender, severity of the ID, age and living arrangement are important factors in predicting health outcomes in general. Hsieh et al. (2013) found being female, having Down syndrome, medication use, lack of moderate physical activity, and soft drink consumption were linked with higher obesity levels. Gazizova, Puri, Singh, and Dhaliwal (2012) reported that gender, ID severity, and serum triglycerides were important predictors of BMI. Even though the scope and nature of studies varied greatly, some variables appear consistently in the research and are potential candidates for cost model development.

Obesity is associated with higher risks for a number of health conditions. It is strongly linked to type 2 diabetes (Mokdad et al., 2003), hypertension (Rahmouni, Correia, Haynes, & Mark, 2005), and hyperlipidemia (Crawford et al., 2010), and is associated with higher risks of stroke, cancer, asthma and coronary heart disease (Guh et al., 2009). Because obesity generally persists into and affects the entire adulthood, much attention has been devoted to curbing obesity in children and adolescents. Since many of the health consequences of obesity are compounded over time (Dietz, 1998), the study of adults is a logical starting point for estimating obesity-related costs.

Although obesity is one of the most grave health disparities in people with IDD (Hsieh et al., 2013; Phillips et al., 2014; Rimmer & Yamaki, 2006; Rimmer et al., 2010). Accessible and evidence-based weight programs have been shown to be very effective in managing obesity in this population (Hamilton, Hankey, Miller, Boyle, & Melville, 2007).

B. Obesity and Health Care Expenditures

1. <u>Health care expenditures in the United States</u>

Obesity accounts for roughly 6% to 9% of national aggregate medical expenditures in the United States (Finkelstein, Fiebelkorn, & Wang, 2003; Finkelstein et al., 2009; Thompson & Wolf, 2001; Withrow & Alter, 2011). Approximately half of the obesityrelated expenditures were funded by Medicare or Medicaid (Finkelstein et al., 2003). As such, obesity has been established as a major driver of health care expenditures in the general population (Bach Xuan et al., 2013; Finkelstein et al., 2003; Karpur & Bruyère, 2012; Thompson & Wolf, 2001; Withrow & Alter, 2011; Wolf & Colditz, 1998). Since very little is known about health care expenditures among people with IDD, obesity is a good starting point for cost related investigations.

2. **Obesity and chronic health conditions**

Obesity can influence health care expenditures in many ways. Its impacts in the forms of coronary heart disease, hypertension, diabetes, and cancer are particularly costly (Wang, McPherson, Marsh, Gortmaker, & Brown, 2011; Withrow & Alter, 2011). There are two main approaches to estimating health care expenditures associated with obesity. The "top down" approach, commonly seen in many earlier studies (Wolf & Colditz, 1998), is typically based on population level obesity prevalence statistics and the relative risks of comorbidities derived from previous studies. The "bottom up" approach, on the other hand, typically relies on individual level data and multivariate regression methodology, and is more flexible (Dee et al., 2014). While both approaches have limitations, the latter is becoming more widely used in recent years (Withrow & Alter, 2011). One advantage is the ability to account for individual characteristics such as race and age, which have substantial impact over expenditures (Wee et al., 2005).

Bottom up approaches are also capable of accounting for the source of payment for health services.

Anderson, Wiener, Finkelstein, and Armour (2011) studied the interaction between disability, obesity and health care expenditures using MEPS data. They found that obesity was associated with considerable additional health care expenditures for people with disabilities, compared with people without disabilities but with obesity. Obese people with disabilities also had much higher prevalence of diabetes. Older age also seemed to have affected health expenditures, with Medicare being the highest overall source for obesity-related expenditures.

The change-over-time nature of obesity's effects is an important focus of research since many comorbidities take a considerable amount of time to develop or exacerbate, leading to much higher delayed costs (Daviglus, Liu, Yan, & et al., 2004; Finkelstein, Graham, & Malhotra, 2014; Withrow & Alter, 2011). Using a regional sample and Medicare costs data, Daviglus et al. (2004) reported a "staircase" linear relationship between participants' middle age obesity status and health care expenditure in later years, i.e., incremental costs for the non-overweight, overweight, obese and severely obese groups. Yang and Hall (2008) found that among older adults, overweight or obese status at age 65 is linked to higher lifetime health care expenditures than their normal weight counterparts. Additionally, obesity in young adulthood can negatively impact health care expenditures later in older age (Reither, Olshansky, & Yang, 2011). Conversely, interventions that reduce BMI even slightly can result in substantial cuts in health care costs later (Rtveladze et al., 2013). The change-over-time perspective provides excellent justifications for policymakers to prioritize resources and address obesity now sooner than later. This further warrants obesity and cost studies in the IDD population on the national scale to inform and support policy decisions.

3. Modeling health care expenditures

Models of health care utilization provide a framework for analyzing health care expenditures. A popular model among health researchers is the Andersen model for healthcare services utilization ("The Andersen Model"). The Andersen Model was originally developed to understand health care service use and to measure access to health care (Andersen, 1995). The latest iteration of the model theorizes that determinants of health care use consist of three domains: societal determinants, health services systems and individual determinants (Andersen & Newman, 2005). Figure 1 below depicts the structure of Andersen Model. Societal determinants include factors such as technology and norms. Health services systems conceptualize the structure within which health care goods and services are provided in society. The third domain is individual determinants, in which three levels are identified: predisposing factors, enabling resources, and illness level factors. The present study focused on individual determinants because changes on both societal determinants and health services system domains cannot be measured using available variables in the NHIS-MEPS dataset.

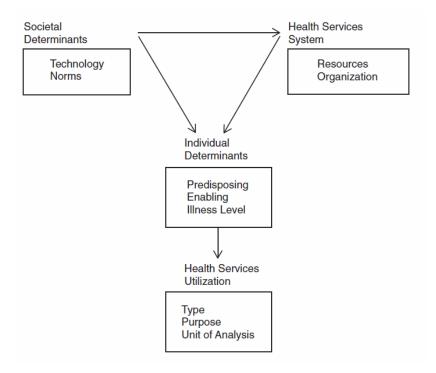


Figure 1. The Andersen model framework for health services utilization (Andersen & Newman,

2005)

Figure 2 shows the adapted Andersen Model framework used in the present study. The three levels of individual determinants of health care utilization are placed in a linear form, leading up to utilization, which generates health care expenditures. The first level, predisposing factors, consists of demographics (age, sex, marital status, etc.) and social structure (education, race/ethnicity). Enabling resources refer to family resources (income and health insurance status) and community resources (region, urban-rural). The third level, illness level, involves perceived (self-reported) illnesses and health conditions. It is hypothesized that fulfilled and unmet health needs will return to predisposing factors, forming a feedback loop (Andersen, 1995). Research shows that health care expenditures for people with disabilities generally were influenced by similar factors. Demographics such as age, sex, and race/ethnicity have considerable effects (Turk, Kerry, Corney, Rowlands, & Khattran, 2010). Among people who are overweight or obese, expenditures appear to have a linear relationship with age, but are not affected by gender (Bell, Zimmerman, Arterburn, & Maciejewski, 2011). Hispanic or other racial or ethnic groups tend to have lower health care satisfaction and lower expenditures (Fenton, Jerant, Bertakis, & Franks, 2012). Families with lower socioeconomic status tend to use and spend less on health care (Yu, Bellamy, Schwalberg, & Drum, 2001). For example, families with public insurance reported lower health care utilization and poorer health than families with private insurance (Piette, Wagner, Potter, & Schillinger, 2004). For families with children and adolescents with IDD, caregiving significantly decreases health care expenditures due to reduced income (Doran et al., 2012).

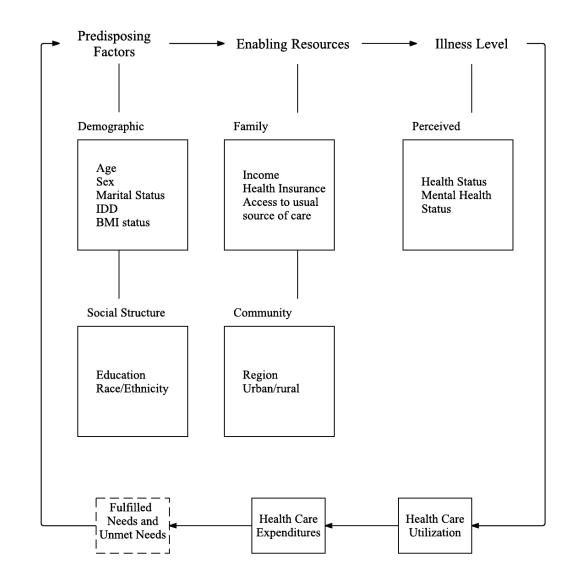


Figure 2. The adapted Andersen model individual determinants framework for health services

utilization and expenditures

For the IDD population, researchers have found important relationships between health care utilization and age, sex (Chiang et al., 2013; Turk et al., 2010), race/ethnicity, socioeconomic status, and health insurance coverage (Chiang et al., 2013; Weller, Minkovitz, & Anderson, 2003), residential area (Chiang et al., 2013), and chronic conditions, and disability (Boulet, Boyle, & Schieve, 2009). Together, the adapted Andersen Model framework provides a comprehensive view of what should be included in the models of health care utilization and expenditures for Americans with IDD.

C. <u>Lack of Data on Intellectual and Developmental Disabilities and Linkage as a</u> <u>Solution</u>

There are a number of ways to define "disability." In U.S. national health surveillance systems, three approaches for counting people with disabilities have emerged (Fujiura & Rutkowski-Kmitta, 2001): the impairment-based approach, the functional limitation based approach, and the disablement process/social context approach. In an impairment based approach, a person with IDD would be identified by the medical diagnosis and classification of their impairment and symptoms; in a functional limitation based approach, they would be identified by the limitations in their life activities; in the disablement process/social context approach, they would be identified by the activity participation restrictions and environmental barriers they constantly face. Operational definitions based on the three approaches can be very different from each other.

To study Americans with IDD as a population, IDD definition and classification systems are needed. The definition and classification of IDD have changed significantly over the last few decades (Ford, Acosta, & Sutcliffe, 2013). The shifting of definitions has long been a challenge in research, resulting in the lack of available research data on IDD, or "being invisible in data" (Krahn et al., 2010; Krahn et al., 2006). In recent years, such "invisibility" was made worse by the fact that the so-called "functional limitation" approach (as used in American Community Survey) is gaining popularity in health surveys. Counting people with intellectual and developmental disabilities using a functional limitation approach is difficult (Krahn et al., 2010). In this approach, only one question is used to access cognitive functions. This approach cannot differentiate between cognitive limitations caused by IDD, aging-related conditions (e.g., Alzheimer's disease), or brain injury (Krahn et al., 2010).

Most existing health studies and surveys have adopted different operational definitions of IDD (Morgan et al., 2012). Inconsistencies of definitions made it difficult to make proper comparisons and draw conclusions (Rimmer et al., 2011; Rimmer et al., 2010). Since surveys with different purposes will necessarily adopt different definitions, it is unlikely that a unified approach will be used across all systems. A novel approach -- data systems linkage, is increasingly employed in recent disability research studies as a solution. Typically based on "data crosswalks" using shared identifiers, data linkages are made possible by inter- or intraagency collaboration. The linkage approach provides critical access for disability research to address the minority status and nature of diverse definitions often seen in disability data. Anderson et al. (2011), for example, estimated the national aggregate health care expenditures associated with disability using linked data drawn from MEPS and NHIS and found 3.5 times higher health care expenditures among Americans with disabilities. In another study, the linkage approach was used to explore the increased rates of primary/secondary health conditions in people with mobility limitations (Rasch, Hochberg, Magder, Magaziner, & Altman, 2008; Rasch, Magder, Hochberg, Magaziner, & Altman, 2008).

Even though individuals with IDD are typically not explicitly excluded, very often their input into surveys is based on proxy-reports, usually by a parent or care provider (Matthews et al., 2011). There have been many criticisms of the use of proxy reports, for example, they tend to underestimate the prevalence of obesity (Rimmer et al., 2010), pain, and mental health problems (Turk et al., 2011). At the same time, a common alternative, self-report has also been criticized for use in this population, due to inaccuracies in recall and reporting health-related behavior and status (Draheim, Williams, & McCubbin, 2002b; Rimmer et al., 2010). As an alternative to both proxy and self-reporting, objective measurement is used in this population quite successfully. For example, the Healthy Athletes program, operated by Special Olympics, has been providing height and weight data measured by trained health professionals to obesity researchers (Lloyd, Temple, & Foley, 2012). It is also effective at measuring some health behaviors, such as physical activity (Matthews et al., 2011). However, objective measures cannot address subjective health states such as health beliefs, attitudes or mental health related questions.

The present study aimed to use a linked NHIS-MEPS dataset to describe health care expenditures and estimate costs associated with obesity in Americans with IDD. Linking the data unlocks the strengths of both data systems and makes possible their use in IDD health care expenditure related research. MEPS is one of the most comprehensive national survey on health care access, utilization, and costs, but does not contain identifiers for IDD; at the same time, NHIS has a screening item for IDD but only provide limited expenditures information. With the linked dataset, national estimates could be drawn for both descriptive and model developmental purposes.

III. METHODS

The analysis of the pooled dataset of linked NHIS and MEPS files was conducted in multiple stages. The initial stages of the analysis focused on describing the extent, use, source of payment, and other characteristics of health care expenditures in IDD families, followed by regression model development and cost estimations in the later stages.

A. **Data Sources**

Data from the MEPS (years 2002 to 2011) and NHIS (years 2000 to 2010) were used. Each year, the MEPS uses the previous year's NHIS as a sampling frame to provide nationally representative estimates for the noninstutionalized civilian population of the U.S. The MEPS sample typically represents about three-eighths of the NHIS responding households (Ezzati-Rice, Rohde, & Greenblatt, 2008).

1. <u>National Health Interview Survey</u>

The National Health Interview Survey (1957-current) is an annual survey focusing on the prevalence, distribution, and effects of illness and disability in the U.S. (National Center for Health Statistics, 2010) The main function of the survey is to provide data to track health status, health care access and progress toward achieving national health objectives.

The NHIS collects data through in-person household interviews in the computer assisted personal interview (CAPI) mode. U.S. Bureau of the Census trains interviewers following procedures specified by the National Center for Health Statistics. Since 1997, the NHIS questionnaire contains both a set of questions that remain relatively stable from year to year, known as the Core questionnaire, and thematic sets of questions reflecting current health data needs, known as the Supplements. The Core consists of four components: Household, Family, Sample Adult, and Sample Child. The Household and Family components collect demographic

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information on all of the individuals in the household, as well as health status and limitations, injuries, healthcare access and utilization, health insurance and income. The Sample Adult and Sample Child questionnaires collect information on health status, health care services and health behaviors from randomly selected family members. For the Family Core section, all adult members of the households (17 and over) who are at home are invited to respond to the questions concerning themselves. For children, and adults who are not at home at the time, a responsible adult family member (18 and over) provide answers to questions concerning the absent or underage family member. For the Sample Adult section, one adult family member is randomly selected and answers this section of questions on his/her own behalf. For the Sample Child section, usually a parent or knowledgeable family member completes the questionnaire. The entire interview usually takes about an hour to complete. The present study only used information obtained from the Family Core section.

The NHIS's sampling plan is redesigned every ten years. The current plan was in effect from 2006. The current sample consists of 428 primary sampling units (PSU's) drawn from a pool of more than 1,900 PSU's across the country. An oversampling scheme is in place, such that Black, Hispanic, and Asian individuals are oversampled. However, people with disabilities are not oversampled. After 2011, the annual sample size is about 35,000 households each month, which contain about 87,500 individuals. The annual response rate is about 90%.

2. Medical Expenditure Panel Survey

The Medical Expenditure Panel Survey (MEPS) is a comprehensive source of data on health care expenditures in the U.S. noninstitutionalized population. The main purpose of MEPS is to provide information on health care use and spending, insurance coverage, and accessibility of health care in the U.S. There are multiple components in the MEPS, but the present study only concerns MEPS household component. For ease of discussions, throughout the proposal, the MEPS household component will be referred to as the "MEPS."

Although the MEPS also uses in-person household interviews in CAPI mode, there are many differences from the NHIS. Instead of a one-time interview, five rounds of interviews are conducted over two calendar years. In each of the five interviews, a core instrument about all persons in the household is administered. In follow-up interviews, respondent are asked to update data provided in previous interviews such as employment and health insurance. In addition, a one-time self-administered questionnaire is completed to collect information on children and adult health behaviors

There are no separate sample adult or child questionnaires in the MEPS. Generally, one "knowledgeable adult household member" provides answers on behalf of the whole family. However, participation from other household members who keep records and are willing to participate is also "encouraged" (Agency for Healthcare Research and Quality, 2015). There are no variables specifying which questions were answered by which household member. The MEPS interview consists of a number of "sections" covering specific topics, and the order of sections can vary from interview to interview. The topics covered include health status, physical and mental conditions identified through medical events, charges and sources of payment for medical events, access to care, hospital stays, income, employment, etc., which somewhat overlap with NHIS topics. However, the emphasis of MEPS lies heavily on the financial aspects of those topics. An average interview lasts 1.5 hours but the time could vary depending on the size of the household (Agency for Healthcare Research and Quality, 2015).

The sampling frame of MEPS is drawn from the NHIS, therefore, the PSU's are a subset of the NHIS sample. An overlapping panel design is used: each year, a new panel of sample households is selected, and for each panel data are collected for two consecutive calendar years. For years 2001-2010, the sample sizes are about 12,000 households, which contain about 32,000 individuals. The overall response rate is about 55%, which is a product of the NHIS response rate, the proportion of successful inclusion, and the conditional response rate for both MEPS years. To adjust for the unique survey design, for survey nonresponse and for population totals, the MEPS provides sampling weights that are used in descriptive and more advanced analyses.

3. **Data preparation**

Both NHIS and MEPS data are publicly available online. A special file, also publicly available upon request, is used to link individual cases of the NHIS to the MEPS. The "key" file contains a crosswalk that allows data analysts to match records one-to-one using the MEPS and NHIS person-level files. At the beginning of dataset preparation, all NHIS and MEPS person-level files were downloaded. Ten linkages (one for each MEPS year) were created using record layout files provided by the Agency for Healthcare Research and Quality (AHRQ). For each year of MEPS, two years of NHIS files were concatenated, sorted, and subsequently merged with the MEPS consolidated file by a unique case ID/MEPS year combination. After the merge, date-of-birth checks and totals checks were completed to ensure data integrity.

The sample sizes for persons with IDD were small for each year, therefore pooling multiple years of data was necessary. Due to use of the same PSU's and overlap between persons in consecutive years of the same panel, MEPS data are not independent across years. Positive correlations between cases might result in underestimation of standard errors. However, it is valid to pool multiple years of data because each year's data is designed to be nationally representative (Sommers, 2006). Correct variance structure of strata and PSU were used (Agency

for Healthcare Research and Quality, 2013b). As such, any estimates were interpreted as a tenyear average for the 2002-2011 period.

B. Sample

1. **Disability identification**

In the present study, IDD identification was based on two screening methods. The primary method was use of the NHIS cause of activity limitations variables in the Health Status and Limitation of Activity section of the Family Core. The respondent was asked whether any household member had an activity limitation or needed assistance with activities of daily living (eating, bathing, dressing, and getting around inside the home) or instrumental activities of daily living (household chores, doing necessary business, and shopping or running errands). The respondent was then asked to identify the condition(s) responsible for the activity limitation from flash cards that listed conditions. Different flash cards were used for adults aged (18+ years) versus children (under 18 years) with adults having 34 conditions to select from while children had 13 options. Cases were included as having IDD if "intellectual disability" (year 2011) or "mental retardation" (years pre-2011) or "other developmental problem (e.g., cerebral palsy)" was selected as the primary cause for the limitation(s). This screening method yielded 1,932 cases. A secondary screening method used the MEPS Medical Conditions files, which contained detailed information on the medical conditions reported by MEPS respondents. This method identified 242 additional cases. As such, the total unweighted sample size was 2,174. The total unweighted sample size with non-missing BMI information was 1,897. A flowchart of the sample selection process is included (Figure 3).

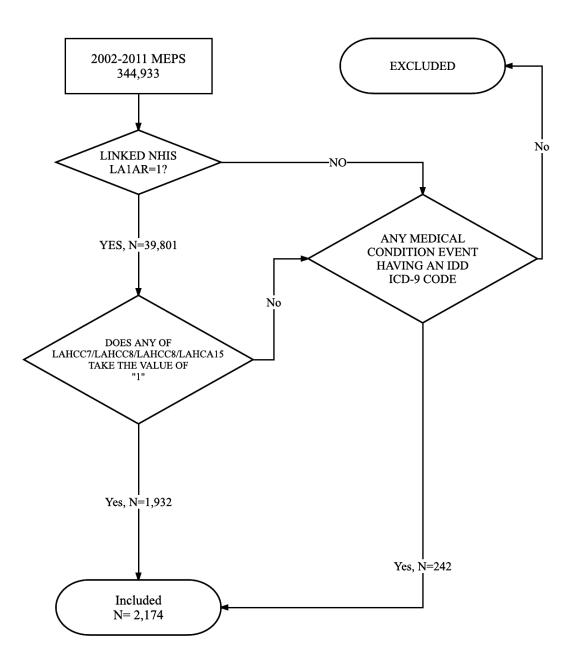


Figure 3. The sample selection process

C. <u>Measures</u>

1. Dependent measures

a. **Utilization**

In health care research, utilization is generally defined as "the outcome of the interaction between health professionals and patients" (Donabedian, 1973, p. 173). However, given the secondary nature of the study, what constituted utilization was dictated by the conventions of the MEPS. Utilization definitions varied. For instance, Hospital Inpatient utilization was quantified by numbers of discharges and inpatient nights, whereas Prescription Medicines utilization was quantified by the number of times a medication was purchased and refilled. Rather than units of service use, Home Health Care (HHC) utilization was quantified on a days per provider per-month basis. Specifically, if a person used care from two different providers in one day, the usage would be counted as "two" services days in the month; however, if they used the same provider's care twice in one day, it would only be counted as "one" day in a month (Agency for Healthcare Research and Quality, 2013a). This is partly because HHC includes care or services provided by various types of health care workers: certified nursing assistant, companion, dietitian/nutritionist, hospice worker, homemaker, infusion therapist, medical doctor, nurse/nurse practitioner, nurse's aide, occupational therapist, personal care attendant, physical therapist, respiratory therapist, social worker, and speech therapist (Agency for Healthcare Research and Quality, 2011). Also, HHC entailed different types of care: medical treatments, therapy, provision of medical equipment or assistive devices support, daily activities or personal care tasks, and companionship (Agency for Healthcare Research and Quality, 2008). Overall, one utilization can be viewed as one quantifiable interaction with the health care system.

b. <u>Expenditures</u>

Both actual expenditures and regression-estimated expenditures were used as dependent variables in different stages of the analyses. Actual expenditures were used to answer Questions 2 and 3. It should be noted that actual expenditures in MEPS are operationalized as "actual payments" rather than "charges." This includes payments from out-ofpocket, private insurance, Medicaid/Medicare and other sources. Indirect payments as well as over-the-counter drugs are not included. A key dependent measure is total annual health care expenditure, which is defined in the MEPS as the "sum of direct payments for care provided" during the (calendar) year (Agency for Healthcare Research and Quality, 2013a). Next, expenditures were broken down into nine types of health care spending: office-based visits, hospital outpatient visits, hospital emergency room (ER) visits, hospital inpatient visits, dental care, home health care, medications, glass/contact lenses, and other equipment/supply expenditures. Finally, expenditures reported as subtotals by each category of service and by different sources of payment were also used as dependent variables. MEPS provided 12 source of payment categories, many of which were uncommon and not relevant for the purpose of this study. Therefore, after combining the uncommon categories, only five categories were used: out of pocket, Medicare, Medicaid, private insurance, and other.

Several steps were taken by AHRQ to ensure the quality of available data on expenditures. First, in the case of multiple payments to a medical provider that occurred in a certain year, total annual payments were calculated as the "flat fee" expenditure. Second, the MEPS Medical Provider Component provided a sample of office-based physician visits, hospital-based events and prescribed medicine, the expenditures of which were verified through records in addition to self-report. Third, missing data were imputed via an adjusted algorithm by AHRQ. Lastly, several data cleaning procedures were taken by AHRQ to address problems such as copayments misreported as total payments, Medicare/Medicaid misclassifications and misreported out-of-pocket payments. No additional imputation or data cleaning was conducted. All expenditures were converted to 2014 dollars using the Bureau of Labor Statistics Consumer Price Index (CPI) as shown in Appendix D (Bureau of Labor Statistics, 2014).

2. **Predictor variables**

Initially, thirteen predictor variables are evaluated: obesity/BMI status, year of survey, age, sex, race/ethnicity, household income status, geographical region, urban/rural, education status, marital status, insurance coverage, perceived health status, and perceived mental health status. Since a single respondent generally reports for a household, most of the listed variables were considered proxy-reported. Education was defined as the years of education the sample person has attained as of their first MEPS survey. In this study sample, by age and cohort effect. Therefore, education status was dropped from further analysis.

a. **Obesity rates and body mass index status**

BMI was pre-calculated by AHRQ from height and weight information provided by the survey respondent (Agency for Healthcare Research and Quality, 2008). Obesity is defined as having a BMI of 30 or higher in adults, and having a BMI at or above 95th percentile for appropriate age group in children (National Institutes of Health, 1998). BMI status was coded as: (1) not overweight nor obese, (2) overweight, and (3) obese. Overweight is defined as having a BMI between 25 (including 25) and 29.9 in adults, and having a BMI of 85th-95th percentile for appropriate age group in children (National Institutes of Health, 1998).

Year of survey was included as a dummy variable to control for unobserved, time-related effects such as economic and political climate. MEPS age, sex, and race/ethnicity variables were

used instead of NHIS variables to be consistent with the context and time of utilization and expenditures data collection. Race/ethnicity was re-structured into four categories: 1) Non-Latino White, 2) Non-Latino Black, 3) Latino, and 4) other. Household income was coded in relation to the Federal Poverty Line (FPL) thresholds, with categories of <125% FPL (poor and near poor), 125%-199% FPL (low income), 200–399% FPL (middle income), and 400%+ FPL (high income). Each sampled person was classified as living in one of the four geographical regions, Northeast, Midwest, South, and West, using the definition by U.S. Census Bureau (Brown, 2006). A binary Metropolitan Statistical Area (MSA) status was used to indicate whether the household was urban/MSA or rural/not MSA. An MSA is defined as a large population "nucleus" with nearby economically- and socially-connected communities (Agency for Healthcare Research and Quality, 2004). Marital status was binary (married vs. not married). Finally, insurance status was coded as any private, public only and uninsured.

D. <u>Analysis</u>

All utilization and expenditures analyses used the Andersen model as the organizing framework. The Andersen model assumes that health care service utilization and expenditures are functions of one's predisposing, enabling and need factors (Coughlan, Yeh, O'Neill, & Frick, 2014). In this study, age, sex, marital status, and race/ethnicity represent predisposing factors. Enabling resources consisted of income, health insurance status, region, and urban-rural status. The illness level factors were perceived health status and perceived mental health status.

In the first stage of analysis, a priori comparisons of the obese and non-obese members of the IDD subpopulation were conducted across predisposing factors, enabling resources and illness level factors. STATA survey mean and survey proportion commands were used with subpopulation specifications and survey design setup that accounts for the complex survey design of MEPS. To test differences between groups, Wald tests with Sidak adjustment were conducted to obtain F and p values. The Wald tests with Sidak adjustment strategy addresses the potential errors in inference when multiple comparisons are made. The alpha level was set to .05. Mean values of annual health care expenditures were reported by type and sources of payment, in 2014 dollars. Mean values of health care utilization were also reported. Expenditures and utilization were compared between obese and non-obese groups.

Regression-estimated expenditures were used to answer Research Question 3. Once a regression model was established, estimated or fitted expenditures were calculated by inserting the known or observed values of independent variables into the equation (Wooldridge, 2012). In most cases, the fitted values will not equal the actual values but the discrepancies are minimized through the regression process. The estimation of regression-fitted expenditures takes into account impacts from an array of factors such as age, sex, race, and income. Therefore, using estimated expenditures can identify the drivers of the health care costs, and provide a better-informed approximation of obesity's unique impact on health care spending identify the drivers of the health care costs (Finkelstein et al., 2009). In the present study, a two-part regression model was used to generate estimated expenditures.

Two stages of regression were conducted to derive obesity-associated estimated expenditures. This study started with a one-part Ordinary Least Squares (OLS) multivariate regression model, as recommended by Buntin & Zaslavsky (2004). The advantages of a one-part model are the ease of interpretation, especially when the outcome variable was expenditures, and that the predictions would not be biased by heteroscedasticity (Buntin & Zaslavsky, 2004). Coefficients and test values for the overall model, year fixed effects, BMI status and all other variables were calculated. The caveat for interpreting the OLS model is that it has a number of important assumptions, for example, errors are normally distributed centered on zero, errors are independent with identical variance, etc. (Buntin & Zaslavsky, 2004). As a result, the OLS model is typically unable to estimate cost variables due to the zero values in non-users of services, extreme values in high service users and the fact that there are generally no negative cost values. Using only OLS regressions without adjustments on cost dependent variables could result in biased parameters. Therefore, in the second stage, a Two-Part Model (TPM) regression approach was employed. This approach, pioneered by Tobin (1958) and Cragg (1971) and recently seen in studies such as Finkelstein et al. (2009) in their estimation of obesity-attributable health care expenditures, first considers the probability of having any amount of health care expenditure, and then estimates the total expenditure conditional on having a positive spending amount. By doing this, the TPM effectively addresses zero values, extreme values and absence of negative cost values, which are common problems when using a typical health expenditures dataset. For example, an OLS model will result in biased estimates because a significant proportion of the sample would have no expenditures. The TPM uses a logit model in the first part, a log link, and an OLS model with gamma variance distribution in the second part. This addresses the non-independence and skewed distribution of variances, improving the fit of the overall model. The TPM was employed to address Research Question 3.

Standard statistical software packages are generally not capable of generating unbiased sample variances for survey data. Therefore, all analyses were conducted using Stata 13 (StataCorp, 2013) with appropriate survey commands capable of correcting for standard errors for clustering and stratification. A custom survey weight variable (final person weight divided by number of years pooled--ten) was applied to ensure the estimates account for pooling multiple years of data, following instructions from the AHRQ (Agency for Healthcare Research and Quality, 2013b).

IV. RESULTS

A. **Descriptive Characteristics**

1. **By disability status**

There were 2,174 total sampled persons with IDD (Table I). Their obesity rate was significantly higher than the non-IDD sample (29.3% vs. 25.4%). The majority were younger than 25 years (60.1% combined), disproportionately male (57.5%), and non-Latino white (67.2%), compared to the non-IDD population mean age 38.2 years (51.2% female). The IDD group had significantly higher percentages of Non-Latino Black and other race/ethnicities persons. The IDD group was also poorer--about half were poor or had low income (<199% FPL), while roughly 70% of the non-IDD group had middle or high income (>200% FPL). The majority (nearly 80%) of sampled IDD persons lived in an urban setting. Most of the sampled persons with IDD were not married. The majority (53.9%) only had public insurance, compared to 18.6% in the non-IDD group. A small set of the sampled persons with IDD perceived fair/poor general health (8.9%) and mental health (14.0%). However, both percentages were significantly higher than those of the non-IDD group (p < .001).

AND WITHOUT IDD							
	Ν	IDD	NON-IDD	p value			
N (%)		2,174 (0.66)	306,900 (99.3)	<.001			
Obese	1,897	29.3 (1.6)	25.4 (0.2)	.012			
Predisposing Factors							
Mean age (SE)	2,174	25.4 (0.7)	38.2 (0.1)	<.001			
<18		43.4 (1.6)	22.3 (0.2)	<.001			
18-64		52.8 (1.6)	64.4 (0.2)	<.001			
>64		3.7 (0.6)	13.3 (0.2)	<.001			
Male	2,174	57.5 (1.6)	48.8 (0.1)	<.001			
Race/Ethnicity	2,059						
Non-Latino White		67.2 (1.8)	67.8 (0.6)	.725			
Non-Latino Black		16.7 (1.3)	12.2 (0.4)	<.001			
Latino		13.3 (1.2)	14.8 (0.5)	.167			
Other		2.7 (0.5)	5.2 (0.2)	<.001			
Enabling Factors							
Geographical region	2,158						
Northeast		22.3 (1.8)	18.3 (0.5)	.019			
Midwest		23.9 (1.9)	22.1 (0.6)	.335			
South		31.8 (1.7)	36.4 (0.7)	.006			
West		22.0 (1.7)	23.2 (0.6)	.478			
Annual household income	2,174						
<125% FPL (%)		30.0 (1.3)	17.3 (0.3)	<.001			
125%-199% FPL		19.5 (1.2)	13.7 (0.2)	<.001			
200%-399% FPL		30.1 (1.5)	31.0 (0.2)	.518			
400%+ FPL		20.4 (1.4)	37.9 (0.4)	<.001			
MSA	2,158	79.7 (2.1)	83.2 (0.7)	.061			
Married	2,174	6.5 (1.0)	42.9 (0.3)	.145			
Insurance status	2,174						
Any private		39.8 (1.8)	68.9 (0.4)	<.001			
Public only		53.9 (1.8)	18.6 (0.3)	<.001			
Uninsured		6.3 (0.8)	12.5 (0.2)	<.001			
Illness Level Factors							
Ever fair/poor health	1,951	8.9 (0.8)	5.3 (0.1)	<.001			
Ever fair/poor mental health status	1,937	14.0 (1.0)	2.4 (0.1)	<.001			

 TABLE I

 COMPARISON OF DESCRIPTIVE CHARACTERISTICS OF SAMPLED PERSONS WITH

 AND WITHOUT IDD

Note: Percentages are calculated using weighted data.

2. **Obese vs. non-obese within disability group**

There were 1,897 persons with non-missing BMI values in the IDD sample. There were considerable differences between non-obese (BMI<30) and obese (BMI=30 or higher) persons with IDD (Table II). Notably, obese individuals were significantly older (p < .001), more likely to be poor (FPL<125%, p = .01), more likely to have public insurance only (p < .002), and more likely to perceive fair/poor health (p = .014) compared with non-obese individuals. They also were more likely to be living in the south (p = .034), less likely to be high income (>400% FPL income, p = .020), and less likely to have any private insurance (p = .003).

SAMPLED PERSONS WITH IDD							
	Ν	Non-Obese	Obese	p value			
N (%)		1,310 (70.7)	587 (29.3)	<.001			
Predisposing Factors							
Mean age (SE)	1,897	27.1 (0.9)	32.1 (1.0)	<.001			
<18		39.5 (2.1)	21.7 (2.5)	<.001			
18-64		56.1(2.1)	75.1 (2.6)	<.001			
>64		4.4 (0.9)	3.2 (0.9)	.325			
Male	1,897	59.9 (2.04)	52.7 (3.3)	.060			
Race/Ethnicity	1,885						
Non-Latino White		69.8 (2.1)	64.1 (3.2)	.096			
Non-Latino Black		15.9 (1.5)	20.1 (2.4)	.107			
Latino		11.1 (1.3)	13.6 (2.1)	.258			
Other		3.1 (0.6)	2.2 (1.1)	.434			
Enabling Factors							
Geographical region	1,897						
Northeast		22.5 (2.1)	25.4 (3.2)	.361			
Midwest		24.5 (2.2)	19.9 (2.7)	.124			
South		29.6 (2.1)	37.0 (3.3)	.034			
West		23.5 (2.1)	17.8 (3.0)	.074			
Annual household income	1,897						
<125% FPL (%)		28.3 (1.5)	36.4 (2.9)	.010			
125%-199% FPL		19.1 (1.5)	22.2 (2.4)	.277			
200%-399% FPL		31.2 (1.8)	27.3 (2.8)	.206			
400% + FPL		21.4 (1.7)	14.2 (2.6)	.020			
MSA	1,897	79.6 (2.4)	79.8 (2.9)	.951			
Married	1,897	6.4 (1.4)	10.2 (2.2)	.145			
Insurance status	1,897						
Any private		39.8 (2.3)	29.4 (2.9)	.003			
Public only		54.2 (2.3)	62.4 (3.0)	.002			
Uninsured		6.0 (0.9)	8.2 (1.9)	.268			
Illness Level Factors							
Ever fair/poor health	1,897	8.0 (0.9)	13.8 (2.2)	.014			
Ever fair/poor mental health status	1,897	14.7 (1.3)	16.2 (2.0)	.554			

 TABLE II

 COMPARISON OF DESCRIPTIVE CHARACTERISTICS OF OBESE VS. NON-OBESE

 SAMPLED PERSONS WITH IDD

Note: Percentages are calculated using weighted data.

B. <u>Health Care Expenditures and Utilization of Obese and Non-Obese Individuals with</u> Intellectual and Developmental Disabilities

1. <u>Types of health care expenditures</u>

Tables III and IV present the per capita (across users and non-users of service) and per user mean health care expenditures by obesity status and type in 2014 dollars. The total per capita mean health care expenditures of non-obese and obese persons with IDD was \$6,706 and \$6,642, respectively. There were no significant differences between non-obese and obese persons in any of the categories. The highest level of expenditures for both groups were for HHC, Medications, and Office-Based Visits.

Among users, the total expenditures for non-obese and obese persons with IDD were \$7,565 and \$7,501, respectively. There were no significant differences between non-obese and obese persons in any categories. In both groups, Hospital Inpatient expenditures replaced Office-Based Visits in the top three expenditures categories, ranking second with over \$10,000 spent.

	I YPE IN 2014 DOLLARS							
			Non-Obese		Obese			
	Non-IDD	SE	IDD	SE	IDD	SE	p value	
Office-Based Visits	992	11	1136	123	1481	789	.348	
Hospital Outpatient	391	10	245	51	372	136	.377	
Hospital ER	143	3	99	24	127	38	.524	
Hospital Inpatient	1286	41	622	166	1113	355	.209	
Dental	312	4	307	38	174	52	.599	
HHC	150	12	2305	501	1521	378	.599	
Medications	911	13	1511	266	1799	213	.218	
Glass/Contact Lenses	47	1	33	4	29	6	.576	
Other Equipment/ Supply	38	1	162	81	47	14	.160	
Total payments	4300	46	6706	747	6642	679	.950	

TABLE IIIPER CAPITA MEAN HEALTH CARE EXPENDITURES BY OBESITY STATUS AND
TYPE IN 2014 DOLLARS

TABLE IVIDD PER USER MEAN HEALTH CARE EXPENDITURES BY OBESITY STATUS AND
TYPE IN 2014 DOLLARS

	User n	User %	Non-Obese	SE	Obese	SE	<i>p</i> value
Office-Based Visits	1444	76.1	1481	159	1823	429	.444
Hospital Outpatient	153	8.1	1537	277	1904	642	.592
Hospital ER	152	8.0	722	144	746	198	.920
Hospital Inpatient	73	3.8	10336	1824	11909	2843	.632
Dental	721	38.0	693	78	736	118	.491
HHC	217	11.4	20044	3736	14075	2582	.201
Medications	1336	70.4	2152	370	2464	268	.393
Glass/Contact Lenses	240	12.7	233	16	248	28	.650
Other Equipment/ Supply	168	8.9	1521	731	709	166	.278
Total	1650	87.0	7565	837	7501	730	.954

2. <u>Sources of payment</u>

Tables V and VI present the IDD per capita and per user mean health care expenditures by obesity status and source of payment in 2014 dollars. The principal payer of IDD health care expenditures was Medicaid, with \$3,251 and \$3,272 per capita in non-obese and obese groups, accounting for almost half of the total amount. No significant differences were found between the non-obese and obese groups.

Among users of services, more than 68% of sampled persons with IDD had positive outof-pocket spending amounts, but the top payer remains Medicaid (\$6,675 vs. \$5,412 for nonobese and obese). Medicare and private insurance ranked second and third for both groups.

	Non-Obese	SE	Obese	SE	<i>p</i> value
Out of Pocket	687	93	765	195	.716
Medicare	1036	242	1177	241	.681
Medicaid	3251	477	3272	452	.975
Private Insurance	1172	337	891	246	.498
Other Sources	561	157	538	142	.914
TOTAL	6706	747	6642	679	.950

TABLE VIDD PER CAPITA HEALTH CARE EXPENDITURES BY OBESITY STATUS AND
SOURCE OF PAYMENT IN 2014 DOLLARS

IDD I LK OSLK IIL	IDD TER OSER HEALTH CARE EXTENDITORES DI OBESITI SIATOS AND SOURCE										
OF PAYMENT IN 2014 DOLLARS											
	User n	User %	Non-Obese	SE	Obese	SE	<i>p</i> value				
Out of Pocket	1307	68.9	846	124	1040	257	.740				
Medicare	451	23.8	5216	1117	3655	597	.240				
Medicaid	1108	58.4	6675	922	5412	697	.279				
Private Insurance	432	22.8	3528	973	3651	832	.923				
Other Sources	430	22.7	2437	643	2420	588	.985				
TOTAL	1650	87.0	7564	836	7501	730	.954				

TABLE VIIDD PER USER HEALTH CARE EXPENDITURES BY OBESITY STATUS AND SOURCE
OF PAYMENT IN 2014 DOLLARS

3. **Utilization**

Health care utilization in all categories except home health care are reported in Table VII and Table VIII. There were a number of significant differences in health care utilization between the non-obese and obese groups. Notably, in both per capita and per user comparisons, the obese group had significant higher utilization in ER Visits and Prescription Medicines utilization. Among users, the ER Visits were not significantly different but Prescription Medicines remained different.

The top three categories with highest number of persons with positive utilization were Office-Based Visits (77.5%), Prescription Medicines (70.5%), and Dental Visits (38.4%). Among users of Hospital Inpatient services, an average of about 1.40 discharges and 7.44 inpatient nights were reported for both non-obese and obese groups.

1
value
.208
.621
.026
.395
.325
.001
.452
-

 TABLE VII

 IDD PER CAPITA NON-HCC HEALTH CARE UTILIZATION BY OBESITY STATUS

IDD PER USER NON-HCC HEALTH CARE UTILIZATION BY OBESITY STATUS							
	User	User	Non-				
	n	%	Obese	SE	Obese	SE	p value
Total Office Based Visits	1471	77.5	9.80	0.87	12.47	2.35	.265
Total Outpatient Visits	294	15.5	3.3	0.48	2.86	0.78	.653
Total Emergency Room Visits	138	7.3	1.64	0.18	1.75	0.22	.679
Total # of Hospital Discharges	144	7.6	1.49	0.14	1.37	0.13	.552
Total # of Hospital Inpatient Nights	137	7.2	7.44	1.70	7.52	1.34	.970
Total Prescription Medicines	1337	70.5	19.4	1.09	26.3	1.75	.001
Total Dental Visits	729	38.4	2.47	0.15	2.59	0.28	.452

 TABLE VIII

 IDD PER USER NON-HCC HEALTH CARE UTILIZATION BY OBESITY STATUS

Home Health Care utilization was reported separately in Tables IX and X; again, unlike other types of medical events, which were counted on a per-visit or per-use basis, HHC was quantified on a per-month basis (Agency for Healthcare Research and Quality, 2013a). The average per capita utilization of HHC was 18.46 services days among non-obese, and 13.72 among obese persons with IDD. Among users, 148.48 service days per person were reported for non-obese persons and 117.90 for obese persons. There were no significant differences between non-obese and obese groups. High utilization were reported for users of HHC. Over 110 service days were received per user from formal care workers employed by agencies, hospitals, or

nursing homes, which accounts for about 10% of all sampled persons with IDD. Note that, receiving care from a nursing home employee does not constitute living in an institution. It must be noted that MEPS only collects data for the noninstitutionalized population. If a person lived in a nursing home full-time during a survey period, they would be considered an "out-of-scope" sample person and no utilization or expenditures data would be collected for the period they spent in institutions.

IDD PER CAPITA HOME HEALTH CARE DAYS BY OBESITY STATUS								
	Non-Obese	SE	Obese	SE	p value			
Total HHC Days	18.46	2.90	13.72	2.71	.235			
Agency Sponsored	12.98	2.21	11.28	2.60	.612			
Paid Independent Providers	1.49	0.92	0.18	0.09	.158			
Informal Provider	4.60	1.41	2.24	0.98	.165			

TABLE IX

IDD PER USER HOME HEALTH CARE DAYS BY OBESITY STATUS										
	User	User	Non-							
	n	%	Obese	SE	Obese	SE	p value			
Total HHC Days	231	12.2	148.48	15.71	117.90	12.80	.129			
Agency Sponsored	193	10.2	126.45	14.77	118.13	15.31	.691			
Paid Independent Providers	18	0.9	120.38	56.50	27.40	9.73	.121			
Informal Provider	50	2.6	140.41	26.41	103.70	19.24	.258			

 TABLE X

 IDD PER USER HOME HEALTH CARE DAYS BY OBESITY STATUS

4. Multivariate regression

The OLS multivariate regression (Table XI) had an overall significant model effect, F(28, 379) = 3.35, p < .001. Since this was a linear regression model, coefficients can be interpreted as the difference in total expenditures between different predictor values and the reference. Those who were under 18 years of age (\$2068, t = 2.20, p = .028) and over 64 years (\$4414, t = 2.29, p = .023) had significantly higher total health care expenditures. Uninsured individuals had significantly lower (\$4045) estimated health care expenditures compared with persons with any private insurance, t = 5.18, SE = 780, p < .001. Persons who experienced fair or poor health had significantly higher (\$5,374) estimated health care expenditures, t = 3.65, SE=1472, p < .001. Finally, when compared with non-Latino white persons, non-Latino Black individuals had significantly lower health care expenditures (\$1,883), t = -2.63, SE = 717, p = .009. No other variables were significant in the model.

TABLE XI

	LEVI	EL FACTORS	,	
		Coefficients	Test value	p value
Overall Model			3.35	<.001
Year Fixed Effects				
2002	Ref			
2003		519.1	0.63	.528
2004		611.4	0.74	.460
2005		1947.7	1.09	.276
2006		1361.5	1.29	.196
2007		1685.2	0.95	.340
2008		768.9	0.72	.474
2009		1051.3	0.91	.363
2010		1170.5	1.06	.292
2011		630.1	0.72	.472
BMI status				
Not overweight/obese	Ref			
Overweight		743.2	1.07	.285
Obese		1200.3	1.47	.143
Predisposing Factors				
Age				
<18		2067.8	2.20	.028
18-64	Ref			
>64		4413.9	2.29	.023
Sex				
Female	Ref			
Male		-1338.7	-1.56	.119
Race/Ethnicity				
Non-Latino White	Ref			
Non-Latino Black		-1883.4	-2.63	.009
Latino		-304.2	-0.21	.832
Other		-1050.5	-0.72	.472

MULTIVARIATE REGRESSION MODELING TOTAL NON-HCC HEALTH CARE EXPENDITURES BY BMI STATUS AND PREDISPOSING, ENABLING AND ILLNESS

LEVEL FA		,		
		Coefficients	Test value	<i>p</i> value
Enabling Factors				
Geographical Region				
Northeast	Ref			
Midwest		177.3	0.17	.864
South		80.0	0.06	.955
West		-620.9	-0.55	.582
Annual Household Income				
<125% FPL (%)	Ref			
125%-199% FPL		-408.9	-0.65	.518
200%-399% FPL		354.8	0.52	.603
400% + FPL		164.2	0.15	.879
Urban/rural status				
Non-MSA	Ref			
MSA		1029.3	1.71	.088
Insurance status				
Any private	Ref			
Public only		-817.6	-1.05	.295
Uninsured		-4045.4	-5.18	<.001
Illness Level Factors				
Good-Excellent Health	Ref			
Ever Fair/poor Health		5374.4	3.65	<.001
Ever Fair/poor Mental Health Status		1151.0	1.77	.077

MULTIVARIATE REGRESSION MODELING TOTAL NON-HCC HEALTH CARE EXPENDITURES BY BMI STATUS AND PREDISPOSING, ENABLING AND ILLNESS LEVEL FACTORS (continued)

5. Multivariate two-part model regressions

The Two-Part Model regression model was significant, F(27, 375) = 4.22, p< .001. Part One of the Two-Part Model (Table XII) estimated the probability of having a positive (non-zero) expenditures value. The overall proportion of health care users was 98.6%. The year fixed effects and BMI status were not significant in this part. Individuals under 18 were more likely to have expenditures (t = 3.10, p = .002). Similar to the OLS regression, uninsured individuals (t=5.29, p < .001) and individuals in the non-Latino other race/ethnicity category were less likely to have health care expenditures than the rest of the sample. On the other hand, persons who experienced fair or poor health (t = 2.39, p = .018) and mental health status (t=2.81, p= .005) were more likely to have expenditures. Similar to the OLS model results, non-Latino Black Persons were less likely to have a expenditures (t = -3.27, p < .001).

Part Two of the TPM utilized a Gamma error distribution General Linear Model (GLM) and was connected to Part One via a log link. It is a common procedure to fit models with positive only data and skewed distribution. Table XIII presents the results of the second part of the TPM. Obese individuals were more likely to have higher expenditures (t = 2.77, p < .006). Age under 18 (t = 2.57, p = .010) and over 64 (t = 6.67, p < .001) were significant predictors of higher expenditures. Men had lower expected expenditures than women did (t = 2.41, p = .017). Compared with the reference group, uninsured individuals (t = 5.13, p < .001) were estimated to have significantly lower expenditures, and those with perceived fair/poor health (t=5.24, p < .001) and mental health status (t = 2.89, p = .004) statuses estimated higher expenditures.

		Coefficients	Test value	<i>p</i> value
Overall Model			4.22	<.001
Year Fixed Effects				
2002	Ref			
2003		0.03	0.07	.947
2004		0.30	0.78	.433
2005		0.64	1.53	.126
2006		0.40	0.88	.380
2007		-0.04	-0.08	.934
2008		-0.39	-0.98	.328
2009		-0.24	-0.64	.523
2010		-0.18	-0.42	.672
2011		0.46	1.36	.176
BMI status				
Not overweight/obese	Ref			
Overweight		0.39	1.48	.140
Obese		0.23	0.77	.444
Predisposing Factors				
Age				
<18		0.78	3.10	.002
18-64	Ref			
>64		-	-	
Sex				
Female	Ref			
Male		-0.29	-1.21	.228
Race/Ethnicity				
Non-Latino White	Ref			
Non-Latino Black		-0.84	-3.27	<.001
Latino		-0.44	-1.58	.115
Other		-1.08	-2.90	.004

 TABLE XII

 PART ONE OF MULTIVARIATE TWO-PART MODEL REGRESSION (LOGIT)

		Coefficients	Test value	<i>p</i> value
Enabling Factors				-
Geographical Region				
Northeast	Ref			
Midwest		0.07	0.41	.680
South		0.07	0.37	.711
West		-0.06	-0.34	.737
Annual Household Income				
<125% FPL (%)	Ref			
125%-199% FPL		-0.19	-1.52	.130
200%-399% FPL		0.04	0.33	.740
400%+ FPL		0.08	0.47	.639
Urban/rural status				
Non-MSA	Ref			
MSA		0.19	1.58	.114
Insurance status				
Any private	Ref			
Public only		-0.03	-0.21	.832
Uninsured		-1.08	-5.13	<.001
Illness Level Factors				
Good-Excellent Health	Ref			
Ever Fair/poor Health		0.76	5.24	<.001
Ever Fair/poor Mental		0.30	2.89	.004
Health Status				

 TABLE XII

 PART ONE OF MULTIVARIATE TWO-PART MODEL REGRESSION (LOGIT) (continued)

PART TWO OF MULTIVA	RIATE T			
		Coefficients	Test value	p value
Overall Model			4.18	<.001
Year Fixed Effects				
2002	Ref			
2003		0.30	1.65	.100
2004		0.13	0.77	.444
2005		0.30	1.30	.194
2006		0.29	1.65	.099
2007		0.40	1.62	.105
2008		0.40	1.89	.060
2009		0.29	1.38	.169
2010		0.30	1.46	.144
2011		0.16	0.91	.365
BMI status				
Not overweight/obese	Ref			
Overweight		0.23	1.87	.062
Obese		0.38	2.77	.006
Predisposing Factors				
Age				
<18		0.39	2.57	.010
18-64	Ref			
>64		0.73	6.67	<.001
Sex				
Female	Ref			
Male		-0.30	-2.41	.017
Race/Ethnicity				
Non-Latino White	Ref			
Non-Latino Black		-0.39	-2.51	.013
Latino		-0.02	-0.08	.940
Other		0.13	0.33	.739

 TABLE XIII

 PART TWO OF MULTIVARIATE TWO-PART MODEL REGRESSION (GLM)

		Coefficients	Test value	<i>p</i> value
Enabling Factors				
Geographical Region				
Northeast	Ref			
Midwest		0.12	0.65	.518
South		0.02	0.09	.932
West		-0.15	-0.83	.408
Annual Household Income				
<125% FPL (%)	Ref			
125%-199% FPL		-0.14	-1.06	.288
200%-399% FPL		0.21	1.48	.140
400%+ FPL		0.32	1.43	.154
Urban/rural status				
Non-MSA	Ref			
MSA		0.26	1.97	.050
Insurance status				
Any private	Ref			
Public only		0.16	1.04	.300
Uninsured		-1.31	-6.27	.000
Illness Level Factors				
Good-Excellent Health	Ref			
Ever Fair/poor Health		0.82	4.80	.000
Ever Fair/poor Mental				
Health Status		0.39	3.12	.002

 TABLE XIII

 PART TWO OF MULTIVARIATE TWO-PART MODEL REGRESSION (GLM) (continue)

6. Estimated health care expenditures

Table XIV presents the comparisons of estimated per capita and per user total health care expenditures by BMI status, based on coefficients derived from the TPM (see Tables XIITABLE X and XIII). For each observation, predictor variable values were plugged in to calculate the fitted expenditures for each of the three BMI status groups. Overall, the obese (\$5706) group had the highest estimated expenditures, F(2, 394) = 13.11, p < .001, while the difference in total expenditures between the overweight and NOVOB groups was not statistically significant, F(1, 394) = 1.81, p = .327.

EXPENDITURES BY BMI STATUS										
	NOVOB* Overweight Obese									
	User n	User %	Mean	SE	Mean	SE	Mean	SE	Test value	p value
PER CAPITA			4140	119	4470	143	5473	225	15.34	<.001 ^{bc}
PER USER	1,639	86.3	4358	128	4619	149	5706	244	13.11	<.001 ^{bc}

TABLE XIVIDD ESTIMATED PER CAPITA AND PER USER MEAN TOTAL HEALTH CARE
EXPENDITURES BY BMI STATUS

Note: *NOVOB - Not overweight nor obese

^a Not overweight nor obese vs. Overweight, p < .05

^b Not overweight nor obese vs. Obese, p < .05

^c Overweight vs. Obese, p < .05

Table XV presents the comparisons of estimated per capita health care expenditures by type and BMI status, based on coefficients derived from the TPM (see TPM results). The obese group had the highest estimated expenditures in four categories: office-based visits, hospital

outpatient, hospital inpatient, and medications. The overweight group had overall highest estimated expenditures but was the highest group in only one category -- home health care. Compared to the NOVOB group, they had significantly higher estimated expenditures in hospital ER and home health care, but lower estimated expenditures in hospital inpatient, glass/contact lenses, and other equipment/supply.

TYPE & BMI STATUS									
	NOVOB		Overw	Overweight		Obese			
	Mean	SE	Mean	SE	Mean	SE	value	p value	
Office-Based									
Visits	1134.0	34.4	1151.2	48.6	1446.8	73.9	8.62	<.001 ^{bc}	
Hospital									
Outpatient	336.7	20.9	354.6	25.5	486.2	32.7	8.14	$<.001^{bc}$	
Hospital ER	108.7	7.8	213.5	21.3	190.3	20.5	13.79	<.001 ^{ab}	
Hospital									
Inpatient	862.4	74.0	404.2	37.6	1314.3	124.3	35.36	$< .001^{abc}$	
Dental	343.9	15.2	297.1	18.0	286.3	20.0	4.62	.010 ^b	
HHC	1437.1	121.9	3248.0	355.2	1852.1	180.0	13.34	<.001 ^{ac}	
Medications	1451.0	60.8	1491.9	61.8	2051.4	139.6	8.32	$<.001^{bc}$	
Glass/Contact									
Lenses	39.5	1.6	24.6	1.2	28.7	1.4	27.27	<.001 ^{abc}	
Other									
Equipment/									
Supply	217.0	15.8	62.6	9.2	100.7	15.2	38.70	<.001 ^{abc}	
OVERALL	5772.3	186.1	7984.2	290.4	7478.8	474.5	25.10	<.001 ^{ab}	

 Table XV

 IDD ESTIMATED PER CAPITA MEAN TOTAL HEALTH CARE EXPENDITURES BY

 TYPE & BMI STATUS

Note: *NOVOB - Not overweight nor obese

^a Not overweight nor obese vs. Overweight, p < .05

^b Not overweight nor obese vs. Obese, p < .05

^c Overweight vs. Obese, p < .05

SOURCE OF PAYMENT AND BMI STATUS								
	Not overweight							
_	nor ob	bese	Overweight		Obese		Test	
	Mean	SE	Mean	SE	Mean	SE	value	p value
Out of Pocket	664.5	36.9	623.3	42.0	796.0	57.0	3.11	.046 ^{bc}
Medicare	891.5	140.3	846.5	90.1	1773.7	221.1	8.33	$.002^{bc}$
Medicaid	1513.8	77.9	1681.5	103.0	1873.4	97.8	4.39	.013 ^b
Private Insurance	2574.9	138.4	2129.2	108.1	3094.3	209.2	8.96	.002 ^{ac}
Other Sources	259.4	18.1	441.4	35.1	441.7	24.1	28.26	<.001 ^{ab}
OVERALL	4139.8	119.5	4469.8	142.8	5472.9	225.3	15.34	<.001 ^{bc}

 Table XVI

 AVERAGE IDD ESTIMATED NON-HCC HEALTH CARE EXPENDITURES BY

 SOURCE OF PAYMENT AND BMI STATUS

Note: ^a Not overweight nor obese vs. Overweight

^b Not overweight nor obese vs. Obese

^c Overweight vs. Obese

Table XVI shows the comparisons of estimated per capita health care expenditures by source of payment and BMI status, based on coefficients derived from the TPM. The obese group had the highest expenditures. The overweight group showed higher expenditures in other sources, but otherwise similar results as the NOVOB group, and even lower expenditures in private insurance payments.

V. DISCUSSION

In the following sections, the three research topics are separately discussed: 1) obesity prevalence among Americans with IDD, 2) comparisons on their total health care expenditures, costs by types of services, and sources of payment, and 3) obesity's impact on health care expenditures of Americans with IDD. Finally, the closing sections covered the limitations and implications of the study, and presented recommendations for future research and policy making efforts.

A. <u>Obesity Status of Noninstitutionalized Americans with Intellectual and</u> <u>Developmental Disabilities</u>

Existing studies general agree that Americans with IDD have higher levels of obesity compared with the general population (Melville et al., 2008; Rimmer & Yamaki, 2006; Rimmer et al., 2010). However, consensus has not been reached on its prevalence within the population. Recent reports of obesity prevalence have ranged from 32% (Harris et al., 2003), around 35% (Moran et al., 2005; Yamaki, 2005), to as high as 71% in study participants with Down Syndrome (Rimmer & Wang, 2005). The discrepancies in estimates have been attributed to sample biases, for example, drawing from different living settings and using non-representative, convenience samples (Barnes et al., 2013; Rimmer, Braddock, & Marks, 1995; Rimmer & Wang, 2005). Large-scale studies using national surveys are rare. Notably, a recent study (Havercamp & Scott, 2015) used large, combined samples from Behavior Risk Factor Surveillance Survey and the National Core Indicators Consumer Survey and found the obesity rate to be at 31.1% for Years 2009-2011. In the present study, the overall obesity rate was 29.3%. However, caution should be used when comparing this obesity rate to the Havercamp and Scott study for a number of reasons. First, the sample in Havercamp and Scott (2015) were primarily (42%) in the age range 35-54, whereas in the present study, the majority (60.1%) of the sample were younger than 25 years, and a little less than half (43.4%) were younger than 18. Second, the sample in Havercamp and Scott (2015) did not exclude institution-living persons. Finally, it is unclear what operational definitions was used to identify persons with IDD from Behavioral Risk Factor Surveillance System and National Core Indicators Consumer Survey in Havercamp and Scott (2015). Despite the methodological differences, the estimates from Havercamp and Scott were similar to the present study. Additionally, IDD obesity rate estimates from the present study are higher than the general population. Also using linked NHIS/MEPS data, Finkelstein et al. (2003) estimated obesity rate for U.S. adults from 1996-1998 to be 17.9%. Even though overall obesity rates increased between the 1990s and the 2000s, the IDD obesity rates obtained from the present study remained significantly elevated compared with the general population.

B. <u>The Extent, Use, Source of Payment, and Other Characteristics of Health Care</u> <u>Expenditures</u>

1. <u>Types of health care expenditures</u>

One of the purposes of the present study is to describe the basic characteristics of health care expenditures of Americans with IDD. The top three total expenditures categories for community-living Americans with IDD were home health care, medications and office-based visits. Compared with the top three expenditures categories for the general population Hospital Inpatient (\$1,286), Office-Based Visits (\$992), and Medications (\$911), the high HHC services expenditures suggest that community-living Americans with IDD have a very different pattern of using their health care resources from their counterparts without IDD. At the time of writing, studies on disability and HHC only examined the elderly persons (Bruce et al., 2002; Koroukian, Murray, & Madigan, 2006). No existing study has systemically examined community-living persons with IDD and HHC. To understand what HHC utilization and expenditures mean for community-living American with IDD, such studies are urgently needed. For example, it is not clear whether HHC has preventative effects such that future health care costs in other categories are lower.

2. Sources of payment

Public and private insurance programs decrease the price of health care and remove barriers to health care utilization. The largest source of payment for IDD health care expenditures was Medicaid. This is not surprising given the role of Medicaid in community living and health care for Americans with IDD since the mid-1980s (Kancherla, Amendah, Grosse, Yeargin-Allsopp, & Van Naarden Braun, 2012). In recent years, health care expenditures on home and community-based services have increased rapidly, therefore it is critical to know more about the drivers of costs for people with IDD and the role of obesity. In this study, obesity was not found to be a significant predictor of higher per capita or per user Medicaid expenditures. However, this outcome did not completely rule out obesity's potential impact as the relatively large standard errors indicated insufficient sample size.

Medicare was the second highest payer of health care in this study. Americans with IDD become eligible for Medicare after two years of receiving Social Security Disability Insurance (Iezzoni et al., 2008). As such, Medicare is an important source of payment for health care expenditures among Americans with IDD. Even though the IDD sample in the present study was largely skewed toward younger ages (96.5% under age 65), about 12.4% of those under the age 65 used Medicare to pay for health care. The sample also included 342 individuals with IDD who had positive expenditures in both Medicare and Medicaid, suggesting that they are dually eligible. There have been many reports regarding the higher levels of health care utilization and

expenditures incurred by dually eligible individuals (Kane, Wysocki, Parashuram, Shippee, & Lum, 2013; Reichard & Fox, 2013). However, most studies did not separately study the subgroups of the highly heterogeneous dual enrollees. Relatively little is known about Medicare beneficiaries with IDD and their health. As Medicare spending continues to rise, it is important to keep gaining understanding of the determinants and drivers of the rising costs in the different populations that Medicare serves.

Even though only a fraction of sampled persons with IDD used private insurance, it was the third highest payer. Previous research showed that the efficacy of private insurance was mixed for different families because of high premiums, high deductibles, and inadequate coverage in areas such as dental care (Reichard, Sacco, Turnbull, & Scotti, 2004). Due to time and resource constraints, the present study did not examine individual characteristics of private insurance. It would also be interesting to see whether a combination of private and public insurance provides better protection against financial burden from medical events.

Out of pocket expenditures were used by many (68.9% of sampled persons with IDD) but on average a smaller source of payment than expected. However, this does not necessarily imply low financial burden associated with health care expenditures in families of Americans with IDD because this study did not examine the co-occurrence of poverty and out of pocket expenditures. Given that those with IDD were more likely (49.5% vs 31%) than those without IDD to be from poor or low income households, poverty and out of pocket expenditures are important topics to be examined in the future.

3. Health care utilization

One underlying assumption of the theoretical framework used in this study was that health care expenditures were the direct consequences of health care utilization. The three leading categories in utilization were the same as expenditures: HHC, Prescription medicines, and Office-Based Visits. However, the extent of expenditures did not necessarily reflect the degree of utilization due to the nature of different costs associating with different types of services, as well as different unit of measurement. For example, total Office-Based Visits were much higher than Hospital Outpatient Visits both in users and non-users of services, but Office-Based Visits expenditures were similar to Hospital Outpatient expenditures among users. Therefore, even though many service categories seemed to have yielded very low utilization, their financial impact cannot be overlooked.

a. Non-home-health-care utilization

Results showed high use of Prescription Medicines. This includes both the initial purchase and refills. Although lower than the national average, rates of use were a concern because age is a significant driver for utilization in this category. In 2006 for example, the average utilization for ages 0-4, 5-17, and 18-44 in the general population were 3.9, 5.9, and 9.3 purchases/refills, respectively (Agency for Healthcare Research and Quality, 2012). In the present study sample the rate was much higher: 13.6 and 19.3 purchases/refills for non-obese and obese participants with IDD. This suggests that Americans with IDD are much more likely to have higher medication utilization than their same-age counterparts without IDD. It is unclear what types of prescription medication were purchased. Previous research has shown that mood stabilizers, antiepileptic medication and antipsychotic drugs use in adults with ID was common and has adverse effects, including weight gains, drowsiness, and neutropenia (Deb, Sohanpal, Soni, Lentre, & Unwin, 2007). As such, future research should further examine this disparity of utilization and its potential relationship with adverse effects, e.g., elevated obesity rates in the IDD population.

Dental care utilization was low for the Americans with IDD. With almost half of the sample being 17 years or younger, the figure is considerably lower than the national average for ages 2 - 17 in the general population (Agency for Healthcare Research and Quality, 2006). Inadequate dental care has been cited as a major health issue for Americans with IDD (Anders & Davis, 2010). Low dental care utilization in the present study warrants a more in-depth examination in future studies.

b. Home health care utilization

Examples of "agency-sponsored" care provider include occupational/physical therapy, homemakers, hospice workers, nurses, and home health aides. The service days received from formal health workers employed by agencies, hospitals, or nursing homes were high. However, with the data available in MEPS, it was not possible to determine what services were used, and whether they were actually health care or disability support. To date, the literature on home care is limited and generally related to aging and end-oflife care (Bruce et al., 2002; Koroukian et al., 2006; Tuffrey-Wijne, Hogg, & Curfs, 2007). Therefore, there is a pressing need for analyzing the details of HHC utilization and expenditures for all ages in future research efforts.

There has been a great deal of research on the topic of caregiving and related outcomes (Caldwell, 2008; Murphy, Christian, Caplin, & Young, 2007; Stacey, 2005). Family caregivers of people with IDD tend to have poorer overall health and mental health status (Magaña & Smith, 2006a, 2006b; Savage & Bailey, 2004). In the present study, informal home health care services were high among users of the service. In MEPS this category is identified as unpaid care, i.e. no expenditures data were collected for utilization of this type. It is worth noting that this category excluded family caregivers who lived in the sampled household but included family

and friends who lived elsewhere. MEPS also did not specify which family member/friend provided care. Therefore, unfortunately this study was not able to further examine the topic of health care expenditures of family caregivers.

Paid independent home health care had the fewest service utilization days out of the three categories. Typical examples of a paid independent provider include companions and nursing assistants. Details of the utilization in this category were not available in MEPS annual consolidated files and therefore were not included in the analysis.

C. <u>Two-Part Regression Model and Estimated Health Care Expenditures</u>

The OLS multivariate regression was mainly used as a preliminary test and was not presumed to provide accurate estimates of health care expenditures. In this simplistic model, only a few predictors were significant (age, race/ethnicity, insurance status, perceived health). Notably, the key variable in the present study--BMI status was not significant, which suggests that OLS regression might not be a suitable model for the task of examining the relationship between obesity and expenditures.

The two part regression addressed Research Question 3 - "Using a two-part regression model, what are the estimated annual health care expenditures for noninstitutionalized obese and non-obese Americans with IDD?" To my knowledge, this is the first study to estimate health care expenditures of Americans with IDD with the Two-Part Model (TPM) regression approach. Estimates of expenditures were generated as outcomes of the TPM. Contrasting the OLS regressions, the year fixed effects, BMI status, as well as other predisposing factors (age) and enabling resources variables (MSA) were significant in this model.

1. Expenditures by body mass index status

Overall, the obese group had the highest non-HHC expenditures. A linear relationship between low to high BMI status and expenditures was found. When HHC is included, health care expenditures peaked at overweight (BMI 25-29.9) in both per capita and per user estimates. However, after excluding HHC costs, being overweight was only associated with an estimated additional \$330 in expenditures compared with NOVOB. Being obese is associated with an estimated additional \$1,333 in expenditures compared with the reference group. This outcome differs from the findings of (Finkelstein et al., 2003), who estimated the adult medical spending attributable to overweight was about one third of what was attributable to obesity (\$247, 14.5% vs \$732, 37.4%). Compared with Finkelstein et al. (2003), who used an exclusively adult sample, the present study included individuals of all ages, and used ageappropriate BMI standards in generating the BMI status variable. Children are less likely to be obese, and when obese, are less likely to have co-morbidities of the same amount and severity as adults, thus potentially associating with lower expenditures (Reilly et al., 2003), but the present study still found higher associated costs. Granted, Finkelstein et al. (2003) used data collected from Years 1996-1998, whereas in the present study I used year 2002-2011. However, the discrepancy in associated costs warrants a more in-depth examination.

2. Expenditures by type and body mass index status

The overweight group had the overall highest predicted expenditures but was only the highest group in one category, HHC. This suggests the importance of HHC might be a critical contributor to the overweight group's high overall expenditures. To my knowledge, this is the first study to highlight HHC in overweight Americans with IDD and their health expenditures. It is possible that compared with obese individuals, the overweight participants with IDD used a wider range of services such as a combination of assistive device support, occupational/physical therapy, and personal assistants. Overweight participants with IDD were also on average 1.5 years younger than obese participants, which could have an impact on their HHC usage. An in-depth examination of different types of HHC utilization and expenditures by age group among overweight Americans with IDD should be conducted.

The obese group had the highest predicted expenditures in four categories: office-based visits, hospital outpatient, hospital inpatient, and medications. This could theoretically be explained by higher relative risks of related diseases (Wolf & Colditz, 1998), such as type 2 diabetes, coronary heart disease, and hypertension. It is of interest to examine the detailed features of office-based visits, hospital outpatient, hospital inpatient, and medications health care expenditures, and see if they support the hypothesis that obesity drives costs through those pathways.

3. Expenditures by source of payment and body mass index status

The obese group had the highest estimated expenditures in out of pocket, Medicare, and private insurance payments. High out of pocket expenditures are concerning because obese individuals were also significantly more likely to be in the bottom two income groups (<199% FPL). High out of pocket spending could lead to higher financial burden and unmet health needs in families with children (Wisk & Witt, 2012). It is imperative for next research efforts to address high out of pocket health care expenditures of obese Americans with IDD.

Existing research suggests that high Medicare spending could be linked to chronic conditions (Thorpe & Howard, 2006). The present study was not able to include the number of chronic conditions as a predictor, therefore, unable to replicate the finding. However, perceived

health/mental status can be viewed as a proxy measure of chronic conditions. Source of Payment Payment TPM regression results (not shown in this manuscript) showed that perceived health/mental health are significant predictors of Medicare expenditures. In the future, it is of interest to examine chronic condition's role in driving up Medicare expenditures.

To sum up, the present study found that community-living Americans with IDD had higher obesity rate than the general population, but lower than other recent estimates. High utilization and expenditures were found in HHC, Prescription Medicines and Office-Based Visits categories. Medicaid was the main source of payment for health care expenditures. Being overweight and obese were separate, major drivers of health care expenditures. Given the intrinsic limitations of the data used, caution is advised in interpreting the results.

D. Limitations

The present study has a number of theoretical and methodological limitations. First, the unit of analysis was "the individual." The study framework assumes that each individual was independent of others, while there could have been a great deal of interplay of factors between family members. By operating on the family level, key concepts and variables such as number of family members living in the same household, presence of parents/children, financial burden, unmet healthcare needs, stress, coping, and resilience could be examined. Multilevel model could be used to analyze the clustering effects of individuals within families. However, due to time and resource constraints, I had chosen to limit the scope of the present study to individual level characteristics and outcomes.

Second, this was essentially a cross-sectional study even though ten years of data were used and MEPS had a two-year longitudinal panel setup. Longitudinal components could allow examination and tracking of important changes such as health insurance and health status overtime and potentially permit causal inference. However, because BMI was not tracked longitudinally within MEPS two-year panels, in the present study, the dataset was treated as a nationally representative cross-sectional average of the years included.

Third, it must be noted that both NHIS and MEPS data were based on self-report and proxy-report and were subject to recall bias, social desirability bias, and acquiescence bias, among other limitations (Gorber, Tremblay, Moher, & Gorber, 2007). Although misreporting due to recall errors could potentially misrepresent health care utilization and expenditures information, there were built-in mechanisms in MEPS using the Medical Provider Component, thus limiting the impact of these types of errors.

Most critically, in many cases the sample size was still inadequate to yield satisfactory standard errors for more refined group comparisons, even though this is one of the few studies that used national survey data. This further demonstrates the need for creating and maintaining large, sustainable, nationally representative samples of Americans with IDD.

E. **Implications and Recommendations**

To my knowledge, the present study is one of the first studies that used nationally representative data to study obesity in community living Americans with IDD. It provided a first look at the health care utilization and expenditures in noninstitutionalized Americans with IDD. With linked national level data that spanned ten years, this study provided robust evidence that the community-living individuals with IDD in the U.S. were more obese than the general population during the past decade. With a nationally representative sample of Americans with IDD spanning the lifespan, this study puts obesity rates among individuals with IDD slightly below prior estimates (Melville et al., 2008; Stancliffe et al., 2011; Yamaki, 2005), but above those of the general population. With stronger confidence in the representativeness of the sample than the other reports, the study provides strong additional evidence that obesity as a health disparity still exists for this subpopulation. The consequences of this health disparity in the form increased risks for chronic conditions and mortality as well as poorer overall health outcomes are cause for concern for stakeholders in the well being and health of persons with IDD. Information is power and it is vital for the U.S. enhances and improves population-based data collection on obesity status, health status and health risks for people with IDD. This study established a point of reference for future nationally-representative comparisons so that change-over-time and major shifts in health status can be observed.

The present study is also one of the first studies that used nationally representative data to explore health utilization and expenditures of obese and non-obese community living Americans with IDD. Through a priori comparisons, it was found that obese individuals had higher utilization in ER and Prescription Medicines than non-obese Americans with IDD, which, to my knowledge, is the first time such differences have been documented using national data. In the regression analysis, the study identified important predictors of higher health care spending: obesity, non-Latino Black identity, age (under 18 or over 64 years of age), gender (female), and having perceived fair or poor physical or mental health status. These results represent new additions to the literature on IDD and health care and suggest the importance of greater attention to issues of health care spending and needs of the socially disadvantaged (i.e., women, children, persons of color) subgroups within community living people with IDD.

The study found obesity and overweight status to be separate, significant drivers of health care expenditures. In this era of rising health care costs, the distinction has important implications for different stakeholders of IDD. For persons with IDD and their family, it is important to know that weight management can translate to cost management, and unmanaged

overweight and obesity could carry hefty price tags in terms of health care spending. For uninsured individuals and families, they might even lead to tremendous out of pocket spending, especially when they are more likely to use ER services and purchase more medications. For health care researchers, this information suggests the inclusion of weight status as a key demographic variable and the potential value in investigating the mechanisms by which different BMI status affects health outcomes, utilization and eventually, expenditures. HHC is an important category of care in terms of total costs and deserves more systematic research to better understand the dynamic of costs and overweight status. For health care professionals and policy makers, such knowledge can potentially reduce demand by increase the supply of targeted high quality, accessible health services that best address the health needs of Americans with IDD. For example, providing evidence-based, universally-designed health promotion and nutrition programs to community living individuals with IDD could positively impact health (Doody & Doody, 2012; Heller, Fisher, Marks, & Hsieh, 2013) and reduce the demand for health care associated with obesity. Another example is training staff to work with patients with IDD, providing free clinics and referral services through subsidization, and developing more costefficient HHC through in-home medical technology are potential targeted services that might reduce demand and costs. In summary, highlighting the key role of obesity in today's environment of rising health costs can help the IDD community thrive financially and achieve better health.

F. Conclusion

With the expanding obesity epidemic and the rising costs of medical care in the United States over the last few decades, Americans with IDD as a group are likely to face great challenges in both obesity and health care expenditures. These challenges, formerly "invisible", should continue to be revealed and highlighted. The present study marks the first step towards mapping out the mechanisms and determinants of health care expenditures of noninstitutionalized Americans with IDD, and examined obesity's role in increased utilization and expenditures. The study found evidence that supports links between overweight and obesity status and higher overall estimated health care expenditures, as well as specific types and payers of expenditures throughout Years 2002-2011. Future research should continue this understudied topic and identify effective strategies for eliminating the disparities in health status, health care, and expenditures between Americans with and without IDD.

This report of the status of health care utilization and expenditures in Americans with ID highlights the fact that through the decade following the 2002 *Closing the Gap* report from the Surgeon General, Americans with IDD still face a multitude of disadvantages and disparities in health status, health care and overall well-being. It also calls for utilization and expenditures categories to be more systematically investigated and understood, especially for Office-Based Provider, HHC, and Prescription Medicine. Finally, it reminds all stakeholders and allies of the U.S. IDD community to break the "invisibility" in national data and to advocate with a stronger, more united and informed voice. Eventually, this knowledge should be used to inform policy-making and research efforts to bridge the gap that is health disparities between Americans with and without IDD.

APPENDICES

Appendix A

UNIVERSITY OF ILLINOIS AT CHICAGO

Office for the Protection of Research Subjects (OPRS) Office of the Vice Chancellor for Research (MC 672) 203 Administrative Office Building 1737 West Polk Street Chicago, Illinois 60612-7227

Notice of Determination of Human Subject Research

June 9, 2015

20150617-90577-1

Henan Li Disability and Human Development 1640 W. Roosevelt Rd., Room 216 M/C 626 Chicago, IL 60608 Phone: (312) 857-8583

RE: Protocol # 2015-0617 "Obesity and Health Care Expenditures of Americans with Intellectual and Developmental Disabilities"

Sponsor: None

Dear Henan Li:

The UIC Office for the Protection of Research Subjects received your "Determination of Whether an Activity Represents Human Subjects Research" application, and has determined that this activity **DOES** <u>NOT</u> meet the definition of human subject research as defined by 45 CFR 46.102(f).

You may conduct your activity without further submission to the IRB.

If this activity is used in conjunction with any other research involving human subjects or if it is modified in any way, it must be re-reviewed by OPRS staff.

V	Applicable	
Variable	for	Survey Question
la1ar	Any	Are you/ Are any family members LIMITED IN ANY WAY in any
		activities because of physical, mental or emotional problems?
lahcc	2-17 yrs	What conditions or health problems cause their limitations?
		* Enter all that apply
		Vision/problem seeing
		Hearing problem
		Speech problem
		Asthma/breathing problem
		Birth defect
		Injury
		Mental retardation
		Other developmental problem (e.g., cerebral palsy)
		Other mental, emotional or behavioral problem
		Bone, joint, or muscle problem
		Epilepsy or seizures
		Learning disability
		Attention Deficit/Hyperactivity Disorder (ADD/ADHD) Other
		impairment/problem (Specify one)
		Other impairment/problem (Specify one)
		Refused
	10	Do not know/not sure
lahca	18 yrs+	What conditions or health problems cause their limitations?
		* Enter all that apply
		01 Vision/problem seeing
		02 Hearing problem
		03 Arthritis/rheumatism
		04 Back or neck problem
		05 Fracture, bone/joint injury
		06 Other injury
		07 Heart problem
		08 Stroke problem
		09 Hypertension/high blood pressure
		10 Diabetes
		11 Lung/breathing problem(e.g., asthma and emphysema)
		12 Cancer
		13 Birth defect
		14 Mental retardation
		15 Other developmental problem (e.g., cerebral palsy)
		16 Senility
		17 Depression/anxiety/emotional problem
		18 Weight problem

Appendix B National Health Interview Survey (NHIS) Measures

Appendix B (continued) National Health Interview Survey (NHIS) Measures (continued)

19 Missing limbs (fingers, toes or digits), amputee 20 Kidney, bladder or renal problems 21 Circulation problems (including blood clots) 22 Benign tumors, cysts 23 Fibromyalgia, lupus 24 Osteoporosis, tendinitis 25 Epilepsy, seizures 26 Multiple Sclerosis (MS), Muscular Dystrophy (MD) 27 Polio(myelitis), paralysis, para/quadriplegia 28 Parkinson's disease, other tremors 29 Other nerve damage, including carpal tunnel syndrome 30 Hernia 31 Ulcer 32 Varicose veins, hemorrhoids 33 Thyroid problems, Grave's disease, gout 34 Knee problems (not arthritis (03), not joint injury(05)) 35 Migraine headaches (not just headaches) 90 Other impairment/problem (Specify one) 91 Other impairment/problem (Specify one) 97 Refused 99 Do not know/not sure

	Medical Ex	xpenditure Panel Survey (MEPS) Measures
	Applicable	
Variable	for	Survey Question/ Variable Description
CHBMI42X	6-17 yrs	Child's Body Mass Index (BMI) as based on child's reported
		height and weight (6 - 17)
BMINDX53	18 yrs and	Adult Body Mass Index (BMI) as based on reported
	older	height and weight
AGE	Any	"represents the exact age, calculated from date of birth and indicates age status as of (December 31 st of the survey year)"
SEX	Any	"were initially determined from (NHIS surveys). The SEX variable was verified and, if necessary, corrected during each MEPS interview. The data for new household members (persons who were not members of the household at the time of the NHIS interviews) were also obtained during each MEPS Round. When gender of the member was not available from the NHIS interviews and was not ascertained during one of the subsequent MEPS interviews, it was assigned in the following way. The person's first name was used to assign gender if obvious (no cases were resolved in this way). If the person's first name provided no indication of gender, then family relationships were reviewed (no cases were resolved this way). If neither of these approaches made it possible to determine the individual's gender, gender was randomly assigned"
RACEX	Any	Recoded Race variable with the following categories: White - no other race reported Black - no other race reported American Indian/Alaska Native - no other race reported Native Hawaiian/Pacific Islander - no other race reported Multiple races reported
RACETHNX	Any	Recoded Race/ethnicity variable with the following categories: Hispanic Non-Hispanic Black Non-Hispanic Asian Other race/Not Hispanic
EDUCYR	5 yrs and older	Number of years of education completed
MARRYX	16 yrs and older	Current Marital Status as of Dec 31 st of survey year
REGION	Any	Census region (Northeast, Midwest, South, West)

Appendix C Medical Expenditure Panel Survey (MEPS) Measures

POVCAT	Any	Constructed from household income into five poverty
IOVCAI	Tilly	categories: negative or poor (less than 100%), near poor
		(100% to less than 125%), low income (125% to less than
		200%), middle income ($200%$ to less than $400%$), and high
		income (greater than or equal to 400%).
MSA	Any	Indicates whether or not the household is found in a
	2	Metropolitan Statistical Area, defined by Office of
		Management and Budget (OMB).
INSCOV	Any	Summary constructed variable for health insurance coverage,
	-	with three values:
		1 = ANY PRIVATE (Person had any private insurance
		coverage [including TRICARE/CHAMPVA] any time during
		2011)
		2 = PUBLIC ONLY (Person had only public insurance
		coverage during 2011)
		3 = UNINSURED (Person was uninsured during all of 2011)
RTHLTH	Any	Perceived health status:
		1 EXCELLENT
		2 VERY GOOD
		3 GOOD
		4 FAIR
		5 POOR
MNHLTH	Any	Perceived mental health status:
		1 EXCELLENT
		2 VERY GOOD
		3 GOOD
		4 FAIR
		5 POOR

Appendix C (continued) Medical Expenditure Panel Survey (MEPS) Measures (continued)

Appendix D ANNUAL AVERAGE CONSUMER PRICE INDEX, YEAR 2002-2011

YEAR	СРІ	Percent Change from Previous Period
2002	179.9	1.6
2003	184.0	2.3
2004	188.9	2.7
2005	195.3	3.4
2006	201.6	3.2
2007	207.342	2.8
2008	215.303	3.8
2009	214.537	-0.4
2010	218.056	1.6
2011	224.939	3.2

Note: The base period (100) is 1982-84. More information can be found here: http://www.bls.gov/cpi/

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EDUCATION

2015 (expected)	Ph.D., Disability Studies University of Illinois at Chicago, Chicago, IL
2013	M.S. in Kinesiology Adapted Physical Education/ Disability and Movement Indiana University, Bloomington, IN
2008	B.S. Sport/Applied Psychology Wuhan Institute of Physical Education, China

RESEARCH EXPERIENCE

2013- Present	Research Assistant, Rehabilitation Research and Training Center (RRTC), Health and Function of Individuals with Intellectual and Developmental Disabilities, PI Glenn Fujiura PhD
2012-2013	Research Assistant, Rehabilitation Research and Training Center (RRTC), Cultural Equivalence of Autism Assessment for Latino Children, PI Sandra Magana PhD

PUBLICATIONS

Li, H., Frey, G. C., McCormick, B. P., & Johnston, J. D. (2015). Comparison of obesity among Chinese and U.S. Special Olympic athletes with intellectual disabilities. Research in Developmental Disabilities, 41–42, 94-100. doi: http://dx.doi.org/10.1016/j.ridd.2015.05.005

Magaña, S., **Li, H.**, Miranda, E. and Paradiso de Sayu, R. (2015), Improving health behaviours of Latina mothers of youths and adults with intellectual and developmental disabilities. Journal of Intellectual Disability Research, 59: 397–410. doi: 10.1111/jir.12139

ORAL PRESENTATIONS

Fujiura, G.T., **Li, H.**, Magana, S., & Parish, S. (2015, June). Health Care Costs for Americans with Intellectual and Developmental Disabilities: A National Analysis of Access and Spending 2002-2011. 139th Annual Meeting of the American Association on Intellectual and Developmental Disabilities, Louisville, KY.

Li, H., Fujiura, G.T. (2014, November). Estimating Health Care Expenditures of Americans with Intellectual Disability Using National-Level Data. 142nd Annual Meeting of the American Public Health Association, New Orleans, LA.

Magana, S., **Li, H.** (2013, November). Improving Health Behaviors of Latina Mothers of Youth with Developmental Disabilities. 141st Annual Meeting of the American Public Health Association, Boston, MA.

Hsieh, K., **Li**, **H**., Rimmer J. (2013, November). Promoting Physical Activity and Good Nutrition for People with Intellectual Disabilities. 141st Annual Meeting of the American Public Health Association, Boston, MA.

POSTER PRESENTATIONS

Li, H., Frey, G.C., McCormick B., Johnston J. D. (2012, October). Comparisons of Physical Activity between Chinese and United States Special Olympic Athletes. 140th Annual Meeting of the American Public Health Association, San Francisco, CA.

Li, H., Bodde A., Magnagi R., Frey, G.C. (2009, November). Estimating Health Care Expenditures of Americans with Intellectual Disability Using National-Level Data. 137th Annual Meeting of the American Public Health Association, Philadelphia, PA.

LEADERSHIP POSITIONS

2013-2015	Treasurer Co-Chair, American Public Health Association Disability
	Section

AWARDS

2013 Student Scholarship, American Public Health Association Disability Section

PROFESSIONAL MEMBERSHIPS

August 2008-PresentStudent Member, Disability Section, American Public Health
Association