ENTERING CANADIAN LONG-TERM CARE WITH OBESITY: EXPLORING INITIAL ASSESSMENT DATA

by

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Abstract

The Canadian population is aging, and rates of obesity are also on the rise. These demographic changes have implications for the long-term care (LTC) system in Canada that need to be better understood, yet little is known about the population with obesity in Canadian LTC. In this thesis, an exploratory analysis of residents newly entering LTC between 2010 and 2020 is provided. Cross-tabulations and chi-squared statistical testing ($p \leq 0.001$) were employed to analyze retroactive, consecutive cross-sectional initial assessment data (N=350,348) from the Canadian Institute for Health Information's (CIHI) Community Care Reporting System (CCRS) to explore the levels of obesity, demographic characteristics (age, sex, primary language, rural or urban previous residency), rates of health conditions, and independence and assistance levels of activities of daily living (ADLs). Over the full study period, the rate of obesity for the population entering LTC was 19%, and 7% entered with at least class II obesity (≥ 35 kg/m^2). Rates of obesity and BMI obesity categories tended to increase incrementally over the course of the study period. Those entering LTC with obesity were more likely to be younger, female, English/French speaking, and arriving from rural areas. Individuals with obesity had lower rates of dementia and higher levels of independence when performing ADLs. They also exhibited higher rates of diabetes and a greater need for two+ person assistance for ADLs. This thesis begins to fill in the gap in our understanding of the population with obesity in LTC, providing a broad picture of the heterogeneous nature of the population, including important differences in health and ADL profiles across the three obesity BMI categories (i.e., classes I-III).

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I dedicate this thesis to all those who have family, or themselves are facing challenges in accessing healthcare and to those working tirelessly and selfless in healthcare making differences everyday in the worlds of those families.

Chapter One: Introduction

The Canadian healthcare system is designed to have more specialized and resource intensive care concentrated in larger centres. A member of my family, who happens to be bariatric, experienced a health emergency that required transportation to a hospital in a larger center. Their access to necessary care was delayed for several days. We were told that a major reason for this delay was that there was, at the time, only one aircraft capable of transporting a bariatric patient in the province. Luckily for this family member, they were able to wait for the aircraft to finish transporting another patient, re-fuel, and reset pilot hours before being transported.

This experience initiated my curiosity and concern about how well-equipped our healthcare system is for providing appropriate and quality care to persons with higher body mass index (BMI). The presence of weight bias in society and the healthcare system added to the feeling of the importance of this topic. At the same time, I was also aware of the reports signalling concern for the aging Canadian population and what that would mean for the Canadian healthcare system, including long-term care (LTC). Ultimately, the idea to study persons with obesity newly residing in Canadian a long-term care facility (LTCF) enabled me to combine these two interests.

My thesis journey began in 2019, and the importance of understanding obesity and its effects on care in long-term care facilities (LTCFs) was further emphasized by the dramatic impact of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2 or COVID-19) pandemic that began the following year. The effects of the pandemic on Canadian LTC brought with it calls for reform, highlighting the need to understand the staffing and resource demand of

all persons residing in LTCFs (Canadian Institute for Health Information, 2020b; Ho, 2020; Stall et al., 2021).

By offering an evidence-based understanding of the group of older adults with obesity, this thesis is intended to begin filling gaps in knowledge surrounding this population. It also intends to help dispel weight-based stereotypes, stigma, and barriers for those with obesity. Additionally, the thesis focuses on the population entering LTCFs specifically (as opposed to persons already residing in a LTCF), providing information for LTC and for in-community and alternative care structures. Canadian Institute for Health Information's (CIHI) initial assessment data collected in select LTCFs between Jan-1-2010 through Dec-31-2020 is utilized to explore the incidence of those entering LTC with obesity, their demographics, and their care needs.

Research Objective and Questions

This thesis aims to learn more about changes in the rates of obesity seen in the population entering LTC and to prepare a profile of the health and care needs of this population segment. The following research questions were developed to achieve this objective:

1) What is the rate of obesity among those persons newly residing in a LTCF, and has this rate increased over time?
2) What are the demographic and health characteristics of those entering LTC with obesity, and how do these characteristics compare to newly admitted persons residing in a LTCF who are not considered obese?
3) What are the care needs of those entering LTC with obesity, and how do these needs compare to newly admitted persons residing in a LTCF who are not considered obese?
4) What are the differences seen in these three questions when applied to six BMI categories rather than just obese and non-obese?

Overview of the Thesis

In chapter two, I offer a review of the literature that informs this research. The chapter begins with a brief overview of LTC in Canada, followed by a discussion of obesity, its definitions, relation to body mass index (BMI), and possible adjustments to the health risks associated with obesity. After that, discussion of the prevalence of obesity in the general population and long-term care is offered. I then provide a discussion of factors known to lead to an increased risk of needing LTC, the presence of obesity-based barriers, and the ways in which having obesity interacts with age, health conditions, and activities of daily living (ADLs) in LTC settings. Finally, I consider literature about equity in healthcare, emphasising the barriers and biases faced by individuals with obesity and the rationalization for using first-person language when conducting obesity-based research.

Chapter three outlines the data and methods used to conduct my analysis. First, the research sample is defined, and the research design is outlined. This includes a detailed discussion of the CCRS dataset from CIHI generally and the particular variables included in the dataset. This is followed by a discussion of the quantitative methods and statistical tests employed, including a description of an index created to track multi-morbidities and the use of proportional ratios to visually represent differences in ADL levels across the BMI spectrum.

The findings of this work are presented in chapter four. These findings are organized into three sections. The first section provides estimates of the numbers of persons newly residing in a LTCF by BMI category. The second section offers a profile of the demographic and health characteristics of the persons newly residing in a LTCF by BMI category. The third section examines ADLs by BMI category, with levels stratified by illness (dementia, non-dementia).

In chapter five, I offer a discussion of the major findings of the research. Particular attention is paid here to how my research findings relate to relevant literature in Canadian and international study contexts. I begin with a summarization of the results of the study and the critical highlights of the profile created. This discussion then expands to the care needs of individuals with obesity in LTCFs specific to the different rates of illnesses (i.e., diabetes and dementia), and considers the need for nuance in the management of obesity and diabetes in LTCFs. Another key finding discussed is the usefulness of BMI threshold levels amongst an older adult population and the suggestion to lower the risks associated with low levels of obesity for this population. There is then a brief section on the COVID-19 pandemic and its impact on the data and the Canadian LTC sector. The chapter ends with a consideration of whether persons with obesity in LTCFs should be considered a priority population for the purposes of ensuring health equity.

In chapter six, I conclude the thesis by considering the limitations of my analysis, key policy considerations, plans for knowledge dissemination, and suggestions for further study. The limitations relate to the nature of the initial assessments, simplified geographical definitions, lack of information about facility characteristics, and missing data. Key policy considerations call attention to the unique care needs and resource implications of individuals with obesity in LTCFs, noting especially the heterogeneity of the LTC population with obesity. Implications are also described, focusing on the increase in obesity rates and the need to evaluate the Canadian LTC sector's ability to provide adequate care to those with higher obesity levels. I then outline plans for knowledge dissemination to researchers, policy makers and practitioners. Lastly, I call for more research on, and with, persons living with obesity in LTCFs.

Chapter Two: Literature Review

Long-Term Care in Canada

Canada provides institutional care outside of hospitals through long-term care (LTC) and its long-term care facilities (LTCFs), often called nursing homes, continuing care facilities, and residential care homes (hereafter referred to simply as LTC or LTCFs). LTC is defined by Health Canada (Government of Canada, 2004, sec. Long-term Facilities-based Care) as generally providing "living accommodations for people who require on-site delivery of 24-hour, 7 days a week supervised care, including professional health services, personal care, and services such as meals, laundry, and housekeeping". LTCFs fall under the provincial jurisdiction of healthcare provision and are not publicly insured under the Canada Health Act (Government of Canada, 2004). Canadian LTCFs offer a range of services and ownership types, with 46% of Canadian facilities publicly owned, 29% privately owned and for-profit, 23% privately owned and not-for-profit, and 2% privately owned without a breakdown of profit or non-profit (Canadian Institute for Health Information, 2021c). The distribution of privately and publicly owned LTCFs varies widely across Canada, with, for example, 98% of Newfoundland and Labrador's 40 LTCFs publicly owned compared to only 16% of Ontario's 627 LTCFs (Canadian Institute for Health Information, 2021c).The Canadian long-term care sector was not purposefully developed but evolved over time. Beginning with roots in the Elizabethan Poor Law of 1601 and alongside religious orders, poorhouses were tasked with caring for those unable to care for themselves (e.g., the poor, mentally ill, and older adults) (Estabrooks et al., 2020). In the early 20th century, the gradual introduction of facilities tailored to an older adult population gave rise to more modern institutional LTCFs (Estabrooks et al., 2020). In general, modern LTCFs are institutionalized settings, with multiple people living communally in a facility staffed with

various health and life care professionals, providing accommodation and care for older adults unable to live in their own homes. While modern LTCFs provide services to people of a range of ages, the large majority of persons residing in LTCFs continue to be older adults.

Approximately 53% of persons residing in Canadian LTCFs are over the age of 84, with only 6.8% of the LTC population below the age of 65 (Canadian Institute for Health Information, 2022b). It is of interest to LTCFs that the Canadian population is undergoing a demographic shift as baby boomers (those born between 1946 and 1964) reach a more advanced age. The number of Canadians over the age of 80 in 2040 is expected to be more than double the 2020 population numbers (from 1.7 million to 3.5 to 4 million), with 1.8 million over the age of 85 (Statistics Canada, 2019). Concurrently, older adults will constitute a larger proportion of the population than previous generations, for example, Canadians aged 50-70 accounted for 18% of the total population in 1996, but this proportion grew to 24% of the population in 2016 (Statistics Canada, 1997, 2017b). After the doubling in population size, it is expected that the over-80 age group will then only grow to around 4 or 5 million through to 2060 (Statistics Canada, 2019).

In 2016, there were approximately 246,000 persons residing in Canadian LTCFs (Statistics Canada, 2017a). If the age-specific rates of demand in 2021 remains constant and the projections reported above are correct, the LTC sector will need to accommodate 563,000 people by 2040 as baby boomers reach the average age of a LTC resident (Statistics Canada, 2017a, 2019). This projected demand does not consider factors such as current unmet needs. In 2019, for example, 98.7% of LTC beds in Ontario were utilized, with 34,834 people on the waitlist and an average placement time of approximately 140 days, with wait times ranging from 52 days up to 5 years (Bueckert, 2021; Ontario Long Term Care Association, 2019). Additionally, by encompassing a larger proportion of the population than previous generations, older-adult

healthcare services, including LTC and alternatives to LTC, will need to expand while relying upon a relatively smaller available workforce and tax base (Eisen & Emes, 2022). Having a better understanding about who is transitioning into LTC, and why, will better inform future planning, policies, and funding for programs, including those that delay or prevent the need for expensive institutional LTC while simultaneously preparing LTC for the increase in demand.

While seen as a more cost-effective option over more resource-intensive in-hospital care, LTCFs are generally more expensive than in-community support and other alternatives (Kuluski, Williams, Berta, et al., 2012). Remaining at home with in-community support is generally preferred by older adults, especially after the COVID-19 pandemic (Leroux et al., 2021; Ontario Long Term Care Association, 2015; Weeks et al., 2021). Alongside informal at-home care or formal at-home community care programs, alternative care levels exist in assisted living facilities, greenhouses, virtual villages, or niche retirement communities to name a few (Haber, 2016). Programs, such as rehabilitation/exercise programs, adult day care programs, and early detection services support caregivers and assist in maintaining the physical and cognitive functioning of older adults, especially those with dementia (Canadian Institute for Health Information, 2023). Such home services, alternatives, and programs may help delay or prevent entrance into LTC, and they can also encourage shorter LTC stays, allowing persons residing in a LTCF to transition out of the LTCF; however, there are gaps in understanding availability and eligibility for community-based care services (Freeman et al., 2017). Efforts to minimize LTC through community care programs are hampered because these programs are traditionally underserviced, and there is also an over-reliance and exploitation of unpaid informal and predominantly female caregivers (Haber, 2016; Kuluski, Williams, Laporte, et al., 2012). Gaps in formal care provision are especially prevalent in rural centres, often coupled with an

unfounded assumption that sufficient informal family, community and volunteer services are standing by to substitute (Brassolotto et al., 2020).

The availability and accessibility of such programs are affected by social determinants of health, such as barriers imposed by rural living (Camargo-Plazas et al., 2022; Morgan et al., 2015). Individuals on waitlists for LTC in rural areas in Ontario tended to be less impaired than their urban counterparts, reflecting somewhat the limited capacity for in-community programs in rural areas (Kuluski, Williams, Laporte, et al., 2012). Recently, one in nine new persons residing in a Canadian LTCF had the potential to have been cared for at home if in-community services could have been available (Canadian Institute for Health Information, 2020a), and this number rose to 50% of rural individuals on Ontarian waitlists (Kuluski, Williams, Berta, et al., 2012). Alongside availability limitations, rural and smaller community programs face unique challenges communities benefit from policies and practices that can be customized for a settings based context (Brassolotto et al., 2020). Acknowledging and empowering alternatives and at-home care programs, especially rural and remote home care programs, has the potential to reduce LTC demand (Brassolotto et al., 2020; Canadian Home Care Association, 2006).

The effort to reduce LTC usage also affects the LTC system itself. When Ontario changed its LTC admission policies to delay LTC entrance by increasing required care needs, fewer people qualified for LTC resulting in individuals entering "older, frailer, and in need of more medical and personal care than ever before" (Ontario Long Term Care Association, 2015, p. 2). LTCFs in Ontario, therefore, saw a concentration of high-needs individuals within their facilities, whereas before, there was a mix of needs, consequentially changing the role of LTC without modernizing funding or staffing resources (Ontario Long Term Care Association, 2015). Similar policies have been implemented in other areas, and the results of such policies in these

areas offer insights into what pragmatic success may look like; for example, at-home aging policies in New York State resulted in a delay in seeking institutionalized care of only eight months (Young et al., 2015). Ontario has implemented new policies in 2022, but how well the new funding policies will account for concentrations of high-needs individuals remains to be determined (Ontario Ministry of Long-Term Care, 2022).

The COVID-19 pandemic emerged in Canada in January 2020 and greatly affected the Canadian health sector. LTCFs were heavily impacted as cases of COVID-19 in the Canadian LTC population accounted for 3% of total COVID-19 cases in Canada and 45% of COVID-related deaths (Canadian Institute for Health Information, 2021b). The impacts of COVID-19 and responses to the COVID-19 pandemic were not even across LTCFs or provinces in Canada (Cox et al., 2023; Khaketla et al., 2022; Liu et al., 2020; Patterson et al., 2023; Stall et al., 2020, 2021). Additionally, COVID-19 restrictions and implementation levels varied across regions and between facilities, having far-reaching social, emotional, and health effects on persons residing in Canadian LTCFs, families of those residing in LTCFs, and staff (Chamberlian et al., 2022; Hung et al., 2022; K. Jones et al., 2022). The full effects of the COVID-19 pandemic on Canadian LTCFs will continue to be a focus for researchers (Chen et al., 2023; Thompson et al., 2020; Webber et al., 2022).

Addressing the current demand, and the projected increase, requires the adaptability of both the LTC sector and community-based programs to increase capacity, minimize barriers, and adapt to population needs. Persons residing in a LTCF and older adults in the community are not a homogenous group, and various supports or services are needed to assist with delaying, preventing, or shortening LTC stays. Individuals requiring LTC or support services are vulnerable, with sub-populations facing different barriers to accessing health services (Canadian

Home Care Association, 2006). LTC populations which are under-researched include adults and older adults with obesity, which will be discussed below.

Obesity

Definition

Obesity is a common metabolic/nutritional disease in which "an individual accumulates abnormal or excessive fat for age and gender" (Venes, 2017, pp. 1670–1671). The individualistic nature of the condition of obesity makes its legal definition challenging to ascertain, with debate about whether obesity should be seen as a disability itself or as a disease that results in disability (Mulrooney, 2019; Puhl & Heuer, 2009). Obesity is a complex, multifaceted phenomenon with far-reaching individual and social components. It is important to acknowledge that obesity does not necessarily equate to poorer health and is only one factor that contributes to a person's overall health.

The use of language in research, publishing, and healthcare has implications for those with obesity, and there has been a push to use the ubiquitous 'first-person' language such as 'person with obesity' or 'having obesity' rather than an 'obese person' or 'being obese.' The first-person language of 'having obesity' is used to reposition the rhetoric from one conflating obesity as permeating and defining one's identity to instead describing one as having a medical condition called obesity with an acknowledgement of the complexities surrounding its cause (Mulrooney, 2019). The use of first-person language is not without its critics. An example of a condition whose community does not prefer first-person language is the Autistic community because Autism permeates a person’s identity, with every aspect of their existence seen through a lens of Autism (the choice of language varies by individual as well here) (Porch, 2022, pp. xv–xvii). With Autism as an example of an identity-permeating condition, the concern about obesity is

how far-reaching it is as a feature of one's identity. In the case of first-person language, its purpose is to separate the characteristic of obesity from a person's identity. However, that very act could be seen as implying an "inherent adverse judgement" and places obesity as a "defect" or "burden" separating one from a "normal" form (Meadows & Daníelsdóttir, 2016, pp. 1–2). The descriptors for the extent of obesity continue to evolve, with terms such as 'fat,' 'extreme obesity,' 'morbid obesity,' 'severe obesity,' and 'class I, II, and III' used (referring to levels of Body Mass Index (BMI), described later).

Terminology preferences for how to describe 'having obesity' or 'being obese' and the level of obesity are on an individual basis; however, there appear to be some commonalities. A survey of language preferences amongst those seeking bariatric surgery found that 'person with elevated BMI' and 'person with obesity' were preferable options when addressing a person with obesity (Pearl et al., 2018). When describing someone with high levels of obesity it was more preferential to be described as having 'class III obesity' as in comparison to (in order of decreasing preference) having- a severe BMI, an extreme BMI, severe obesity, extreme obesity, or the least preferred 'morbid obesity.' Likewise, an online survey focused on weight loss motivation and language used in a healthcare setting demonstrated that 'weight' and 'unhealthy weight' were the preferred terms by both those with and without obesity to describe excess weight with 'morbidly obese,' 'fat,' and 'obese' as least desirable (Puhl et al., 2013). However, Meadows and Daníelsdóttir (2016) criticize the reliance upon preference surveys for language usage as they are often based upon prompts that identify weight as a problem a priori, and participants are found within treatment-seeking settings. In contrast, those outside a weight-loss setting would have a different conceptualization of their weight. Furthermore, contrary to these studies, which show 'fat' as the least preferred term (Pearl et al., 2018; Puhl et al., 2013),

Meadows and Daníelsdóttir (2016) claimed that the term 'fat' is the preferred term within the fat acceptance movement. Emphasizing the appropriate use of language when working with persons with obesity is rooted in the effort to reduce and combat weight biases in research and care settings (Puhl & Heuer, 2009). This thesis utilizes first person language (i.e., 'person with obesity') to recognize and acknowledge the stigma associated with having obesity; the intention of using the term obese and obesity is to ensure that the LTC sector can better attend to the needs of those with heavier body types.

Body Mass Index

Obesity is generally diagnosed when the accumulated weight in relation to height, referred to as Body Mass Index (BMI), is over 30 kg/m^2. BMI intends to convey possible increased health risks associated with weighing too much or too little (World Health Organization, 1995). The standardization and relatively cheap and straightforward measurements of BMI make it a helpful tool for tracking and comparing population trends for health research and policy development (Barba et al., 2004).

In 1995, to encourage global reporting and research consistency, the World Health Organization (WHO) established four uniform BMI categories based upon an aggregation of adult population health data reflective of weight-dependent health risks observed with various levels of BMI(kg/m^2): underweight (BMI 15-19.9); normal-weight (BMI 20-24.9); overweight (BMI 25-29.9); and obese (BMI 30 or greater) with each category above and below normal-weight, reflecting increased risk to health (World Health Organization, 1995). When analyzed at a population level, obesity levels suggest a population's increased risk of developing weight-dependent health issues such as cardiovascular risk factors, cancers, diabetes, and all-cause mortality (Guh et al., 2009).

Responding to increasing global obesity rates and levels of obesity in 1997 the original class of obese was expanded into three classes: class I (BMI 30-34.9), class II (BMI 35-39.9), and class III (BMI ≥ 40) emphasizing the health risks associated with increasing obesity (Nuttall, 2015). The 2020 Canadian Adult Obesity Clinical Practices Guidelines (the Canadian Guidelines) consider a BMI ≥ 30 as obese and further differentiates the obese category into five sub-classes, reflecting the increasing number of individuals with higher weights (Rueda-Clausen et al., 2020). These highest BMI categories immerged largely from bariatric medicine and surgery research and have been termed severe obesity (class III, BMI≥40), morbid obesity (class IV, BMI≥50), and super obesity (class V, BMI ≥ 60); with another classification emerging recently of super-super obesity (BMI ≥70) (Sturm & Hattori, 2013; Wilkinson et al., 2019).

The term 'bariatric' is often used for persons with BMI over 40 kg/m^2. As a branch of medicine, 'bariatric' is defined in Taber's Cyclopedic Medical Dictionary as "the branch of medicine that deals with prevention, control, and treatment of obesity" (Venes, 2017, p. 244). This language does not refer to treating a person with obesity but instead is the treatment of obesity itself. The definition of 'bariatric surgery' provides more details pertaining to the patient: "[bariatric] surgery is typically used only for those with a body mass index greater than 40 kg/m^2 or 35 kg/m^2 in the presence of other weight-related health problems, such as hypertension or diabetes mellitus" (Venes, 2017, pp. 2275–2276). Nursing guide books related to the movement and transfer of persons of larger size refer to the bariatric patient as those with a BMI over 40 or who have "large physical dimensions" with "a lack of mobility or other conditions that make moving and handling difficult" (Thomas et al., 2011, p. 388), and as "those limited in health due to physical size, health, mobility, and environmental access or those whose weight and/or size

interferes with the ability to provide safe and reasonable care" (Bariatric Safe Patient Handling and Mobility Guidebook Professional Advisory Group, 2015, p. 2).

Body mass index (BMI) serves as a simple to measure and self-reportable value, making it appealing in its simplicity; however, it is also prone to errors, presents only a static estimation of excess tissue accumulation, and does not consider tissue type or weight fluctuations. While relatively simple, height and weight measurements are still vulnerable to differences in techniques, such as reliance upon an adequately calibrated scale or measuring height standing versus laying versus sitting (Buys et al., 2014; Yamada et al., 2020). On top of differences in techniques, BMI information can be collected via self-reporting, which is prone to errors, including an under-reporting of weight and over-reporting of height, and these errors are consistent enough that formulas exist to adjust self-reported BMI values (Dutton & McLaren, 2014; O'Neill et al., 2019). Another issue with using BMI is the limited information provided by the measurement. BMI on its own is a fixed measurement and does not account for a change in BMI, previous BMI, or time spent with a BMI, which have been suggested as better predictors of health risks, especially amongst older adults (Baik et al., 2000; Keller & Østbye, 2005; Somes et al., 2002; Visscher et al., 2001). The inability to account for individual variance in mass distribution (i.e., location) or type (i.e., muscle versus adipose tissue) is also a drawback of using BMI (Buys et al., 2014; Nuttall, 2015; Rueda-Clausen et al., 2020; Staiano et al., 2012). On its own, BMI does not directly identify obesity-related complications, and using a variety of health metrics when examining an individual's health status is encouraged (Rueda-Clausen et al., 2020; Wharton et al., 2020).

Other health metrics that supplement BMI include a waist-to-height ratio (WHR), waist circumference (WC), and more expensive measurements such as body cell mass (BCM), among

many others. WHR and WC are also relatively low-cost, simple measurements that, when used in conjunction with BMI, increase the robustness of health risk assessments, particularly for older adults when weight becomes redistributed as part of the aging process (Baik et al., 2000; Corona et al., 2017; Fauziana et al., 2016; Price et al., 2006; Staiano et al., 2012). Unfortunately, WHR and WC are less routinely obtained than weight and height and are also vulnerable to issues such as dietary abominable bloating (Rueda-Clausen et al., 2020). Higher technology-based techniques are also available, such as BCM amongst others, which provide a more accurate and in-depth description of tissue type and location of accumulation; however, it is expensive to obtain, maintain, and staff such equipment (Alvero-Cruz et al., 2021; Nuttall, 2015; Volpato et al., 2004). BMI does not provide the most robust information for individual health and should instead be seen as one of many tools in personal healthcare. However, measurements of height and weight are simply and cheaply obtained and are used extensively in clinical, survey, and research settings.

Adjustments of BMI Health Risks

The WHO's BMI health risks are based mainly on Eurocentric population data, yet BMI health risks are non-homogenous, with different health risks based on ethnicity, age, and gender. A population's ethnic makeup may require BMI category risk adjustments according to the WHO and has been explored in obesity-based health research (Barba et al., 2004; S. K. Kumanyika, 2019; Razak et al., 2007)(Barba et al., 2004; S. K. Kumanyika, 2019; Razak et al., 2007). In the Canadian Guidelines, ethnic populations (non-Eurocentric populations) identified as benefitting from BMI category risk adjustments are South-, Southeast-, and East Asian ethnicities wherein higher health risks are placed at lower BMI thresholds, for example, higher risks associated with having an overweight BMI (Rueda-Clausen et al., 2020). Meanwhile, a need for lower BMI

thresholds specific to Aboriginal populations in Canada has been expressed by some studies (Razak et al., 2007), while others do not find such an adjustment warranted (Lear et al., 2007). The Canadian Guidelines acknowledge this debate but have kept Aboriginal BMI thresholds in line with WHO's Eurocentric BMI levels (Rueda-Clausen et al., 2020). In addition to the considerations of ethnicity, the Canadian Guidelines also highlight the need for caution when interpreting the health risks of older adults (Rueda-Clausen et al., 2020, p. 3).

Researchers focused on an older adult population have suggested BMI health risks should be set at higher thresholds for older adults, with overweight and class I obesity treated less detrimentally (Beck & Damkjaer, 2008; Heiat et al., 2001; Landi et al., 2000; Sánchez-García et al., 2007; Van Uffelen et al., 2010). There are complex, interactive factors when aging with obesity, with the literature debating the observed potentially protective role of obesity in older age against the harmful effects of having obesity (Kiesswetter et al., 2014; Rambod et al., 2020; Zhang, Field, et al., 2019). The so-called ‘protective factor’ of obesity in older age is primarily seen as a counter to the associated risk of excess age-related weight loss and malnutrition, and so a higher BMI appears to provide some protection against the risk of mortality often associated with older-age frailty (Bosello & Vanzo, 2021; Lindsted & Singh, 1997; Oreopoulos et al., 2009; Van Uffelen et al., 2010). When reaching older age, there are general changes to the body, including metabolism, appetite, and physical activity (energy uptake and output) changes termed the aging process, and it is in the context of the aging process that the role of obesity may play a protective role. Multiple studies have found that there was a lower risk of mortality in older adults with obesity in combination with some conditions (e.g., dementia) (Beck & Damkjaer, 2008; Franx et al., 2017; García-Ptacek et al., 2014; Grabowski & Ellis, 2001; Veronese et al., 2015). However, other studies found the opposite, with higher mortality rates (Heiat et al., 2001;

I. Janssen & Mark, 2007; M. Wang et al., 2017) or no significant differences (Baik et al., 2000; Landi et al., 2000; Price et al., 2006). Likewise, obesity appeared to offer protection against older age cognitive impairments and developing conditions such as dementia (Rambod et al., 2020; Zhang, Field, et al., 2019), yet other studies found more pronounced and frequent cognitive impairments and higher risk of developing dementia (Bowman et al., 2019; Gonçalves Damascena et al., 2017; Ma et al., 2020). One literature review, in particular, reported that having obesity earlier in life was associated with a higher risk of developing dementia but having a higher BMI at an older age conferred a lower risk (Anjum et al., 2018).

The extent of this 'protective factor' is debatable, with some suggesting that the 'survivor effect' plays a prominent role in the observed phenomenon (Kiesswetter et al., 2014) and, to a minor extent, age-related height decline. Kiesswetter et al. (2014, p. 1259) describe older adults with obesity as a "highly selective survivor group relatively resistant towards physical and cognitive function decline." In other words, older adults with obesity have been subjected to higher rates of obesity-related-mortality risk throughout their life, so only those with the most robust genetic, environmental, and socio-economic benefits survived, which results in an over-appreciation of the 'protective factors' of having obesity (Kiesswetter et al., 2014). Additionally, an age-related decrease in height may lead to an overestimation of BMI and its associated health risks, increasing the appearance of a protective factor (Dey et al., 1999; Sánchez-García et al., 2007). Finally, obesity is consistently associated with an increased risk for functional and co-morbid related disabilities that affect the quality of life (Beck & Damkjaer, 2008; Decaria et al., 2012; Williamson et al., 2023; Zanandrea et al., 2013; Zhang, Field, et al., 2019). How much of a protective factor is conferred by having obesity in older age, and how much is a result of selective survivorship bias, will continue to be an area to be further explored. The importance of

understanding whether obesity should be considered less detrimentally in older adults is also directly related to how obesity in older adults is treated and managed in a healthcare setting.

The treatment of obesity is often weight-loss, with the focus being on losing weight to lower the risks associated with obesity; however, this weight-loss treatment, especially in older adults, carries its risks. When reaching older age, there is an associated slowdown of metabolism and a decrease in energy uptake and output which ultimately results in a redistribution of adipose tissue and a reduction in lean muscle mass (Dey et al., 1999; Fauziana et al., 2016; Perissinotto et al., 2002; Shatenstein et al., 2001). The health risks associated with losing weight, or losing too much weight, therefore, are higher in older adults. When older adults attempt to lose weight, it can result in unhealthy eating habits that, in conjunction with a decreasing appetite and metabolism, may lead to malnutrition or under-nutrition, a situation not intuitively associated with obesity (Bahat et al., 2012; Perissinotto et al., 2002). Since lean muscle mass reduces with older age, attempting to lose weight without the addition of physical activity to maintain muscle can amplify the loss of muscle mass with deleterious effects (Allison et al., 1999). There is also the risk of sarcopenic obesity, a condition defined by relatively low or loss of muscle mass in combination with obesity, resulting in being "frail-with-obesity" (Bays et al., 2022; Blaum et al., 2005; Oreopoulos et al., 2009; Wagenaar et al., 2021). The benefits of losing weight seen in the general population may be less for those with more advanced age (Kopec et al., 2016) and so rather than focus on weight loss, the strategy proposed for older adults with obesity is geared towards maintaining body weight while increasing physical fitness and function (Decaria et al., 2012; Porter Starr et al., 2016). The dangers of losing weight at an older age, in conjunction with the observed lower risks of mortality and cognition decline (although again, the information is conflicting on these areas), leads to the argument of having BMI health risk thresholds set higher

for older adults. Essentially, at an older age, an overweight and class I obesity BMI should be regarded less deleteriously with the focus for overall health on maintaining weight alongside physical activity.

Obesity Prevalence

The number of people with obesity has increased across the globe. Since 1958, adult obesity has increased three-fold, with greater increases in the highest levels of obesity (Twells et al., 2020). Between 1981 and 2007, obesity prevalence roughly doubled in each age group (Public Health Agency of Canada & Canadian Institute for Health Information, 2011). In 2021, 29% of the Canadian population or 8.2 million persons over the age of 12, had obesity, an increase from 2015 levels, where 26% (i.e., 6.9 million people) had obesity (Statistics Canada, 2022b). One of the more concerning areas is an increase in childhood obesity; in 2016, one in three adolescents (i.e., those aged six to 17 years) had childhood obesity, an increase from one in every four in 1985 (Twells et al., 2020). The effect of childhood obesity on subsequent years of life, including older age, is of concern and not addressed here (Lee et al., 2010). The proportion of diseases in the Canadian population attributable to obesity rose 138% for men and 60% for women between 1970 and 2004 (Luo et al., 2007). The rates of obesity continue to increase amongst older adults (65 years or older), going from 1.3 million older Canadians with obesity (27%) to 1.8 million (29%) between the years 2015 and 2021(Statistics Canada, 2022b). These values come from adjusted self-reported BMI levels found in the Canadian Community Health Survey and do not include institutionalized persons (e.g., persons residing in a LTCF) (Statistics Canada, 2022b). The rise in obesity is expected to continue; by 2031, over 33% of Canadians are expected to have obesity (Bancej et al., 2015).

Obesity rates are not homogenous across Canada. There are variations between and within provinces, including amongst urban centers of different sizes and rural areas (I Janssen et al., 2011; Pouliou et al., 2014; Pouliou & Elliott, 2009; Shields & Tjepkema, 2006; Vanasse et al., 2006). In 2015, three of the ten provinces had obesity rates of 33% or higher in their older adult population; by 2021, seven provinces had older-adult obesity rates above 33%; ranging from the highest level of 39% in New Brunswick to the lowest rate of 25% in British Columbia (Statistics Canada, 2022b). Obesity rates are generally higher in rural and smaller cities, with the lowest rates in the largest urban centres (Public Health Agency of Canada, 2020; Shields & Tjepkema, 2006; Stackhouse, 2019). It is unknown if or how closely these heterogeneous rates translate into obesity rates in LTCFs across Canada.

Obesity in Long-Term Care (LTC)

An increase in obesity rates in the general population may be expected to translate into an increase in obesity rates in LTCFs, reflecting patterns across geographic areas (e.g., provincial, rural, urban, and smaller centers). The rates of obesity in Canadian LTCFs are largely unknown. Only two studies reported obesity rates in some Canadian LTCFs; the first was a 1997/98 meta-analysis looking at BMI and mortality rates and reported an average obesity prevalence of 16% in 14 Toronto LTCFs (Veronese et al., 2015). More recently, Shieu et al. (2022) reported an obesity rate of 17% in Western Canadian LTCFs (BC, Alberta, and Manitoba) in 2016/17. As a major source of Canadian LTC data, the Canadian Institute for Health Information (CIHI) collects weight and height measurements; however, it does not report or consider the impact of obesity or BMIs in their public reports on LTC, in-hospital, or in-community populations (Canadian Institute for Health Information, 2017c, 2022b, 2023). The only report regarding obesity found was in reference to bariatric surgeries. (Canadian Institute for Health Information,

2014). Research in other countries, especially America, has examined obesity rates in LTCFs. Drawing inferences from American LTCFs for a Canadian context is difficult as the general population's obesity prevalence varies between the two nations, with lower overall obesity rates in Canada (Siddiqi et al., 2015). However, both countries have seen an increase in obesity rates over the decades, so general changes in American LTCFs may provide insight into how Canadian LTCFs may be similarly affected.

LTCFs in other countries have seen a non-homogenous increase in obesity rates (Cai et al., 2013; Felix et al., 2015; Harris et al., 2020; Lapane & Resnik, 2005; MacDonell et al., 2015; Zhang et al., 2013; Zhang, Field, et al., 2019). A 2015 literature review looking at obesity prevalence in American LTCFs found an increase from an average of 1% in 1992 to 25% in 2002 (Marihart et al., 2015). Likewise, Zhang, Field, et al. (2019) found that, between 2005 and 2015, the average obesity prevalence in American LTCFs increased from 22% to 28%. Rates of obesity varied widely both within and between States, but were consistently higher in rural LTCFs (Harris et al., 2020; Zhang et al., 2013). The variations in obesity rates across facilities are influenced by the geographic distribution of obesity rates in the general population. However, that would not account for the wide range seen in New York State, highlighting that multiple factors influence obesity rates. Obesity rates were also influenced by barriers formed by differences in facility characteristics (Zhang et al., 2013). While obesity acts as a barrier in accessing LTC it also serves as a risk factor for needing LTC.

Obesity has been linked to an increased risk of admission to LTC (Felix et al., 2015; MacDonell et al., 2015; Nizalova et al., 2020; Zizza et al., 2002). Older adults with obesity were twice as likely to be admitted to American LTCFs than their non-obese counterparts (Marihart et al., 2015) with obesity at mid-life also found to increase the risk of admission to LTCFs 25 years

later (Elkins et al., 2006). Obesity appears to increase the need for LTC mainly due to physical disabilities, wherein medical advances have extended the number of years of life for those with obesity, yet those years may be rife with disabilities that require a level of care found in LTCFs (Decaria et al., 2012; Marihart et al., 2015; Williamson et al., 2023; Zanandrea et al., 2013). Having obesity also meant needing LTC at an earlier age, with individuals with obesity entering at younger ages (Ankuda et al., 2017; Cai et al., 2013; Lapane & Resnik, 2005; Shieu et al., 2022; Temkin-Greener et al., 2020; Williamson et al., 2023; Zhang, Field, et al., 2019). This increased risk of admission, however, is met with increased obesity barriers, especially when with higher levels of obesity.

While obesity is seen as a cause for admission to LTCFs, it also simultaneously serves as a barrier to obtaining that admittance into care (Bradway et al., 2017; Hahler, 2002; Welch, 2016; Zanandrea et al., 2013). For those with the highest obesity, the care required may be so unlike standard practice that it is suggested that those in the super-super obese group (BMI > 60 kg/m^2) should not be placed in Canadian LTCFs at all as their unique needs are beyond the scope of what is safely available (Welch, 2016). The organizational structure, facility size, and financial resources appeared to play a role in creating or addressing barriers for those with obesity. Facilities that can access resources through higher resident numbers featured a higher prevalence of obesity; such attributes of the facility included higher occupancy rates, higher bed capacity, multi-facility affiliation, more financial and staffing resources, and a higher resident mix (Harris et al., 2020; Zhang et al., 2013). Additionally, short-term stays were more likely for those with obesity, perhaps because facilities are more attracted to persons with obesity planning for short-term stays due to profit margins that are lost with higher costs and lower reimbursements for extended stays (Harris et al., 2020; Zhang, Lu, et al., 2019). Negative facility

characteristics associated with higher obesity rates included lower quality of care, and lower efficiency, with persons residing in a LTCF with obesity more likely to be admitted to LTCFs of poorer quality (Zhang et al., 2013, 2016). Facilities require the capacity and capital to be able to adequately provide more expensive bariatric equipment (e.g., hospital beds, mobility aids, blood pressure cuffs, catheters), retrofit older infrastructure (e.g., room and hallway size, reinforced lifts), and provide higher staffing ratios and specific training (Beitz, 2014; Cai et al., 2013; Felix et al., 2011; Harris et al., 2018; Rotkoff, 1999). Therefore, facilities with more resources were able to accept a higher rate of persons with obesity as their case mix, and higher numbers compensated the higher costs persons with obesity have when in LTCFs. Nevertheless, because obesity creates barriers and limits the available pool of LTCFs, persons with obesity were also more likely to enter poorer-quality LTCFs (Zhang et al., 2013).

Bariatric equipment is generally larger, bulkier, more expensive, and is less readily available in healthcare settings as it is more challenging to acquire, utilize, and store and is only used by a minority of the population (Boamah et al., 2021; Dockrell & Hurley, 2021; C. Hales et al., 2020; D. Jones et al., 2020; MacDonell et al., 2015; Welch, 2016; Zhang et al., 2013). While equipment requirements vary, generally, once a resident reaches a weight of 115 kg (~250 lbs) larger, reinforced bariatric equipment is utilized to accommodate the girth, weight, and overall size of persons residing in a LTCF while also assisting in the movement and the mobility of resident whose bulk may create dangerous situations to patients and staff otherwise (Canadian Agency for Drugs and Technologies in Health, 2012; Muir & Archer-Heese, 2009). The coverage of the cost of bariatric equipment varies and may be classified as an additional cost separate from the norm; for example, in British Columbia, basic wheelchairs are provided for personal use in LTCFs, yet bariatric wheelchairs are excluded from the definition of a basic

wheelchair, as they are considered specialty equipment (British Columbia Ministry of Health, n.d.). The lack of availability of bariatric equipment and the lack of capacity to safely accommodate said equipment, in any healthcare setting, including in LTCFs, are significant barriers for those seeking safe care (Bradway et al., 2017; Caz Hales et al., 2019; Sardani, 2014). More financially well-off facilities would therefore be more likely to have the capital to obtain, maintain and retrofit for such equipment.

The purchasing of adequate equipment and the retrofitting of older facilities are expensive capital undertakings, and many American facilities still struggle to make this transition (Zhang et al., 2013). Often LTCFs are older buildings, which would require expensive retrofitting to be able to house the equipment needed to care for persons with obesity, such as doorway, room, and hallway sizes, ceiling capacities for lifts, and larger bathrooms, amongst other considerations, such as storing the equipment, emergency preparedness, or elevator capacities (Bradway et al., 2017; Hahler, 2002; C. Hales et al., 2020; Harris et al., 2018; Lapane & Resnik, 2005, 2006; Ramme et al., 2015). Such undertakings are both cost-effective and beneficial for the care staff and the persons residing in a LTCF (Collins et al., 2004), yet not all facilities are capable of handling an increase in obesity prevalence, let alone meet current demands (Harris et al., 2018; Marihart et al., 2015; Roblin et al., 2022). Canadian facilities also vary in their ability to be able to handle bariatric equipment, with some facilities not able to take bariatric patients at all; however, it is unknown how many facilities have the capacity, how many require retrofitting, or even if the number of facilities is already adequate for the demand in the population. The Canadian Standards Association (CSA), a voluntary association engaged in standards development for healthcare facilities, states that the dimensions and clearance of rooms, including inpatient rooms, examination rooms, washrooms, and accessible space require

planning and retrofitting with the explicit intent of accommodating the equipment and space required for those weighing 225-453lbs (Canadian Standards Association, 2018; Welch, 2016). To what extent LTCFs in Canada face the complications of maintaining a separate set of equipment for bariatric persons residing in a LTCF, including in smaller and rural centers, and how that impacts individuals attempting to enter LTCFs and those already in LTCFs is unknown, and is an area for future researchers to explore.

The barriers of obesity when trying to access LTC have been associated with increased length of hospital stays, which contributes to their deterioration and may even result in becoming 'stranded in hospital' (Bradway et al., 2017; Felix et al., 2016; Miles et al., 2012). Becoming 'stranded in hospital' while waiting for home care or LTC is a phenomenon seen in Canada and further strains the Canadian healthcare system (Bender & Holyoke, 2018; Costa et al., 2012; Kuluski et al., 2022). In 2018, Canadian hospitals had 55,000 patients with extended hospital stays waiting for a bed in a Canadian LTCF, plus half as many waiting for home care services (Canadian Institute for Health Information, 2019a). This pressure on the healthcare system has led some provinces to force patients out of hospitals and into LTC up to 150 km away (DeClerq, 2022).Furthermore, refusal to enter into a LTCF when in-hospital also has negative repercussions, with instances of being discharged from the hospital into a shelter or threatened with hefty hospital bills, a situation made more common because of the COVID-19 pandemic (DeClerq, 2022; Mcquillan, 2022). When waiting in Canadian hospitals for LTC admissions higher levels of obesity were associated with longer lengths of stay (Costa et al., 2012). Persons with obesity have fewer LTCFs to choose from, as facilities may be unable to accept bariatric patients or may have the capability but not the availability. The limited stock of adequate facilities available to persons with obesity, may therefore increase the risk of accepting a spot in

a non-preferred LTCF or being forced to enter a LTCF further away from their home (Miles et al., 2012). Current policies in BC have the option of placing a resident into any LTCF, which includes outside of their community, with the option of remaining on waitlists for their preferred LTCF (British Columbia Ministry of Health, n.d.). More research is needed to better understand how obesity impacts the number of days spent waiting for Canadian LTC while in-community, in-hospital, or while in a non-preferred LTCF and the distance a Canadian resident must go from home to find a facility with the capacity and availability for their care needs.

When administrators and staff do accept persons with obesity into a LTCF, they may do so while holding reservations or weight biases that create a negative or under-prepared environment (Felix et al., 2011; Caz Hales et al., 2019; Puhl & Heuer, 2009). Persons with obesity and increasing obesity have a higher risk of needing two+ person assistance when completing daily living tasks (Felix et al., 2011; Harris et al., 2018; D. Jones et al., 2020; Rotkoff, 1999) and higher healthcare costs while in LTCFs (Cai et al., 2013; Williamson et al., 2023; Yang & Zhang, 2014; Zhang et al., 2013). When staffing levels and hours are already stretched thin, as has been reported in many Canadian LTCFs (MacCourt et al., 2020; Ontario Ministry of Long-Term Care, 2020), the more extensive assistance required by patients with obesity is a barrier to acceptance into LTC (Bradway et al., 2017; Felix et al., 2016). Moreover, the lack of equipment availability or accessibility could mean adapting to available resources by using more people to assist adding to concerns for the safety of staff and persons residing in a LTCF as inadequate staff levels and equipment increases the risks of injuries for both staff and persons residing in a LTCF (Felix et al., 2016; Hahler, 2002; Harris & Castle, 2019; D. Jones et al., 2020). Staffing hours are generally based per resident; however, regulations are not consistent across Canada or necessarily based on provincial legislation. For example, BC has no

legislation governing LTC staffing hours or type of staff providing care, utilizing instead provincial guidelines. These guidelines ascribe that each resident receives 3.36 hours of direct care per day, yet this goal is not always reached, and it also appears to put persons residing in a LTCF at risk, with 4.1 hours being identified as a minimum for safe care (MacCourt et al., 2020). Additionally, the inability of funding and staffing algorithms to adjust to two+ person assistance and higher costs of care consequently results in lower reimbursement for services, directly impacting facilities' willingness to take in individuals with obesity (Miles et al., 2012). Addressing these capital and human resources-based barriers is difficult and interweaves multiple areas of a system already straining to adapt and provide care to a growing population (Estabrooks et al., 2020; MacCourt et al., 2020).

Age, Obesity and LTC

Older persons residing in a LTCF with obesity are a small minority of their age group. Research in other countries has also found that persons residing in a LTCF with obesity were more likely to be younger (Cai et al., 2013; Grabowski et al., 2005; Kuchibhatla et al., 2013; Temkin-Greener et al., 2020). Shieu et al. (2022) reported higher rates of obesity in younger age groups (in this case, 51-80 years) residing in Western Canadian LTCFs, which is supported in other countries LTCFs as well. The sub-population of younger persons residing in LTCFs has unique care requirements. Hay and Chaudhury (2015) explored the quality of life for younger persons aged 70 years or below living in LTCFs in British Columbia, finding that younger persons residing in a LTCF had distinctive needs that required more social, emotional, and psychological care, that were often not taken into consideration, as care services and activity programs were geared to an older population. Since LTC is generally tailored toward older individuals, staff may not have the experience or knowledge to care for younger persons residing

in a LTCF, especially those with disabilities and developmental challenges (MacCourt et al., 2020). Specific to care and management of obesity in LTCFs, younger-older adults in LTCFs would not benefit from the potential obesity 'protective factors' associated specifically with the aging processes previously described in older adults (Bosello & Vanzo, 2021; Lindsted & Singh, 1997; Oreopoulos et al., 2009; Van Uffelen et al., 2010), and would not need adjustments to risk thresholds at lower obesity levels. The risk of obesity in adults, in general, is well established in the literature, with a greater risk of mortality, co-morbidities, and disability (Anis et al., 2010; Guh et al., 2009; Landi et al., 2000; Luo et al., 2007; Rao et al., 2018; C. Wang et al., 2016; Wilkinson et al., 2019). The management of obesity in LTCFs for this younger-older adult population would therefore look different from the management of care for older persons residing in a LTCF with obesity, as it may be more appropriate to emphasize weight loss rather than weight management.

Health Conditions, Obesity and LTC

There are many conditions in LTCFs; however, dementia and diabetes are two of the more prominent ones. The prevalence and incidence of dementia increases after the seventh decade of life, with 12% of Canadians aged 80-85 diagnosed with dementia and twice that for individuals over 85 (Public Health Agency of Canada, 2017). Dementia continues to be the most significant contributing factor for needing LTC (Halonen et al., 2019), with 22% of 'stranded in hospital' Ontarians waiting for LTC or home services while with dementia (Canadian Institute for Health Information, 2019a). Older persons with obesity have lower rates of having and lower risks of developing dementia or general cognitive decline (Ankuda et al., 2017; Aslan et al., 2015; Cai et al., 2013; Dahl et al., 2008), yet other studies point to obesity earlier in life and higher rates of developing cognitive issues including dementia (Anjum et al., 2018; Ma et al.,

2020; C. Wang et al., 2016). Both dementia itself and the treatment for dementia are associated with weight loss (Bowman et al., 2019; Franx et al., 2017). Persons with an overweight BMI or obesity may have a partial 'protective factor' for starting with higher weight alongside dementia to allow for some weight loss (de Souto Barreto et al., 2017; García-Ptacek et al., 2014). The literature has found that persons with obesity have lower rates of dementia when in LTCFs even when age and other demographics are considered (Ankuda et al., 2017; Cai et al., 2013). Dementia will continue to be a disease of importance for LTC and increasing the understanding of a minority population (those with obesity and dementia) will be beneficial for health equity in LTCFs.

Diabetes is present in a quarter of the LTC population (Canadian Institute for Health Information, 2022b). The management of diabetes in LTCFs is unique due to its setting. One study that examined diabetes management in LTCFs highlighted the variety of opinions physicians had on the intensity of monitoring and management, target levels, and use of clinical practice guidelines, with a disconnect between expected achievements of diabetes management and actualization of intentions (Osman et al., 2016). Likewise, Lega et al. (2020) found poor self-reported knowledge of diabetes management amongst LTC nurses, registered dieticians, and personal support workers. A lack of knowledge of diabetes management was also related to the overtreatment of frail older adults in LTCFs, as older adults with diabetes need distinct diabetes treatment from diabetes in young persons (Meneilly et al., 2018). Traditional therapeutic diets treating diabetes or obesity in older adults increase the risk of frailty and malnutrition (Bahat et al., 2012; Formiga et al., 2013; Perissinotto et al., 2002). Diabetes will continue to be a prominent condition in LTCFs and understanding the population most at risk (those with obesity) will be beneficial.

Activities of Daily Living, Obesity and LTC

Activities of daily living (ADLs) are tasks performed in a typical day that allow independent living and are a common way to track the demands of patients within long-term care facilities (Canadian Institute for Health Information, 2019b; Harris et al., 2018; Jenkins, 2004; Lapane & Resnik, 2005; Rao et al., 2018; Rotkoff, 1999). Individuals in-community are continuously assessed on their ADLs with an inability to perform specific or an accumulation of tasks, often resulting in referral to further care, such as LTCFs (Venes, 2017, p. 39). Assessing, quantifying, and tracking an individual's ADL abilities through validated assessments allows for comparing expected performance against similar individuals and monitoring changes in abilities. The Resident Assessment Instrument (RAI-MDS 2.0) is utilized by LTCFs participating in CIHI's Community Care Reporting System (CCRS) (Canadian Institute for Health Information, 2019b).

Individuals with obesity have been found to enter LTC with higher independence in cognitive-based abilities, especially late-loss abilities such as eating, but were more likely to exhibit a greater need for extensive assistance with physical-based abilities (Harris et al., 2018; Kosar et al., 2018; Rao et al., 2018; Rotkoff, 1999; C. Wang et al., 2016; Zhang, Field, et al., 2019). Conversely, other studies have found that after considering cognitive status, there were no associations between ADL scores and obesity in older adults (Borda et al., 2021; Kiesswetter et al., 2014). Comparing ADL independence levels of persons newly residing in a LTCFs will provide information on the utilization of resources (two+ person) and may lend some insight into the impact of obesity on independence.

Equity Considerations

> Equity in health is about eliminating unnecessary/avoidable, and unfair/unjust differences in health among population groups and communities.
>
> -Patychuk and Seskar-Hencic, 2008, p. 2

Approaching healthcare with an equity lens requires 1) the identification of priority populations and the populations' needs, 2) understanding the unique barriers and burdens faced in meeting those needs, and subsequently, 3) what policies, interventions, programming, or changes to social and environmental conditions can be implemented to minimize barriers and burdens, and meet those needs (Patychuk & Seskar-Hencic, 2008). Before healthcare policies and interventions can be implemented to their fullest potential and to better capture and acknowledge barriers and burdens faced, the identification of priority populations requires activities such as surveillance research that produce a 'broad picture' of the population in question (Patychuk & Seskar-Hencic, 2008).

The health barriers and burdens of persons with obesity are well-studied in the general population (Ankuda et al., 2017; Phelan et al., 2015; Puhl & Heuer, 2009; Sutin et al., 2015). The population with obesity may face common deficiencies in health equity when interacting with the healthcare system, including LTC (Meadows & Daníelsdóttir, 2016). Research surrounding individuals with obesity in LTCFs in other countries has demonstrated that those with obesity consistently show poorer health and face more significant barriers in both entering LTC and obtaining quality care once admitted (Bradway et al., 2008; Caz Hales et al., 2019; Marihart et al., 2015; Porter Starr et al., 2014; Zanandrea et al., 2013). Such observations suggest that those with obesity in LTCFs should be considered a potential population of interest when ensuring equity in health, and this should be extended to Canadian LTC.

Weight Bias

The understandings around the causes of obesity in healthcare and literature have evolved to include not only behaviour and lifestyle factors in the control of individuals but also socio-economic factors, obesogenic-environments, and genetic determinants that are out of an individual's control (O'Neill et al., 2019). These concepts challenge the previously and often still prevailing conceptualization of obesity as a condition of a character flaw, such as being lazy or lacking willpower (Pearl & Puhl, 2018; Pila et al., 2016). Negative assumptions and judgments about an individual's character, stemming from an individual's weight, are termed 'weight bias.' Weight biasness can be held by any member of society, including internally or by healthcare providers, and can be built into systems and settings.

Weight bias and weight bias internalization occur in both explicit and implicit scenarios in healthcare settings through stigmatization and stereotypes that, in turn, then influence the behaviours of both the healthcare provider and the person with obesity, consequently negatively impacting the patient's physical and mental health (Jackson et al., 2014; Pearl & Puhl, 2018; Phelan et al., 2015; Pila et al., 2016; Sutin et al., 2015). Healthcare providers may exhibit explicit weight bias, such as negative attitudes, language used or blameworthy causes of obesity, (Hauff et al., 2020; Oliver et al., 2021; Phelan et al., 2015; Puhl & Heuer, 2009; Zevin et al., 2021). Healthcare providers may also see obesity as the paramount issue regardless of patients' concerns or approach obesity management in unhelpful ways, negatively impacting patients' healthcare experiences (Meadows & Daníelsdóttir, 2016; Puhl & Heuer, 2009).

Meanwhile, implicit bias is manifested in environmental settings that negatively affect the perceived acceptance of persons with obesity and instead emphasize that they, as a product of their body type, are not the norm (Phelan et al., 2015). Indirect weight bias occurs in the

healthcare setting through deficits in appropriate supplies, equipment, staffing and environmental structures, creating a setting that negatively affects the feelings of acceptance of persons with obesity, reducing the quality of care and contributing to the internalization of weight biasness (Oliver et al., 2021; Pearl & Puhl, 2018; Ramme et al., 2015). Balancing the need to reduce the harmful psychological and social effects of weight biasness while acknowledging the physiological risk factors associated with excess weight is essential to obesity management (Phelan et al., 2015). Nevertheless, healthcare providers may feel unprepared to manage obesity (Katz et al., 2022; Zevin et al., 2021).

By utilizing appropriate language and acknowledging the differences required in health settings for persons with obesity entering long-term care, this thesis aims to reduce settings-based weight bias and discrimination; making it part of the norm to consider differences in BMI allows for settings to strive for equitable healthcare by outwardly and explicitly acknowledging differences in care needs. While obesity has been studied in the general Canadian population, there is scarce information available regarding the prevalence or effects of having obesity in institutional settings such as Canadian LTCFs. Analyzing demographic and clinical data collected during initial assessments from hundreds of LTCFs across Canada over the past decade, this thesis provides the initial 'broad picture' of the population with obesity as they enter LTC. Understanding the healthcare needs of those with obesity is the first step towards physically safer, less stigmatized, and more inclusive environments.

Chapter Three: Methods

Data Sources

This thesis intends to fill gaps in research surrounding Canadian obesity rates in LTCFs, with a focus on the population entering LTC. Individuals who enter a LTCF for the first time are at a major transition point in life. The population transitioning into LTC is not homogenous, and this thesis will consider variations in demographic characteristics, health conditions, and care needs.

Most of the data reported in this thesis originates from micro-data contained within the Continuing Care Reporting System (CCRS), operated by the Canadian Institute for Health Information (CIHI). Launched in 2003, the CCRS is a data-holding system that collects and reports information collected through the Resident Assessment Instrument Minimum Data Set 2.0 Canadian Version (RAI-MDS 2.0) (referred to interchangeably as 'the initial assessment') (InterRAI Corporation & Canadian Institute for Health Information, 2012). Developed by interRAI, a not-for-profit international research network, and modified by CIHI for Canadian use, the RAI-MDS 2.0 is a standardized clinical assessment of patients requiring continuing care (Canadian Institute for Health Information, 2017a). The CCRS data includes Canadian long-term care facilities (LTCFs) that have 24-hour nursing available with publicly funded/subsidized beds (Canadian Institute for Health Information, 2019b). The CCRS reported 192,670 persons residing in LTCFs in the fiscal year 2016-17, which accounted for approximately 75% of all persons residing in Canadian LTCFs (Canadian Institute for Health Information, 2017c; Statistics Canada, 2017a). CIHI regularly publishes reports and makes data publicly available regarding demographics and clinical information of persons residing in LTCFs (Canadian Institute for Health Information, 2017a, 2017b). The CCRS micro-data is therefore a useful resource that

captures demographic and clinical information on a majority of persons residing in a LTCF through validated assessments.

When entering a participating LTCF initial assessments were required to be completed within 14 days of admission to a facility (Canadian Institute for Health Information, 2019b). The data request limited assessments to only the first initial assessment per individual newly admitted to a LTCF by excluding multiple assessments, assessments completed 30 days or more after admission date, and any assessment completed for re-entry, discharge, transfer, or any purpose other than initial entrance (e.g., annual, major changes in ability). Through their internal processes, CIHI determined the level of de-identification required before the release of the data set to ensure confidentiality, this included withholding some demographic information (e.g., marital status), amalgamating some answers (e.g., education), or providing categorized groups (e.g., age groups).

The key characteristic in this thesis was BMI, which was calculated and provided by CIHI categorically. The only facility characteristic obtained was the province or territory of the facility. The key demographic variables included in this report are weight, age, sex, primary language, and location of last residence. Clinical information variables comprise presence of chronic health conditions along with performance and assistance levels of activities of daily living (ADLs)

This thesis also includes information obtained from previous literature regarding the obesity rates and rates of health condition dyads found amongst in-community older Canadians. The obesity rates amongst persons newly residing in a LTCF were compared to the rates of obesity amongst older adults living in the general population (i.e., not in LTCFs) and these in-community rates were obtained through the research produced by Lytvyak et al. (2022) that

utilized Statistics Canada's 2005-2018 Canadian Community Health Surveys (CCHS). Likewise, the rates of health condition dyads in the newly entered LTC population were compared to in-community rates from Statistics Canada's 2008 Canadian Survey of Experiences with Primary Health Care (CSEPHC) as reported by CIHI (Canadian Institute for Health Information, 2011).

Ethics

The Research Ethics Board (REB) of the University of Northern British Columbia determined this research as not requiring REB approval as the project worked with non-identifiable data that is solely accessed through CIHI, with no external linkages, of which CIHI's system manages the privacy and security.

Research Sample

The population of interest was defined as all those entering a Canadian long-term care facility (LTCF) for the first time. The reference population was limited to newly entered persons residing in a CIHI participating LTCF an initial entrance between January 1, 2010, and December 31, 2020, and not entering from another LTCF.

Research Design

The study utilized retroactively obtained, consecutive cross-sectional data previously collected during the initial assessment between 2010-2020 inclusive. This study examined the initial assessment data to create a descriptive account of the newly entered LTC population with a focus on the differences between the sub-populations defined by their obesity or BMI status. The annual 'incidence' of obesity and BMI statuses among those recently admitted to LTC were calculated. Provincial and territory obesity rates were also examined as a characteristic of the facilities. Utilizing the entire populations newly entered between 2010-2020, as defined by their BMI, a demographic profile and analysis of health and ADL indicators was created. The

demographic variables considered were age, sex, primary language spoken, and last location of residence. These are described in more detail in 3.4.3. Health status was evaluated with frequencies of chronic conditions, multiple conditions, and most common dyads of conditions. This is described in more detail in section 3.4.4. Finally, ADLs were summarized as to whether an individual could or could not perform independently, and whether or not two+-person assistance was provided. This is described in more detail in section 3.4.5. Combined, these variables provide a 'broad picture' of the population newly entered into participating LTCFs while highlighting the difference between population with obesity and other BMIs.

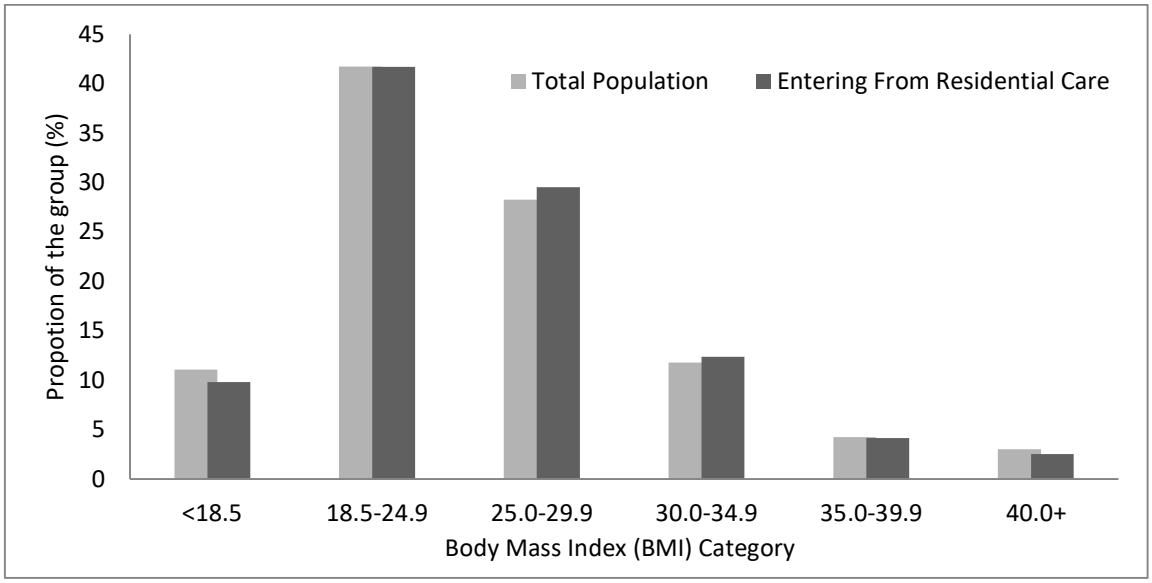
Initial Data and Clean-up

The data request to CIHI yielded a total of 448,337 unique initial assessments. In the initial screening of assessments 4,033 (1%) were removed due to missing weight (2,121) or less than 10 kg (1,922), secondly, 87,414 cases (20%) had an entry service type listed as residential care and were removed, and finally 6,542 cases (2%) were removed due to missing BMI records. After this screening, there were 350,348 assessments utilized for analyses. A further breakdown of the removal based on entry service type and missing BMI follows.

The service type of the admitting facility was collected with ten options but provided in four (private home/apt with or without home care, inpatient, residential care, and ambulatory health services or other services).With a high proportion of the original assessments entering from residential care (n=87,414), the distribution of BMI categories was explored for these assessments and found to largely mirror the distribution of the total population (Figure 1). These assessments were then removed from the population.

Figure 1

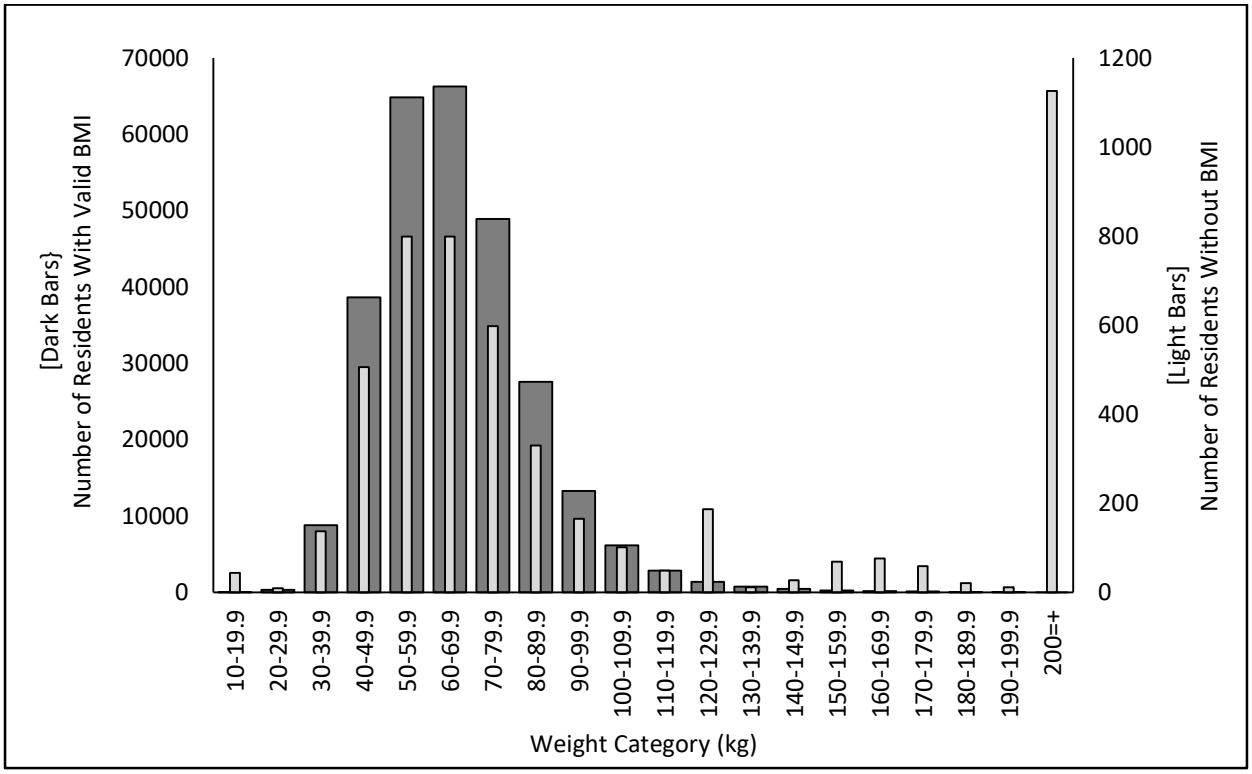
Distribution of Body Mass Index (BMI) of All Persons Newly Residing in a Long-term Care Facility (N=356,890) and Persons Newly Residing in a Long-term Care Facility Entering from Residential Care (n=87,414), 2010-2020



Assessments with a missing BMI, but with a valid weight, were initially to be included in the 'weight only' analysis (n= 6,542). However, when exploring the distribution of missing BMI by weight categories there was a notable issue for the lightest category (<20kg), and the heaviest category (>120 kg), especially the ≥ 200 kg category (Figure 2). The more extreme weights had relatively high numbers of missing BMIs compared to the number of individuals within the category. Of the persons newly residing in a LTCF, 96% (n= 1,126) in the heaviest weight category (≥ 200 kg) and 50% in the lightest category (<20kg) did not have a valid BMI. The likelihood of an adult weighing under 20 kg or over 200 kg is low, so the spikes at the more extreme categories are most likely due to input errors. As such, any results would be greatly skewed in these relatively small categories. Overall, there were less than 5% of persons newly residing in a LTCF with a missing BMI, so these assessments were also excluded from the weight-only analysis.

Figure 2

Valid and Missing Body Mass Index (BMI) by Weight Category of Persons Newly Residing in a Long-term Care Facility (N=350,348), 2010-2020



Facility Characteristics

The expansion and varying provincial commitment levels to the CCRSs over time may affect longitudinal results, so the interpretation of annual trends occurring between 2010 and 2020 should be done with caution (Canadian Institute for Health Information, 2019b). Provincial and Territory information for Alberta, British Columbia, and Ontario, were provided independently, however, largely due to relatively small numbers of participating facilities, the 'Other' group was an amalgamation of Manitoba, Newfoundland and Labrador, Nova Scotia, Saskatchewan, and the Yukon Territory (Table 1). Most provinces had full commitment to the CCRS program, however Saskatchewan and Manitoba only had partial commitment (Canadian Institute for Health Information, 2020c). Of note, Saskatchewan had no participating facilities in

FY 20/21 but had +130 facilities submitting the years previous. A separate data request would have been required to obtain the information on 2010-2015, however, due to time constraints and previous delays this was not undertaken. Table 1 shows the publicly available data for the number of participating facilities.

Table 1

Number of Participating Long-Term Care Facilities by Fiscal Year, 2016/17-2020/21

Province	Fiscal Year % (n)				
	16/17	17/18	18/19	19/20	20/21
Alberta	13 (174)	13 (174)	13 (177)	14 (180)	15 (181)
BC	22 (297)	22 (298)	22 (297)	23 (299)	25 (299)
Ontario	47 (626)	47 (626)	47 (626)	47 (623)	53 (620)
'Other' group	18 (235)	18 (233)	17 (219)	16 (216)	7 (79)
Total	100 (1332)	100 (1331)	100 (1319)	100 (1318)	100 (1179)

Province and Territory in the 'Other' group	Fiscal Year % (n)				
	16/17	17/18	18/19	19/20	20/21
Manitoba	16 (37)	17 (39)	18 (39)	18 (39)	48 (38)
Newfoundland and Labrador	17 (39)	15 (35)	16 (35)	16 (35)	46 (36)
Nova Scotia	0 (0)	2 (2)	0 (0)	0 (0)	0 (0)
Saskatchewan	66 (154)	65 (152)	64 (140)	63 (137)	0 (0)
The Yukon	2 (5)	2 (5)	2 (5)	2 (5)	6 (5)
Total 'Other' group	100 (235)	100 (233)	100 (219)	100 (216)	100 (79)

Demographic Variables

The initial assessments provided various variables for analysis. CIHI limited some variable information due to confidentiality concerns. BMI and weight-only were used for incidence analyses. CIHI provided BMI using the WHO's six categories. Class III obesity is the highest category provided, the low number of individuals in and above this category prevented the use of higher obesity. Weight was provided in kilograms to the first decimal and transformed into <115k, 115-134.9, 135-154.9, ≥155.

Alongside BMI, demographic variables included age, sex, primary language, and location of last residence. Categories. Age was provided in 5-year categories, with <20 years as the youngest group, and ≥ 85 years as the oldest, and these were transformed into ten-year age groups (<50, 50-59, 60-69, 70-79, ≥80). The variable of sex utilized male, female and 'other'. Primary language spoken was recorded in the assessment; however, this variable was provided dichotomously as speaking one of the official languages (English/French) or not doing so. Finally, the location of last residence was provided as either rural or urban and was based on the most recent postal code before entering LTC. CIHI defined rural and urban utilizing Statistics Canada's Statistical Area Classification (SAC) with urban defined as SAC Types 1-3 (census metropolitan areas (CMAs) and census agglomerations (CAs) and rural defined as SAC Types 4-8 (areas outside CMAs and CAs) (Canadian Institute for Health Information, 2022a).

Morbidity and Multiple Morbidities

Multiple indexes have been utilized by surveys and research to account for the impact of accumulation and different combinations of health conditions, with indexes counting from four to upwards of fifteen conditions. Indexes used in research by Tooth et al. (2008) on multi-morbidities and ADLs, and Halonen et al.'s (2019) research on multi-morbidities and LTC admissions along with indexes used in three Canadian surveys were compared for overlapping conditions to create an index for this thesis. The three surveys were, starting with most recent, the Canadian Survey on Access to Health Care and Pharmaceuticals During the Pandemic (SAHCPDP), Barriers to Care for People with Chronic Health Conditions (BCPCHC) and the Canadian Survey of Experiences with Primary Health Care (CSE-PHC) (Statistics Canada, 2009, 2012, 2021). Finally, some of the conditions recorded in the CRRS data set from CIHI were combined to better fit definitions within the developed index (see list below). Based on this index

a count of multiple morbidities amongst persons newly residing in a LTCF was developed.The final list of 14 conditions developed for this multi-morbidity index was:

- Hypertension (high blood pressure),
- Dementia/Alzheimer's (combined),
- Arthritis,
- Diabetes Mellitus,
- Osteoporosis,
- Depression,
- Stroke,
- Emphysema/COPD,
- Anemia,
- Cancer,
- Asthma,
- Liver Disease,
- Hip Fracture,
- Heart Disease (a combination of CIHI's RAI-MDS 2.0 congestive heart failure, other cardiovascular diseases, and arteriosclerotic heart disease (ASHD))

For those conditions that were combined (i.e., Heart Disease is the combination of the RAI-MDS 2.0's conditions of congestive heart failure, other cardiovascular diseases, and arteriosclerotic heart disease (ASHD)), a single variable was created called Heart Disease. Having one or more of those three listed conditions resulted in a single positive result for the Heart Disease variable. The same was done for the Dementia/Alzheimer's variable. This index of conditions was utilized to provide a count of multi-morbidities seen in the population of persons newly residing in LTCFs, and to explore if there are differences in the number and rates of multi-morbidities by BMI status.

Activities of Daily Living - Independence

For simplicity, the independence levels of persons newly residing in a LTCF were transformed into dichotomous readings of whether or not an individual performed the activity independently. Being independent was defined as "No help or oversight or help/oversight provided only 1 or 2 times during last 7 days"(Canadian Institute for Health Information, 2016).

Literature looking at obesity in American LTCFs found an increase in two+ person physical assistance for those with obesity, namely for activities with a larger physical component (e.g., bed mobility) (Harris et al., 2018; Zhang, Field, et al., 2019). Assistance provided for ADLs was limited to whether or not two+ person assistance was required.

Statistical Tests

Two separate analyses were conducted for each point of interest. The first compared the proportions of those with obesity (BMI $\geq$ 30 kg/m^2) to those without obesity. The second analysis used the six WHO BMI categories, with normal BMI situated as the reference group against each of the other 'non-normal' BMI categories. Statistical analysis was performed using SPSS version 28 (IBM Corp., 2021). The data was populated into Cross-Tabulation tables and Chi-squared tests, with significance levels of $p \leq 0.001$, were utilized for these assessments (Polit & Beck, 2017, p. 392).

Proportional ratios (PRs) on the line graphs were utilized to visually represent the differences of independence for multiple ADLs between those with and without obesity, while also taking dementia into account. The PRs also allowed for the comparison across multiple BMIs, with and without dementia. Obesity PRs were first calculated by dividing the proportion of persons newly residing in a LTCF with obesity operating at an independent level by the proportion of persons newly residing in a LTCF without obesity operating at an independent level. Secondly, when using the six BMI categories, persons newly residing in a LTCF with a normal BMI were set as the reference population, and the BMI PRs were calculated for each "non-normal" BMI category by dividing the proportion of independence of the BMI category over the reference categories' independence proportion. Each calculation had two PRs created for each of their ADLs: one PR for those with dementia (x) and one PR for those without dementia

(o). A PR significantly greater than 1.0 indicates a higher proportion of independence amongst those with obesity, a PR significantly less than 1.0 indicates lower independence, and a PR of 1.0 indicates no difference. In the case of the six BMI categories, the PR values refer to the performance level of the 'non-normal' BMI in relation to the reference group. Secondly, the length between the x and o visually showcases the relative differences seen between the populations with and without dementia. Finally, these lengths and PR positions can be compared between the BMI categories.

Chapter Four: Results

Obesity rates in the Canadian general population have been increasing over the past century. As the population ages, little is known about how the rising number of obese older adults will affect the long-term care (LTC) population. Since research into obesity in Canadian LTC is sparse, the focus here is to produce information that may be used to inform future research and policy about LTC capacity and resources. This will be achieved through an exploration of rates of obesity recorded in initial assessments of persons newly residing in a long-term care facility (LTCF) (N=340,348) over a 10-year period (2010-2020), and the development of a profile that examines the demographic characteristics, health conditions, and levels of independence relative to their Body Mass Index (BMI) upon entry to a LTCF. The prevalence of obesity in LTCFs will be influenced by the influx of new individuals into LTCFs, so it is worthwhile to provide an estimate of this influence and how it changes over time. Individuals transitioning into the LTC population have been under different social and environmental influences as compared to those living in LTCFs and represent a population that could be a target for policies and programs that delay or prevent LTC admission. Examining persons newly residing in a LTCF over time offers an opportunity to identify broader societal changes (e.g., rising rates of obesity) and the implications these may have for LTC now and in the future.

Assessment Frequencies

The number of first initial assessments remained relatively constant, with a slight increase in numbers between 2010 and 2019 (Figure 3). There is a notable drop in the number of assessments between 2019 to 2020, where the number of assessments decreases by 9,646 or by 30% of the total first initial assessments in 2019. This is most likely due to a combination of the

COVID-19 pandemic and the withdrawal of Saskatchewan from the program in 2020. This pattern was also seen at the provincial/territorial level, with relative stability over the 9-year period and a formidable drop in numbers for each group (Figure 4). Most notably in 2020 there was a 41% drop in first initial assessments in Ontario and 36% in the 'Other' group.

Figure 3

Annual Frequency of First Initial Assessment of Persons Newly Residing in a Long-term Care Facility (N=350,348), 2010-2020

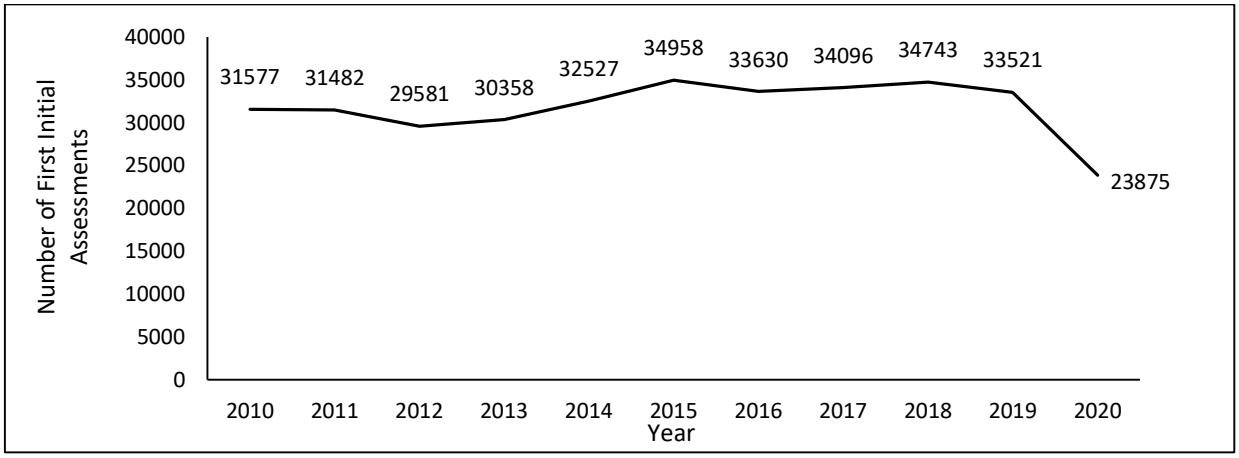
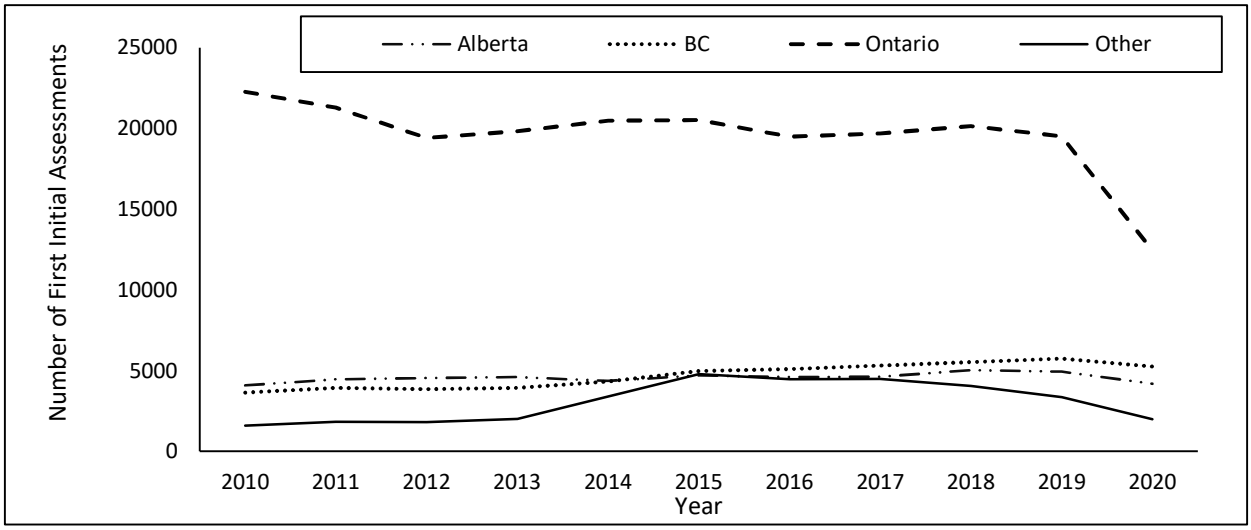


Figure 4

Annual Provincial/ Territorial Frequencies of First Initial Assessment of Persons Newly Residing in a Long-term Care Facility (N=350,348), 2010-2020



Note. Other = Manitoba, Newfoundland and Labrador, Nova Scotia, Saskatchewan, and the Yukon.

Profile of Persons Newly Residing in a LTCF (2010-2020)

Between 2010 and 2020, inclusive, there were 350,348 unique initial assessments submitted from LTCFs that participated in the Continue Care Reporting System (CCRS). The profile developed of those newly residing in a LTCF showed an older-adult population, with 68% entering at the age of 80 or older, and a further 20% entering between the ages of 70 and 79. The population was predominantly female (61%, n=214,497), had a primary language of either English or French (86%, n=302,212), and had a previous primary residence in an urban area (84%, n=271,427). Obesity was present in 19% of the population, with 12% having class I, 4% having class II and 3% having class IIII obesity. Much of the population had hypertension (i.e., high blood pressure) (61%, n=212,511), or dementia/Alzheimer's (54%, n=190,415). With arthritis (35%, n=123,708), diabetes (26%, n=91,809), osteoporosis (22%, n=76,020) and depression (22%, n=75,829) the next most common conditions. A full list of the rates of chronic conditions can be found in Appendices 1-2. Most (n=301,314), or 86%, of the persons newly residing in a LTCFs also entered with multi-morbidities (two+ conditions). Finally, nearly one-third of the sample population required two or more people to assist in performing the ADLs of transfer (33%, n=116,654), toileting (33%, n=114,877), or bathing (30%, 105,858). Meanwhile, one-third of the population were noted to perform at an independent level when undertaking the activities of eating (34%, n=120,365) and bed mobility (32%, n=110,464). A full list of the assistance provided, and self-performance levels of all ADLs, are provided in Appendices 3-6.

Incidence

This section provides incidence rates of persons newly residing in a LTCF with obesity (i.e., BMI $\geq$ 30 kg/m^2) to those entering LTCFs without obesity (i.e., BMI <30 kg/m^2), as well as the rates across the World Health Organization's (WHO) BMI categories, including the three

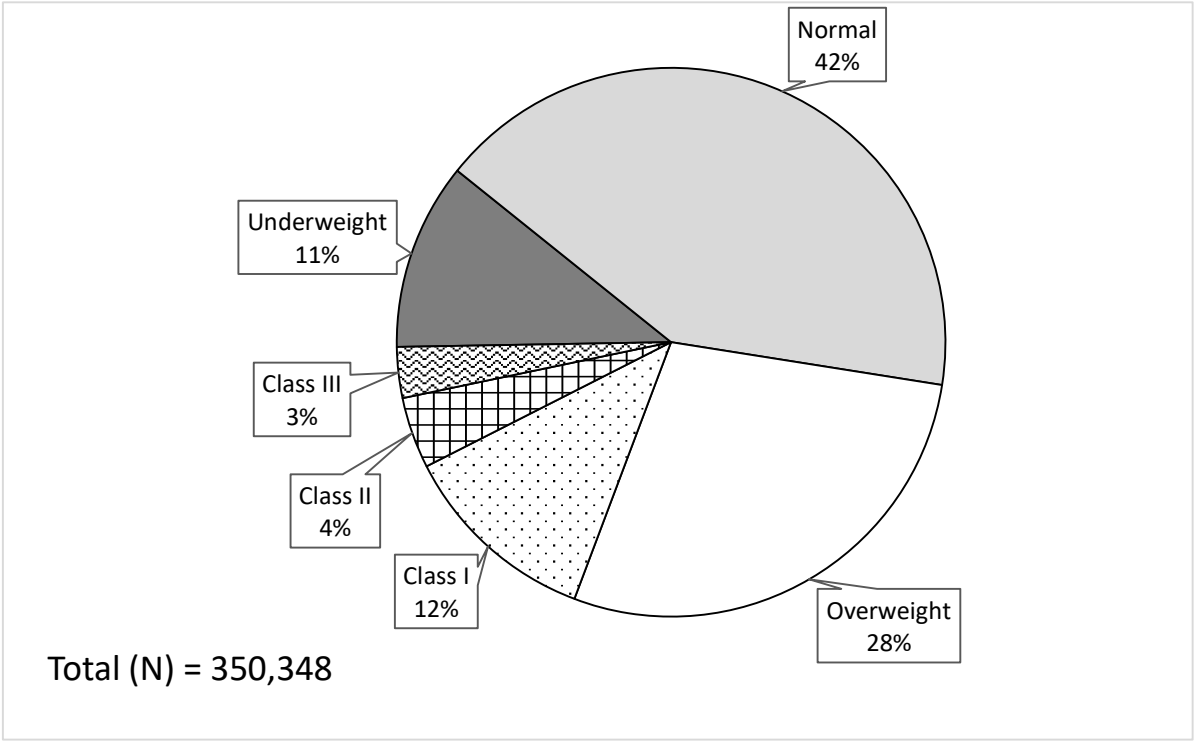
classes of obese BMIs. For additional comparison, the prevalence of obesity rates for older adults residing in community settings are also included. Additionally, obesity rates amongst the newly entered LTC population are examined across available information for provincial and territorial location. Finally, an analysis of the incidence of persons newly residing in a LTCF at risk of requiring specialized bariatric equipment is provided.

Frequency of Obesity

Obesity was present in 19% (n=66,508) of the 350,358 individuals entering LTC between 2010-2020 (Figure 5). The majority of individuals entering LTCFs with obesity were in the class I category (n=41,279, or 63% of those with obesity), while those with more extreme obesity levels (classes II and III) accounted for 7% (n=25,229) of persons newly residing in a LTCF over this time period.

Figure 5

Persons Newly Residing in a Long-term Care Facility by Body Mass Index (BMI) Category (N=350,348), 2010-2020

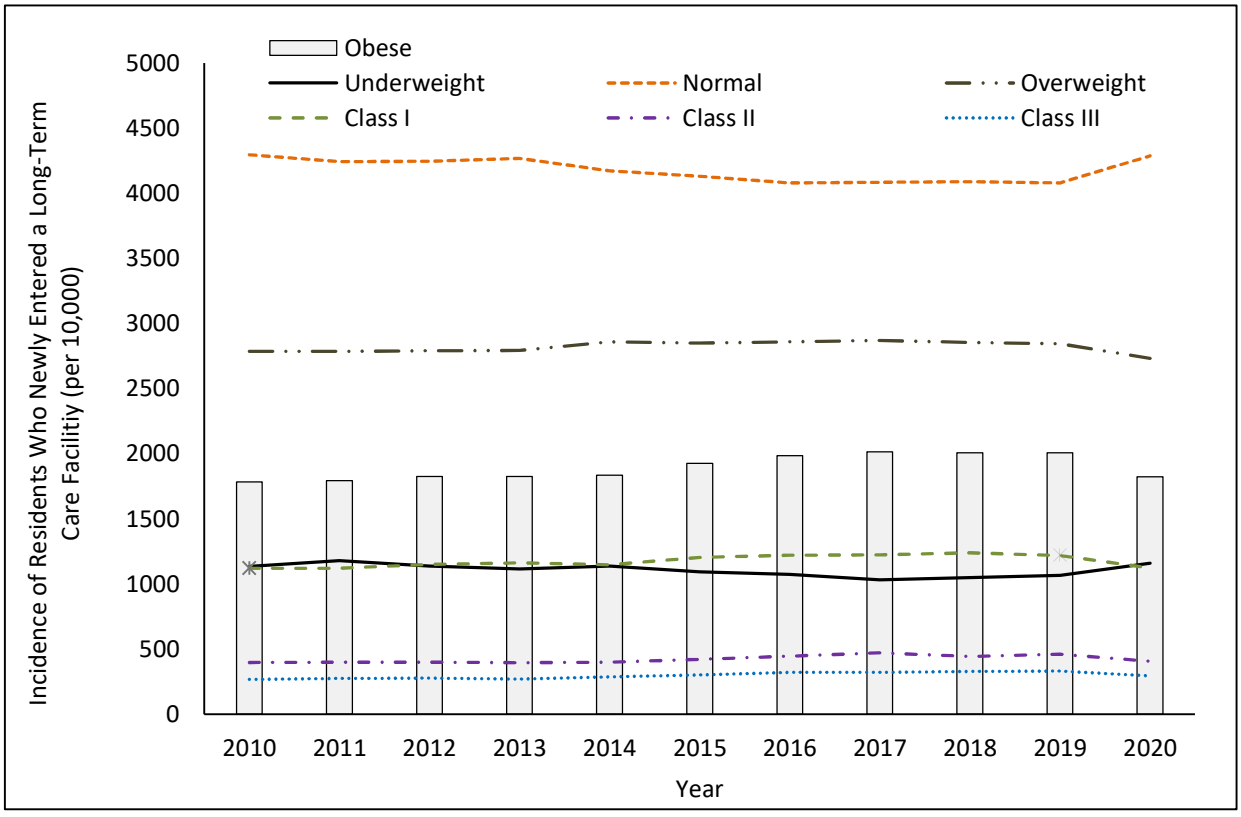


Incidence of Obesity

The incidence of obesity (per 10,000) generally increased over the 10-year period, with the incidence in 2019 being 13% higher than 2010 levels. The only decrease occurred in 2020, where the incidence dropped by 9% from the previous year (Figure 6). The COVID-19 pandemic had a profound impact on persons living in LTCFs and facilities in 2020. As such, the figures for 2020 may be regarded as an anomaly. Overall, there was a direct relationship between higher BMI categories and greater increases in incidence levels (Figure 6). The share of newly entered individuals categorized with obesity classes I, II and III increased 9%, 15% and 22% respectively between 2010 and 2019. Again, the intake in 2020 was an exception, where there was a decrease in the share of persons newly residing in a LTCF categorized as obese.

Figure 6

Annual Rates of Body Mass Index (BMI) Amongst Persons Newly Residing in a Long-term Care Facility (N=350,348), 2010-2020



Provincial Incidence of Obesity

As discussed in the methods chapter, the CCRS dataset from CIHI only allow for certain provincial and territorial comparisons. The category 'Other' refers to the four provinces and one territory that are included in the CCRS dataset from CIHI but had too few facilities to allow for the release of provincial or territorial identifiers. This 'Other' group includes the Yukon territory, and the provinces of Manitoba, Newfoundland and Labrador, Nova Scotia, and Saskatchewan. The majority of the newly entered population was based in Ontario (n=215,026 or 63% of newly entered individuals). The proportion of the newly entered population with obesity and the distribution of BMI categories were generally similar between provinces (Table 2). The exception was BC, which had a slightly lower rate of obesity overall and in each class of obesity.

Table 2

Frequencies of Body Mass Index (BMI) Categories of Persons Newly Residing in a Long-term Care Facility by Geographical Group (N=350,348), 2010-2020

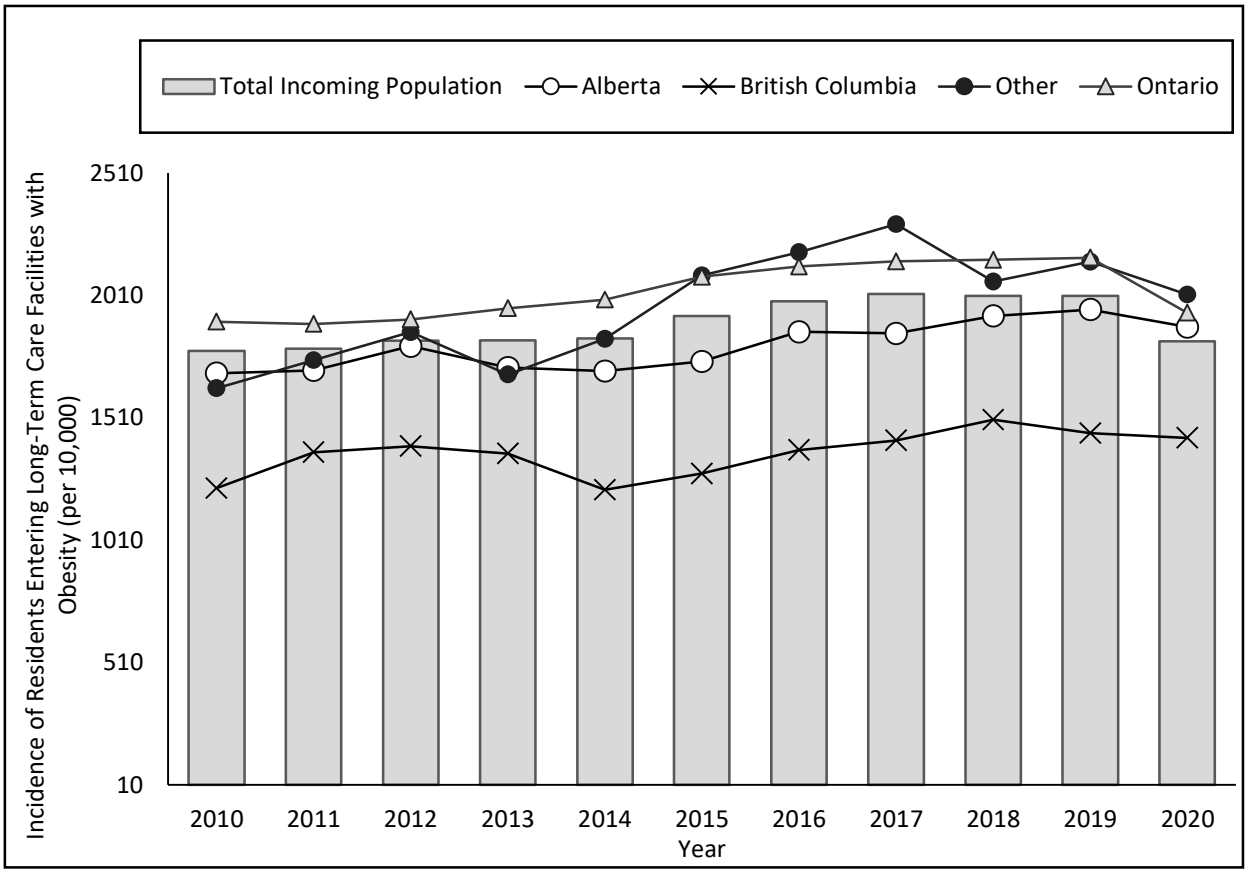
BMI Category	Province/Territory %(n)			
	Alberta (15%, n=50,750) % (n)	BC (15%, n=51,412) % (n)	Ontario (61% n=215,026) % (n)	'Other' (10%, n=33,735) % (n)
Obesity				
Non-Obese	82 (41,034)	86 (44,438)	80 (171,468)	80 (26,900)
Obese	18 (9,041)	14 (7,074)	20 (43,558)	20 (6,835)
BMI				
Underweight	12 (6,111)	13 (6,906)	10 (22,130)	10 (3,524)
Normal	43 (21,413)	46 (23,846)	41 (87,366)	40 (13,599)
Overweight	27 (13,510)	27 (13,686)	29 (61,972)	29 (9,777)
Class I	11 (5,547)	9 (4,614)	12 (26,876)	13 (4,242)
Class II	4 (2,019)	3 (1,431)	5 (9,858)	4 (1,481)
Class III	3 (1,475)	2 (1,029)	3 (6,824)	3 (1,112)
Total	100 (50,750)	100 (51,412)	100 (215,026)	100 (33,735)

Note. a) 'Other'= Manitoba, Newfoundland and Labrador, Nova Scotia, Saskatchewan, and the Yukon.

Over the ten-year period (2010-2020), obesity (BMI ≥ 30) incidence rates showed a general increase in each geographical category, with notable decreases in 2020 observed in all regions represented (Figure 7). British Columbia (BC) had the lowest incidence of obesity each year while Ontario and the 'Other' group category tended to record the highest incidences of obesity over the ten-year period.

Figure 7

Annual Rates of Obesity Amongst Persons Newly Residing in a Long-term Care Facility by Geographical Group (N=350,348), 2010-2020



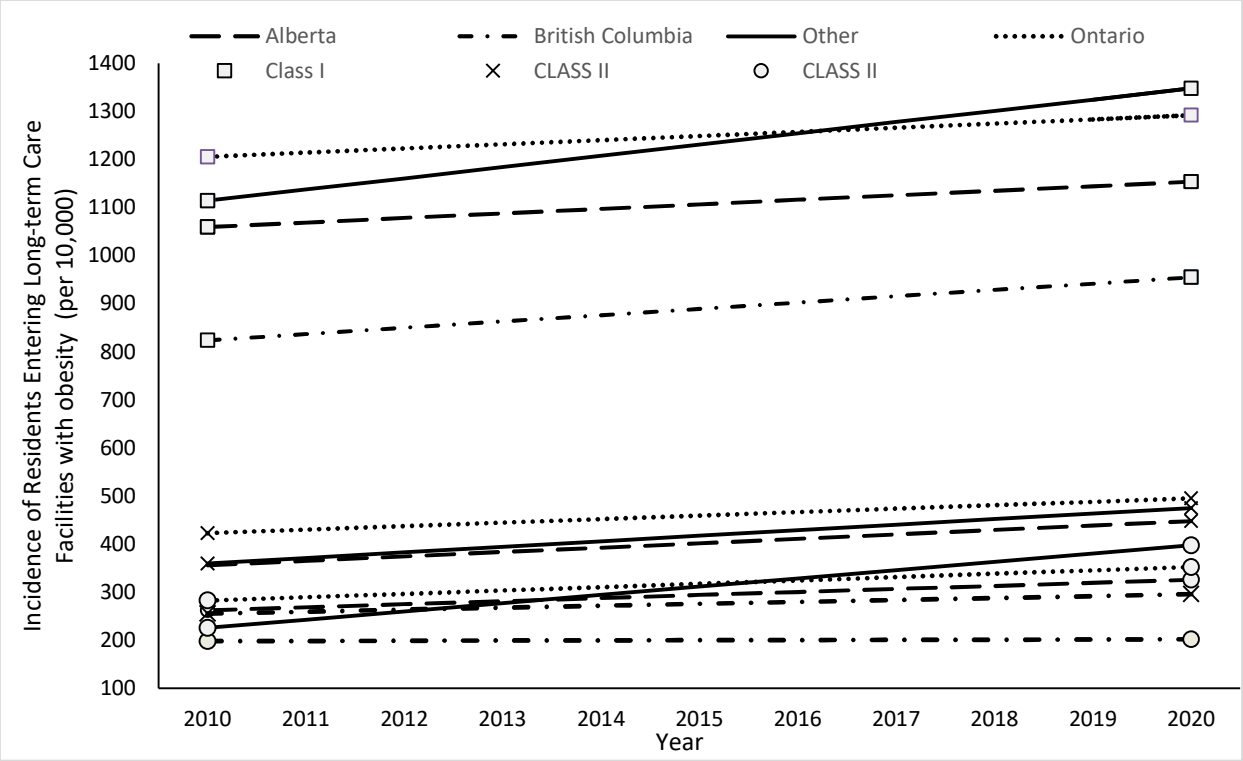
Note. a) 'Other' group = Manitoba, Newfoundland and Labrador, Nova Scotia, Saskatchewan, and the Yukon.

A further examination of the changes in incidences for the three classes of obesity are presented as trend lines in Figure 8. The trend lines indicate that the 'Other' group geographical category observed the greatest increases in each of the classes of obesity, with class III

increasing by 55%. BC saw the lowest growth in each of the classes of obesity, where those with class I obesity only increased by 12%, while the shares of those with class II and III obesity remained stable. In Alberta, BC, and Ontario, the highest rates of growth were amongst newly entered individuals with class I obesity, while the highest rates of growth in the 'Other' category was persons newly residing in a LTCF with class III obesity.

Figure 8

Trend Lines of Obese Classes Amongst Persons Newly Residing in a Long-term Care Facility by Geographical Group (N=350,348), 2010-2020



Note. Other = Manitoba, Newfoundland and Labrador, Nova Scotia, Saskatchewan, and the Yukon.

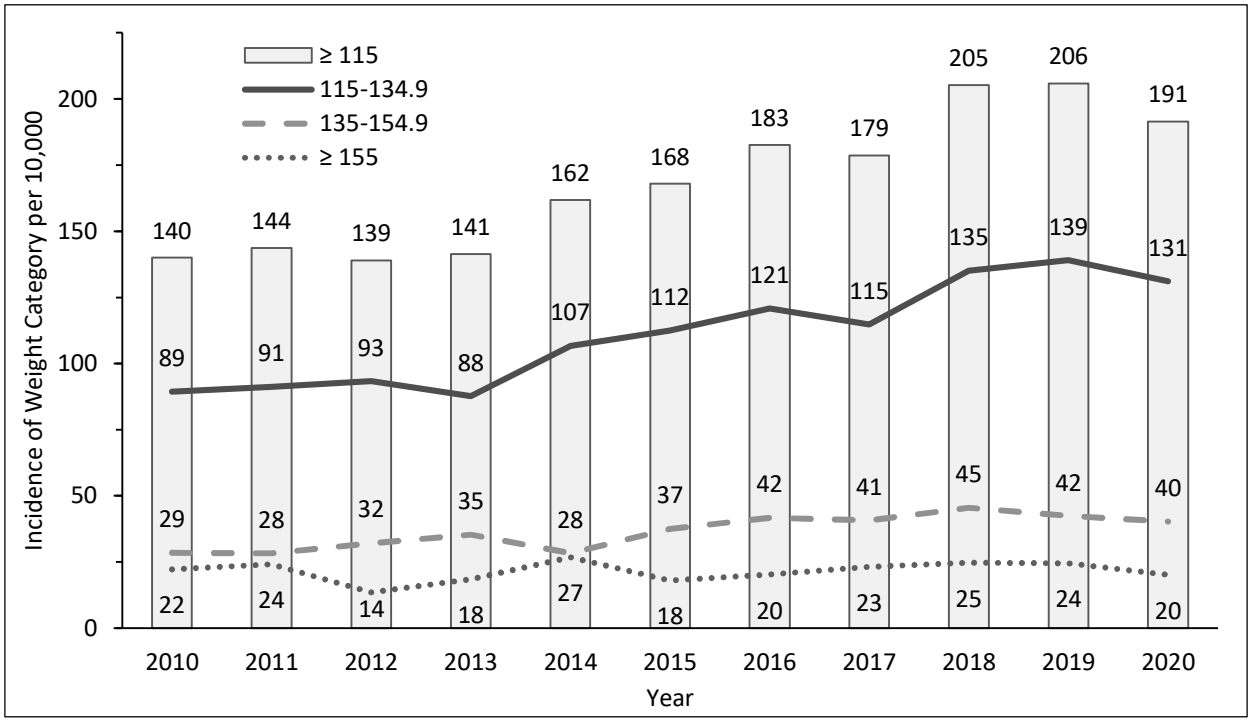
Incidence of Persons Newly Residing in a Long-term Care Facility Weighing 115 Kg or More

The Body Mass Index (BMI), and its categories of obesity, does not give a full account of the presence of heavier persons newly residing in a LTCF. Regardless of BMI, heavier individuals are at greater risk of requiring costly bariatric equipment and facility

accommodations. Bariatric equipment is generally recommended for those that have a weight at or above 115 kg (approx. 250 lbs). Those weighing 115 kg or more accounted for a very small proportion of the newly entered LTC population (1.7% of those entering between 2010-2020, (n=5,930)). The incidence of persons newly residing in a LTCF in this weight category however increased by 47% over the 10-year period (Figure 9). Amongst those entering with a weight ≥ 115 kg, over two thirds were in the 115-134.9 kg group (n=3,896), and about 20% weighed between 135 and 154.9 kg (n=1,279). The incidence of those weighing between 115-134.9 kg increased the most (56%), followed by those weighing between 135-154.9 kg (49%).

Figure 9

Annual Rates of Individuals at Risk of Needing Bariatric Equipment Amongst Persons Newly Residing in a Long-term Care Facility (N=350,348), 2010-2020



Summary of Incidence of Obesity

Incidence of obesity remained relatively constant over the 10-year period (2010-2020), although rates of growth (while modest) were highest in those with class II and III obesity. The

year 2020 stood out as unique as it was the only year-on-year where a decrease in obesity incidence was observed. This is most likely related to the onset of the COVID-19 pandemic within Canada. The moderate increase of obesity, and higher rates in class II and class III, was generally reflected in provincial and territorial rates. While Ontario had the highest levels of incidence and BC the lowest, rates of growth remained comparable with Alberta. The 'Other' category did exhibit higher rates of growth in class I and class III obesity. When considering only weight as a characteristic of persons newly residing in a LTCF, there was notable increase in incidence, with both 115-134.9 kg and 135-154.9 kg showing increases in incidence of approximately 50% over the 10-year period. Overall, obesity incidence rates have increased modestly, with higher levels of growth occurring in the more extreme class II and III, particularly in the jurisdictions grouped as 'Other.'

Demographic Characteristics

Available data from CIHI's CCRS dataset allowed for an analysis of basic demographic features including age, sex, primary language, and place of residence prior to entry into LTC. Comparing the demographics of persons newly residing in a LTCF through a lens of BMI provides a descriptive profile not only of those with and without obesity, but also each BMI class. The profile offered here is based upon an amalgamation of the consecutive cross-sectional initial assessment data entered over a 10-year period (2010-2020) and provides an explorative description of persons initially transitioning into CIHI-participating LTCFs.

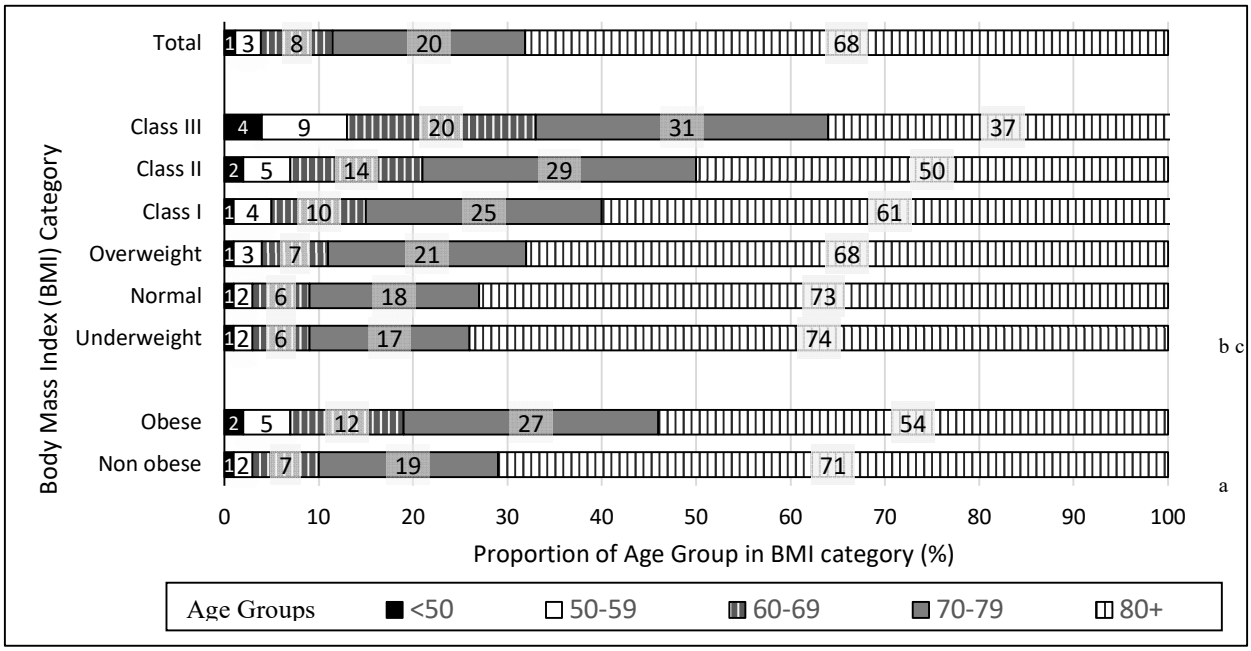
Age Distribution

Of all individuals entering LTCFs between 2010-2020, over two thirds of the population were 80 years of age or older (68%, n=238,636), with nearly 90% aged 70 years or older (n=310,167). A third of persons newly residing in a LTCF aged 69 years or younger had obesity

(n=12,524), while only 25% aged 70-79 (n=17,845) and 15% aged 80 years and older (n=36,139) had obesity. Figure 10 displays the age distribution seen in each of the BMI categories. When factoring in BMI categories, there was an inverse relation between age at entry into LTC and the presence for obesity. Nearly half of the individuals classified as obese entering LTC were under the age of 80 (46%, n=30,369), while only 29% of those without obesity were under 80 (n=81,343). When examining persons newly residing in a LTCF by BMI category, there were important differences in age distribution. Most notably, the nearly two thirds of persons entering LTCFs with class III obesity, and half of those with class II, were under the age of 80 (n=6,629 and n=7,370 respectively) (Figure 10).

Figure 10

Age Distribution of Persons Newly Residing in a Long-term Care Facility (N=350,348), 2010-2020



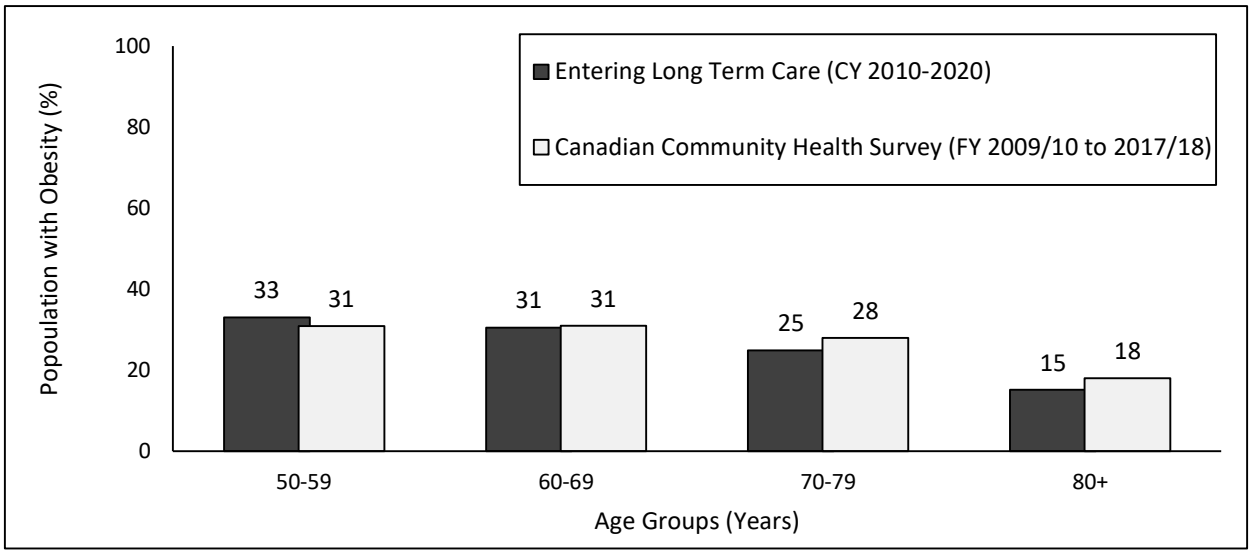
Note. a) [a] The proportion of each age group is significantly different between obese and non-obese ($p \leq 0.001$). b) [b] Normal BMI (reference group) is significantly different for each age group of the BMIs overweight thru class III ($p \leq 0.001$). c) [c] normal BMI (reference group) is only significantly different from underweight age group 80+ years ($p \leq 0.001$).

Age Groups; In-Community and Entering Long-term Care

The available CCRS data from CIHI and CCHS data allow for a comparison of obesity rates among the population entering LTC compared to older adults living in community settings. While the above section looked at the age distribution of the BMI categories, age group obesity rates needed to be utilized to compare to the in-community population. The obesity rates for the newly entered LTC population under the age of 70 was twice that of the newly entered population 80 years and older (Figure 11). Lytvyak, Straube, Modi, & Lee (2022) conducted a consecutive, cross-sectional study of the Canadian Community Health Survey (CCHS) for the cycles 2005-2017/18. Their results provide information on obesity rates specific to the age groups but, unfortunately, there is no breakdown of BMI classes (Figure 11). Comparing LTC and in-community obesity rates, Figure 11 shows that the rates of obesity are generally similar, although younger individuals entering LTCFs (under 60 years old) had slightly higher rates of obesity, while persons newly residing in a LTCF aged 70 years and older had slightly lower rates of obesity than those residing in community settings.

Figure 11

Comparison of Rates of Obesity for Persons Aged 50 and Older Newly Residing in a Long-term Care Facility (n=346,283) and Adults Aged 50 years or Older Residing in Community Settings (n=288,547), 2009-2018

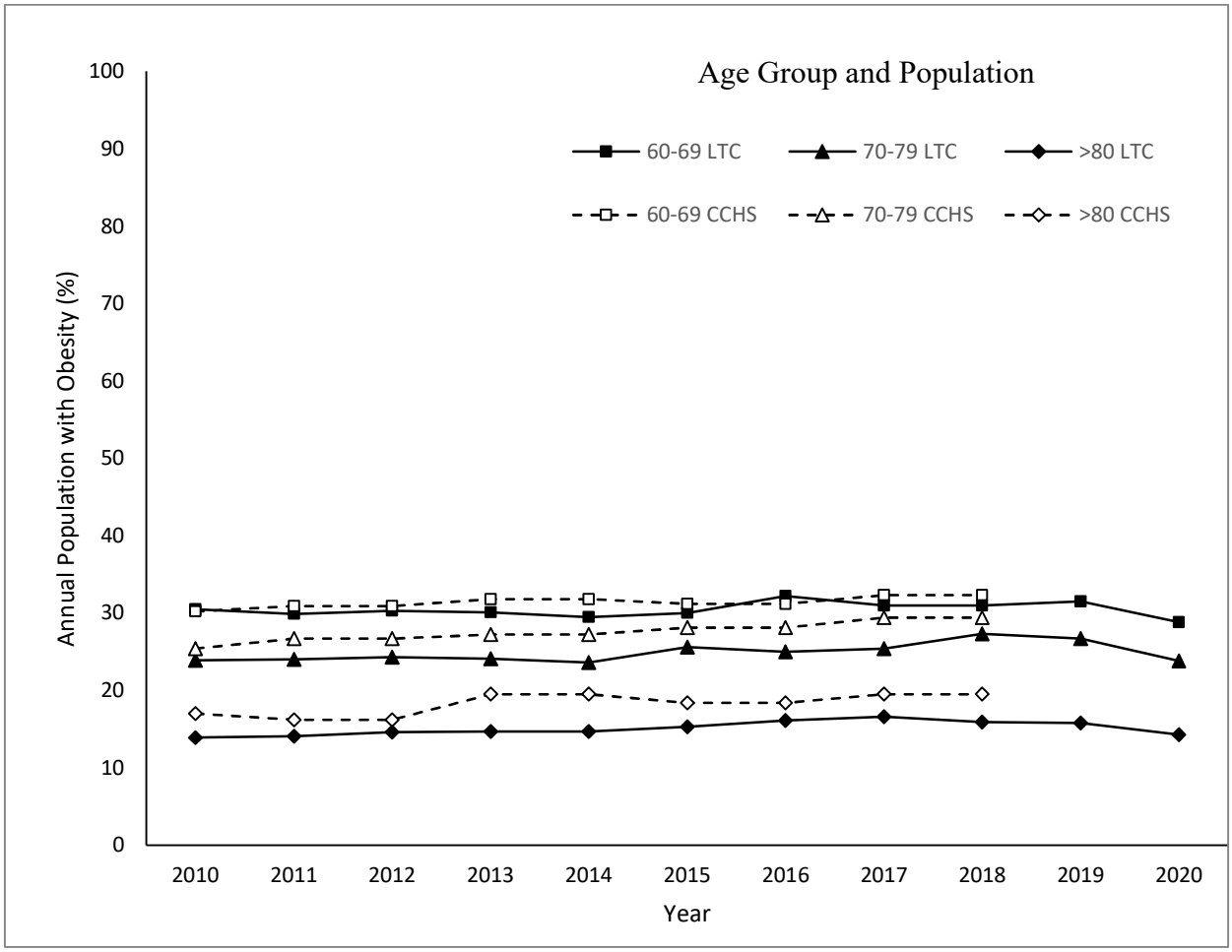


Note. a) Canadian Community Health Survey Data adapted from "Trends in obesity across Canada from 2005 to 2018: a consecutive cross-sectional population-based study," by Lytvyak, E., Straube, S., Modi, R., & Lee, K. K. (2022). CMAJ Open, 10(2), E439–E449. https://doi.org/10.9778/cmajo.20210205. b) CY= Calendar Year, FY = Fiscal Year.

A further comparison of the obesity rates seen in the community and the newly entered LTC population over time (2010-2020) is provided in Figure 12. The rates of obesity for both the CCHS and the LTC populations remained fairly constant over the 10-year period, with slightly higher rates for each age groups amongst the CCHS population.

Figure 12

Rates of Obesity Amongst Persons Aged 60+ Newly Residing a in Long-term Care Facility (n=336,762) and Older Adults Aged 60+ in Community Settings, 2010-2020 (n=192,641), 2010-2018



Note. a) LTC = Newly Entered Long-term Care Residents; b) CCHS = Canadian Community Health Survey population living in-community; c) CCHS data adapted from "Trends in obesity across Canada from 2005 to 2018: a consecutive cross-sectional population-based study," by Lytvyak, E., Straube, S., Modi, R., & Lee, K. K. (2022). CMAJ Open, 10(2), E439–E449. https://doi.org/10.9778/cmajo.20210205

Sex

The CIHI assessments included options for female, male and 'other', and did not include information on gender identity. Only 278 individuals (0.1%) were listed under this 'other' option. For this reason, this research offers an analysis of the distribution of males and females but is unable to examine gender identity. Not surprisingly, the population entering LTC between 2010-2020 was predominately female (Table 3). There were slightly higher rates of obesity amongst females than males. Across the BMI spectrum, females were more likely to have an underweight BMI than males, and males an overweight BMI. The sex distribution of the BMI categories is displayed in Figure 13. Persons newly residing in a LTCF with obesity were slightly more likely to be female. The difference in sex distribution was more apparent when the full range of BMI categories were considered. The more extreme BMI categories were more likely to be female (underweight and classes II and III), whereas those in the overweight category were likely to be males (Figure 13).

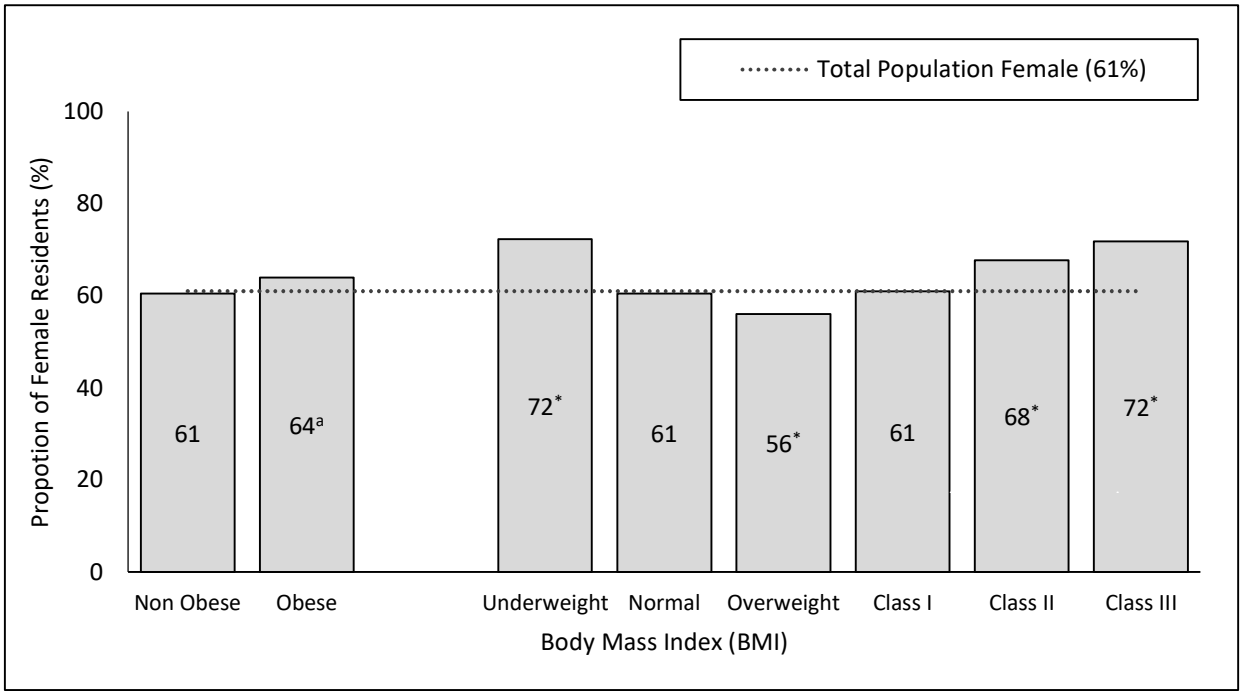
Table 3

Rates of Body Mass Index (BMI) Categories by Sex of Persons Newly Residing in a Long-term Care Facility (N=348,970), 2010-2020

BMI Category	Sex % (n)			
	Males 39% (134,473)		Females 61% (214,497)	
Obesity				
Non-Obese	82	(111,799)	80	(171,813)
Obese	18	(23,774)	20	(42,684)
BMI				
Underweight	8	(10,689)	13	(27,956)
Normal	43	(57,650)	41	(88,470)
Overweight	32	(43,460)	26	(88,470)
Class I	12	(16,070)	12	(25,177)
Class II	4	(4,766)	5	(10,010)
Class III	2	(2,938)	3	(7,497)
Total	100	(134,473)	100	(214,497)

Figure 13

Sex Distribution of Persons Newly Residing in a Long-term Care Facility (N=348,970), 2010-2020



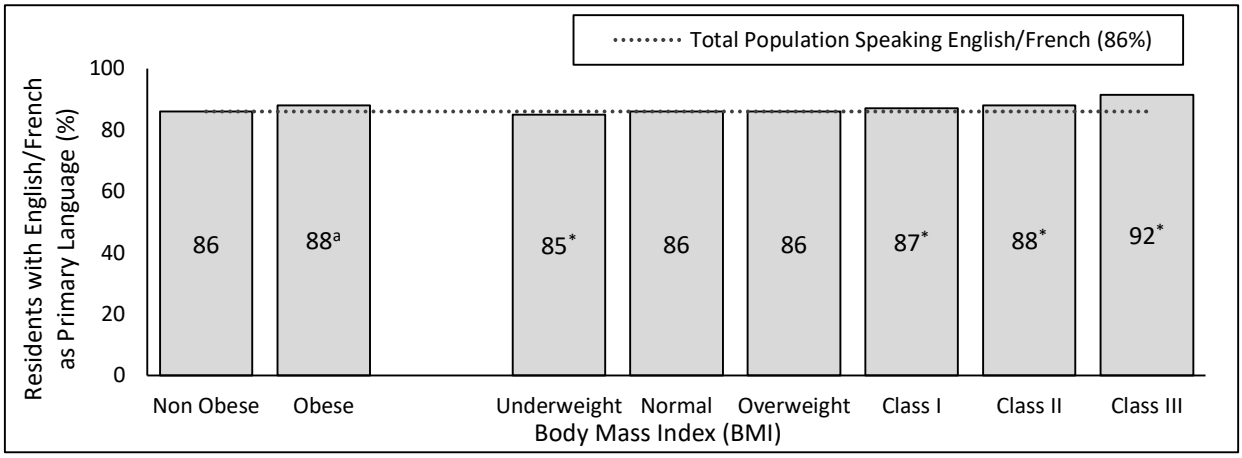
Note. a) [a] Significantly different from non-obese ($p \leq 0.001$). b) * Significantly different from the reference group (normal BMI) ($p \leq 0.001$).

Language

The CCRS dataset from CIHI provided dichotomous information on an individual's primary language, with those using English or French (i.e., Canada's "official languages") as one category, and those using any other language as the 'Other' category. The majority (86%, n=302,212) of individuals entering LTC (2010-2020) spoke either English and/or French as their primary language (Figure 14). Generally, there was little difference across BMI categories, although those with a class III obesity were slightly more likely to speak one of the two official languages.

Figure 14

Primary Language Distribution of Persons Newly Residing in a Long-term Care Facility (N=350,348), 2010-2020



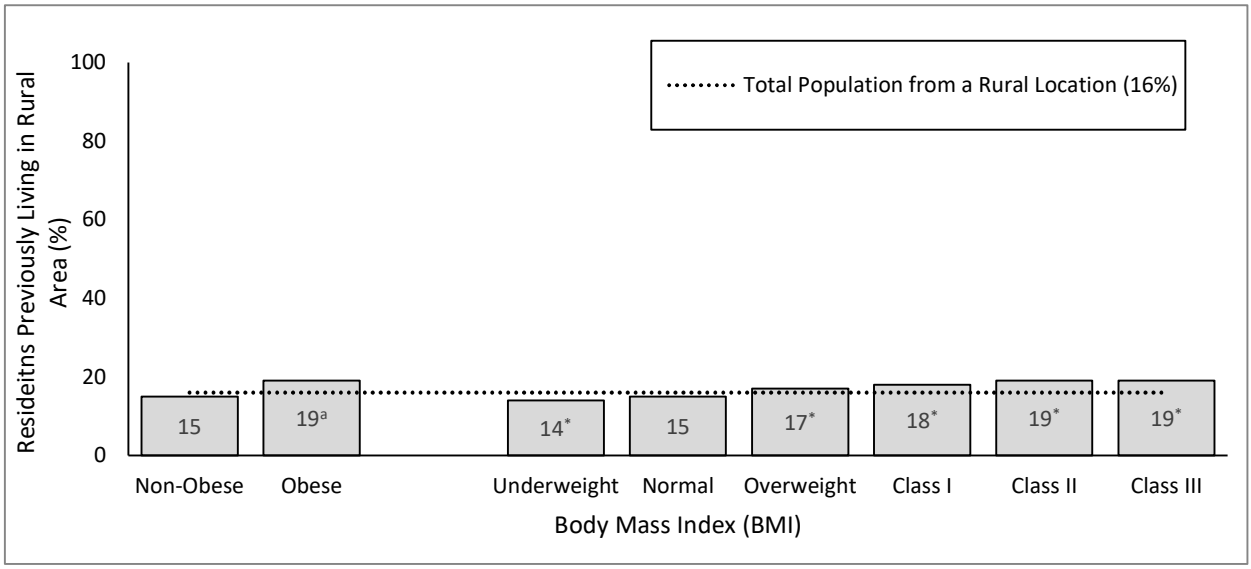
Note. a) [a] Significantly different from non-obese ($p \leq 0.001$). b) * Significantly different from the reference group (normal BMI) ($p \leq 0.001$).

Location of Last Residence

The CCRS dataset from CIHI included a variable that records where newly entered individuals lived immediately prior to entering a LTCF. This is a dichotomous variable with the categories urban or rural. Urban is defined here as Statistics Canada's census metropolitan area or census agglomeration area (Canadian Institute for Health Information, 2022a). The majority of newly entered individuals (84%, n=271,427) lived in urban areas prior to entering a LTCF. Persons newly residing in a LTCF with obesity were slightly but significantly more likely to have resided in a rural area prior to LTC ($p \leq 0.001$) (Figure 15). BMI categories had little effect on these distributions, although there was a modest increase in the rural share of the three obese classes of persons newly residing in a LTCF.

Figure 15

Location of Last Residence of Persons Newly Residing in a Long-term Care Facility (N=350,348), 2010-2020



Note. a) [a] Significantly different from non-obese ($p \leq 0.001$). b) * Significantly different from the reference group (normal BMI) ($p \leq 0.001$).

Location of Last Residence by Province/Territory

Since rural living is greatly influenced by what part of the country one resides, a further look at how rural living played out at the provincial or territorial level was undertaken. Provincial comparisons with Alberta should be done with caution as 30% of individuals entering Albertan LTC were listed as having an 'unknown' previous location (n=15,098); compared with between 3-7% in the other provincial/territorial groups (total number of unknown, including Alberta, n=26,914). Only those individuals with a known location of last residence were included in the analysis presented in Table 4 (N=323,434).

There were provincial discrepancies between provinces, with Alberta and the geographical category ‘Other’ (i.e., Manitoba, Newfoundland and Labrador, Nova Scotia, Saskatchewan, the Yukon) having over double the proportion of individuals from a rural area

compared to BC and Ontario. All the provinces and the 'Other' group reported significantly higher rates of rural living amongst their persons residing in a LTCF with obesity (p≤0.001). BC and Ontario exhibited very minor difference across the BMI categories. Alberta and the 'Other' group, meanwhile, both saw wider ranges of rural living between the BMI categories with greater rates of rural living amongst those with an overweight or higher BMI.

Table 4

Location of Last Residence of Persons Newly Residing in a Long-term Care Facility by Province (N=340,358), 2010-2020

Province (% Rural[a])	Total Population		Non-obese (81%, n=283840)		Obese (19%, n=66508)		p-value
	%	(n)	%	(n)	%	(n)	(df=1)
Alberta	26	(8,960)	24	(6,876)	32	(2,084)	<0.001
British Columbia	11	(5,075)	10	(4,223)	13	(852)	<0.001
Ontario	14	(28,860)	15	(22,409)	14	(6,451)	<0.001
'Other'[b]	28	(9,112)	27	(6,977)	32	(2,135)	<0.001

	Underweight 11% (38,671)		Normal 42% (146,224)		Overweight 28% (98,945)		Class I 12% (41,279)		Class II 4% (14,789)		Class III 3% (10,440)	
	%	(n)	%	(n)	%	(n)	%	(n)	%	(n)	%	(n)
Alberta	20*	(842)00	23	(3,413)00	28*	(1,410)00	31*	(1,250)00	34*	(494)00	31*	(340)00
British Columbia	9	(584)	10	(2,229)	11*	(1,410)	13*	(546)	14*	(181)	13*	(125)
Ontario	12*	(2,583)	13	(11,096)	15*	(8,730)	16*	(3,959)	16*	(1,488)	15*	(1,004)
'Other'[b]	24	(813)	25	(3,358)	29*	(2,806)	30*	(1,247)	35*	(507)	35*	(381)

Note. a) [a] Rural defined as outside of Statistics' Canada census metropolitan area or census agglomeration area. b) [b] 'Other' composed of Manitoba, Newfoundland and Labrador, Nova Scotia, Saskatchewan and Yukon Facilities. c) * Significantly different from the reference group (normal BMI) (p≤0.001).

Summary of Demographic Profile

A demographic profile was developed from the preceding analysis of the consecutive, cross-sectional data of the population entering long-term care facilities (LTCFs) between 2010-2020. Over the ten-year period, people with obesity were most notably entering at a younger age than those without obesity ($p \leq 0.001$). Persons newly residing in a LTCF with obesity were also slightly but significantly more likely to be female, speak English/French as a primary language, and have previously lived in a rural area ($p \leq 0.001$). When breaking the 'obese' population into the three BMI categories, these trends became more apparent.

Health Status

The CCRS dataset from CIHI included variables for many different chronic and acute conditions, symptoms, and health indicators. The relationship of obesity and the presence of chronic conditions amongst long-term care persons residing in a LTCF has been looked at in other countries, with higher rates of certain conditions (e.g., diabetes), and lower rates of others (e.g., dementia) being noted (Ankuda et al., 2017; Cai et al., 2013). Chronic conditions, such as diabetes and dementia, have different influences over the need for LTC, and require different types of services and care for management while in LTCFs (Canadian Institute for Health Information, 2014; Desai et al., 2004; Munshi et al., 2016; Nunez, 2021). To develop a broad understanding of the health status of persons newly residing in a LTCF in relation to obesity and BMI levels, this analysis describes the presences of the most common chronic conditions, including an analysis of multiple chronic conditions and dyads of conditions.

Chronic Health Conditions

The CCRS dataset from CIHI included information about chronic health conditions which allowed for calculation of rates. Chronic health conditions listed in were present in at least

20% of the total newly entered population or amongst 20% of individuals within a specific BMI category. An unabridged version of Table 5 (all conditions) is provided in the Appendices 1-2. Conditions are noted that have higher or lower rates amongst those with obesity and its classes, and conditions are also described as having a positive, negative, or no relationship with increasing BMI.

The most prominent conditions in the population as a whole were hypertension (i.e., high blood pressure) (61%, n=212,511), dementia/Alzheimer's (referred to as dementia herein) (54%, n=190,415), arthritis (35%, n=123,708), diabetes (26%, n=91,809), osteoporosis (22%, n=76,020) and depression (22%, n=75,829) (Table5). The proportions of most conditions shifted with the introduction of BMI categories. Hypertension remained the most common condition in every BMI category. For those with an underweight BMI, however, the prevalence of dementia was the same as hypertension.

Persons newly residing in a LTCF with obesity had notably significantly higher rates of diabetes (39% vs 23%), arthritis (42% vs 34%), hypertension (66% vs 59%), and congestive heart failure (CHF) (20% vs 14%), and significantly lower rates of dementia (44%, 57%) and osteoporosis (16% vs 23%) (Table 5). To a lesser extent, but still significant, those with obesity also had higher rates of allergies, depression, emphysema/ chronic obstructive pulmonary disease (COPD), and hypothyroidism, and lower rates of cerebrovascular accident (i.e., stroke) ($p \leq 0.001$). These differences became more apparent when examined across all BMI categories.

Conditions that were positively associated with an increasing BMI were diabetes, congestive heart failure (CHF), and arthritis. Diabetes exhibited the most dramatic difference by BMI category of any condition, where 41-44% of individuals with any level of obesity had diabetes compared to 22% of those with a normal BMI. Conditions that were not positively

associated across all BMI categories, but rather were positively associated only with increasing levels of obesity, were allergies, emphysema/COPD, and depression.

Osteoporosis was the only condition with a negative association across all BMIs, with double the rates in the underweight category as compared to those with class II or III obesity. Dementia, meanwhile, did not have a direct relationship with every BMI category, and was significantly less prevalent in each of the classes of obesity. Finally, stroke was not associated directly with BMI, and the lowest rates were seen amongst those with class III obesity.

Table 5

Chronic Health Conditions of Persons Newly Residing in a Long-term Care Facility (N=350,348), 2010-2020

Chronic Health Condition	Total Population % (n)		< or > 30 kg/m^2 %(n)				
	100% (350,348)		< 30 kg/m^2 81% (283,840)		≥ 30 kg/m^2 19% (66,508)		p-value
	%	n	%	n	%	n	(df=1)
Hypertension	61	(212,511)	59	(168,520)	66	(43,991)	<0.001
Dementia and/or Alzheimer's	54	(190,415)	57	(161,348)	44	(29,067)	<0.001
Arthritis	35	(123,708)	34	(95,848)	42	(27,860)	<0.001
Diabetes mellitus	26	(91,809)	23	(65,673)	39	(26,136)	<0.001
Osteoporosis	22	(76,020)	23	(65,386)	16	(10,634)	<0.001
Depression	22	(75,829)	21	(58,958)	25	(16,871)	<0.001
Allergies	20	(74,659)	19	(53,709)	23	(15,580)	<0.001
Cerebrovascular accident (stroke)	19	(65,116)	19	(53,099)	18	(12,017)	<0.001
Hypothyroidism	17	(59,677)	17	(47,257)	19	(12,420)	<0.001
Emphysema/ COPD	16	(56,617)	16	(44,344)	19	(12,273)	<0.001
Congestive heart failure	15	(51,277)	14	(38,216)	20	(13,061)	<0.001

	Body Mass Index (BMI) Categories % (n)					
	Underweight 11% (38,671)	Normal 42% (146,224)	Overweight 28% (98,945)	Class I 12% (41,279)	Class II 4% (14,789)	Class III 3% (10,440)
	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)
Hypertension	54* (20,757)00	59 (85,858)00	63* (61,905)00	66* (27,072)00	66* (10,010)00	66* (6,909)00
Dementia and/or Alzheimer's	54* (20,976)	58 (85,139)	56* (55,233)	49* (20,389)	27* (5,827)	27* (2,851)
Arthritis	31* (11,799)	33 (48,172)	36* (35,877)	41* (16,790)	44* (6,489)	44* (4,581)
Diabetes mellitus	15* (5,740)	22 (31,586)	29* (28,347)	36* (14,732)	48* (6,442)	48* (4,962)
Osteoporosis	31* (12,153)	24 (34,640)	19* (18,593)	17* (6,935)	14* (2,250)	14* (1,449)
Depression	20 (7,754)	20 (29,657)	22* (21,547)	24* (9,903)	29* (3,939)	29* (3,029)
Allergies	19 (7,245)	18 (26,953)	20* (19,511)	22* (9,012)	28* (3,675)	28* (2,893)
Cerebrovascular accident (stroke)	16* (6,236)	19 (27,402)	20* (19,461)	19 (7,871)	15* (2,610)	15* (1,536)
Hypothyroidism	17 (6,390)	17 (24,227)	17 (16,640)	18* (7,386)	20* (2,913)	20* (2,121)
Emphysema/ COPD	22* (8,356)	15 (21,960)	14* (14,028)	17* (6,913)	23* (2,967)	23* (2,393)
Congestive heart failure	12 (4,732)	13 (18,921)	15* (14,574)	18* (7,441)	23* (3,183)	23* (2,437)

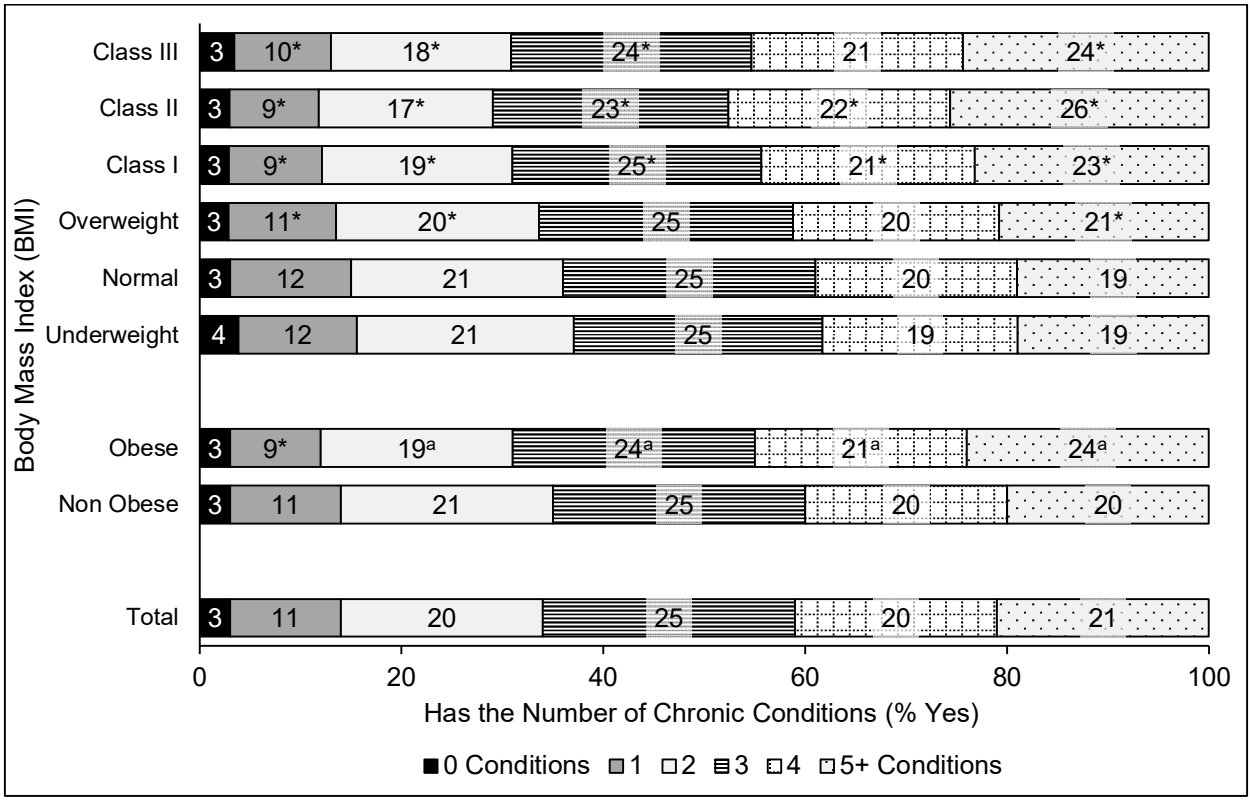
Note. a) [a] Significantly different from non-obese ($p \leq 0.001$). b) * Significantly different from the reference group (normal BMI) ($p \leq 0.001$).

Multiple Chronic Health Conditions

Multiple chronic conditions were considered utilizing a list developed using Statistics Canada surveys regarding chronic conditions (SAHCPDP and CSEPHC) and other literature, as described in Chapter 3 (Methods). The vast majority (n=301,314), or 86%, of newly entered individuals had two or more conditions (**Error! Reference source not found.**). Persons newly residing in a LTCF with obesity were marginally more likely to have multiple conditions (two+ conditions). When comparing rates across BMI categories, there was little difference, although those with classes I, II and III obesity were more likely to report 3 or more conditions.

Figure 16

Multiple Chronic Health Conditions of Persons Newly Residing in a Long-term Care Facility (N=350,348), 2010-2020



Note. a) [a] Significantly different from non-obese ($p \leq 0.001$). b) * Significantly different from the reference group (Normal BMI) ($p \leq 0.001$) b) conditions considered: Hypertension, Dementia/Alzheimer's (combined), Arthritis, Diabetes Mellitus, Osteoporosis, Depression, Stroke, Heart disease (a combination of Arteriosclerotic heart disease (ASHD), Congestive Heart Failure, and 'Other Cardiovascular disease'), Emphysema/COPD, Anemia, Cancer, Asthma, Liver Disease, Hip Fracture.

Multi-Morbidities Over Time

A comparison of the incidences of multi-morbidities showed no notable significant changes over the 10-year period (2010-2020) in any BMI category. These results are provided in Appendix 7.

Dyads of Chronic Conditions

While the CCRS dataset from CIHI did not allow for an analysis of severity of disease progression or length of time with diagnosis, it did allow for a count of the most common dyads. A dyad refers to having two conditions simultaneously. Having multiple chronic conditions has wide ranging implications for treatment, health management and outcome prognoses. A CIHI (2011) study of older adults (>65 years) living in-community, based on Statistics Canada's 2008 Canadian Survey of Experiences With Primary Healthcare (CSEPHC), provides information rates of having multiple conditions and the most common dyads for that population (Canadian Institute for Health Information, 2011). The top five dyads of the population entering LTC are summarized in Table 6, alongside information from that CIHI report. A limitation of this comparison is that the index utilized by the CSEPHC did not include dementia, a common chronic condition in the LTC population (Canadian Institute for Health Information, 2011).

The overall prevalence of dyads in general were higher amongst persons newly residing in a LTCF , as compared to older adults living in community (Canadian Institute for Health Information, 2011) (Table 6). This is to be expected, as the population entering LTC represents those whose health has declined to the point of needing more intensive care. Excluding dementia, the most common dyads in both populations were [hypertension-arthritis] (LTC 24%, in-community 14%), [hypertension-heart disease] (23%, 12%), and [hypertension diabetes] (19%, 11%).

The relationship between dyads and BMI status amongst the newly entered LTC population was apparent in some dyads and not others. Dyads containing any combination of dementia, diabetes or osteoporosis showed the most sensitivity to BMIs. Two of the dyads seen in the highest frequencies in the in-community population and LTC population ([hypertension-

arthritis] and [hypertension-heart disease]) remained in the top five dyads regardless of BMI, and the rates of both dyads exhibited a positive relationship with increasing BMI. Since LTC dyads include dementia, [hypertension-dementia] is the most common dyad amongst persons newly residing in a LTCF, present in both a third of the total LTC population and the population without obesity. However, [hypertension-dementia] occurred at lower rates and was tied with [hypertension-diabetes] for second most common dyad for those with obesity (29%). Likewise, across the BMI categories, [hypertension-dementia] was the most prevalent dyad for all those with a BMI under class II obesity, while the most prevalent dyad among those with classes II and III obesity was [hypertension-diabetes]. Diabetes only appeared in the highest BMI categories, while osteoporosis was seen only in the underweight category, and dementia does not appear in the top five dyads of persons residing in a LTCF with class III obesity.

Managing multiple chronic conditions is a common occurrence in LTCFs. When compared to older adults living in community settings, persons newly residing in a LTCF had a higher frequency of dyads, and the dyad pairings appear to be affected by BMI. That said, hypertension, heart disease, and arthritis were common in various dyads regardless of BMI. The BMI dependent conditions included osteoporosis amongst the underweight, dementia for those without obesity, and diabetes for those with obesity.

Table 6

Top Five Dyads of Chronic Health Conditions of Persons Newly Residing in a Long-term Care Facility, 2010-2020 (n=350,348), and In-Community Adults Over 65 for the Year 2008 (n=3,132)

Top five dyads of those entering LTC 2010-2020	Top five dyads from in-community older adults[b]
Hypertension and Dementia (33%) Hypertension and Arthritis (24%) Hypertension and Heart Disease (23%) Arthritis and Dementia (19%) Hypertension and Diabetes (19%)	High blood pressure and arthritis (14%); High blood pressure and heart disease (12%); High blood pressure and diabetes (11%); Heart disease and arthritis (6%); and High blood pressure and cancer (6%).

Top five dyads of those entering LTC 2010-2020, by Body Mass Index

Without Obesity	With Obesity
Hypertension and Dementia (34%) Hypertension and Arthritis (22%) Hypertension and Heart Disease (22%) Arthritis and Dementia (19%) Hypertension and Diabetes (18%)	Hypertension and Arthritis (30%) Hypertension and Diabetes (29%) Hypertension and Dementia (29%) Hypertension and Heart Disease (28%) Arthritis and Dementia (19%)

Underweight	Normal	Overweight
HT & Dementia (30%) HT & Osteoporosis (18%) HT & Heart Disease (18%) HT & Arthritis (18%) Dementia & Osteoporosis (18%)	HT & Dementia (34%) HT & Heart Disease (21%) HT & Arthritis (21%) Arthritis & Dementia (19%) Heart Disease & Dementia (18%)	HT & Dementia (35%) HT & Arthritis (25%) HT & Heart Disease (24%) Arthritis & Dementia (21%) Heart Disease & Dementia (20%)

Class I	Class II	Class III
HT & Dementia (32%) HT & Arthritis (29%) HT & Heart Disease (27%) HT & Diabetes (27%) Arthritis & Dementia (20%)	HT & Diabetes (35%) HT & Arthritis (32%) HT & Heart Disease (30%) HT & Dementia (27%) Heart Disease & Diabetes (20%)	HT & Diabetes (35%) HT & Arthritis (32%) HT & Heart Disease (29%) Heart Disease & Diabetes (22%) Arthritis & Diabetes (21%)

Note. a) LTC - Canadian Institute for Health Information Participating Long-Term Care Facilities. b) Adapted from: Canadian Institute for Health Information. (2011). Seniors and the Healthcare System: What Is the Impact of Multiple Chronic Conditions ?, (January). Retrieved from https://secure.cihi.ca/free_products/air-chronic_disease_aib_en.pdf.

Summary of Chronic Health Conditions

Hypertension, dementia, and arthritis were present in much of the population entering LTC between 2010-2020. Persons newly residing in a LTCF with obesity entered with higher frequencies of all the top chronic conditions, except for having lower frequencies of dementia, stroke, and osteoporosis. The rates for many chronic conditions varied by BMI category. The most prominent of these were diabetes, dementia, and osteoporosis. Diabetes, chronic heart failure (CHF) and arthritis were positively associated with increasing BMI while osteoporosis was negatively associated with increasing BMI. Dementia rates, meanwhile, decreased with increasing obesity. The highest BMI categories saw about half the rates of dementia and osteoporosis and twice the frequency of diabetes as seen in the reference population. Persons newly residing in a LTCF with obesity were more likely to have five+ conditions and the likelihood of reporting three or more conditions increased with BMI levels. Finally, while [hypertension-arthritis] and [hypertension-heart disease] were prominent across the BMI categories, [hypertension-dementia] was the most common dyad for persons newly residing in a LTCF with a BMI below class II obesity, and [hypertension-diabetes] for those with class II or class III obesity. Overall, while dementia is present in the majority of the LTC population other conditions, especially diabetes, appeared to be more prevalent for the populations with higher BMIs.

Activities of Daily Living (ADLs)

The ability to perform activities of daily living (ADLs), and the level of support needed for persons newly residing in a LTCF to perform these activities, are included in the initial assessments, and assessed herein. The ability to perform ADLs, along with changes in performance abilities, provide information on overall health status and autonomy of persons

residing in LTCFs (Canadian Institute for Health Information, n.d.). Research on older adults with obesity living in institutions have highlighted the impact obesity has on ADL performance, including the greater need for two+ person assistance when performing the ADLs (Harris et al., 2018), and being able to perform certain ADLs at a higher level of independence, while sometime performing other worse (Amankwaa et al., 2022; Bahat et al., 2012; Kiesswetter et al., 2014). For simplification, this research examines those requiring two+ person physical assistance, and those whose self-performance was assessed as 'independent'. Two+ person physical assistance was chosen as this more resource intensive level of assistance has been explored in previous literature surrounding individuals with obesity in long-term care settings (Harris et al., 2018; Kosar et al., 2018; Zhang, Field, et al., 2019). Independent self-performance represents individuals who require the least amount of assistance and have the highest level of functioning. The results are stratified by the presence or not of a dementia diagnosis. This was done to provide an estimate of the level of cognitive impairment that would affect independent self-performance of ADLs. It is important to note that there is a high likelihood that dementia is underdiagnosed (Parker et al., 2020), thus underestimating the level of cognitive impairment present in the population studied. All the values of assistance provided, and self performance are provided in Appendices 3-6.

Two+ Person Assistance

For all persons newly residing in a LTCF there was little to no requirement for two+ person assistance for the ADL activities of eating, walking, and locomotion (≤ 4% required two+ person assistance). The remaining ADLs are displayed in Table 7. Most notably, a third of the newly entered population required two+ person assistance with the ADLs transfer, toileting, and bathing (Table 7). Having obesity resulted in higher rates of two+ person assistance for every

ADL (excluding eating, walking and locomotion), but the differences, while significant ($p \leq 0.001$), were not large (≤4% difference). There were greater differences in needing two+ person assistance across the BMI categories, with ADLs seeing max ranges in proportions of 8-13%. The normal, overweight and class I obese groups have very similar levels of needing two+ person assistance. While those with underweight BMI required slightly more assistance than the three middle BMIs (i.e., normal, overweight, class I obese), those with class II and class III obesity were most likely to require two+ person assistance. The similarities between the three middle BMI groups hides the assistance requirements of the more extreme BMIs. Overall, having obesity resulted in higher rates of needing two+ person assistance, and need was greater amongst those with the highest BMI.

Table 7

Two+ Person Assistance Required by Person Newly Residing in a Long-term Care Facility (N=350,348), 2010-2020

Activity of Daily Living	Total Population (100%, N=350348)	Two+ Person Assist Required Non Obese (81%, n=283840)	Obese (19%, n=66508)	p-value (df=1)
	% (n)	% (n)	% (n)	
Dressing	19 (65,088)	18 (51,212)	21 (13,876)	<0.001
Bed Mobility	28 (97,396)	27 (76,515)	31 (20,881)	<0.001
Transfer	33 (116,654)	33 (92,466)	36 (24,088)	<0.001
Toileting	33 (114,877)	32 (90,993)	36 (23,884)	<0.001
Personal Hygiene	19 (66,389)	18 (52,272)	21 (14,117)	<0.001
Bathing	30 (105,838)	30 (84,121)	33 (21,717)	<0.001

Activity of Daily Living	Underweight (11%, n=38,671)	Normal (42% n=146,224)	Overweight (28%, n=98,945)	Class I (12%, n=41,279)	Class II (4%, n=14,789)	Class III (3%, n=10,440)
	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)
Dressing	19 (7,496)*	18 (26,117)	18 (17,599)	19* (7,996)	21* (3,130)	26* (2,750)
Bed Mobility	30 (11,717)*	27 (11,717)	26 (38,775)	29* (11,940)	33* (4,824)	39* (4,117)
Transfer	37 (14,368)*	32 (14,368)	31* (47,237)	34 (14,005)	38* (5,577)	43* (4,506)
Toileting	35 (13,650)*	32 (13,650)	31 (46,491)	34* (14,030)	37* (5,422)	42* (4,432)
Personal Hygiene	20 (7,578)*	18 (7,578)	18 (26,730)	20* (8,105)	22* (3,211)	27* (2,801)
Bathing	31 (12,077)*	29 (12,077)	29 (42,997)	31* (12,852)	33* (4,928)	38* (3,937)

Note. a) * Significantly different from the reference group (normal BMI) ($p \leq 0.001$).

Self Performance of Activities of Daily Living (ADLs)

The analysis reported in Table 8 stratifies persons newly residing in a LTCF by dementia status and finds an inverse relation between rates of dementia and obesity.

Table 8

Stratified Frequencies of Dementia and Body Mass Index for Person Newly Residing in a Long-term Care Facility (N=350,348), 2010-2020

Body Mass Index (BMI)	Not Stratified		With Dementia		Without Dementia		p-value
	%	(n)	%	(n)	%	(n)	(df=1)
Obesity							
Non-Obese	81	(283,840)	85	(161,348)	77	(122,492)	<0.001
Obese	19	(66,508)	15	(29,067)	23	(37,441)	<0.001
BMI Category							
Underweight	11	(38,671)	11	(20,976)	11	(17,695)	0.651
Normal	42	(146,224)	45	(85,139)	38	(61,085)	<0.001
Overweight	28	(98,945)	29	(55,233)	27	(43,712)	<0.001
Class I	12	(41,279)	11	(20,389)	13	(20,890)	<0.001
Class II	4	(14,789)	3	(5,827)	6	(8,962)	<0.001
Class III	3	(10,440)	2	(2,851)	5	(7,589)	<0.001
Total	100	(350,348)	54	(190,415)	45	(159,933)	<0.001

Note. * Significantly higher proportion between those with and without dementia ($p \leq 0.001$).

Proportional Ratios

The proportions of persons newly residing in a LTCF operating at a level considered independent when performing the activities of daily living (ADLs) are provided in Table 9 and Table 10. Figure 17 uses proportional ratios (PRs) to compare the ADL independence rates of those with and without obesity, while Figure 18 compare BMI categories to those with a 'normal' BMI (i.e., the reference group chosen for this analysis). The added layer of stratifying by dementia results in two proportional ratios (PRs) for each ADL and these results are contained to their dementia stratified group. The two PRs for each ADL are presented in such a

way as to allow for a visual representation of the results in Figures 17 and 18 (refer to Chapter 3, Methods).

ADL Independence as Stratified by Dementia and Obesity

Before stratifying by dementia, those with obesity had significantly higher levels of independence for eating, and both locomotion on and off unit, with minor differences in other ADLs ($p \leq 0.001$) (Table 9), "Not Stratified"). These associations persisted even when stratified by dementia status. Regardless of obesity status, having dementia resulted in lower rates of independence in eating, dressing, hygiene, and locomotion off unit (Table 9). However, the negative impact of dementia was less apparent in the independence for the activities of bed mobility, transfer, walking in room, and walking in corridor, again regardless of obesity status. The conditions other than dementia (without dementia group) appeared to be associated with higher independence for more intricate ADLs or for leaving the unit but was associated with lower independence with less intricate skills and mobility on unit (Table 9). Further analysis of these proportions of independence and their relation to obesity are considered in Figure 17 using proportional ratios.

Table 9

Independence of Activities of Daily Living (ADLs) for Person Newly Residing in a Long-term Care Facility (N=350,348), 2010-2020

Activity of Daily Living (Independent)	Population Stratified by Dementia and Obesity status					
	Not Stratified (100%, N=350,348)		With Dementia (54% n=190,415)		Without Dementia (46%. n=159,933)	
	Non-obese (81% n=283,840)	Obese (19% n=66,508)	Non-obese (85%, n=161,348)	Obese (15%, n=29,067)	Non-obese (77%, n=122,492)	Obese (23%, n=37,441)
	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)
Eating	33 (93,823)	40* (26,542)	30 (48,029)	35* (10,081)	37 (45,794)	44* (16,461)
Dressing	8 (22,038)	8 (5,544)	7 (10,873)	7 (2,038)	9 (11,165)	9 (3,506)
Bed Mobility	32 (90,220)	30* (20,244)	34 (54,371)	34 (9,957)	29 (35,849)	27* (10,287)
Transfer	26 (64,823)	25* (14,639)	26 (41,955)	27 (7,825)	19 (22,868)	18 (6,814)
Locomotion On Unit	26 (75,136)	30* (19,724)	27 (42,980)	29* (8,415)	26 (32,156)	30* (11,309)
Locomotion Off Unit	16 (44,953)	20* (13,239)	14 (22,409)	16* (4,637)	18 (22,544)	23* (8,602)
Walk in Room	27 (77,895)	27* (17,854)	31 (50,786)	34* (9,837)	22 (27,109)	21 (8,017)
Walk in Corridor	23 (65,311)	22* (14,905)	26 (42,748)	28* (8,263)	18 (22,563)	18 (6,642)
Toileting	14 (38,990)	14 (9,348)	14 (21,948)	14 (4,153)	14 (17,042)	14 (5,195)
Hygiene	8 (20,996)	7* (5,730)	6 (9,234)	6 (1,764)	10 (11,762)	11* (3,966)
Bathing	1 (2,957)	1 (812)	1 (1,446)	1 (302)	1 (1,511)	1 (510)

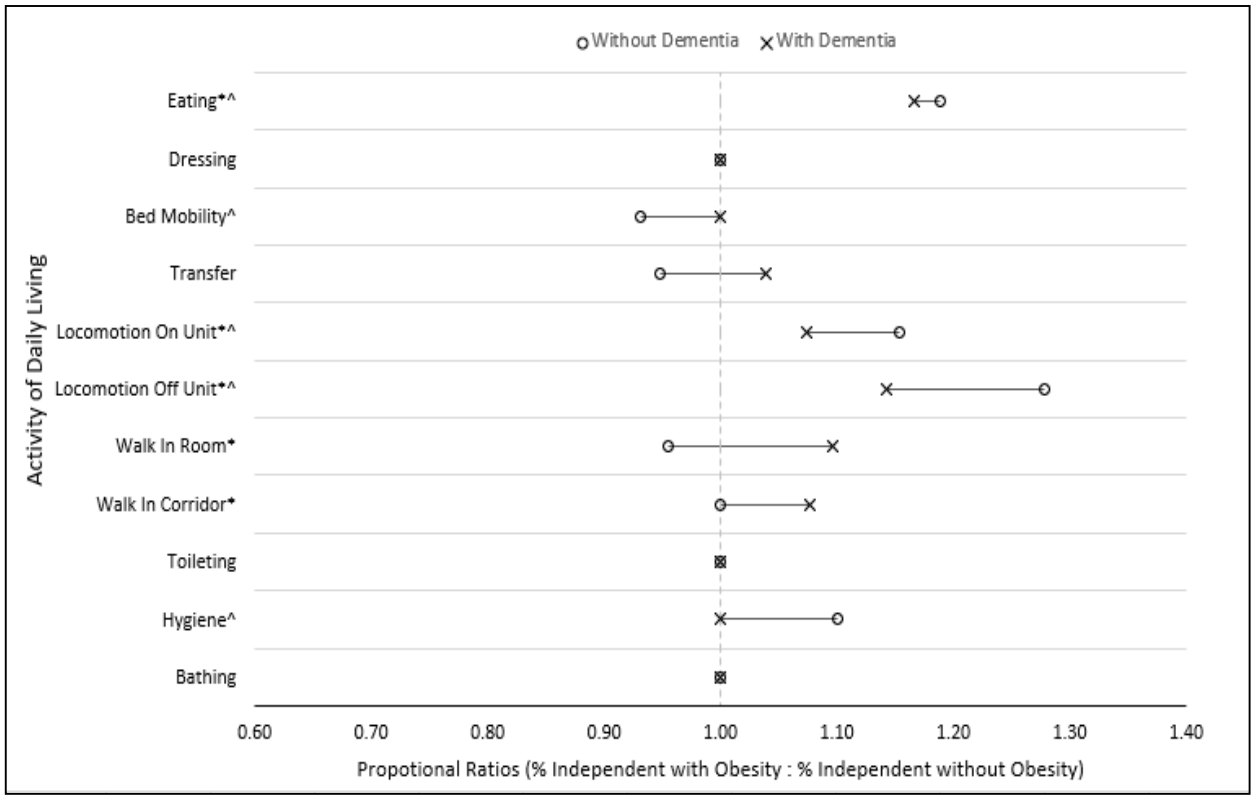
Note: *Significantly different proportion from non-obese of same dementia status ($p \leq 0.001$).

The proportional ratios (PR) comparing the proportions of independence between those with and without obesity are displayed in Figure 17. Eating, locomotion on unit and locomotion off unit were the only ADLs to have significantly higher rates of independence for those with obesity, regardless of dementia status ($p \leq 0.001$). Dementia did not appear to influence independence PRs for eating however dementia resulted in smaller PRs for locomotion on and off unit (i.e., the 'benefit' of obesity for independence of these ADLs was greater amongst those

without dementia). While there were significant differences in bed mobility, walk in room, walk in corridor and hygiene, the effects of these were small ($p \leq 0.001$).

Figure 17

Proportional Ratios of Obesity Status for Independence in Activities of Daily Living of Persons Newly Residing in a Long-term Care Facility (N=350,348), 2010-2020



Note. a) * Significant difference between non-obese and obese groups with dementia ($p \leq 0.001$).

^ Significant difference between non-obese and obese groups without dementia ($p \leq 0.001$).

b) A proportional ratio of 1 shows an equal independence ratio, > 1.0 shows higher independence for those with obesity, and <1.0 shows lower independence for those with obesity.

ADL Independence Level of Reference Group (Normal BMI)

The proportional ratios for underweight, overweight, class I, class II and class III were calculated relative to those with a normal BMI (i.e., the reference category). Values of independence for the reference group are provided in Table 10, while the values of independence for the remaining 'non-normal' BMIs are provided in Appendix 8. When comparing the normal BMI group by dementia status, having dementia was associated with significantly lower likelihood of independence when performing the tasks of eating, dressing, locomotion off unit, and personal hygiene and a significantly higher likely to be independent for bed mobility, transfer, walking in room, and walking in corridor (Table 10) ($p \leq 0.001$).

Table 10

Independence of Activities of Daily Living, for Person Newly Residing in a Long-term Care Facility with a Normal Body Mass Index (N=146,224), 2010-2020

Activity of Daily Living	Dementia Status (N)						
	Not Stratified (N=146,224)		With Dementia (58%, n=85,139)		Without Dementia (42%, n=61,085)		p-value
	%	(n)	%	(n)	%	(n)	(df=1)
Eating	32	(47,200)	29	(24,842)	37	(22,358)	<0.001
Dressing	8	(11,249)	7	(57,73)	9	(5,476)	<0.001
Bed Mobility	32	(46,711)	34	(28,761)	29	(17,950)	<0.001
Transfer	23	(33,528)	26	(22,170)	19	(11,358)	<0.001
Locomotion on Unit	26	(38,403)	26	(22,511)	26	(15,892)	0.069
Locomotion off Unit	16	(22,687)	14	(11,654)	18	(11,033)	<0.001
Walking In Room	28	(40,238)	31	(26,648)	22	(13,590)	<0.001
Walking In Corridor	23	(33,655)	26	(22,363)	18	(11,292)	<0.001
Toileting	14	(19,923)	14	(11,561)	14	(8,362)	0.545
Personal hygiene	7	(10,601)	6	(48,97)	9	(5,704)	<0.001
Bathing	1	(1,464)	1	(752)	1	(712)	<0.001

The results for those with an underweight BMI (Figure 18(i)) show clear differences in independence, where, regardless of dementia status, having an underweight BMI resulted in

significantly lower independence (PRs <1.0, p≤0.001). The second consideration of PRs shows that having dementia appeared to exacerbate the impact underweight BMI had on ADL independence, resulting in lower proportion of independence for those with an underweight BMI and also dementia (x PRs < o PRs). This impact of dementia appeared most exaggerated for bed mobility. Overall, having an underweight BMI resulted in lower ADL performances, which were further stressed by having dementia and underweight together, and it was especially noticeable in bed mobility.

The result for those with an overweight BMI (Figure 18(ii)) reveal consistently significantly higher rates of independence amongst those with an overweight BMI, regardless of dementia status, with the exceptions of dressing, hygiene and bed mobility. Dressing and hygiene saw significantly higher rates of independence only amongst those without dementia and bed mobility had higher rates only for those with dementia (p≤0.001). Overall, dementia status seemed to have only minor impacts on most ADLs (short line between x and o), however the difference was notable in dressing and hygiene. While an overweight BMI was associated with higher rates of independence in most ADLs, this was not seen for dressing and hygiene.

Class I obesity results (Figure 18(iii)) show more similarities to the reference group than seen in the overweight graph. Regardless of dementia status, having class I obesity was associated with higher rates of independence for the ADLs of eating, locomotion on unit, and locomotion off unit. For those without dementia, having class I obesity also resulted in significantly higher independence rates for hygiene. Meanwhile, those with dementia and class I obesity saw significantly higher rates of independence for bed mobility, transfer, and both walking in room and corridor (p≤0.001). Persons newly residing in a LTCF with dementia and

class I obesity outperformed in twice as many ADLs as compared to the class I obesity group without dementia.

Persons newly residing in a LTCF with class II obesity were the most similar to the reference groups, regardless of dementia status (Figure 18(iv)). There were only two ADLs, eating and locomotion off unit in which those with dementia and class II obesity had significantly higher rates than their normal BMI counterparts with dementia. Meanwhile those without dementia also had significantly higher rates of independence for eating, and locomotion off unit, but also locomotion on unit and bed mobility. Stratifying by dementia status did not appear to impact the independence proportional ratios of eating or bed mobility, however it resulted in lower PRs for locomotion on and more so locomotion off unit.

Finally, persons newly residing in a LTCF with dementia but with a class III BMI had significantly higher rates of independence in eating, but otherwise were similar to the reference group without dementia ($p \leq 0.001$) (Figure 18(v)). Persons newly residing in a LTCF without dementia however saw significantly different rates of independence for most ADLs, both higher and lower. Eating, locomotion and off unit had significantly higher rates of independence for those with class III, while bed mobility, transfer, walk in room, and walk in corridor were significantly lower. The impact of dementia was greatest for walk in corridor and walk in room, followed by locomotion on unit and off unit.

Figure 18

Proportional Ratios of Body Mass Index Categories of Independence of Activities of Daily Living for Persons Newly Residing in a Long-term Care Facility (N=350,348), 2010-2020

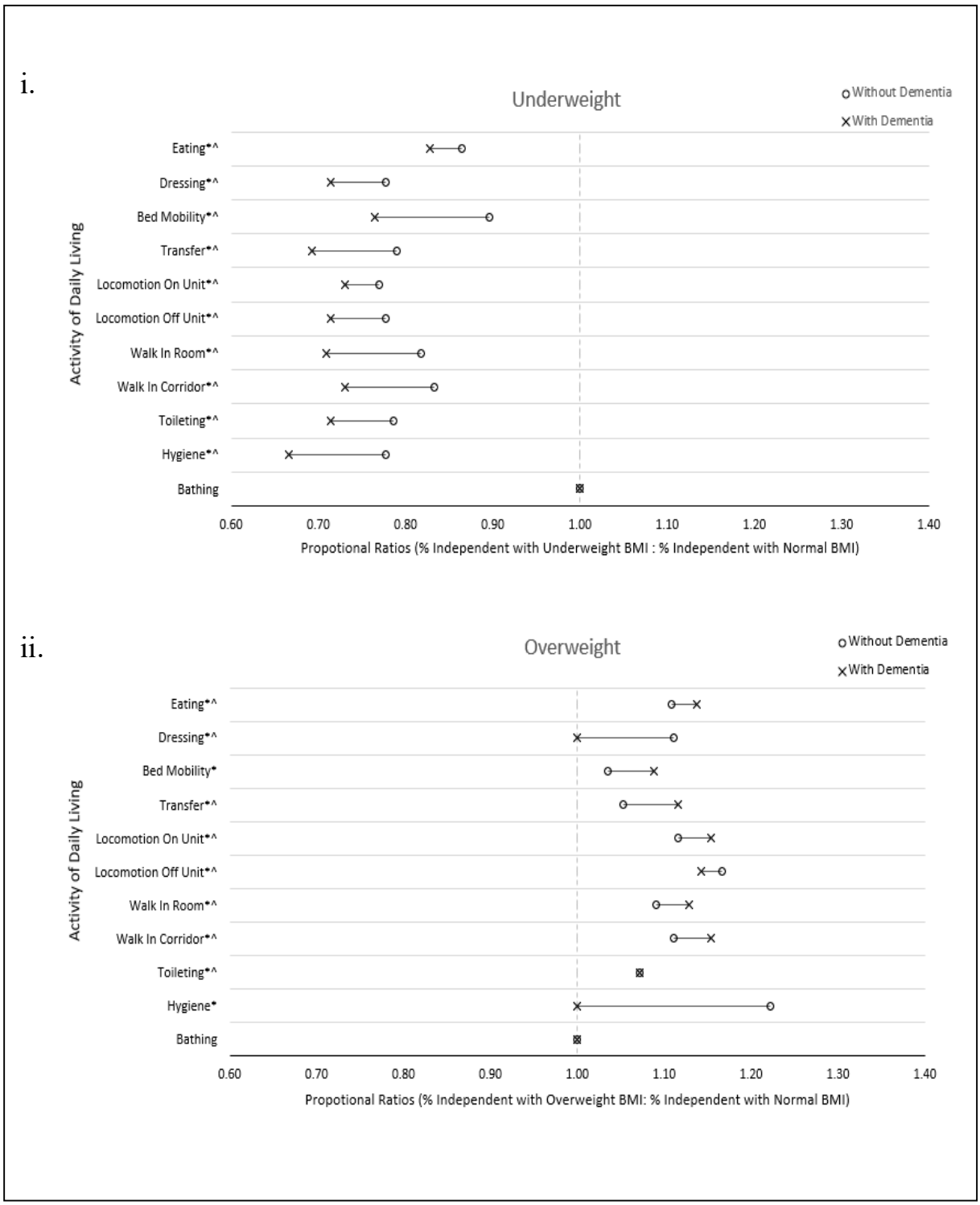
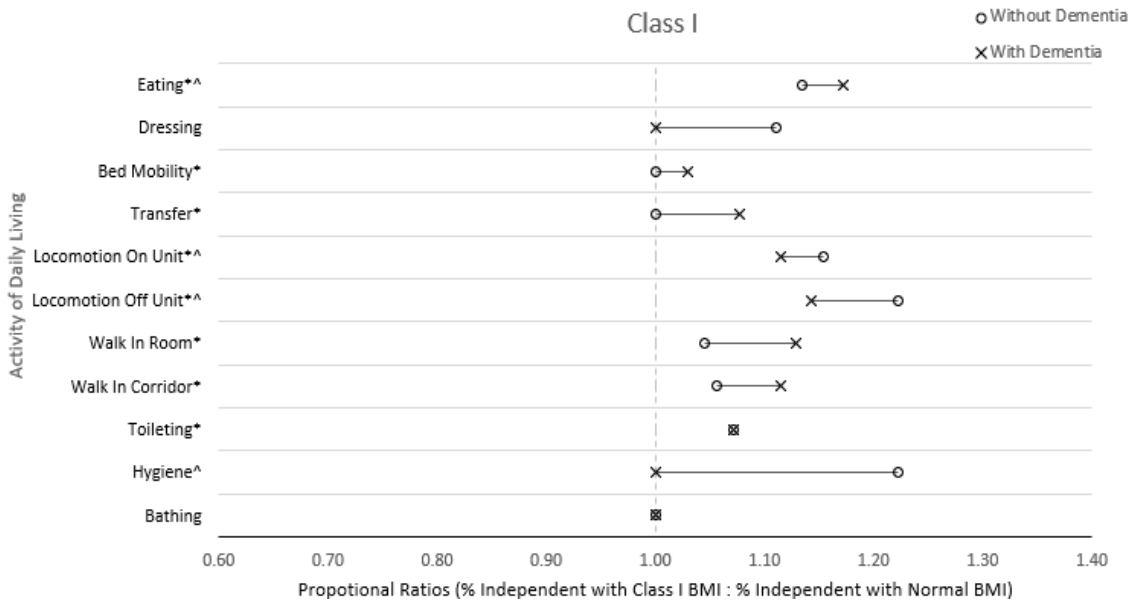


Figure 18 (Continued).

iii.



iv.

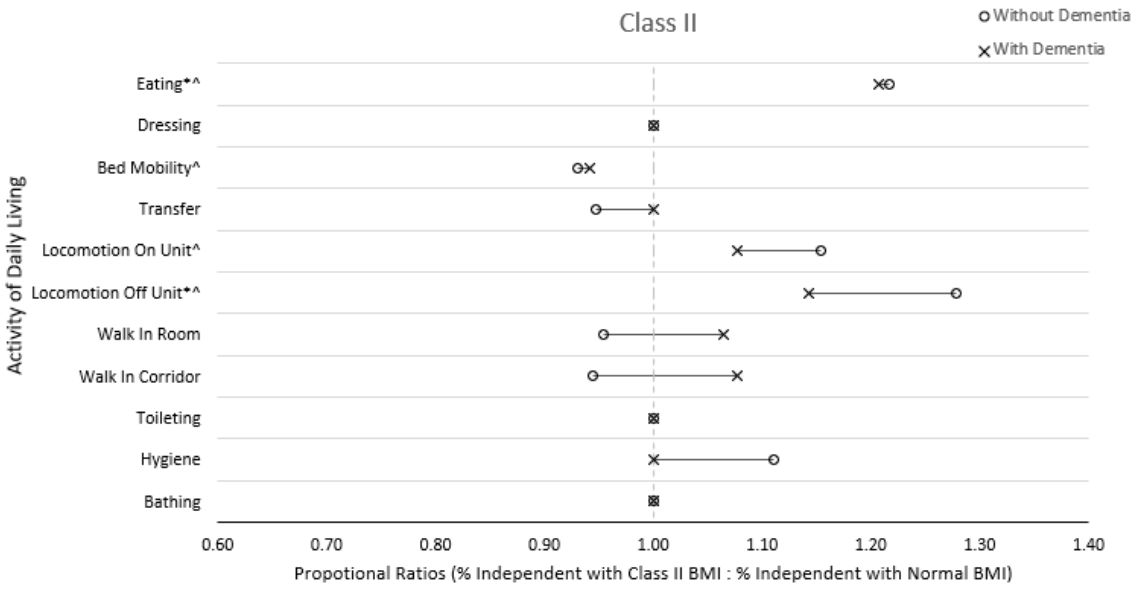
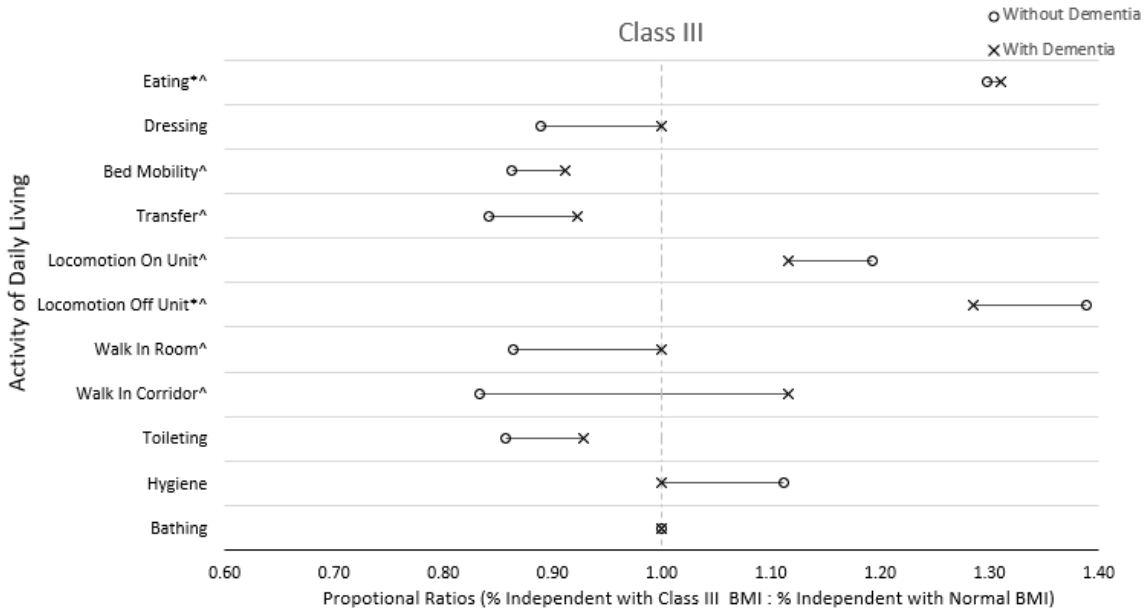


Figure 18 (Continued).

v.



Note. a) * Significant difference between 'the BMI in the title' and normal BMI $p \leq 0.001$ for those with dementia (x). ^ Significant difference between 'the BMI in the title' and normal BMI $p \leq 0.001$ for those without dementia (o). b) A proportional ratio of 1 shows an equal independence ratio, > 1.0 shows higher independence over the reference group, and <1.0 shows lower independence than the reference group.

Summary of Self Performance of Activities of Daily Living (ADLs)

There was a relationship between the ability to perform certain activities of daily living (ADLs) independently and an individual's dementia status and their Body Mass Index (BMI). Overall, regardless of dementia status, having an overweight or class I obesity was associated with better independence in most ADLs. The ADLs of eating, locomotion on unit and locomotion off unit were most consistently showed greater rates of independence across all

BMIs above normal weight. Meanwhile class II obesity, with and without dementia, and class III obesity with dementia had more in common than differences with the normal BMI group. The underweight group had the lowest rates of independence. Finally, while dementia resulted in lower independence for many of the ADLs, especially in the underweight, the difference in PR were often minor, and for class III obesity having dementia resulted in higher PRs.

Overall, the data indicated an association between the BMI status of persons newly residing in a LTCF and their ADL performance. The data also suggested that the presence of dementia influenced the impact of BMI on self performance. Regardless of dementia status, persons newly residing in a LTCF with an underweight BMI had lower independence, while those with an overweight or class I obesity appear to perform ADLs more independently.

Summary of Results

The incidence of obesity amongst individuals entering Canadian long-term care increased incrementally over the last 10 years (2010-2020). There were notable differences in provincial/territorial LTC obesity levels and rates of increase in these, although increases in obesity rates were observed in all geographical categories. The overall incidence of obesity was comparable to the prevalence of obesity amongst the in-community Canadian population aged 80+ (2010-2018). Obesity rates among persons newly residing in a LTCF declined sharply with age, although these patterns are also consistent with those observed among the population of older adults living in community settings. Likewise, levels of obesity were typically higher among persons newly residing in a LTCF from rural areas, but this is in line with generally higher rates of obesity among older rural individuals more generally. Finally, obesity rates did not differ much by sex or primary language.

Health conditions such as hypertension permeated the LTC population regardless of BMI, however dementia, congestive heart failure, osteoporosis and diabetes had connections to BMI. Those with obesity were more likely to have diabetes and congestive heart failure and less likely to have dementia or osteoporosis. People with obesity generally, and with increasing levels of obese BMI, were more likely to have increasing numbers of chronic conditions when entering LTC. The combinations of these conditions showed that hypertension, heart disease, and arthritis were in the top five dyads of every BMI category, however diabetes was far more prominent amongst those with the heaviest BMIs. Persons with obesity were also more likely to requires two+ person assistance in their ADLs. Finally, having an overweight or class I BMI was associated with greater independence of ADLs. As BMI increased to class II and III obesity, this association decreased, especially for those without dementia.

Overall, the data suggested that the populations entering LTC with a normal BMI, overweight BMI or class I obese BMI were more similar than different in their demographics, health conditions and ADL functioning. The more extreme BMIs of underweight, class II obesity and class III obesity exhibited more chronic health conditions, and required more two+ person assistance, but had better ADL functioning for eating, and locomotion-based tasks. These differences were often masked when utilizing the arguably arbitrary grouping of obese and non-obese individuals.

Chapter Five: Discussion

Canadian long-term care facilities (LTCFs) are on the cusp of a population shift. As baby boomers enter retirement and later retirement years, there is a projected large increase in the demand for LTC and other health services utilized by an older population (Banerjee, 2007; Estabrooks et al., 2020; Roblin et al., 2022). Monitoring the initial wave of baby boomers entering long-term care (LTC) provides insights about potential changes in future LTC populations. LTC is seen as more expensive in comparison to other alternatives such as at-home aging services or facilities for lower care needs (Bender & Holyoke, 2018; Haber, 2016), and staying out of LTC is generally preferred by older adults (Leroux et al., 2021; Weeks et al., 2021; Westwood, 2016). One strategy in meeting this increase in demand is to delay entrance into LTC, which can have financial and system capacity benefits (Canadian Institute for Health Information, 2017c). Understanding the population entering into LTC will therefore provide direction for programs aimed at delaying or preventing the transition into LTC (Canadian Institute for Health Information, 2020a).

Alongside an aging population, obesity rates in the general Canadian population have increased over time (Bancej et al., 2015; Lytvyak et al., 2022; Twells et al., 2014), but how this translates into obesity rates in the Canadian LTC population has not been widely studied. Evidence from other countries suggests that obesity is associated with a greater risk of requiring LTC, more costly use of services in LTCFs , and a greater risk of needing specialized equipment and two+ person assistance (Cai et al., 2013; Felix et al., 2011; Miles et al., 2012; Williamson et al., 2023). The findings reported in this thesis suggest those with obesity represent a minority of the population newly residing in a LTCF (19%), but that rates of obesity in this group increased 13% between 2010-2019, and those with heavier BMIs experienced an even greater increase

over this period. Moreover, the incidence of persons with a body weight at risk of needing costly bariatric equipment increased by 50%. It unknown how this increase in obesity rates and risk of bariatric equipment has impacted Canadian LTC. Although the Canadian Standards Association does include accessibility requirements, including for bariatric equipment (Canadian Standards Association, 2018), ensuring health equity for these individuals residing in LTCFs may be difficult to achieve as older facilities have previously been designed for individuals with different body types and care needs.

What Do We Know About Persons Newly Residing In LTCFs with Obesity?

Utilizing CIHI initial assessment data collected between 2010-2020 inclusive, the findings of this research suggest that persons newly residing in a LTCF with obesity were, in many ways, reasonably representative of the older Canadian population and the LTC population in general, at least for many of the demographic characteristics considered. A closer examination of the data, however, reveals a more nuanced understanding of the characteristics and needs of this LTC sub-population.

While the majority of the LTC population is female (61%), the data suggests that females newly admitted to LTC in Canada were disproportionately represented in the more extreme BMI categories (i.e., classes II and III obesity and underweight, had a proportion of 68%, 72% and 72% female respectively). Previous studies in other countries reported that persons residing in a LTCFs with obesity were more likely to be female, but these studies do not report on levels of obesity (Cai et al., 2013; Kuchibhatla et al., 2013). Sex and gender are highly interrelated, and while the data looks at sex specifically there is well established literature on gendered factors related to obesity, such as survivorship rates, likelihood of living alone, and care roles, all of which attribute to higher rates for females in LTCFs (Mudrazija et al., 2015). Gruneir, Forrester,

Camacho, Gill, and Bronskill, (2013), for example, found that women entered into Canadian LTCFs at a younger age, while men presented with higher levels of needs. Obesity also carries a gendered disparity in a variety of factors, including employment, education settings, romantic relationships, healthcare and mental health treatment, and portrayals in the media, all of which have a significant negative impact on health, quality of life, and socioeconomic outcomes (Fikkan & Rothblum, 2012; Jovančević & Jović, 2022). There are also other gendered considerations outside the men and women binary that could potentially impact an individual's ability or willingness to access LTC, however the CCRS dataset from CIHI was limited to only sex. Understanding the population entering LTC will, by the nature of the demographics, require more particular attention to the gendered processes of interpersonal relations that older females experience, while also being aware of the intersection of gender-specific weight biases, including internalization-biases, that older adults with obesity face.

In addition to gendered considerations, there is a need for the continued acknowledgement and consideration for LGBTQ+ persons that face unique challenges and fears when accessing and living in LTCFs (Fasullo et al., 2021; Hafford-Letchfield et al., 2018; Taha et al., 2022; Villar et al., 2022; Westwood, 2016). For LGBTQ+ people with obesity, there is an intersection of health related stigmas, resulting in higher health risks (Paine, 2021). The older generation has seen higher rates of erasure of diverse gendered and sexual orientation identities (Hafford-Letchfield et al., 2018; Neville & Henrickson, 2010; Statistics Canada, 2022a), which emphasizes the need for creating space for this population in LTCFs. Future research would do well to explore the older LGBTQ+ population experiences of living both in-community and when accessing LTC, ensuring the inclusion of experiences of weight biases or barriers

encountered, such exercises will help to normalize their experiences and explore possible health equity issues they may face.

In addition to sex differences, persons newly residing in a LTCF with obesity entered LTC at a relatively younger age, with significantly higher proportions in every age group under 80+ ($p \leq 0.001$). Indeed, most individuals with class II or class III obesity entered LTC before the age of 80. This is consistent with findings of previous studies looking at obesity in LTCFs in other countries (Ankuda et al., 2017; Bradway et al., 2008; Kuchibhatla et al., 2013; Zhang et al., 2013). There are many implications to consider when examining the health equity of a younger LTC population. Two main considerations are the consequences of having a younger-older adult population in LTCFs, and the reasons for transitioning into LTC at a younger age. For the first consideration, facilities have been tailored to address the needs of an older population, including such considerations of room temperature, dietary options, mealtimes, and scheduled activities. Younger individuals residing in LTCFs, however, have been found to have different social, emotional and psychological needs then their older counterparts, with the risk of depression and social isolation when these needs are left unmet (Hay & Chaudhury, 2015; Shieu et al., 2022; Tapley, 2018). The second aspect to consider is that the reasons a person enters LTC at a relatively younger age may differ from those affecting older incoming persons. Entering LTC generally means that the level of burden from an individual's health conditions outweigh the efforts or capacities available to cope in a community or alternative setting. The findings of this research show that entering LTC at a younger age was more likely related to complications of diabetes, rather than dementia, and may have also been influenced by the need for more extensive two+ person assistance, which would place a greater burden on alternative support services.

An important subgroup identified in the demographic profile of persons newly residing in a LTCF are those whose primary language is something 'other' than one of Canada's two Official Languages. In Canada, a primary language other than English or French is associated with immigration status and ethnicity. Both characteristics have implications for older adults with obesity in LTCFs. Not speaking English/French as a primary language increases the risk of an incongruence of communication between persons residing in a LTCF and the facility and its staff. An incongruence of languages may be a result of speaking an official language but not of the location of residence (e.g., speaking French in an English part of the country), immigration status, being from First Nations, Métis or Inuit communities, or deafness (Bowen, 2001). Regardless of its cause, having mismatched communication languages acts a barrier in accessing healthcare (Bowen, 2001; Pot et al., 2020) and impacts quality of care (Jeong et al., 2020; Koehn et al., 2018; Non-communiciable Diseases Risk Factor Collaboration (NCD-RisC), 2016; Qiao, 2020; Reppas-Rindlisbacher et al., 2022). Only a small minority of those with obesity, and even fewer with higher classes of obesity, reported speaking a primary language other than English/French. This minority of a minority group may be facing intersecting negative factors of weight biases (including culturally influenced weight biases) and an incongruence of language and/or culture. Older immigrant adults living in Canadian LTCFs with obesity, especially higher levels of obesity, may encounter barriers unlike their majority counterparts, and providing equitable care for such a minority group would require further exploration of these experiences.

Finally, this analysis considered the influence of fairly crude indicators of urban or rural location of residence prior to entering LTC. The findings of this analysis suggest higher rates of obesity among those entering LTC from rural locations, with some differences observed between the provinces and territory included in the analysis. Providing and accessing healthcare resources

while living in a rural setting are major challenges for the Canadian healthcare system and people living in a rural area. Canadians in rural and smaller centers face barriers in accessing both LTCFs and alternatives to LTC with recent findings showing that fifty percent of individuals entering into Canadian LTCFs from rural areas could have been diverted if adequate community care was available (Canadian Institute for Health Information, 2020a; Kuluski, Williams, Berta, et al., 2012; Kuluski, Williams, Laporte, et al., 2012). Community care for various programs such as dementia and diabetes were also found to be harder to access and limited in availability in rural Canada (Camargo-Plazas et al., 2022; Morgan et al., 2015). An individual in a rural area may face limited local availability with the nearest LTC placement farther away than if they were in an urban center that had more options within a reasonable distance from home. As an example, the closure of a rural LTCF with dementia specialization in rural Alberta forced persons residing in the LTCF to transfer to urban based facilities located hours away, negatively impacting the persons residing in the LTCF and their families (Brassolotto et al., 2020). Obesity, like dementia, has specialized considerations for care, with higher levels of obesity requiring facilities to have the structural capacities to handle bariatric equipment, if a facility, such as the one in Alberta, can be closed because the health service agency deemed it 'too costly to repair'(Brassolotto et al., 2020), than the cost of retrofitting older buildings for bariatric use may also be 'too costly' and instead force individuals to enter into centralized care in urban centers. It is unknown to what extent this occurs in a Canadian context or if the problem is greater in rural areas; while Miles et al., (2012) reported that 52% of placements of patients with obesity from hospitals in a southern American state had difficulty placing within a "reasonable distance" from home, they were unable to determine if the problems were greater in rural areas. There is, therefore, an intersection of barriers that may be

experienced, whereby having higher obesity may limit the number of LTCFs with the capacity to accept bariatric patients, and living in a rural area means there are even more limited resources. The resilience and resourcefulness of individuals with higher levels of obesity in rural and smaller areas should be explored further, particularly with respect to how they manage the barriers of a healthcare system filled with weight bias coupled with limited availability and accessibility of LTC.

Understanding the Care Needs of Persons Newly Residing In LTCFs with Obesity

The initial assessments conducted on, or shortly after, entry to LTC offer a general understanding of condition prevalence amongst persons newly residing in a LTCF. While the prevalence of conditions in Canadian LTCFs are well studied (Canadian Institute for Health Information, 2020c), this data adds to the literature as it includes differences seen in the newly entered populations with and without obesity and across BMIs. The information highlights differences and does not attempt to attribute obesity as the reason for the differences. In addition, the statistical results should be treated with caution given the large number of assessments considered. That is, a significant difference noted in a large sample does not necessarily imply clinical significance. Rather than relying simple on statistical significance, the discussion and results focused on the proportions with the greatest differences which may prove to be more clinically relevant.

Dementia and diabetes are two of the major conditions in LTC populations (Canadian Institute for Health Information, 2020c). The rates of both dementia and diabetes amongst persons newly residing in a LTCF showed relationships with BMI levels, and these relationships are considered below.

Dementia is a prominent condition appearing in 25% of the oldest Canadians and is projected to grow in incidence as the population ages (Public Health Agency of Canada, 2017). While the majority (61%) of Canadians with dementia live outside of LTC, dementia is the largest contributing factor for needing LTC (Canadian Institute for Health Information, 2023; Halonen et al., 2019). It was, therefore, unsurprising that the newly entered LTC population had a higher prevalence of dementia (54%) than the in-community population. The rate of dementia was lower amongst those with obesity, and decreased with increasing BMI, reflecting previous literature on LTC populations in other countries (Ankuda et al., 2017; Cai et al., 2013). A contributing factor could be the younger age that individuals with obesity enter LTCFs. Since this research was limited in scope, statistics on confounding variables were not undertaken. Other research looking at obesity in LTCFs, however, noted rates of dementia in persons residing in a LTCF with obesity remained lower even after taking demographics such as age into account (Ankuda et al., 2017; Cai et al., 2013). Dementia is notoriously difficult to diagnose (Parker et al., 2020), and there is a high risk it has been underdiagnosed in the population newly residing in LTCFs. The use of a dementia diagnosis, therefore, likely underestimates the extent of cognitive impairments present in this population.

There is a complex relationship between dementia and obesity. On the one hand, obesity increases the risk of developing dementia (Anjum et al., 2018; Ma et al., 2020), but having obesity later in life has also been linked to a lower risk of dementia (Anjum et al., 2018; Dahl et al., 2008). The pervasiveness of biases, including healthy survivor effect and pre-dementia-diagnoses weight loss, may account for some discrepancies (Anjum et al., 2018; Bowman et al., 2019). There might be lower rates of dementia in the higher categories of the newly entered LTC population because some treatments for dementia are associated with weight loss, and would

shift persons previously with obesity into lower BMI categories (Franx et al., 2017). Interestingly, the ability for individuals with obesity to be able to lose weight during such treatments contributes to the so-called ‘protective factor’ against mortality attributed to obesity in older adults (de Souto Barreto et al., 2017; García-Ptacek et al., 2014). Either way, dementia is prominent in the newly entered LTC population, and in-community management programs and dementia specific alternatives to LTC will continue to be important in relieving the pressures placed on LTCFs. While a Canadian national dementia strategy has been adapted, there are still challenges in meeting growing demand for community-based dementia services (Estabrooks et al., 2020; Morgan et al., 2015).

Obesity has increased in the general population, and with it there are concerns about the concurrent rise in diabetes (Anis et al., 2010; Janssen, 2013; Ryan, 2009). Diabetes was present in 26% of the persons newly residing in a LTCF. Unsurprisingly, persons newly residing in a LTCF with obesity had higher rates of diabetes (39%) than their counterparts without obesity, a finding generally reflected in studies in other countries (Ankuda et al., 2017; Cai et al., 2013; Grabowski et al., 2005; Shieu et al., 2022). While diabetes was present in every BMI category, rates were generally higher as BMI increased, peaking at rates of 48% for those with class III obesity. Research into discrete obesity categories in LTCFs is more limited, but the literature available shows that women over 70 demonstrated positive relationship with diabetes and increasing BMI (Van Uffelen et al., 2010). A study by Zhang et al. (2019), for instance, reported the odds of having diabetes in LTCFs were two-, three- and four-times higher for those with class I, II or III obesity respectively as compared to their normal BMI counterparts.

Diabetes in LTCFs has been highlighted in the literature for its challenges. The management of diabetes is impacted by LTC staff who have self-reported poor knowledge in

caring for diabetes in the LTC setting (Lega et al., 2020), with a disconnect between what physicians' believe diabetes management should achieve and its actualization in LTCFs (Osman et al., 2016). Recent research in Toronto, Canada, has also highlighted the potentially unsafe, overly controlled treatment of diabetes amongst older adults in LTCFs (Lega et al., 2021). There is already much effort in managing diabetes in-community, and the information here highlights that diabetes is prominent in LTC settings, especially amongst the population with higher rates of obesity.

Individual programs for chronic conditions, such as diabetes or dementia, are important in keeping Canadians out of LTC, but the ability to access healthcare professionals confident in their ability to help manage multiple conditions plays a role as well. The presence of multiple morbidities (2+) was higher amongst those with obesity, and with increasing obesity. Those with obesity, especially class II obesity had the highest rates of having 4 and especially 5+ conditions. Previous literature has found that the number of conditions older adults had increased with age over 50 (Machado et al., 2013), and also with increasing BMI (Amankwaa et al., 2022; Machado et al., 2013). Older adults with multiple chronic conditions faced increased hospitalization and readmission rates (Rodrigues et al., 2022), increased LTC admission, and increased mortality (Halonen et al., 2019; Viljanen et al., 2021). The management of multiple chronic conditions in community is important to delay entrance into LTC, especially for those with obesity. However, healthcare workers felt underprepared when helping older Canadians living in-community manage multiple chronic conditions (Ploeg et al., 2019). One of the goals of management of such conditions is ensure that the condition(s) do not negatively impact the ability to function independently or semi-independently in-community.

Having a chronic condition, such as dementia or diabetes, or else multiple conditions, does not translate directly into impairment, however, the progression or mismanagement of such conditions may lead to disability. Activities of daily living (ADLs) are benchmark activities that give some indication of functional capabilities. Persons newly residing in a LTCF with obesity, regardless of dementia status, had higher or equal rates of independence for each of the ADLs, with little exception. However, persons newly residing in a LTCF with obesity were also more likely to need two+ person assistance.

Interestingly, persons newly residing in a LTCF with class I obesity or an overweight BMI had similar levels of independence in their ADLs, and both had higher independence levels than their counterparts with normal BMI. This held true for the groups with and without dementia. As there is debate about the threshold of the health risks associated with obesity for older adults (Amankwaa et al., 2022; de Souto Barreto et al., 2017) these results provide some evidence in favor of not being overly concerned about lower levels of obesity levels in older adults in LTCFs, as independence levels indicated among those with overweight or class I obesity could be seen as an indication for overall health. However, the results also show that there is an upper limit to the association of greater independence seen with obesity in older adults. Independence levels begin to taper off with class II obesity, with class III obesity exhibiting lower levels or equal levels of independence compared to the normal weight group. While overall independence levels were higher amongst those with obesity, the data also showed that when assistance was needed it was more likely to be extensive.

Persons newly residing in a LTCF with obesity were more likely to need two+ person assistance in performing ADLs, a finding also reflected in previous research (Harris et al., 2018; Kosar et al., 2018). Such assistance translates to a higher usage of staffing resources. Barriers

form when funding algorithms do not allow appropriate compensations, as facilities become less likely to accept obese patients due to an increase in the reduction of quality of care and an increase in staff injuries (Ankuda et al., 2017; Bariatric Safe Patient Handling and Mobility Guidebook Professional Advisory Group, 2015; Muir & Archer-Heese, 2009). American researchers have criticized their funding models where increased obesity rates have not been met with increased staffing hours per person (Harris et al., 2018). Canadian policies and funding models should be examined to determine if funding strategies take into account higher rates of two+ person assistance, and other bariatric specific care needs. In Ontario, for example, LTC funding is provided as a per diem per bed type (e.g., long-term, short-term), which includes assigned staffing hours (Ontario Ministry of Long-Term Care, 2022). The total funding from these per diems are then adjusted based on based on Case Mix Index (CMI) and Resources Utilized Groups (RUGs) scores, both of which rely upon the RAI-MDS 2.0 assessments (Ontario Ministry of Long-Term Care, 2022). This assessments have been criticized by health practitioners for not accurately reflecting the needs of persons residing in a LTCF with bariatric care requirements, however there is little to no research linking this characteristic with weaknesses in the assessment (Sutherland et al., 2013), additionally, both the CMI and RUGs do not include two+ person assistance in their calculations (Canadian Institute for Health Information, 2018). Recognizing the higher staffing needs per patient with higher obesity has been suggested as a way of addressing some of the barriers faced by those with obesity attempting to access LTC (Felix et al., 2018). It is unknown how such a funding model in a Canadian context, with its mix of private, public-profit, and public-non-profit facilities, would impact the willingness or ability for LTCFs to able to accept individuals with obesity.

The Limitations and Usefulness of BMI Categories Amongst Persons Newly Residing In a LTCF

The risk of requiring bariatric equipment increases with weight and does not rely upon BMI. Bariatric equipment is generally required for those with a mass of 115 kg (~250lbs) or higher to ensure safety and quality of care (Felix et al., 2011; Caz Hales et al., 2019; Muir & Archer-Heese, 2009). Accounting for only 2% of the total population over the ten-year period (n=5,930), the demand for bariatric equipment increased nearly 50% as incidence of individuals with both 115-135 kg or135-155 kg increased. The need for bariatric equipment, and the lack of that equipment in facilities, can act as a barrier in obtaining access to LTC. Barriers include not only the procurement of more expensive equipment, but also the capacity to accommodate (e.g., room, doorway, and hallway sizes) and store the bulkier equipment (Felix et al., 2011; Hahler, 2002; C. Hales et al., 2020; D. Jones et al., 2020). While the most recent edition of the voluntary-based Canadian standards for LTC planning and design included updated requirements for dimension and clearances to accommodation bariatric spaces, (Canadian Standards Association, 2018), the extent to which facilities have been retrofitted to accommodate is an area that needs be explored further. As the data shows, there has been an increase in the number of people at risk of requiring bariatric equipment entering LTC. Such an increase in demand may be associated with an increase in costs as facilities purchase, house and retrofit for such equipment (Felix et al., 2011; C. Hales et al., 2020; Miles et al., 2012).

This study utilized obese and non-obese categories, alongside the six BMI categories, as well as a weight only incidence analysis. Two observations were made. First, the weight only analysis showed a greater rate of increase in the number of individuals who entered with a bariatric weight (115kg) as compared to the BMI analysis of class II obesity and class III obesity.

BMI analysis should not be solely utilized when looking to understand the supply and demand balance of bariatric equipment in LTCFs. Second, the use of non-obese and obese continuously masked the differences seen in the more extreme BMIs. The differences noted for the demographics, prevalence of health conditions and independence levels of ADLs increased with increasing obesity, however the effects of having class I obesity were often very similar to individuals with an overweight BMI and normal BMI. The observations suggest that consideration of 'obese' as a single group masks more prominent differences within this category and may limit the potential contributions of data simplified to reporting characteristics defined as simply obese when informing responsive practice and policies.

The Impacts of the COVID-19 Pandemic

It is beyond the scope of this thesis to attempt to measure or fully consider the impact of COVID-19 across the LTC sector. The data analyzed here, however, does show a notable decrease in the number of first initial assessments in 2020, and lower obesity rates then were previously trending. The decrease in the number of first initial assessments was not seen at equal rates across the regions, with BC and Alberta seeing little impact. Additionally, none of the 130+ facilities from Saskatchewan, which otherwise would account for 60% of the 'Other' group, were included in the CCRS dataset from CIHI for the fiscal year 2020/21. This discrepancy contributed to the anomaly of 2020 data. The decreases noted elsewhere could be for a variety of reasons, including a slowing of new admissions or entries and re-entries from acute care facilities (Jeffords, 2021; Sibbald, 2020), Ontario for example temporarily stopped admitting people into LTC in mid-April 2020 and only resumed in facilities without active outbreaks (Sibbald, 2020). The lower numbers were reflected in a drop in healthcare access across the system, including all-admissions to LTC (Canadian Institute for Health Information, 2021b) and non-COVID-19

related hospital admissions (Canadian Institute for Health Information, 2021a). These all-admission to LTC remained low through the end of 2020 in contrast to the recovery in other healthcare sectors (Canadian Institute for Health Information, 2021b; A. Jones et al., 2022). Due to the nature of the data, it is unknown whether initial assessments for admission reflected this delay in recovery.

Along with a drop in overall numbers of new LTC admissions, the rate of obesity was notably lower in 2020. The non-homogenous decrease in initial assessment numbers across regions may have impacted the overall obesity rates, since Ontario had some of the highest rates, and BC the lowest. It is not known how COVID-19 impacted weight biases and barriers for accessing healthcare services. Increased isolation impacted the entire population, however those with reported higher risks of complications of COVID, which included older adults and those with obesity, may have had different experiences. Policies encouraging the exit of persons residing in a LTCF most capable of leaving LTC, may have disproportionately impacted persons with obesity, as they were generally younger, with higher rates of independence. While other research is emerging looking at LTC populations pre-pandemic, and during pandemic (A. Jones et al., 2022), it may serve well for future research to include an obesity specific lens in their research on COVID-19 in LTCFs.

A Priority Population

As Patychuk & Seskar-Hencic (2008) outline, ensuring healthcare equity first involves the identification of priority populations, followed by an analysis of unique burdens and barriers, and then identifying future steps in policy making. A priority population within the context of healthcare has been described as "those that are experiencing and/or at increased risk of poor health outcomes due to the burden of disease and/or factors for disease; the determinants of

health, including the social determinants of health; and/or the intersection between them" (Ontario Ministry of Health and Long Term Care, 2018, p. 13). Individuals with obesity experience increased health risks. First, the nature of obesity itself, or the burden of obesity, results in an increased risk of poor health outcomes. Secondly, having obesity is directly related to social determinants of health, as weight biases, obesity-specific barriers, and obesogenic environments intersect to negatively impact health outcomes, including in LTC settings (Bradway et al., 2017; Felix et al., 2016; Caz Hales et al., 2019; S. Kumanyika et al., 2002; Pearl & Puhl, 2018; Phelan et al., 2015; Public Health Agency of Canada & Canadian Institute for Health Information, 2011). Despite the complex challenges related to obesity, this population remains underserved, with multiple sectors of the healthcare system possibly biased, unprepared, and undereducated.

The LTC sector in Canada must not only adapt to serve an aging population but also one that is characterized by increased rates of obesity. It is important to look more closely at whether and how the population entering LTC is changing over time in order to adapt facilities and processes to address explicit and implicit biases and barriers. Older adults in general, and persons in LTCFs more particularly, are not homogenous groups. While the majority of persons newly residing in a LTCF do not have obesity, there is an important and apparently growing segment of the population with varying levels of obesity. These persons newly residing in a LTCF exhibit particular patterns of health issues, independence levels, needs for assistance and social, and psychological and emotional needs that require special recognition and attention to ensure health equity.

Chapter Six: Conclusion and Recommendations

This thesis is intended to begin filling gaps in our understanding of obesity in Canadian long-term care (LTC). Obesity in other countries is associated more generally with an increased risk for admission to LTC, risk of entrance at younger ages, and higher costs of care in LTCFs. Having obesity is also known to act as a barrier to obtaining entrance to LTCFs and, once in LTCFs, obesity is known to act as a barrier to receiving high quality of care. The research presented here offers unique insights into the population first entering LTC and thus undergoing an important point of transition. The CCRS dataset from CIHI collected through initial assessments provides the opportunity to retroactively look at this transitioning population over a ten-year period and utilize previously untapped weight and height measurements to understand better the presence and implications of obesity in this population. The focus of this research therefore provides opportunities to consider not just the needs and concerns of those entering LTC with obesity, but also ways to consider preventative and management interventions aimed at delaying entry to LTC.

Limitations

Geography

While the CIHI CCRS dataset analyzed in this thesis was large, caution should be exercised when seeking to generalize the findings to the Canadian population of persons newly residing in a LTCF. The provinces of Quebec, Prince Edward Island, New Brunswick, most of Nova Scotia, along with the Northwest Territories and Nunavut were not included in the dataset. Based on the number of persons residing in LTCFs CIHI CCRS reported for in fiscal year 2016/17, roughly 75% of all persons residing in Canadian LTCFs are included in the full CCRS data set (Canadian Institute for Health Information, 2017c; Statistics Canada, 2017a).

The rural and urban designation of a resident's last location was limited by the simplified definition of urban and rural, wherein urban was defined as a population of more than 10,000 people (Canadian Institute for Health Information, 2022a). Rural and smaller urban centres are not homogenous in their challenges (Gatrell & Elliott, 2009). Major differences in healthcare provisions and utilization created by geographical settings extend well beyond a minimum population threshold between ‘urban’ and ‘rural’. The geographical and social distinguishing features of communities based on size and distance would be expected to impact LTC, alternatives to LTC, in-community programs and individual capacities. For these reasons, the data analyzed here are incapable of capturing nuance in the strengths and resilience of rural communities and facilities.

Assessments

The nature of the initial assessment data was limited in its capturing of chronic condition's severity or influence on entrance, some demographic information, facility characteristics, and BMI category thresholds. Initial assessments provided rates of chronic conditions; however, there is no context for individual severity or progression of illness. The presence of a chronic condition may not be directly related to the cause of the need for LTC. This lack of contextual information is a limitation of the study, and the literature would benefit if the major contributing factors for LTC were better highlighted.

The demographic information made available to this thesis was limited by the assessment itself, but even some of the demographic information collected in the assessment has been suppressed by CIHI for reasons of confidentiality. Further research would do well to collect and examine more demographic information, including socio-economic considerations (e.g., household income, level of education attained), expanded gender identities, sexual orientations,

ethnic identity, and immigration status, to further enrich the demographic profile of persons with obesity in and entering LTC. Some of these demographic features have been found to be confounders for contributing to the risks of gaining weight (e.g., socio-economic), and for affecting obesity related health risks (e.g., lower thresholds of risks for certain ethnicities (Rueda-Clausen et al., 2020). Other demographics may have an interactive effect with obesity when looking to access LTC since, separately, obesity and, for example, immigrations status (Castañeda et al., 2015; Qureshi et al., 2021) or LGBTQ+ status are each associated with a greater risk of encountering barriers to entering LTC.

Facility characteristics are prominent influences for obesity-based barriers (Bradway et al., 2017; Felix et al., 2016; Harris et al., 2020; Zhang et al., 2013). While the data allowed for an individual's last location prior to entry into LTC, this did not mean the LTCF had the same rural or urban designation. Rural and small community LTCFs may have organizational, structural, and financial hurdles that are exacerbated by their geographical settings. Geography is one of many characteristics that would influence the capacity and willingness of facilities to accept individuals with larger levels of obesity in a Canadian context. Other contextual characteristics might include private or public ownership, case mix, or multi-facility affiliation (Zhang et al., 2013). It is a limitation that obesity rates could not be compared based upon facility characteristics and this is a point for future research to consider.

The Body Mass Index (BMI) was utilized as height and weight were collected in the initial assessments of the persons newly residing in LTCFs. BMI, in general, provides a simple measurement that quickly, but crudely, captures increased health risks associated with increasing adipose tissue while taking height into account. As mentioned previously, the use of BMI brings concern for its validity as a health metric (e.g., at the individual level, BMI does not distinguish

tissue type or accumulation location). However, BMI can be useful for population level studies. At a population level, BMI provides an estimate for increased health risks associated with increasing obesity, where the more inherent differences seen at an individual level are balanced out and general trends can be observed. The use of BMI at a population level, nevertheless, has noteworthy limitations. The standard WHO BMI health risk thresholds are based predominately on younger-adult and Eurocentric populations (Barba et al., 2004; S. K. Kumanyika, 2019; Razak et al., 2007; Rueda-Clausen et al., 2020). The sample population in this study is comprised largely of older-adults and includes persons of non-European origin. Future research would do well to consider BMI thresholds that are age- and ethnicity-adjusted.

Finally, the data is imitated to only three WHO obese sub-categories (classes I-III). The Canadian Guidelines lay out five sub-categories of obesity; however, due to the small number of individuals in these higher groups (approximately 10,000 individuals entered with class III obesity over the ten years), CIHI only provided three sub-categories. The nuanced differences in heavier populations are lost, and the number of individuals at these weights in Canadian LTC is still unknown.

Missing Data

Data with larger portions of missing data and/or low confidence were eliminated (i.e., RUGs, neighbourhood income, and education). Resources Utilized Groups (RUGs) scores and education were missing from 40% and 30% of persons newly residing in a LTCF respectively. Neighbourhood income was provided by quintile, but the distribution was affected by the removal of over 20% of the assessments during the data clean-up phase. Both education and neighbourhood income were analyzed in cross-tabulations with BMI, but produced no notable

differences and, due to low confidence from the number of missing values, they were not included in the results.

Selection Bias

The assessment data collected for this study reflects those individuals that have successfully gained entrance into a LTCF. As discussed, the literature has found that those with obesity face barriers when accessing LTC, such as equipment availability (Miles et al., 2012) and attitudes of staff (Felix et al., 2011). It is not known to what extent persons with obesity face barriers when trying to access Canadian LTC, and the sample population reflects the bias of only providing information on those able to contend successfully with such challenges. The sample population may be, biased towards those persons with obesity that are seen as most profitable, such as short-term stays, as was highlighted in the literature (Harris et al., 2020; Zhang, Lu, et al., 2019). The selection bias also impacts the observations of obesity incidence rates. While the LTC sector has newer Canadian Standards for increased accessibility, including considerations for the bariatric facilities, the extent to which these voluntary guidelines have been pursued is unknown. The incidence rates reported in this study reflect the capacity for the LTC sector to be able to accept bariatric and other persons with higher levels of obesity. It is unknown how many bariatric beds are available in LTCFs, what their occupancy rates are, and what unmet need exists. Having adequate numbers of suitable beds in an accessible manner (for example within a geographically reasonable distance from home) would reduce barriers. However, operating with a surplus of bariatric beds, resulting in low occupancy rates of those beds, may increase the barriers faced by persons *without* obesity as costs as this equipment cannot be safely utilized by persons of a non-bariatric stature. Further explorations of unmet

needs for LTC among the population with obesity are needed to better understand the real demand for LTC from this group.

The Population Newly Admitted to LTC with Obesity

The Canadian literature lacks research on the population with obesity in LTCFs. As one step towards addressing this gap in knowledge, this thesis looks at obesity amongst those newly admitted to LTC. Nearly 20% of the population entering LTC had obesity, and 7% had class II or III obesity. The rate of obesity in this group remained relatively constant, with moderate growth between 2010 and 2020 and a greater increase in the proportion of persons with the heaviest BMIs (class II and class III obesity). It is difficult to say if this is in line with other research on obesity rates in LTCFs as this study is limited to those newly admitted and not the entire population. Previous research looking at obesity rates in LTCFs reported an increase between 1992-2002 (Lapane & Resnik, 2006), 1999-2013 (Marihart et al., 2015) and 2005-2015 (Zhang, Field, et al., 2019), but these studies were conducted somewhat earlier than the research reported in this thesis. There is some indication, for instance, that rates of increase in adult population obesity began leveling off after 1999 (Rokholm et al., 2010). Like previous research, the profile of persons newly residing in a LTCF with obesity describes a heterogeneous population more likely to be female and younger, with higher rates of diabetes and multi-morbidities but lower instances of dementia. The population also had higher independence rates generally yet was more likely to require two+ person assistance. The data demonstrated that persons newly residing in a LTCF with lower levels of obesity (class I) were similar to overweight and normal BMI counterparts with respect to levels of conditions and care needs, adding to the debate of BMI health risks thresholds for older adults with obesity.

The data here adds to the literature that persons with obesity and higher levels of obesity are more likely to be transitioning into Canadian LTC at younger ages and more likely to have diabetes at the time of transition and emphasizes the heterogeneity of the LTC population. Two main sub-populations are identified, younger-older adults with obesity and older adults with obesity, (with a spectrum between them) with different considerations for care within LTCFs and preventative services. These populations are united in their obesity in that the management of obesity is complex in LTCFs; there are higher rates of obesity-related conditions such as diabetes, the social and health implications of facing weight biases in the healthcare system, and obesity-based barriers when trying to access LTC or other alternatives. However, the populations also differ in the management of obesity. Older adults should focus on maintaining weight rather than losing weight, as may be prescribed to younger people. Finally, there are different social, emotional, and physical needs for younger-older adults than what is provided in LTC settings tailored to an older population.

Implications

The demand for LTC is projected to double by 2040, so encouraging the education, management and treatment of obesity, diabetes and dementia in the community may alleviate some of that pressure. Preparing for the future of an aging population goes beyond creating new facilities and beds and requires creating space for facilities to anticipate and accommodate changing needs in LTCFs, such as those that come with rising rates of obesity and bariatric care. New LTCFs should be designed to house bariatric equipment and efforts are needed to retrofit existing facilities to handle such equipment. A key implication of this study is the evidence it presents that the number of individuals with higher levels of obesity (class II and class III) and those at risk of needing bariatric equipment has grown. Efforts are needed to evaluate and most

likely increase care services and infrastructure of LTCFs to be able to support persons residing in a LTCF across the full BMI spectrum. Concurrently strengthening obesity, diabetes and dementia home support and management programs (including education of health practitioners) may help to delay or prevent LTC and encourage transitioning out of LTC. Additionally, more expensive acute care settings (i.e., hospitals) may also benefit from such investments as those waiting in acute settings are able to transition into LTC, or into community with proper supports.

Research into the adequacy of LTC meeting the population demands needs to include obesity as a factor for needing LTC and as a barrier to accessing that LTC. It is unknown what the current unmet demands for the care of individuals with higher levels of obesity are and how these demands differ across the healthcare geographies. Likewise, it is unknown what the levels of supply, accessibility levels, and occupancy rates are for bariatric and obesity focused care and equipment.

Knowledge Dissemination

There are three identified audiences for this thesis – academic researchers, policy makers and administrators, and healthcare providers and practitioners. For the academic audience, preliminary findings were presented at two conferences, the Canadian Association of Geographers in May 2022, and the Western Division of the Canadian Association of Geographers in March 2023. I intend to prepare a manuscript for peer review with the goal of publishing in an academic journal (e.g., *Obesity, Journal of Gerontology, Journal of Nutrition, Health, and Aging*). The thesis will be made publicly available via Library and Archives Canada.

Recommendations for Future Actions and Research

To increase the understanding of the population newly entered into LTC with obesity, future research should look more closely at broader demographic factors such as gender,

sexuality, ethnicity, and immigration status. Additionally, the care needs and independence of the population with a bariatric weight and higher levels of obesity (class II and class III) should be further examined. While this thesis captured the population newly entered into LTC, future research should expand to analyse the of levels of obesity and their relation to care needs of those living in LTCFs, including mortality and morbidity rates, length of stays, and resource utilization. There are many areas, including healthcare provider education, in-community chronic conditions programs, and in-LTC chronic condition management policies that would benefit from including a lens of obesity in research and policy.

This thesis provided background quantitative data. There is a need, however, for qualitative research to understand better the experiences of persons in LTCFs (newly entered and already living in LTCFs), and older adults with obesity living in community settings but showing signs of needing LTC. Such research should also include the experiences of family and support systems of these individuals. It is also important to learn more about the experiences and perceptions of LTC administrators and healthcare providers, such as what shortfalls in LTCFs exist for persons residing in a LTCF with obesity regarding care, policy, and administration. Qualitative research and internal audits should also look at two areas of concern raised in the literature. The first is the potential presence of obesity-based barriers when accessing LTC, and the second, which contributes to the first, is the ability for LTC to meet current and future demands for bariatric and higher obesity care.

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Appendices

Appendix 1

Frequency of Health Condition in the Population of Persons Newly Residing in a Long-term Care Facility and by Obesity Status (N=350,348), 2010-2020

Health Condition	Total Population (100%, N=350348)		Body Mass Index (kg/m^2) <30 81%, n= 283840		≥30 19%, n= 66508	
	%	n	%	n	%	n
Hypertension	61	(212,511)	59	(168,520)	66	(43,991)
Dementia other than Alzheimer's disease	44	(155,217)	46	(131,406)	36	(23,811)
Arthritis	35	(123,708)	34	(95,848)	42	(27,860)
Diabetes mellitus	26	(91,809)	23	(65,673)	39	(26,136)
Osteoporosis	22	(76,020)	23	(65,386)	16	(10,634)
Depression	22	(75,829)	21	(58,958)	25	(16,871)
Allergies	20	(69,289)	19	(53,709)	23	(15,580)
Cerebrovascular accident (stroke)	19	(65,116)	19	(53,099)	18	(12,017)
Gastrointestinal disease	18	(61,680)	17	(49,370)	19	(12,310)
Hypothyroidism	17	(59,677)	17	(47,257)	19	(12,420)
Other cardiovascular disease	17	(58,273)	16	(46,334)	18	(11,939)
Emphysema/ COPD	16	(56,617_	16	(44,344)	18	(12,273)
Congestive heart failure	15	(51,277)	13	(38,216)	20	(13,061)
Alzheimer's disease	12	(43,702)	13	(37,174)	10	(6,528)
Anemia	11	(39,964)	12	(33,047)	10	(6,917)
Arteriosclerotic heart disease (ASHD)	11	(39,127)	11	(30,941)	12	(8,186)
Renal failure	11	(38,091)	10	(29,353)	13	(8,738)
Cancer	11	(37,877)	11	(31,544)	10	(6,333)
Cataracts	10	(34,059)	10	(27,839)	9	(6,220)
Anxiety disorder	9	(31,519)	9	(25,099)	10	(6,420)

Urinary tract infection in last 30 days *	8	(26,894)	8	(21,802)	8	(5,092)
Glaucoma	7	(25,438)	8	(21,439)	6	(3,999)
Cardiac dysrhythmia	7	(25,030)	7	(20,078)	7	(4,952)
Macular degeneration	7	(23,685)	7	(19,996)	6	(3,689)
Hip fracture	6	(22,334)	7	(19,790)	4	(2,544)
Parkinson's disease	6	(21,504	6	(18,412)	5	(3,092)
Peripheral vascular disease	6	(19,326	5	(14,655)	7	(4,671)
Transient ischemic attack (TIA)	4	(15,100	4	(12,472)	4	(2,628)
Antibiotic resistant infection (e.g., Methicillin resistant staph)	4	(15,008	4	(11,754)	5	(3,254)
Asthma	4	(13,596	3	(9,683)	6	(3,913)
Hemiplegia/hemiparesis	4	(13,407	4	(10,637)	4	(2,770)
Seizure disorder	4	(12,694	4	(9,954)	4	(2,740)
Aphasia	3	(12,262	4	(10,465)	3	(1,797)
Pneumonia	2	(6,926	2	(5,741)	2	(1,185)
Hypotension	2	(6,163	2	(4,304)	3	(1,944)
Schizophrenia	2	(6,248	2	(5,374)	1	(789)
Pathological bone fracture	2	(5,168	1	(3,643)	3	(1,670)
Bipolar disorder (Manic depressive)	1	(5,313	1	(4,163)	2	(1,005)
Liver disease	1	(4,854	1	(3,724)	2	(1,248)
Wound infection	1	(4,972	1	(3,680)	2	(1,174)
Deep vein thrombosis	1	(3,730	1	(3,077)	1	(685)
Traumatic brain injury *	1	(3,762	1	(2,712)	2	(1,018)
Hyperthyroidism *	1	(3,450	1	(2,274)	2	(1,309)
Missing limb (e.g., Amputation)	1	(3,340	1	(2,743)	1	(707)
Multiple sclerosis	1	(3,347	1	(2,531)	1	(816)
Cellulitis	1	(3,583	1	(2,443)	1	(897)
Respiratory infection	1	(2,937	1	(2,338)	1	(599)
Clostridium difficile	1	(2,330	1	(1,976)	1	(354)
Diabetic retinopathy	<1	(1,704	<1	(1,097)	1	(607)
Viral hepatitis *	<1	(1,645	<1	(1,317)	<1	(328)
Cerebral palsy	<1	(1,080	<1	(799)	<1	(281)
Paraplegia	<1	(1,045)	<1	(740)	<1	(305)

Amyotrophic lateral sclerosis (ALS) *	<1	(841)	<1	(688)	<1	(153)
Septicemia	<1	(814)	<1	(617)	<1	(197)
Quadriplegia *	<1	(682	<1	(523)	<1	(159)
Huntington's chorea	<1	(659)	<1	(589)	<1	(70)
Conjunctivitis *	<1	(616)	<1	(500)	<1	(116)
HIV infection *	<1	(305)	<1	(258)	<1	(47)
Sexually transmitted diseases *	<1	(236)	<1	(186)	<1	(50)
Tuberculosis (active)	<1	(213)	<1	(196)	<1	(17)

Note. * Indicates the conditions which are not significantly different ($p>0.001$). All other conditions are significantly different between the obese (≥ 30 kg/m^2) and non-obese (<30 kg/m^2) groups ($p \leq 0.001$).

Appendix 2

Health Condition Rates in the Population of Persons Newly Residing in a Long-term Care Facility by Body Mass Index (BMI) Status (N=350,348), 2010-2020

Health Condition	Body Mass Index (kg/m^2)											
	Underweight (11%, n= 38,671)		Normal (42%, n=14,6224)		Overweight (28%, n=98,945)		Class I (12%, n=41,279)		Class II (4%, n=14,789)		Class III (3%, n=10440)	
	%	(n)	%	(n)	%	(n)	%	(n)	%	(n)	%	(n)
Hypertension	54*	(20,757)	59	(85,858)	63*	(61,905)	66*	(27,072)	68*	(10,010)	66*	(6,909)
Dementia other than Alzheimer's disease	46*	(17,662)	47	(69,275)	45*	(44,469)	40*	(16,580)	33*	(4,824)	23*	(2,407)
Arthritis	31*	11,799)	33	(48,172)	36*	(35,877)	41*	(16,790)	44*	(6,489)	44*	(4,581)
Diabetes mellitus	15*	(5,740)	22	(31,586)	29*	(28,347)	36*	(14,732)	44*	(6,442)	48*	(4,962)
Osteoporosis	31*	(12,153)	24	(34,640)	19*	(18,593)	17*	(6,935)	15*	(2,250)	14*	(1,449)
Depression	20	(7,754)	20	(29,657)	22*	(21,547)	24*	(9,903)	27*	(3,939)	29*	(3,029)
Allergies	19	(7,245)	18	(26,953)	20*	(19,511)	22*	(9,012)	25*	(3,675)	28*	(2,893)
Cerebrovascular accident (stroke)	16*	(6,236)	19	(27,402)	20*	(19,461)	19	(7,871)	18	(2,610)	15*	(1,536)
Gastrointestinal disease	18	(6,794)	17	(25,102)	18	(17,474)	18*	(7,570)	19*	(2,833)	18	(1,907)
Hypothyroidism	17	(6,390)	17	(24,227)	17	(16,640)	18*	(7,386)	20*	(2,913)	20*	(2,121)
Other cardiovascular disease	15*	(5,651)	16	(23,695)	17*	(16,988)	18*	(7,464)	18*	(2,656)	17	(1,819)
Emphysema/ COPD	22*	(8,356)	15	(21,960)	14*	(14,028)	17*	(6,913)	20*	(2,967)	23*	(2,393)
Congestive heart failure	12	(4,721)	13	(18,921)	15*	(14,574)	18*	(7,441)	22*	(3,183)	23*	(2,437)
Alzheimer's disease	11*	(4,185)	13	(19,671)	13	(13,318)	11*	(4,720)	8*	(1,253)	5	(555)
Anemia	14*	(5,243)	12	(17,279)	11*	(10,525)	10*	(4,253)	11	(1,589)	10*	(1,075)
Arteriosclerotic heart disease (ASHD)	9*	(3,544)	11	(15,642)	12*	(11,755)	12*	(5,102)	13*	(1,878)	12	(1,206)
Renal failure	9*	(3,357)	10	(15,050)	11*	(10,946)	12*	(5,127)	14*	(2,081)	15*	(1,530)
Cancer	12	(4,537)	11	(16,221)	11	(10,786)	10*	(4,046)	9*	(1,403)	8*	(884)
Cataracts	10	(3,791)	10	(14,319)	10	(9,729)	10	(3,986)	9	(1,346)	9	(888)
Anxiety disorder	10*	(3,714)	9	(12,780)	9	(8,605)	9	(3,763)	10*	(1,526)	11*	(1,131)

Urinary tract infection in last 30 days	8	(3,106)	8	(11,257)	8	(7,439)	7	(3,082)	8	(1,172)	8	(838)
Glaucoma	8	(3,118)	8	(11,228)	7*	(7,093)	6*	(2,554)	6*	(880)	5*	(565)
Cardiac dysrhythmia	6*	(2,475)	7	(10,310)	7	(7,293)	7	(3,037)	7	(1,076)	8	(839)
Macular degeneration	8	(2,945)	7	(10,514)	7*	(6,537)	6*	(2,500)	5*	(760)	4*	(429)
Hip fracture	10*	(3,997)	7	(10,588)	5*	(5,205)	4*	(1,691)	4*	(550)	3*	(303)
Parkinson's disease	7	(2,528)	7	(9,820)	6*	(6,064)	5*	(2,204)	4*	(599)	3*	(289)
Peripheral vascular disease	5	(2,024)	5	(7,367)	5	(5,264)	6*	(2,598)	7*	(1,098)	9*	(975)
Transient ischemic attack (TIA)	4*	(1,480)	4	(6,439)	5	(4,553)	4	(1,767)	4*	(544)	3*	(317)
Antibiotic resistant infection (e.g., Methicillin resistant staph)	4	(1,724)	4	(5,974)	4	(4,056)	4	(1,808)	5*	(775)	*6	(671)
Asthma	3	(1,275)	3	(4,759)	4*	(3,649)	5*	(2,071)	6*	(928)	9*	(914)
Hemiplegia/hemiparesis	3*	(1,139)	4	(5,418)	4*	(4,080)	4*	(1,783)	4*	(630)	3	(357)
Seizure disorder	3	(1,232)	3	(5,101)	4	(3,621)	4	(1,601)	5*	(672)	4*	(467)
Aphasia	4	(1,357)	4	(5,445)	4	(3,663)	3*	(1,244)	3*	(373)	*2	(180)
Pneumonia	3*	(1,070)	2	(2,951)	2*	(1,720)	2	(726)	2	(259)	2	(200)
Schizophrenia	1	(460)	1	(2,031)	2*	(1,813)	3*	(1,053)	4*	(520)	4*	(371)
Hypotension	2	(812)	2	(2,921)	2*	(1,641)	1*	(546)	1*	(150)	1*	(93)
Bipolar disorder (Manic depressive)	1	(374)	1	(1,691)	2	(1,578)	2	(903)	3	(417)	3	(350)
Pathological bone fracture	2	(675)	2	(2,240)	1*	(1,248)	1	(571)	2	(236)	2	(198)
Wound infection	2	(599)	1	(1,886)	1	(1,239)	1	(618)	2*	(327)	3*	(303)
Liver disease	1	(435)	1	(1,863)	1	(1,382)	2*	(655)	2*	(309)	2*	(210)
Traumatic brain injury	1*	(335)	1	(1,644)	1	(1,098)	1	(445)	1	(153)	1	(87)
Deep vein thrombosis	1	(297)	1	(1,307)	1*	(1,108)	1*	(596)	2*	(239)	2*	(183)
Cellulitis	1	(229)	1	(1,080)	1	(965)	1	(585)	2	(332)	4	(392)
Hyperthyroidism *no sig. differences	1	(402)	1	(1,373)	1	(968)	1	(415)	1	(166)	1	(126)
Multiple sclerosis	1*	(405)	1	(1,208)	1	(918)	1*	(458)	1*	(195)	2*	(163)
Missing limb (e.g. Amputation)	1	(369)	1	(1,178)	1	(896)	1*	(441)	1*	(220)	2*	(236)
Respiratory infection	1*	(415)	1	(1,178)	1	(745)	1	(382)	1	(110)	1	(107)

Clostridium difficile	1*	(383)	1	(1,062)	1*	(531)	1*	(214)	1	(77)	1	(63)
Diabetic retinopathy	<1*	(77)	<1	(532)	<1*	(488)	1*	(296)	1*	(180)	1*	(131)
Viral hepatitis	<1	(191)	<1	(700)	<1	(426)	<1	(202)	<1	(68)	1	(58)
Cerebral palsy	<1*	(172)	<1	(362)	<1	(265)	<1	(147)	<1*	(67)	1*	(67)
Paraplegia	<1	(87)	<1	(381)	<1	(272)	<1*	(161)	1*	(79)	1*	(65)
Amyotrophic lateral sclerosis (ALS)	<1	(102)	<1	(392)	<1	(194)	<1	(95)	<1	(37)	<1	(21)
Septicemia	<1	(85)	<1	(308)	<1	(224)	<1	(113)	<1	(50)	<1	(34)
Quadriplegia	<1	(71)	<1	(268)	<1	(184)	<1	(92)	<1	(34)	<1	(33)
Huntington's chorea	<1	(126)	<1	(344)	<1*	(119)	<1*	(54)	<1	(13)	<1*	(3)
Conjunctivitis	<1	(72)	<1	(265)	<1	(163)	<1	(71)	<1	(29)	<1	(16)
HIV infection	<1	(52)	<1	(147)	<1	(59)	<1	(31)	<1	(7)	<1	(9)
Sexually transmitted diseases	<1	(24)	<1	(96)	<1	(66)	<1	(29)	<1	(12)	<1	(9)
Tuberculosis (active)	<1*	(52)	<1	(99)	<1	(45)	<1	(12)	<1	(4)	<1	(1)

Note. * Significant difference from the reference group (normal BMI (18.5-24.9 kg/m^2)) ($p \leq 0.001$).

Appendix 3

Activities of Daily Living (ADL) Self Performance of Persons Newly Residing in a Long-term Care Facility by Obesity Status (N=350,348), 2010-2020

			<or ≥ 30 kg/m^2			
Activity Daily Living Self Performance	Total (100%, N=350,348)		<30 kg/m^2 (81%, n=283,840)		≥ 30 kg/m^2 (19%, n=66,508)	
	%	(n)	%	(n)	%	(n)
Bed Mobility						
Independent	32	(110,464)	32^	(90,220)	30	(20,244)
Supervision	9	(32,377)	9^	(26,544)	9	(5,833)
Limited Assistance	16	(57,308)	16^	(46,742)	16	(10,566)
Extensive Assistance	34	(118,820)	33	(94,969)	36^	(23,851)
Total Dependence	9	(31,201)	9	(25,238)	9	(5,963)
Did not Occur	<1	(178)	<1	(127)	<1	(51)
Transfer						
Independent	23	(79,462)	23^	(64,823)	22	(14,639)
Supervision	12	(40,830)	12	(33,196)	11	(7,634)
Limited Assistance	18	(63,132)	18	(51,582)	17	(11,550)
Extensive Assistance	32	(111,117)	32	(89,963)	32	(21,154)
Total Dependence	15	(53,621)	15	(42,453)	17	(11,168)
Did not Occur	1	(2,186)	1	(1,823)	1	(363)
Walking in Room						
Independent	27	(95,749)	27^	(77,895)	27	(17,854)
Supervision	15	(52,811)	15^	(43,066)	15	(9,745)
Limited Assistance	12	(43,375)	13^	(35,618)	12	(7,757)
Extensive Assistance	8	(29,728)	9^	(24,584)	8	(5,144)

Total Dependence	1	(2,144)	1^	(1,839)	<1	(305)
Did not Occur	36	(126,541)	36	(100,838)	39^	(25,703)
Walk in Corridor						
Independent	23	(80,216)	23^	(65,311)	22	(14,905)
Supervision	17	(59,881)	17^	(48,945)	16	(10,936)
Limited Assistance	12	(41,444)	12^	(34,280)	11	(7,164)
Extensive Assistance	8	(27,328)	8^	(22,627)	7	(4,701)
Total Dependence	1	(2,133)	1^	(1,813)	<1	(320)
Did not Occur	40	(139,346)	39	(110,864)	43	(28,482)
Locomotion on unit						
Independent	27	(94,860)	26	(75,136)	30^	(19,724)
Supervision	19	(65,940)	19	(53,542)	19^	(12,398)
Limited Assistance	14	(49,297)	14^	(40,139)	14	(9,158)
Extensive Assistance	18	(63,123)	18	(51,106)	18	(12,017)
Total Dependence	19	(64,987)	19^	(53,935)	17	(11,052)
Did not Occur	3	(12,141)	4^	(9,982)	3	(2,159)
Locomotion off unit						
Independent	17	(58,192)	16	(44,953)	20^	(13,239)
Supervision	16	(57,709)	16	(46,782)	16	(10,927)
Limited Assistance	12	(42,613)	12^	(34,687)	12	(7,926)
Extensive Assistance	14	(49,172)	14	(39,598)	14^	(9,574)
Total Dependence	18	(64,091)	19^	(52,781)	17	(11,310)
Did not Occur	22	(78,571)	23^	(65,039)	20	(13,532)
Dressing						
Independent	8	(27,582)	8	(22,038)	8	(5,544)
Supervision	7	(25,128)	7	(20,618)	7	(4,510)
Limited Assistance	22	(77,539)	22	(62,650)	22	(14,889)
Extensive Assistance	47	(165,877)	47	(133,497)	49^	(32,380)

Total Dependence	15	(53,935)		16^	(44,792)		14	(9,143)
Did not Occur	<1	(287)		<1	(245)		<1	(42)
Eating								
Independent	34	(120,365)		33	(93,823)		40^	(26,542)
Supervision	42	(147,032)		42	(118,105)		43^	(28,927)
Limited Assistance	10	(34,707)		10^	(29,252)		8	(5,455)
Extensive Assistance	8	(27,998)		9^	(24,648)		5	(3,350)
Total Dependence	6	(20,050)		6^	(17,831)		3	(2,219)
Did not Occur	<1	(196)		<1^	(181)		<1	(15)
Toilet								
Independent	14	(48,338)		14	(38,990)		14^	(9,348)
Supervision	8	(27,476)		8^	(22,504)		7	(4,972)
Limited Assistance	18	(63,831)		18	(51,864)		18	(11,967)
Extensive Assistance	42	(146,084)		42	(117,806)		43^	(28,278)
Total Dependence	18	(63,865)		18^	(52,025)		18	(11,840)
Did not Occur	<1	(754)		<1^	(651)		<1	(103)
Personal Hygiene								
Independent	8	(26,726)		7	(20,996)		9^	(5,730)
Supervision	8	(28,031)		8	(22,792)		8	(5,239)
Limited Assistance	21	(75,303)		21	(60,962)		22	(14,341)
Extensive Assistance	45	(159,115)		45	(128,058)		47^	(31,057)
Total Dependence	17	(61,036)		18^	(50,923)		15	(10,113)
Did not Occur	<1	(137)		<1	(109)		<1	(28)
Bathing								
Independent	1	(3,769)		1	(2,957)		1	(812)
Supervision	3	(11,714)		3	(9,445)		3	(2,269)
Limited Assistance	6	(20,941)		6	(16,781)		6	(4,160)
Extensive Assistance	48	(169,726)		48	(135,949)		51^	(33,777)

Total Dependence	37	(129,470)	38^	(106,651)	34 (22,819)
Did not Occur	4	(14,728)	4	(12,057)	4 (2,671)

Note: ^ Significantly larger when comparing obese and non-obese groups ($p<0.05$)

Appendix 4

Activities of Daily Living (ADL) Self Performance of Persons Newly Residing in a Long-term Care Facility by Body Mass Index (N=350,348), 2010-2020

Activity of Daily Living Self-performance	Body Mass Index (BMI) Category											
	Underweight (11%, n=38,671)		Normal (42%, n=146,224)		Overweight (28%, n=98,945)		Class I (12%, n=41,279)		Class II (4%, n=14,789)		Class III (3%, n=10,440)	
	%	(n)	%	(n)	%	(n)	%	(n)	%	(n)	%	(n)
Bed Mobility												
Independent	26*	(10,032)	32	(46,711)	34*	(33,477)	32	(13,170)	29*	(4,322)	26*	(2,752)
Supervision	8*	(3,099)	9	(13,683)	10*	(9,762)	9	(3,810)	8*	(1,249)	7*	(774)
Limited Assistance	17	(6,564)	16	(24,063)	16	(16,115)	16	(6,661)	16	(2,330)	15*	(1,575)
Extensive Assistance	37*	(14,463)	33	(48,745)	32	(31,761)	34*	(14,200)	37*	(5,468)	40*	(4,183)
Total Dependence	12*	(4,486)	9	(12,967)	8*	(7,785)	8*	(3,419)	10	(1,409)	11*	(1,135)
Did not Occur	<1	(27)	<1	(55)	<1	(45)	<1	(19)	<1	(11)	<1	(21)
Transfer												
Independent	17*	(6,470)	23	(33,528)	25*	(24,825)	23	(9,663)	21*	(3,090)	18*	(1,886)
Supervision	10*	(3,724)	12	(17,023)	13*	(12,449)	12	(4,997)	11	(1,609)	10*	(1,028)
Limited Assistance	19	(7,170)	18	(26,710)	18	(17,702)	18	(7,249)	17	(2,588)	16*	(1,713)
Extensive Assistance	35*	(13,724)	32	(46,493)	30*	(29,746)	31	(12,895)	33*	(4,843)	33	(3,416)
Total Dependence	18*	(7,080)	15	(21,633)	14*	(13,740)	15	(6,285)	17*	(2,579)	22*	(2,304)
Did not Occur	1*	(503)	1	(837)	<1	(483)	<1	(190)	1	(80)	1*	(93)
Walking in Room												
Independent	20*	(7,885)	28	(40,238)	30*	(29,772)	29*	(11,774)	26*	(3,777)	22*	(2,303)
Supervision	13*	(4,885)	15	(22,163)	16*	(16,018)	15	(6,332)	14	(2,138)	12*	(1,275)
Limited Assistance	13	(5,093)	13	(18,504)	12*	(12,021)	12*	(4,964)	11*	(1,671)	11*	(1,122)
Extensive Assistance	10*	(3,698)	9	(12,958)	8*	(7,928)	8*	(3,249)	8*	(1,158)	7*	(737)

Total Dependence	1	(348)	1	(964)	1	(527)	<1*	(192)	<1*	(62)	<1	(51)
Did not Occur	43*	(16,762)	35	(51,397)	33*	(32,679)	36	(14,768)	40*	(5,983)	47*	(4,952)
Walk in Corridor												
Independent	17*	(6,519)	23	(33,655)	25*	(25,137)	24	(9,853)	21*	(3,158)	18*	(1,894)
Supervision	14*	(5,270)	17	(25,317)	19*	(18,358)	18	(7,276)	16*	(2,362)	12*	(1,298)
Limited Assistance	12	(4,715)	12	(17,899)	12	(11,666)	11*	(4,694)	10*	(1,520)	9*	(950)
Extensive Assistance	9	(3,313)	8	(11,983)	7*	(7,331)	7*	(3,006)	7*	(1,045)	6*	(650)
Total Dependence	1	(304)	1	(954)	1	(555)	<1*	(203)	<1*	(66)	<1	(51)
Did not Occur	48*	(18,550)	39	(56,416)	36	(35,898)	39	(16,247)	45*	(6,638)	54*	(5,597)
Locomotion on unit												
Independent	20*	(7,639)	26	(38,403)	29*	(29,094)	29*	(12,160)	30*	(4,378)	31*	(3,186)
Supervision	15*	(5,727)	19	(27,620)	20*	(20,195)	20*	(8,185)	18*	(2,628)	15*	(1,585)
Limited Assistance	14	(5,436)	14	(20,825)	14	(13,878)	14	(5,799)	14	(2,028)	13*	(1,331)
Extensive Assistance	20*	(7,837)	18	(26,461)	17*	(16,808)	18	(7,286)	19	(2,765)	19	(1,966)
Total Dependence	26*	(9,984)	19	(27,931)	16*	(16,020)	16*	(6,648)	17*	(2,503)	18	(1,901)
Did not Occur	5*	(2,048)	3	(4,984)	3	(2,950)	3	(1,201)	3	(487)	5*	(471)
Locomotion off unit												
Independent	12*	(4,534)	16	(22,687)	18*	(17,732)	19*	(7,803)	20*	(3,011)	2*3	(2,425)
Supervision	12*	(4,694)	16	(24,104)	18*	(17,984)	18*	(7,298)	15*	(2,266)	13*	(1,363)
Limited Assistance	11*	(4,332)	12	(17,975)	13	(12,380)	12	(5,063)	12	(1,759)	11*	(1,104)
Extensive Assistance	15*	(5,808)	14	(20,485)	13	(13,305)	14	(5,860)	15	(2,208)	14	(1,506)
Total Dependence	24*	(9,145)	19	(27,269)	17*	(16,367)	17*	(6,881)	17*	(2,525)	18	(1,904)
Did not Occur	26*	(10,158)	23	(33,704)	21*	(21,177)	20*	(8,374)	20*	(3,020)	20*	(2,138)
Dressing												
Independent	6*	(2,252)	8	(11,249)	9*	(8,537)	8	(3,483)	8	(1,221)	8	(840)
Supervision	6*	(2,219)	7	(10,618)	8*	(7,781)	7	(3,000)	6*	(945)	5*	(565)
Limited Assistance	19*	(7,516)	22	(32,428)	23*	(22,706)	23*	(9,449)	22	(3,255)	21	(2,185)
Extensive Assistance	49*	(18,909)	47	(68,450)	47	(46,138)	48*	(19,761)	50*	(7,342)	51*	(5,277)

Total Dependence	20*	(7,737)	16	(23,340)	14*	(13,715)	13*	(5,559)	14*	(2,017)	15	(1,567)
Did not Occur	<1	(38)	<1	(139)	<1	(68)	<1	(27)	<1	(9)	<1	(6)
Eating												
Independent	28*	(10,745)	32	(47,200)	36*	(35,878)	38*	(15,774)	41*	(6,068)	45*	(4,700)
Supervision	39*	(14,895)	42	(60,794)	43*	(42,416)	44*	(18,192)	43*	(6,394)	42	(4,341)
Limited Assistance	12*	(4,505)	11	(15,577)	9*	(9,170)	9*	(3,524)	8*	(1,196)	7*	(735)
Extensive Assistance	12*	(4,745)	9	(13,087)	7*	(6,816)	6*	(2,289)	5*	(668)	4*	(393)
Total Dependence	10*	(3,745)	6	(9,476)	5*	(4,610)	4*	(1,491)	3*	(459)	3*	(269)
Did not Occur	<1	(36)	<1	(90)	<1	(55)	<1*	(9)	<1	(4)	<1	(2)
Toilet												
Independent	10*	(4,020)	14	(19,923)	15*	(15,047)	15*	(6,036)	14	(2,021)	12*	(1,291)
Supervision	6*	(2,414)	8	(11,789)	8	(8,301)	8	(3,239)	7*	(1,082)	6*	(651)
Limited Assistance	16*	(6,360)	18	(26,861)	19*	(18,643)	19	(7,684)	17	(2,585)	16*	(1,698)
Extensive Assistance	43*	(16,804)	41	(60,488)	41	(40,514)	42	(17,388)	43*	(6,374)	43*	(4,516)
Total Dependence	23*	(8,928)	18	(26,817)	16*	(16,280)	17*	(6,880)	18	(2,704)	22*	(2,256)
Did not Occur	<1*	(145)	<1	(346)	<1*	(160)	<1*	(52)	<1	(23)	<1	(28)
Personal Hygiene												
Independent	6*	(2,201)	7	(10,601)	8*	(8,194)	9*	(3,536)	9*	(1,294)	9*	(900)
Supervision	6*	(2,456)	8	(11,812)	9*	(8,524)	8	(3,460)	7	(1,104)	6*	(675)
Limited Assistance	19*	(7,280)	21	(31,380)	23*	(22,302)	22	(9,133)	21	(3,163)	20*	(2,045)
Extensive Assistance	46*	(17,845)	45	(65,812)	45	(44,401)	46*	(18,943)	47*	(7,023)	49*	(5,091)
Total Dependence	23*	(8,872)	18	(26,558)	16*	(15,493)	15*	(6,188)	15*	(2,200)	17*	(1,725)
Did not Occur	<1	(17)	<1	(61)	<1	(31)	<1	(19)	<1	(5)	<1	(4)
Bathing												
Independent	1	(300)	1	(1,464)	1	(1,193)	1	(507)	1	(179)	1	(126)
Supervision	2	(891)	3	(4,842)	4*	(3,712)	4*	(1,497)	3	(482)	3	(290)
Limited Assistance	5*	(1,862)	6	(8,647)	6	(6,272)	6	(2,648)	6	(946)	5	(566)
Extensive Assistance	43*	(16,772)	48	(69,669)	50*	(49,508)	51*	(21,101)	51*	(7,526)	49*	(5,150)

Total Dependence	44*	(17,127)	38	(55,271)	35*	(34,253)	34*	(13,860)	34*	(5,068)	37	(3,891)
Did not Occur	4	(1,719)	4	(6,331)	4	(4,007)	4	(1,666)	4	(588)	4	(417)

Note: * Significantly different from the reference group (normal BMI) $p<0.05$.

Appendix 5

Activities of Daily Living (ADLs) Assistance Provided to Persons Newly Residing in a Long-term Care Facility by Obesity Status (N=350,348), 2010-2020

Activity of Daily Living (ADL) Support Provided	Total		<or ≥ 30 kg/m^2			
	Total (100%, N=350,348)		<30 kg/m^2 (81%, n=283,840)		≥ 30 kg/m^2 (19%, n=66,508)	
	%	(n)	%	(n)	%	(n)
Bed Mobility						
No help	26	(91,750)	26^	(75,209)	25	(16,541)
Set-up help only	10	(36,597)	11^	(29,838)	10	(6,759)
One person assist	36	(124,427)	36^	(102,151)	33	(22,276)
Two + persons assist	28	(97,396)	27	(76,515)	31^	(20,881)
Did not occur	<1	(178)	<1	(127)	<1	(51)
Transfer						
No help	20	(68,390)	20^	(56,118)	18	(12,272)
Set-up help only	10	(36,189)	10	(29,278)	10	(6,911)
One person assist	36	(126,929)	37^	(104,055)	34	(22,874)
Two + persons assist	33	(116,654)	33	(92,566)	36^	(24,088)
Did not occur	1	(2,186)	1	(1,823)	1	(363)
Walk in Room						
No help	25	(85,932)	25^	(70,337)	23	(15,595)
Set-up help only	13	(46,489)	13	(37,487)	14^	(9,002)
One person assist	22	(76,343)	22^	(63,035)	20	(13,308)
Two + persons assist	4	(15,043)	4	(12,143)	4	(2,900)
Did not occur	36	(126,541)	36	(100,838)	39^	(25,703)
Walk in Corridor						
No help	22	(77,181)	22^	(63,225)	21	(13,956)
Set-up help only	13	(45,664)	13	(36,932)	13	(8,732)
One person assist	21	(73,002)	21^	(60,487)	19	(12,515)
Two + persons assist	4	(15,155)	4	(12,332)	4	(2,823)
Did not occur	40	(139,346)	39	(110,864)	43^	(28,482)
Locomotion on Unit						
No help	25	(86,353)	24	(69,298)	26^	(17,055)

Set-up help only	16	(54,972)	15	(43,644)	17^	(11,328)
One person assist	54	(189,118)	55^	(154,806)	52	(34,312)
Two + persons assist	2	(7,764)	2	(6,110)	2^	(1,654)
Did not occur	3	(12,141)	4^	(9,982)	3	(2,159)
Locomotion off Unit						
No help	15	(53,343)	15	(42,016)	17^	(11,327)
Set-up help only	11	(39,998)	11	(31,531)	13^	(8,467)
One person assist	49	(173,111)	50^	(141,120)	48	(31,991)
Two + persons assist	2	(5,325)	1	(4,134)	2^	(1,191)
Did not occur	22	(78,571)	23^	(65,039)	20	(13,532)
Dressing						
No help	6	(19,337)	5	(15,550)	6^	(3,787)
Set-up help only	7	(25,573)	7	(20,819)	7	(4,754)
One person assist	69	(240,063)	69^	(196,014)	66	(44,049)
Two + persons assist	19	(65,088)	18	(51,212)	21^	(13,876)
Did not occur	0	(287)	<1	(245)	<1	(42)
Eating						
No help	14	(49,558)	14	(38,512)	17^	(11,046)
Set-up help only	58	(202,103)	57	(160,659)	62^	(41,444)
One person assist	28	(97,152)	29^	(83,373)	21	(13,779)
Two + persons assist	0	(1,339)	<1^	(1,115)	<1	(224)
Did not occur	0	(196)	<1^	(181)	<1	(15)
Toilet						
No help	11	(38,978)	11	(31,665)	11	(7,313)
Set-up help only	7	(25,524)	7	(20,755)	7	(4,769)
One person assist	49	(170,215)	49^	(139,776)	46	(30,439)
Two + persons assist	33	(114,877)	32	(90,993)	36^	(23,884)
Did not occur	0	(754)	<1^	(651)	<1	(103)
Personal Hygiene						
No help	5	(17,032)	5	(13,537)	5^	(3,495)
Set-up help only	8	(29,264)	8	(23,545)	9^	(5,719)
One person assist	68	(237,526)	68^	(194,377)	65	(43,149)
Two + persons assist	19	(66,389)	18	(52,272)	21^*	(14,117)
Did not occur	0	(137)	<1	(109)	<1	(28)
Bathing						
No help	1	(2,731)	1	(2,149)	1	(582)
Set-up help only	3	(11,931)	3	(9,538)	4^	(2,393)

One person assist	61	(215,119)	62^	(175,975)	59	(39,144)
Two + persons assist	30	(105,838)	30	(84,121)	33^	(21,717)
Did not occur	4	(14,728)	4	(12,057)	4	(2,671)

Note. a) ^ Significantly larger when comparing obese and non-obese groups ($p<0.05$) . b) * Significantly different from the reference group (normal BMI, 18.5 - 24.9 kg/m^2).

Appendix 6

Activities of Daily Living (ADLs) Assistance Provided to Persons Newly Residing in a Long-term Care Facility by Body Mass Index (N=350,348), 2010-2020

Activity of Daily Living (ADL) Support Provided	Body Mass Index (BMI) Categories											
	Underweight (11%, n=38,671)		Normal (42%, n=146,224)		Overweight (28%, n=98,945)		Class I (12%, n=41,279)		Class II (4%, n=14,789)		Class III (3%, n=10,440)	
	%	(n)	%	(n)	%	(n)	%	(n)	%	(n)	%	(n)
Bed Mobility												
No help	22*	(8,363)	27	(39,041)	28*	(27,805)	26	(10,819)	24*	(3,505)	21*	(2,217)
Set-up help only	9*	(3,520)	10	(15,319)	11	(10,999)	11	(4,373)	10	(1,476)	9*	(910)
One person assist	39*	(15,044)	6	(53,034)	34*	(34,073)	34*	(14,128)	34*	(4,973)	30*	(3,175)
Two + persons assist	30*	(11,717)	27	(38,775)	26	(26,023)	29*	(11,940)	33*	(4,824)	39*	(4,117)
Did not occur	<1	(27)	<1	(55)	<1	(45)	<1	(19)	<1	(11)	<1	(21)
Transfer												
No help	14*	(5,510)	20	(29,218)	22*	(21,390)	20	(8,186)	17*	(2,548)	15*	(1,538)
Set-up help only	8*	(3,282)	10	(14,926)	11*	(11,070)	11*	(4,473)	10	(1,488)	9*	(950)
One person assist	39*	(15,008)	37	(54,006)	35*	(35,041)	35*	(14,425)	34*	(5,096)	32*	(3,353)
Two + persons assist	37*	(14,368)	32	(47,237)	31*	(30,961)	34*	(14,005)	38*	(5,577)	43*	(4,506)
Did not occur	1*	(503)	1	(837)	<1	(483)	<1	(190)	1	(80)	1*	(93)
Walk in Room												
No help	18*	(7,121)	25	(36,434)	27*	(26,782)	25	(10,403)	22*	(3,261)	18*	(1,931
Set-up help only	11*	(4,160)	13	(19,268)	14*	(14,059)	14*	(5,781)	13	(1,981)	12*	(1,240)
One person assist	23	(8,913)	22	(32,825)	22*	(21,297)	21*	(8,548)	20*	(2,903)	18*	(1,857)

Two + persons assist	4	(1,715)	4	(6,300)	4	(4,128	4	(1,779)	4	(661)	4	(460)
Did not occur	43*	(16,762)	35	(51,397)	33*	(32,679)	36	(14,768)	40*	(5,983)	47*	(4,952)
Walk in Corridor												
No help	16*	(6,247)	22	(32,742)	24*	(24,236)	23	(9,347)	20*	(2,934)	16*	(1,675)
Set-up help only	10*	(3,943)	13	(19,021)	14*	(13,968)	14*	(5,717)	13	(1,880)	11*	(1,135)
One person assist	21	(8,229)	22	(31,596)	21*	(20,662)	20*	(8,211)	18*	(2,702)	15*	(1,602)
Two + persons assist	4	(1,702)	4	(6,449)	4	(4,181)	4	(1,757)	4	(635)	4	(431)
Did not occur	48*	(18,550)	39	(56,416)	36*	(35,898)	39	(16,247)	45*	(6,638)	54*	(5,597)
Locomotion on Unit												
No help	18*	(6,921)	24	(35,671)	27*	(26,706)	26*	(10,822)	25	(3,738)	24	(2,495)
Set-up help only	12*	(4,695)	15	(22,361)	17*	(16,588)	17*	(7,097)	17*	(2,496)	17*	(1,735)
One person assist	62*	(24,110)	55	(80,151)	51*	(50,545)	51*	(21,235)	52*	(7,685)	52*	(5,392)
Two + persons assist	2	(897)	2	(3,057)	2	(2,156)	2	(924)	3*	(383)	3*	(347)
Did not occur	5*	(2,048)	3	(4,984)	3*	(2,950)	3*	(1,201)	3	(487)	5*	(471)
Locomotion off Unit												
No help	11*	(4,145)	15	(21,425)	17*	(16,446)	17*	(6,927)	17*	(2,507)	18*	(1,893)
Set-up help only	8*	(3,212)	11	(16,178)	12*	(12,141)	13*	(5,336)	12*	(1,848)	12*	(1,283)
One person assist	53*	(20,582)	50	(72,823)	48*	(47,715)	48*	(19,986)	48*	(7,136)	47*	(4,869)
Two + persons assist	1	(574)	1	(2,094)	1	(1,466)	2	(656)	2*	(278)	2*	(257)
Did not occur	26	(10,158)	23	(33,704)	21	(21,177)	20	(8,374)	20	(3,020)	20	(2,138)
Dressing												
No help	4*	(1,561)	5	(7,925)	6*	(6,064)	6*	(2,393)	6	(837)	5	(557)
Set-up help only	6*	(2,272)	7	(10,784)	8*	(7,763)	8	(3,120)	7	(1,027)	6*	(607)
One person assist	71*	(27,304)	69	(101,259)	68*	(67,451)	67*	(27,743)	66*	(9,786)	62*	(6,520)
Two + persons assist	19*	(7,496)	18	(26,117)	18	(17,599)	19*	(7,996)	21*	(3,130)	26*	(2,750)
Did not occur	<1	(38)	<1	(139)	<1	(68)	<1	(27)	<1	(9)	<1	(6)

Eating												
No help	11*	(4,127)	13	(19,341)	15*	(15,044)	16*	(6,629)	17*	(2,514)	18*	(1,903)
Set-up help only	51*	(19,796)	56	(82,178)	59*	(58,685)	62*	(25,389)	63*	(9,324)	64*	(6,731)
One person assist	38*	(14,531)	30	(44,044)	25*	(24,798)	22*	(9,116)	20*	(2,901)	17*	(1,762)
Two + persons assist	<1	(181)	<1	(571)	<1	(363)	<1	(136)	<1	(46)	<1	(42)
Did not occur	<1	(36)	<1	(90)	<1	(55)	<1	(9)	<1	(4)	<1	(2)
Toilet												
No help	9*	(3,293)	11	(16,189)	12*	(12,183)	12	(4,780)	11	(1,569)	9*	(964)
Set-up help only	6*	(2,214)	7	(10,835)	8*	(7,706)	7	(3,080)	7	(1,051)	6*	(638)
One person assist	50	(19,369)	49	(72,363)	49*	(48,044)	47*	(19,337)	45*	(6,724)	42*	(4,378)
Two + persons assist	35	(13,650)	32	(46,491)	31*	(30,852)	34*	(14,030)	37*	(5,422)	42*	(4,432)
Did not occur	<1	(145)	<1	(346)	<1	(160)	<1	(52)	<1	(23)	<1	(28)
Personal Hygiene												
No help	4	(1,430)	5	(6,784)	5*	(5,323)	5*	(2,204)	5*	(797)	5	(494)
Set-up help only	7*	(2,575)	8	(12,177)	9*	(8,793)	9*	(3,676)	8	(1,231)	8	(812)
One person assist	70*	(27,071)	69	(100,472)	68*	(66,834)	66*	(27,275)	65*	(9,545)	61*	(6,329)
Two + persons assist	20*	(7,578)	18	(26,730)	18	(17,964)	20*	(8,105)	22*	(3,211)	27*	(2,801)
Did not occur	<1	(17)	<1	(61)	<1	(31)	<1	(19)	<1	(5)	<1	(4)
Bathing												
No help	1	(212)	1	(1,089)	1	(848)	1	(373)	1	(126)	1	(83)
Set-up help only	2*	(930)	3	(4,895)	4*	(3,713)	4*	(1,548)	4	(543)	3	(302)
One person assist	61	(23,733)	62	(90,912)	62	(61,330)	60*	(24,839)	58*	(8,604)	55*	(5,701)
Two + persons assist	31*	(12,077)	29	(42,997)	29	(29,047)	31*	(12,853)	33*	(4,928)	38*	(3,937)
Did not occur	4	(1,719)	4	(6,331)	4	(4,007)	4	(1,666)	4	(588)	4	(417)

Appendix 7

Annual Rates of Multi-Morbidities Amongst Persons Newly Residing in a Long-term Care Facility (N=350,348), 2010-2020

Number of Conditions	Persons newly residing in s LTCF ***without*** **obesity** with the number of conditions (%)										
	Year										
	2010 (n=25,947)	2011 (n=25,840)	2012 (n=24,184)	2013 (n=24,817)	2014 (n=26,564)	2015 (n=28,227)	2016 (n=26,952)	2017 (n=27,226)	2018 (n=27,768)	2019 (n=26,790)	2020 (n=19,525)
0 Conditions	3	3	3	3	3	3	3	3	3	3	3
1	11	10	10	11	11	11	11	12	12	12	11
2	21	21	21	21	20	21	21	20	21	21	21
3	25	25	25	25	25	25	24	25	23	24	25
4	20	20	20	20	20	20	20	20	20	19	20
5+	19	20	21	20	20	20	20	19	19	19	20

	Persons newly residing in s LTCF ***with*** **obesity** with the number of conditions (%)										
	Year										
	2010 (n=5,630)	2011 (n=5,642)	2012 (n=5,397)	2013 (n=5,541)	2014 (n=5,963)	2015 (n=6,731)	2016 (n=6,678)	2017 (n=6,870)	2018 (n=6,975)	2019 (n=6,731)	2020 (n=4,350)
0 Conditions	3	3	3	3	3	3	3	3	3	3	3
1	10	8	8	9	9	10	9	9	9	10	9
2	19	17	17	18	19	18	19	18	19	19	18
3	24	25	24	26	25	25	24	23	23	24	25
4	20	23	22	20	21	21	21	22	21	21	21
5+	23	23	25	25	23	24	24	25	24	23	25

Note: a) Conditions considered: Hypertension, Dementia/Alzheimer's (combined), Arthritis, Diabetes Mellitus, Osteoporosis, Depression, Stroke, Heart disease (a combination of Arteriosclerotic heart disease (ASHD), Congestive Heart Failure, and 'Other Cardiovascular disease'), Emphysema/COPD, Anemia, Cancer, Asthma, Liver Disease, Hip Fracture.

Appendix 8

Independent Self Performance of Activities of Daily Living (ADLs) Stratified by Dementia/ Alzheimer's and Body Mass Index (BMI) for Persons Newly Residing in a LTCFs (N=350,348), 2010-2020

	With Dementia/ Alzheimer's (54%, n=190,415) Body Mass Index (BMI) Categories					
Activity of Daily Living Independent Self-Performance	Underweight	Normal	Overweight	Class I	Class II	Class III
	11%, n=20,976	45%, n=85,139	29%, n=55,233	11%, n=20,389	3%, n=5,827	1%, n=2,851
	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)
Eating	24* (5,029)	29 (24,842)	33* (18,158)	34* (6,956)	35* (2,042)	38* (1,083)
Dressing	5* (994)	7 (5,773)	7 (4,106)	7 (1,452)	7 (387)	7 (199)
Bed Mobility	26* (5.435)	34 (28,761)	37* (20,175)	35 (7,181)	32 (1,888)	31 (888)
Transfer	18* (3,756)	26 (22,170)	29* (16,029)	28* (5,657)	26 (1,497)	24 (671)
Locomotion on Unit	19* (4,064)	26 (22,511)	30* (16,405)	29* (5,943)	28 (1,646)	29 (826)
Locomotion off Unit	10* (2,120)	14 (11,654)	16* (8,635)	16* (3,200)	16* (936)	18* (501)
Walking In Room	22* (4,657)	31 (26,648)	35* (19,481)	35* (7,053)	33 (1,913)	31 (871)
Walking In Corridor	19* (3,923)	26 (22,363)	30* (16,462)	29* (5,932)	28 (1,601)	29 (730)
Toileting	10* (2.057)	14 (11,561)	15* (8,330)	15* (2,997)	14 (792)	13 (364)
Personal hygiene	4* (880)	6 (4,897)	6 (3,457)	6 (1,247)	6 (353)	6 (164)
Bathing	1 (132)	1 (752)	1 (562)	1 (214)	1 (67)	1 (21)

	Without Dementia/ Alzheimer's (46%, n=159,933)					
Activity of Daily Living Independent Self-Performance	Underweight	Normal	Overweight	Class I	Class II	Class III
	11%, n=17,695	38%, n=61,085	27%, n=43,712	13%, n=20,890	6%, n=8,962	5%, n=7,589
	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)
Eating	32* (5,716)	37 (22,358)	41* (17,720)	42* (8,818)	45* (4,026)	48* (3,617)
Dressing	7* (1,258)	9 (5,476)	10* (4,431)	10 (2,031)	9 (834)	8 (641)
Bed Mobility	26* (4,597)	29 (17,950)	30 (13,302)	29 (5,989)	27* (2,434)	25* (1,864)
Transfer	15* (2,714)	19 (11,358)	20* (8,796)	19 (4,006)	18 (1,593)	16* (1,215)
Locomotion on Unit	20* (3,575)	26 (15,892)	29* (12,689)	30* (6,217)	30* (2,732)	31* (2,360)
Locomotion off Unit	14* (2.414)	18 (11.033)	21* (9.097)	22* (4.603)	23* (2.075)	25* (1,924)
Walking In Room	18* (3.228)	22 (13.590)	24* (10.291)	23* (4.721)	21 (1,864)	19* (1,432)
Walking In Corridor	15* (2,596)	18 (11,292)	20* (8,675)	19* (3,921)	17 (1,557)	15* (1,164)
Toileting	11* (1,963)	14 (8,362)	15* (6,717)	15 (3,039)	14 (1,229)	12 (927)
Personal hygiene	7* (1,321)	9 (5,704)	11* (4,737)	11* (2,289)	10 (941)	10 (736)
Bathing	1 (168)	1 (712)	1 (631)	1 (293)	1 (112)	1 (206)

Note. a) * Significantly different from the reference group (normal BMI) of the stratified group ($p \leq 0.001$) b) U=Underweight, N=Normal, O=Overweight, I = Class I, II = Class II, III = Class II.