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Gender roles and physical function in old age

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RÉSUMÉ

Contexte : Les différences de fonctionnement physique entre les hommes et les femmes ne sont pas bien comprises. Les chercheurs ont porté attention aux différences biologiques entre les hommes et les femmes mais ne se sont pas concentrés sur les différences de fonctionnement physique et de mobilité qui pourraient être reliées au sexe et au genre. En particulier, les effets de la masculinité et de la féminité sur le fonctionnement physique des personnes âgées n'ont pas été examinés.

Objectifs : L'objectif principal de cette recherche est d'évaluer l'association entre fonctionnement physique et rôles de genre. Pour atteindre cet objectif, nous avons examiné : 1) la validité de la version courte (12 items) de l'Inventaire des rôles sexués de Bem (IRSB) ; 2) les associations transversales et longitudinales entre l'IRSB et des indicateurs de mobilité et de performance physique, et finalement 3) les variables jouant un rôle de médiation entre l'IRSB et la performance physique.

Méthodes : Les données de l'étude internationale sur la mobilité au cours du vieillissement (IMIAS) recueillies en 2012 et 2014 ont été utilisées dans cette recherche. Cette étude s'est déroulée dans 5 villes : Saint-Hyacinthe (Québec) and Kingston (Ontario) au Canada, Tirana (Albanie), Manizales (Colombie) et Natal (Brésil), avec un échantillon approximatif à chaque site de 200 hommes et 200 femmes âgés de 65 à 74 ans vivant dans la communauté (N=2004). Deux aspects du fonctionnement physique ont été examinés dans cette thèse : la mobilité et la performance physique. La mobilité a été mesurée par deux questions sur la difficulté à marcher un Km et à monter un étage d'escaliers. La performance physique a été objectivée par le Short Physical Performance Battery (SPPB). Cette batterie inclut des mesures de la marche, de

l'équilibre et de la force musculaire et elle mesure le temps requis pour exécuter trois tests : marcher quatre mètres, se tenir début en position de tandem et se lever d'une chaise cinq fois.

Pour la validation psychométrique de l'instrument IRSB, des analyses factorielles exploratoires et confirmatoires ont été réalisées. Pour les études d'associations transversales, des analyses de régression de Poisson ont permis l'estimation des ratios de prévalence pour les incapacités de mobilité et la mauvaise performance physique, comparant les rôles masculins, féminins et indifférenciés. Pour l'étude de l'incidence de la mauvaise performance physique, les estimations de risque relatif ont été obtenues à l'aide de la régression de Poisson. L'étude des variables de médiation entre les rôles de genre et la performance physique a inclus le tabagisme, l'inactivité physique, la consommation d'alcool, l'index de masse corporelle élevé, le nombre de maladies chroniques et la dépression. Finalement, une méta-analyse a été effectuée pour examiner l'homogénéité des associations entre les rôles de genre et la performance physique dans les cinq sites de recherche.

Résultats : Les résultats des analyses factorielles pour l'instrument de mesure IRSB ont révélé qu'une solution à deux facteurs (instrumentalité-expression) donne une validité conceptuelle satisfaisante, ainsi qu'un ajustement aux données supérieur par rapport à une solution à trois facteurs. La solution à deux facteurs permet d'assigner un score de masculinité et un score de féminité à chaque participant et de classifier les personnes âgées dans quatre catégories selon leur typologie de rôle de genre : masculin, féminin, androgyne et indifférencié. En ce qui concerne les associations avec les indicateurs de mobilité et de fonctionnement physique, les rôles féminins et indifférenciés sont des facteurs indépendants associés à la prévalence des incapacités dans la mobilité et à la mauvaise performance après ajustement avec des variables de confusion potentielle. Les rôles féminins et indifférenciés sont des facteurs de risque associés

à une détérioration plus rapide du fonctionnement des extrémités inferieures. Nous avons rapporté une incidence de mauvaise performance physique plus élevée pour ceux qui adoptent un rôle féminin (IRR ajusté=2.36, intervalle de confiance de 95% 1.55-3.60) ou le rôle indifférencié (IRR ajusté=2.19, 95% Intervalle de confiance de 95% 1.45-3.30) comparé au rôle androgyne. Le score de masculinité est associé à la performance physique, alors que le score de féminité ne l'est pas. Une augmentation d'une unité sur le score de masculinité est associée à une incidence de mauvais fonctionnement physique plus faible (IRR ajusté=0.76, 95% intervalle de confiance de 95% 0.67-0.87). Les rôles de genre agissent sur les comportements de santé (tabagisme et inactivité physique), sur l'index de masse corporelle et sur les maladies chroniques et la dépression, tous des facteurs de risque pour la performance physique. Les effets des rôles de genre ne sont que partiellement expliqués par ces facteurs de médiation et un effet direct des rôles de genre sur le fonctionnement physique reste toujours significatif.

Conclusion : Les rôles de genre sont présents dans tous les cinq sites de recherche. La mobilité et la performance physique des personnes âgées sont associées au type de rôle de genre avec un possible effet protecteur pour les personnes androgynes, indépendamment du fait qu'ils soient un homme ou une femme. Les rôles de genre semblent influencer les comportements de santé et les risques de développer une maladie chronique et de souffrir de dépression, ce qui peut avoir des effets sur la fonction physique au cours du vieillissement. Cette étude est la première sur le sujet et nos résultats devraient être confirmés par des études futures avant d'être traduits en interventions concrètes de santé publique.

Mots-clés : Masculinité, Femininité, Rôles de genre, Fonctionnment physique, Analyses longitudianles, Veuillissement

ABSTRACT

Background: Gender differences in mobility disability among older adults are not well understood. Studies have focused on the biological differences between men and women, but not on the mobility differences due to interrelationships of sex and gender. The associations between masculinity, and femininity on physical function in old age have never been examined.

Objective: The main objective of this dissertation is to study the relationships between physical function and gender roles in old age. To accomplish this objective, I have: 1) assessed the psychometric properties and construct validity of the 12-items short form Bem Sex Roles Inventory (BSRI), 2) examined the cross-sectional associations between BSRI and mobility and physical performance, and 3) examined mediating pathways between BSRI and physical performance.

Methods: A total of 2004 community-dwelling older adults from the International Mobility in Aging Study (IMIAS) aged 65 to 74 years were recruited in Natal (Brazil), Manizales (Colombia), Tirana (Albania), Kingston (Ontario, Canada), and Saint-Hyacinthe (Quebec, Canada). Two aspects of mobility loss will be assessed in this dissertation: first, Mobility disability is a self-reported measure of the difficulty to walk half a mile or climb one flight of stairs without assistance. Second, poor physical function or performance of the lower extremities which is assessed by an objective tool and defined as inability to perform physical action in the manner considered normal in the short physical performance battery (SPPB). This battery includes three timed tests of lower extremity function: a hierarchical test of standing balance, a four-meter walk, and five repetitive chair stands.

To assess the validity of BSRI in old age as a measure of gender roles. The psychometric properties of the 12- items short form BSRI were assessed by means of exploratory (EFA) and

confirmatory factor analysis (CFA). To assess the cross-sectional associations between gender roles and both measures of mobility loss, I used Poisson regression analysis to estimate prevalence rate ratios of gender role types using the androgynous type as reference category. To calculate the incidence of poor physical performance after two years of follow up, Poisson regression was conducted for the estimation of relative risks. Body mass index, smoking, alcohol consumption, physical activity, chronic diseases, and depression were tested as potential mediators in the pathway between gender roles and physical performance in old age. Finally, taking account the possible differences in associations between countries, I have conducted a meta-analysis to estimate overall effects of masculinity and femininity scores on physical performance based on five distinct studies representing each research site of IMIAS.

Results: The results of Exploratory Factor Analysis revealed a three-factor model. This model was further confirmed by CFA and compared with the original two-factor structure model. CFA results revealed that a two-factor solution (instrumentality-expressiveness) has satisfactory construct validity and superior fit to data compared to the three-factor solution. These factor analysis findings allowed to calculate scores of masculinity and femininity and classify participants into four categories according to gender roles: Masculine, feminine, androgynous and undifferentiated. Feminine and undifferentiated gender roles are independent risk factors associated with the prevalence of mobility disability and low physical performance in older adults. Consistent with cross sectional analysis, higher incidence of poor physical performance was observed among participants endorsing the feminine role or the undifferentiated role compared to the androgynous role. Higher masculinity but not femininity scores predicted good physical performance two years later. Gender roles predicted poor physical performance through statistically significant direct and indirect pathways. Cumulative smoking, BMI,

physical activity, multimorbidity, and depression were serial mediators explaining the indirect effect of gender roles on physical performance. These intermediate behavioral and pathological pathways only partially mediated the observed associations. None of the potential serial mediators in the present study could completely account for the association between gender roles and physical performance.

Conclusions: Traditional gender roles are existent in the five research sites of IMIAS. Gender roles influence physical function in old age with a possible protective effect of androgyny in old age independent of biological sex. Gender roles influence health behaviors which in turn contribute to chronic conditions and faster decline of lower extremities physical function. This study adds to the scant literature on this topic and the findings obtained from this dissertation need to be confirmed by future longitudinal studies for the appropriate translation into public health actions.

Keywords: Masculinity, Femininity, Gender roles, Physical function, Longitudinal analyses, Aging

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List of Acronyms

AIC	Akaike's Information Criteria
BCC	Browne-Cudeck Criterion
BSRI	Bem Sex Role Inventory
BSRI-M	Bem Sex Role Inventory – Masculinity scale
BSRI-F	Bem Sex Role Inventory – Femininity scale
CIHR	Canadian Institute of Health Research
CFA	Confirmatory Factor Analysis
CFI	Bentler Comparative Fit Index
EFA	Exploratory Factor Analysis
EPESE	Established Populations for Epidemiologic Studies of the Elderly
GFI	Goodness-of-Fit Index
GRO	Gender Role Orientations
HRS	Health and Retirement Study
IMIAS	International Mobility in Aging Study
NHANES	National Health and Nutrition Examination Survey
RMSEA	Root Mean Square Error of Approximation
SPPB	Short Physical Performance Battery
UNDP	United Nations Development Program
WHO	World Health Organization

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CHAPTER 1. INTRODUCTION

The number of older adults aged 60 years and older will almost double from approximately 12% to 22% of the world's population by 2050, and 80% of the older adult population will be living in low and middle-income countries (World Health Organization 2015). In Canada, for example, this age group will increase by 91 % between 2010 and 2030, but will then abate to 19 % between 2030 and 2050 (Reher 2015). This remarkable phenomenon of the older adult population worldwide will have social and economic consequences and is expected to be associated with higher levels of disabilities as a result of the aging process and chronic conditions.

Mobility in old age is the ability to move independently without help in one's environment that extends from an individual's home to the neighborhood, and to regions beyond (Webber, Porter et al. 2010). Mobility is fundamental to elderly autonomy, independence and high quality of life (Hirvensalo, Rantanen et al. 2000, Shumway-Cook, Ciol et al. 2005, Davis, Bryan et al. 2015). In Canada, approximately, 20.5 % of older adults who are 65 years and older report mobility disability (Statistics Canada 2013), while these prevalence estimates are much higher in low and middle-income countries (ranging from 27 % to 42%) (Mechakra-Tahiri, Freeman et al. 2012).

Mobility disability in community-dwelling older adults represents a preclinical transitional stage in the pathway to more severe disability. Meanwhile, as population aging is a striking phenomenon in both developed and developing countries and the baby boom generation grows old, mobility loss will remain a significant public health challenge in older adults for the foreseeable future (Siren and Hakamies-Blomqvist 2009). It is a predictor of falling, disability, hospitalization, long-term health care costs, social isolation and mortality, but it can also be postponed or reversed (Guralnik, Ferrucci et al. 2000, Hirvensalo, Rantanen

et al. 2000, Penninx, Ferrucci et al. 2000, Centers for Disease and Prevention 2003, Iezzoni 2003, van Kan, Rolland et al. 2009, McDermott, Liu et al. 2011).

Older women are substantially more likely to experience mobility limitations than men of the same age (Leveille, Penninx et al. 2000). Interestingly, the extent of difference in mobility disability between old men and old women varies across studies and locations worldwide (Ahacic, Parker et al. 2000, Leveille, Penninx et al. 2000, Avlund 2004, Orfila, Ferrer et al. 2006, Zunzunegui, Alvarado et al. 2009, Miszkurka, Zunzunegui et al. 2012). Several hypotheses have been formulated to explain these gender differences. However, they have not been thoroughly tested. The majority of studies compare men and women's prevalence or incidence of mobility disability without attempting to explain them. Others have hypothesized that differences in socioeconomic circumstances or differences in self-reporting are the primary explanation of those differences between men and women.

Men and women comparisons englobe sex (biological) and gender (social) differences between men and women, these are intermingled and cannot be easily disentangled. It is important to recognize that the social construction of gender in a given society depends on the historical time and geographical place. As an illustration, Ahacic has shown how mobility disability differences between men and women diminish in Sweden as the country moves towards gender equality(Ahacic, Parker et al. 2000). He wrote that gender equality leads to equal opportunities for education, occupations and salaries, and more freedom for women to choose their reproductive choices and health behaviors, such as leisure physical activity.

Gender differences in society are expressed through norms and values imposed by some societal institutions such as governments, family roles and traditions, religion, and mass media (Courtenay 2000). Through these socio-cultural factors, there is a power imbalance in

the relations of men and women which manifests itself in the social sphere, the gender division of labor and the relationships of men and women inside the family and the marital bond. As a result of power imbalance, women are more often confined to what is considered feminine roles and men are pushed into hegemonic masculinity roles (Courtenay 2000, Connell 2012).

These gender roles are socially and culturally assigned personality attributes and behaviors expected of women and men (Lindsey 2005). Within any society, some personality characteristics, behaviors, interests, and roles are thought of as masculine while others are feminine (Williams and Best 1982). In 1974, Sandra Bem (Bem 1974) developed the Bem Sex Role Inventory (BSRI) to measure masculinity and femininity, as personality traits that lead to acting to face daily life situations and expressing emotions respectively. She also proposed a typology or categories based on masculinity and femininity. Individuals who score high on masculinity and low on femininity are classified as 'masculine". Similarly, individuals are classified as "feminine" if they score high on femininity and low on masculinity. High scorers on both the masculinity and femininity scales are classified as "androgynous", while those scoring low on both are classified as "undifferentiated".

There is a body of literature suggesting the relationship between these gender roles and different health outcomes. In the current thesis, I review this literature and use data from The International Mobility in Aging Study (IMIAS), which is a prospective cohort study of non-institutionalized men and women aged between 65 and 74 years from five sites: Natal, Brazil, Manizales, Colombia, Tirana, Albania, Kingston and Saint-Hyacinthe respectively in Ontario and Quebec, Canada. To the best of my knowledge, this is the first study that allows assessing the potential contribution of gender roles toward understanding the relationship between gender and physical function in a large international sample of older adults. This study will

advance the current scarce literature on the role of these gender-related characteristics on physical function and subsequent disability in older adults, in addition to a well-established set of risk factors for functional decline.

This Ph.D. thesis comprises of six chapters including the current introduction, a review of the literature, the objectives of the study, the methods, the manuscript of three articles, two of which have been published and the third one is under review, and a discussion and conclusion section. These chapters are followed by a bibliography and appendices sections.

The introduction chapter provides the rationale for the present study. The review of the literature covers different aspects on the subject of the study and provides an overview of the previous literature relevant to this study with a focus on physical function in old age, assessed by physical performance and mobility disability, and gender roles. The objective chapter presents the specific objectives of this research project. The methodology chapter includes information on the source of data, study design, exposure, outcomes, confounding variables and mediators and statistical analysis. The results chapter describes the results of the three studies that were carried out to investigate the objectives. The first article of this dissertation examines the psychometric properties and the factor structure of the short form of 12 items of BSRI as a measure of gender roles among older adults. In the second article, the cross-sectional associations between gender roles and measures of physical function are reported. In the third article, the prospective associations between gender roles and incidence of poor physical performance after two years of follow-up and possible causal pathways for those associations are examined using mediation analyses.

Finally, the discussion chapter presents a discussion of the acquired results in relationship to the original objectives and hypotheses, the strengths, and limitations of this

thesis, and its public health implications given that gender stereotypes prevail in current times and societies. The discussion ends with recommendations for future research and an overall conclusion. The bibliography section contains all articles, books, and reports cited in this thesis.

CHAPTER 2. LITERATURE REVIEW

2.1 PHYSICAL FUNCTION AND MOBILITY IN OLD AGE

Physical function is the ability to perform an action or activity (Guralnik , Ferrucci et al. 1995). Two aspects of the limitations of physical function have been differentiated: restrictions associated with the upper extremity function (e.g., reaching up) and the lower extremity function (e.g., walking) (Lawrence and Jette 1996). Mobility in old age is the ability to move independently without help in one's environment that expand from one's home to the neighborhood, and to regions beyond (Webber, Porter et al. 2010). Mobility is considered as a functional outcome of critical importance to older people (Centers for Disease and Prevention 2003). It is an essential feature of human function, and it depends on the function of many systems of the body (musculoskeletal, joint, cardiovascular, vision, brain, and central nervous systems) (Rantakokko, Manty et al. 2013).

In the current thesis, two aspects of mobility loss will be considered: first, poor physical function or performance of the lower extremities which is assessed by an objective tool and defined as inability to perform physical action in the manner considered normal in the short physical performance battery (SPPB) (Guralnik , Ferrucci et al. 1995). Second, mobility disability, defined as the limitations in the ability to move in one's environment and resulting from the gap between the limitations of lower extremity physical function and the demands of the environment in which the older adult lives. Mobility disability is a self-reported measure of the difficulty to walk half a mile or climb one flight of stairs without assistance. It is a precursor of further functional decline and subsequent severe forms of disability (Guralnik, Ferrucci et al. 1995, Lawrence and Jette 1996, Dunlop, Hughes et al. 1997).

Self-reported mobility disabilities are common in old age. For instance, in a longitudinal study conducted in three regions of USA, the prevalence of mobility loss in older

adults aged over 65 was approximately 29.9% at baseline and 35 % of those who were mobile at baseline lost mobility after four years of follow-up (Guralnik, LaCroix et al. 1993). Data from The Health, Aging and Body Composition (Health ABC) study in the US show that 46% of the cohort developed mobility limitations over 6.5 years of follow-up in elderly aged between 70-79 years (Koster, Patel et al. 2008). Analyses of data from the British Regional Heart Study in a younger population aged between 52-73 years suggest that 10.5% of those who were mobile at baseline reported mobility limitation 4 years later, and of those who had mobility limitation at baseline (12.3% of total participants), 27.1 % reported recovery of mobility limitations 4 years later (Wannamethee, Ebrahim et al. 2005).

In Canada, the Canadian Disability Survey estimates prevalence of mobility disability, based on difficulty walking or climbing steps, of 14% in men and women aged 65 to 74 without gender differences; in this age group, these prevalence figures ranged from 10% to 22% in men and from 12 % to 21% in women across the 10 Canadian provinces (Statistics Canada 2013).

2.2 MOBILITY DISABILITY IN THE LATE LIFE DISABLEMENT PROCESS

Late life disablement is a complex, and dynamic process which takes place during the life course of an individual and it depends on the features of the society and culture to which this person belongs.

Several conceptual models have been proposed to examine this process (Nagi 1976, Organization 1980). In 1994, Verbrugge and Jette introduced innovations and extensions to previous works in their model called " The disablement process" (Verbrugge and Jette 1994). The principal pathways in the late-life disablement process are described as follows : Pathology (presence of chronic diseases and/or physiological changes affecting specific body

systems such as cognitive, or visions systems), leads to impairment (dysfunctions and structural abnormalities in specific body systems such as decreased muscle strength and balance or sensory impairments.), which in turn result in functional limitations (limitations in the performance of basic physical and mental tasks considered normal within a socio-cultural or physical environment), which then lead to mobility disability and further may result in difficulty in doing activities of daily living (ADL) (Guralnik and Simonsick 1993, Ostir, Carlson et al. 1999).

It is worth noting that mobility disability encompasses both contextual and physical function determinants, and is related to, but has a substantial unique difference from ADLs disability and instrumental activities of daily living (Rejeski, Ip et al. 2008). Over time, disability can affect some global outcomes such as quality of life or lead to downward-spiraling functions, development of new pathologies and their associated dysfunctions. Verbrugge and Jette demonstrated in their model that there are intra-individual and extra-individual factors that can play a role in delaying or speeding up the progression from pathology to functional limitations and consequently to disability. Intra-individual factors include behavioural and lifestyle factors such as smoking, leisure activities, and physical activity, psychosocial and coping attributes (e.g., self-efficacy, social engagement, and gender roles), and activity accommodation (changes in the kinds of activities, frequency, and length of doing them). Extra-individual factors include medical care & rehabilitation, therapeutic regimens, medications, social networks and personal assistance, adaptive equipment, structural modifications at the job, home, and public transportation. Because mobility disability is a preclinical transition stage to ADLs and instrumental activities of daily living disability, a full understanding of its risk factors is potentially useful for better understanding of the

disablement process. This knowledge can be used to guide prevention of more severe disability.

2.3 RISK FACTORS OF MOBILITY DISABILITY IN OLD AGE

There are multiple determinants of the onset of mobility disability and recovery from disability in old age. These factors span over the life-course of an individual during childhood, adulthood, and old age. **They range from demographic and socioeconomic characteristics, health behaviors, chronic physical and mental conditions through physiological factors to psychosocial and physical characteristics of the environment** (Webber, Porter et al. 2010). Demographic factors include age and sex and marital status. Socioeconomic factors are usually assessed following the Weberian tradition by the social class indicators of education, occupation and income or wealth. Health inequalities based on social class differences are amenable to intervention by public policies towards equality. Individual health behaviors include smoking, alcohol drinking, and physical activity. Individual health behaviours are constructed and formed throughout the life course and are amenable to modification, and hence have also the potential for intervention. Physiological factors are related to the progression of chronic diseases such as oral conditions, vision impairment and eye diseases, depression, obesity, and additional age-related chronic conditions such as diabetes, lower extremity peripheral arterial disease, musculoskeletal diseases, hypertension, heart disease and chronic respiratory conditions. Elderly people who suffer chronic diseases are at higher risk of developing mobility limitations and are less likely to recover from mobility limitations. Better therapeutic and clinical management of chronic diseases may be useful in postponing the onset of mobility disabilities and promoting recovery. Psychosocial factors are defined as social conditions influencing individual psychological factors and vice versa (Theorell 2007). They

represent the inter-relationship between social (environment or context) and psychological (individual) factors; they are related to the social and cultural context in which the old person lives. Psychosocial factors include social networks, social engagement and social support, resilience and other personality traits such as gender roles. Environmental factors are related to the social and physical environment in which the older adult lives and include neighborhood characteristics such as neighborhood, social capital and socioeconomic status, physical barriers to mobility, and lack of personal safety due to crime. However, the mechanism by which some of these factors predispose to the onset of mobility disability is largely unclear. Understanding these factors will enable us to target suitable public health interventions to prevent or postpone mobility disability and promote recovery from these disabilities in elderly population.

2.3.1 Demographic factors

As people live longer, they are more likely to develop mobility limitations and disability (Ho, Woo et al. 1997, Tilvis, Lallukka et al. 1997). Around one-third to one-half of older adults aged 65 years and more are more likely to report mobility limitations, and these prevalence estimate increases dramatically with age (Leveille, Penninx et al. , Shumway-Cook, Ciol et al. 2005). An age gradient of the prevalence of mobility disability has been observed among older adults, being steeper in women compared to men (Leveille, Penninx et al. 2000).

Older women are expected to report more mobility limitations than men of the same age (Ahacic, Parker et al. 2000, Avlund 2004, Murtagh and Hubert 2004, Orfila, Ferrer et al. 2006, Zunzunegui, Alvarado et al. 2009, Miszkurka, Zunzunegui et al. 2012). Most of the reported studies aimed at explaining the differences between older men and women in

mobility disability without trying to distinguish between gender and sex. Older women with chronic conditions are more likely to report disabilities compared with men with the same conditions (Whitson, Landerman et al. 2010, Kingston, Davies et al. 2014). In Japan, men 90–99 years old exhibited higher functional abilities than 80–89-years old and centenarian respondents suggesting that males who live longer are physically healthier than their female counterparts (Freeman, Kurosawa et al. 2010). This supports the sex cross-over phenomenon described by Ohrui et al. (Ohrui, Yamada et al. 2004) suggesting that physically weaker men died at younger ages, and only the physically strongest men can survive to advanced old age while women continue to survive with more physical impairments (Case and Paxson 2005). Later on this chapter, I will review the studies reported in the literature aiming at explaining gender differences in physical function.

Marriage, whether living with children or not and not living alone, has been shown to decrease the risk of functional disability (Mor, Murphy et al. 1989, Waite and Hughes 1999). While, in some studies the benefits were only pronounced among men (Strawbridge, Camacho et al. 1993) or women (Avlund, Due et al. 2002). Living alone was associated with poor physical performance in old age (Sousa, Guerra et al. 2014).

2.3.2 Life course social and economic adversity

In a systematic review of nineteen studies, low childhood socioeconomic position contributed to poor physical capabilities among older adults in terms of grip strength, walking speed, chair and standing balance (Birnie, Cooper et al. 2011) . Childhood social and economic adversities were associated with low physical performance among older adults (Sousa, Guerra et al. 2014). Interestingly, the prevalence of poor physical performance in old age was higher in low-middle income countries compared to research sites from Canada

(Sousa, Guerra et al. 2014). Childhood hunger was associated with higher prevalence of mobility disability in older adults from Latin American countries (Alvarado, Guerra et al. 2007).

Education level was found to be a strong predictor of mobility disability in old age. In England, researchers explored the association between education level and mobility disability and recovery of disability (Jagger, Matthews et al. 2007). Findings from this study suggest that those with less than nine years' education had higher ADL and mobility disability prevalence and higher incidence and lower recovery of mobility disability. Data from three populations of the Established Populations for Epidemiological Study of the Elderly (EPESE) show that men and women with 0-7 years of educations were 65 % and 70 % at risk of developing incident mobility disability in later life compared to those with 12 or more years of schooling (Melzer, Izmirlian et al. 2001). However, education level did not have any significant effect on the recovery from mobility disability.

Low financial assets and poverty predict the onset of mobility limitation in elderly men and women (Nilsson, Avlund et al. 2011). Poor material wealth in terms of income and tenure was associated with functional decline in a population of non-disabled persons aged 75 years in Denmark (Avlund, Damsgaard et al. 2004). Increasing the monthly benefits from US federal cash transfer program is a significant and negative predictor of mobility limitations for single poor elderly (Herd, Schoeni et al. 2008). Other findings from studies conducted in Latin American countries suggest that inequality in income and educational attainment are the most important markers of socioeconomic status associated with group differences in mobility disability prevalence in old age (Melzer and Parahyba 2004, Alvarado, Guerra et al. 2007).

2.3.3 HEALTH BEHAVIOURS

2.3.3.1 Smoking

Cumulative former smoking has been shown to be associated with higher risk of decreased functional ability at the age of 75 years compared to never smoking (Stovring, Avlund et al. 2004). Current smoking was significantly associated with increased odds of mobility limitation (LaCroix, Guralnik et al. 1993, Wannamethee, Ebrahim et al. 2005). There was no significant difference in recovery rates between continuing smokers and long-term non-smokers, but those who stopped smoking in the last four years were least likely to report recovery (Wannamethee, Ebrahim et al. 2005).

2.3.3.2 Alcohol

Alcohol drinking, and perhaps wine-drinking in particular, is associated with lower mortality in old age (Tolvanen, Seppa et al. 2005). Being a Heavy drinker (LaCroix, Guralnik et al. 1993, Wannamethee, Ebrahim et al. 2005) or a former alcohol drinker (Koster, Penninx et al. 2007) were associated with a significant increase in the odds of developing mobility limitations (Wannamethee, Ebrahim et al. 2005). The association between alcohol consumption and mobility impairment was significantly higher among abstainers compared to moderate drinkers (Weyerer, Schaufele et al. 2009).

2.3.3.3 Physical activity

Positive influences of physical activity both on many chronic diseases and on the preservation of mobility are well documented. Regular physical exercise and moderate training has a positive effect on mobility (Pahor, Guralnik et al. 2014) and thereby improves independence and reduces falls (Ho, Woo et al. 1997, Wannamethee, Ebrahim et al. 2005,

Guidelines Group Hesse Pharmacotherapy Guidelines by Family Doctors for Family, Bergert et al. 2009). Low self-reported physical activity increased the risk of mobility limitations (Koster, Patel et al. 2008). Findings from a single-blinded randomized controlled trial in Finland show that among older people, a single individualized physical activity counseling session with a supportive phone contact every four months for two years had a positive effect on mobility. This association remained significant 1.5 years post intervention in those reporting difficulty in walking 2 km but not in those reporting difficulty in walking 0.5 km (Manty, Heinonen et al. 2009). Additionally, exercise and regular activity have been suggested to maintain mobility in people as they age (Buckwalter 1997). Older adult from the Chianti region in Italy who reported higher levels of physical activity in midlife had better mobility in old age than less physically active ones (Patel, Coppin et al. 2006). The impact of pet ownership on older adults and its associated health benefits has been well-documented (Serpell 1991, Raina, Waltner-Toews et al. 1999, Thorpe, Kreisle et al. 2006). A cross-sectional and longitudinal analysis of a prospective cohort in the US indicated that the mobility advantage of elderly dog ownership was seen only among those who are dog walkers for at least three times per week and was similar to that associated with any walking (Thorpe, Simonsick et al. 2006). The relative importance of physical activity programs in old age has been reported from the findings from the LIFE study randomized clinical trial (Pahor, Guralnik et al. 2014). A structured, moderate-intensity physical activity program compared a health education program, predicted lower risk of mobility disability among older adults at risk of disability.

2.3.4 Chronic diseases

Multiple chronic conditions are associated with greater likelihood of mobility disability in older adults (Quinones, Markwardt et al. 2016, Yokota, Van der Heyden et al. 2016), and reduced odds of recovery of mobility limitation (Wannamethee, Ebrahim et al. 2005). Around Sixty-seven percent of adults over age 50 years have multiple and simultaneously occurring chronic conditions, which increase with age, from 50% for persons under 65 years old years to 62% for those aged 65-74 years and 81.5% for those aged ≥85 years (Salive 2013). The odds of developing mobility limitation adjusted for age and comorbidities increased with increasing number of chronic diseases (Wannamethee, Ebrahim et al. 2005). Findings from this study suggest that cardiovascular disease, diabetes, chronic obstructive airway disease, arthritis, breathlessness, and leg pain were strongly associated with developing mobility limitation (after adjustment for each of the other diseases and symptoms). By contrast, no association was observed with cancer, history of hypertension, or the other diseases group after adjustment.

Data are from 2,920 men and women, 70-79 years, participating in the Health ABC study without mobility limitations at baseline demonstrated that those experiencing metabolic syndrome components (dyslipidemia, abdominal obesity, insulin resistance, or hypertension) are 46 % more likely to develop incident mobility limitations after 4.5 years of follow-up (Penninx, Nicklas et al. 2009). The risk increased when more metabolic syndrome components were present. African Americans who reported two or more medical conditions had higher odds of mobility limitation than those who reported one or fewer medical conditions (Thorpe, Clay et al. 2011). In a stratified analysis by sex, this association remained statistically significant but stronger among women (Whitson, Landerman et al. 2010, Thorpe, Clay et al. 2011).

Cross-sectional and longitudinal studies have associated diabetes with increased risk of disabilities in mobility and in instrumental and basic activities of living (Gregg, Beckles et al. 2000, Gregg and Caspersen 2005).

There is evidence on the role of lower extremity peripheral arterial disease on functional decline and mobility disability in old age (McDermott, Greenland et al. 2001, McDermott, Greenland et al. 2002, McDermott, Liu et al. 2004, McDermott, Guralnik et al. 2007). Participants from WALCS (Walking and Leg Circulation Study) with lower extremity peripheral arterial disease (PAD) with declining functional performance are at increased risk for later mobility loss (HR=3.5; p=0.002) (McDermott, Liu et al. 2011). Among women and men with PAD, findings suggest men may be at increased risk for adverse limb events compared with women (Hussain, Lindsay et al. 2016).

Results from Eleanor Simonsick and colleagues as part of the Health, Ageing and Body Composition study demonstrate mild subclinical hypothyroidism may delay the decline in functional mobility in elderly individuals (Simonsick, Newman et al. 2009).

Musculoskeletal diseases, and especially osteoarthritis conditions, are the most common pathologies that are the cause of pain in old age especially among women (Leveille, Fried et al. 2002) and are associated with worsening of physical function over time (Øiestad, White et al. 2016, Zambon, Siviero et al. 2016). Preliminary findings from the North Staffordshire Osteoarthritis Project (NorStOP) show that among participants aged 50 years and more, episodes of musculoskeletal pain speed the normal age-related decline in mobility. Individuals experiencing those episodes of pain do not return to the same levels of mobility as their pain-free counterparts (Muller, Thomas et al. 2011). Middle-aged persons who report a history of arthritis are more likely to develop mobility limitations as they enter old age

(Covinsky, Lindquist et al. 2008). Low back pain (LBP) and neck pain (NP) are common conditions in old age, leading to impaired functional ability and decreased independence (Hartvigsen, Christensen et al. 2004, Zarit, Griffiths et al. 2004). In a cross-sectional analysis from the 2004 Health and Retirement Study (HRS) among persons aged 50 and older, Subjects with pain develop the functional limitations classically associated with aging at much earlier ages (Covinsky, Lindquist et al. 2009). Thus, early diagnosis and management strategies for pain should be considered among elderly.

Maintenance of muscle mass is thought to contribute to mobility which impacts on quality of life in old age. However, results from different studies are not consistent. For instance, findings from a cross-sectional analysis of a population representative sample of elderly aged 70 years and more and living in United States, suggest that low muscle mass with or without high percentage of body fat were not associated with a greater likelihood of reporting functional limitations (Davison, Ford et al. 2002). Results from the Health, Aging, and Body Composition study shows that prevention of greater fatness in old age may decrease the loss of lean mass and maintain muscle quality and thereby reducing disability and mobility impairments (Koster, Ding et al. 2011). Loss of muscle strength as a result of normal aging is reported to impair functional ability. The annual change in stride length and grip strength also predicted disability in mobility and upper extremity function (Hirsch, Buzkova et al. 2012). Current research on the combination of obesity with poor muscle strength (dynapenic-obesity) suggests a potential additive effect of both components on poor functional status in old age (Visser 2011).

Older adults with a Body Mass Index (BMI), and waist circumference in the normal range may be less likely to develop functional limitations in old age. There is a body of

evidence showing that inappropriate eating patterns are linked to obesity (Torres and Nowson 2007), and is strongly associated with a future decline in mobility in old age. Early onset of obesity partially mediated through current BMI, low handgrip strength, impaired squatting, and running difficulties in middle age were significant predictors of incident walking limitation in old age among Finns (Stenhohn, Rantanen et al. 2007, Stenholm, Sainio et al. 2007).

Body mass index is a proxy of eating patterns (Soares and Macedo 2015). Early life Onset of overweight and obesity leads to an increased risk of mobility limitation among community-dwelling US adults aged 70-79 years (Houston, Ding et al. 2009). Those who reported weight change (i.e. weight gain or loss) after the age of 50 years were more prone to cardiovascular risk and consequently to mobility limitations later in life (Harris, Savage et al. 1997). Findings from The Health, Aging and Body Composition (Health ABC) longitudinal study suggest that overweight and obese old persons were at higher risk for mobility limitations (Koster, Patel et al. 2008). In France, findings from a large cross-sectional study suggest that obese older men and women (BMI between 30 and 35 kg/m2), were 60% more likely to have mobility limitations compared to those with a BMI between 23 and 27 kg/m2 (Larrieu, Peres et al. 2004). The risk is increased three times in those with BMI of 35 kg/m2 and higher. In men only, being underweight with BMI less than 21 kg/m2 was associated with two times greater risk of mobility limitation. In overweight women (BMI between 27 and 30 kg/m2) the risk of mobility limitations increased by 30%. In a study of twin sisters, genetic predisposition to higher BMI across middle age increased the risk for poorer mobility in old age (Ortega-Alonso, Sipila et al. 2009). Findings from a prospective cohort in the UK suggest that in men with mobility limitation, those who gained weight (moderate and substantial

weight gain) were less likely to report recovery than those with stable weight (Wannamethee, Ebrahim et al. 2005).

Older adults with higher waist circumference as a proxy for abdominal obesity were approximately two times at risk of developing mobility limitations than those with low waist circumference in a large prospective cohort from Spain (Guallar-Castillon, Sagardui-Villamor et al. 2007). Thus, maintaining normal BMI and waist circumferences measures seems relevant for the prevention of mobility limitations in old age.

There is a body of evidence on the possible bidirectional relationship between cognitive and physical function in old age. Cognitive function is associated with the development of incident mobility impairment and physical function decline in community-dwelling elders (Wahl, Schmitt et al. 2010, Buchman, Boyle et al. 2011, Clay, Thorpe et al. 2015). Therefore, maintaining cognitive functions is essential for successful aging (Yaffe, Fiocco et al. 2009). Mobility limitations and physical function measured by gait speed, and balance are considered as an early predictor of cognitive decline and dementia in older adults (Verghese, Lipton et al. 2002, Ramakers, Visser et al. 2007, Verghese, Wang et al. 2007, Ursin, Bergland et al. 2015).

The association between depression and mobility limitation can be assumed to be causally reciprocal. Depression can increase the subsequent risk for physical disability and, in turn, physical disability results in increased depressive symptoms. African-American women who reported major depressive symptoms had nearly three times the odds of mobility limitation than those without major depressive symptoms. This association was slightly higher among men from the same cohort (Thorpe, Clay et al. 2011). Similar findings have been reported from Established Populations for Epidemiologic Studies of the Elderly (EPESE

study) and the Finnish Migrant Health and Wellbeing Study (Penninx, Leveille et al. 1999, Rask, Castaneda et al. 2015). Meanwhile, there is some evidence from longitudinal studies that reduced mobility and disability can increase the risk of depression in older adults (Dent, Waite et al. 1999, Lampinen and Heikkinen 2003).

Visual impairments are associated with mobility limitations in old age. In prospective analyses controlling for potential confounders from Established Populations for the Epidemiologic Studies of the Elderly study, participants with severe visual impairment had 3-fold higher odds of incident mobility and activity of daily living limitations than those with the acuity of 20/40 or better ($P < 0.001$) (Salive, Guralnik et al. 1994). Results from the same study indicate that those with poor vision were about half as likely to improve in function as those with better acuity, but this relationship was only statistically significant for improvement in mobility limitations. Few studies have examined the link between the type of visual impairment and mobility limitations. These studies found that glaucoma older adults or those with multiple aspects of visual impairments are more likely to report the highest mobility limitations (Popescu, Boisjoly et al. 2011, Swenor, Simonsick et al. 2015).

The association between poor oral health and mobility limitations has been studied. Findings from a cross-sectional analysis of a study carried out in Denmark indicate that poor oral health was inter-related to mobility disability in elderly aged 75 and 80 years respectively (Avlund, Holm-Pedersen et al. 2001). In another population-based study aged 60 years and older issued from NHANES survey, poor oral health, specifically edentulism and severe periodontitis, is associated with a lower extremity mobility disability (Yu, Lai et al. 2011). However, a causal relationship from both studies is not evident because of the cross-sectional

study designs and lack of known biological plausibility. These findings may be important if the focus is to promote a good healthy life in old age.

The serum concentration of interleukin 6 (IL-6), tumor necrosis factor [TNF]-α and C-Reactive protein (CRP) are measures of chronic inflammation and play a role in the aging process (Singh and Newman 2011). Elevated levels of IL-6 and tumor necrosis factor [TNF]-α contribute to functional decline and incident mobility disability in old age (Ferrucci, Harris et al. 1999, Ferrucci, Corsi et al. 2005, Vasunilashorn, Ferrucci et al. 2013). C-Reactive protein (CRP) is an independent predictor of cardiovascular disease (Padayachee, Rodseth et al. 2009). An elevated level of CRP may be an important indicator of risk for impairment, poor physical performance, as well as disability (Kuo, Bean et al. 2006, Sousa, Zunzunegui et al. 2016). Measurement of these inflammatory markers may be useful in identifying and targeting elderly individuals who may require intervention to prevent loss of function and disability (Yoshida, Iwasa et al. 2010, Vasunilashorn, Ferrucci et al. 2013, Sousa, Zunzunegui et al. 2016).

2.3.5 Psychosocial factors

2.3.5.1 Harm avoidance as a personality trait

Harm avoidance as a personality trait refers a tendency to worry, fear uncertainty, be shy, and tire quickly. Findings from the Rush Memory and Aging Project suggest that old persons with high levels of harm avoidance were nearly three times as likely to report mobility limitations compared to participants with low levels, and these effects mainly reflected fatigability and fear of uncertainty (Wilson, Buchman et al. 2006). There is some evidence of an association between these personality traits and physical function and indicate health behavior as an important intermediate pathway (Tolea, Terracciano et al. 2012).

2.3.5.2 Social networks and support

Berkman and colleagues have introduced a theoretical model that define concepts such as social networks, social engagement and social support (Berkman, Glass et al. 2000). Social networks form the web of social relations or ties that surround us. They are defined by their structure (number of ties, proximity of relationship) and function (frequency of contacts, reciprocity, duration). They can be further classified according to the nature or the particular role of the relationship (spouse, children, relatives, friends). Social engagement is defined as community involvement i.e. it results for the enactment of potential ties in real life activities such as getting together with friends, attending social functions or sports events, doing unpaid community or volunteer roles, attend church or religious activities. Social networks influence health status by providing many kinds of support such as instrumental and financial, or informational or through emotional or appraisal means. Thus, social support may exert a mediating role between the social network and health.

Most of the studies have focussed on later stages in the disablement process such as ADLs disability and instrumental activities of daily life disabilities (Mendes de Leon, Glass et al. 1999, Mendes de Leon, Gold et al. 2001, Zunzunegui, Rodriguez-Laso et al. 2005). However, limited data are available from longitudinal studies about the association between social relations and earlier onsets of disabilities and functional abilities. Examining the link between social relations and mobility limitations and recovery in persons who are mobile at baseline may elucidate the role of social relations in elderly populations.

Social relations may be related to decreased risk of mobility limitations and increased incidence of recovery of mobility limitations in elderly and in turn to less disability in late life. Possible mechanisms underlying the association between social relations and mobility decline in elderly are still largely unknown. First, functions of social networks and social engagement may reinforce meaningful social roles (Berkman, Glass et al. 2000) and purpose in life, thereby providing a sense of value, belongings, and attachment contributing to reduced risk of incident disability (Boyle, Buchman et al. 2010). Having a purpose in life refers to the sense that life has meaning and direction and that one's goals and potential are being achieved or are achievable (Boyle, Barnes et al. 2009). Greater purpose in life has been shown to be associated positive well-being dimensions (Zika and Chamberlain 1992). Thus, being embedded in strong social relations with the family, and friends in the community and having a purpose in life may provide motivation to maintain functional abilities in old age (Avlund, Lund et al. 2004). Second, benefits of social engagement in patients with osteoarthritis (joint pain and limited function) have been documented (Gignac, Backman et al. 2008, Wilkie and Peat 2008). Social engagement may act to increase the likelihood of practicing physical activities among elderly and thereby, may be able to reinforce muscle and joint functions in a way to postpone functional decline in late life. Findings from a longitudinal study of older persons in Chicago (Rush Memory and Aging Project) free of dementia and did not report mobility limitations at baseline, suggest that those who reported high level of social activity were 1.5 times more likely to remain free of mobility disability as compared to persons with low level of social activity after 5 years of follow-up (James, Boyle et al. 2011). This association did not vary significantly by age, sex, or education. However, in a stratified analysis, the authors indicated that beneficial effects of social engagement were stronger for men. Also, results from the same

longitudinal study suggest that elderly having a greater purpose in life were 39 % less at risk of developing mobility disability after 4.8 years of follow-up (Boyle, Buchman et al. 2010).

High social participation has been shown to decrease the risk of functional decline in the 75-year-old men and women, while instrumental social support was a risk factor for functional decline among the 80-year-old men (Avlund, Lund et al. 2004). C.J. Nilsson et al. have studied the combined effect of socioeconomic position and social relations on mobility limitations among old Danes (Nilsson, Avlund et al. 2011). Findings from this study suggest having low social participation was associated with higher odds for mobility limitations, and the effect was stronger among men. The combined effect of low social participation and low financial assets significantly increased the odds for the onset of mobility disability among both genders, yet the tendencies were stronger for men.

2.3.6 Neighborhoods and built environments factors

The mobility dimensions model portrayed by Patla and Shumway-Cook demonstrate that the characteristics of the neighborhood community and environment in which old people live and the extent to which these areas are safe and free from barriers to promote walking and physical activities might predict the onset of mobility limitations (Patla and Shumway-Cook 1999).

The association between neighborhood disadvantage and physical functioning or mobility disability beyond the impact of individual characteristics has been explored (Freedman, Grafova et al. 2008, Lang, Llewellyn et al. 2008, Beard, Blaney et al. 2009). Older people living in deprived neighbourhoods are significantly more likely to experience incident mobility difficulties than those in less deprived neighbourhoods while the mechanisms explaining these associations are still unclear. As the perception of neighborhood safety

improves, older adults are more likely to report lower odds of mobility limitations (McLeod 2016). Environments characterized by high crime rate are considered as barriers to physical activity among older adults (Glass and Balfour 2003). Lack of personal safety due to crime is frequent in many Latin American cities as reported by IMIAS participants in Manizales and Natal (Sánchez-González and Rodríguez-Rodríguez 2015). Shumway-Cook and colleagues reported that individuals with mobility disability were more likely to avoid physical challenges to mobility than non-disabled individuals i.e. busy streets, slippery surfaces, streets with traffic lights, stairs and uneven surfaces and going out in snowy weather (Shumway-Cook, Patla et al. 2003). There has been much progress in roads and street planning in developed countries to foster pedestrian safety compared to developing countries. These developments might have contributed to inequalities in mobility limitations between these countries. Future research might be able to take into consideration these factors.

2.4 SEX/GENDER INEQUALITIES IN MOBILITY DISABILITY IN EARLY OLD AGE

Gender refers to the array of socially constructed roles and relationships, personality traits, attitudes, behaviours, values, relative power and influence that society ascribes to the two sexes on a differential basis (CIHR 2010). Sex is a biological construct that refers to the biological differences between females and males and is distinct and not interchangeable with gender (Krieger 2003). Many studies have demonstrated that women have greater prevalence and incidence of mobility disability than men. The magnitude of these differences in mobility disability between old men and old women varies across studies and locations worldwide.

First, I will briefly summarize results from studies in elderly populations from high-income countries. In the US, data in elderly populations over 65 years from the Established

Populations for the Epidemiologic Studies of the Elderly (EPESE) in the New Haven site showed that more women (58.7%) than men (41.3%) reported gross mobility limitations defined as inability to perform any of the following tasks: heavy housework, walk half a mile, or walk up and down stairs *(Merrill, Seeman et al. 1997)*. Another analysis of data from 3 communities (East Boston, Iowa, New Haven) of the EPESE study showed higher prevalence of mobility disability (defined as inability to walk half a mile or walk up and down stairs) among women aged 65 to 74 (23%) compared to men (15.5%) *(Leveille, Penninx et al. 2000)*. The prevalence of mobility disability was also different across the three different sites among men and women in the same age category. Women had higher incidence of mobility disability and the differences in incidence rates of mobility disability between men and women were 3.5%, 8.7% and 2.7% at age 70, 80, and 90 respectively. Meanwhile, recovery rates from mobility disability were higher in men than in women across all age categories. Data from community-dwelling people aged 65 and over in Spain, suggest that men were more likely to report complete function than women (53.6 % vs. 44.7 %) after two years of follow-up *(Beland and Zunzunegui 1999)*. The prevalence of mobility disability (defined as any difficulty in picking up or carrying a shopping bag or any difficulty in climbing one flight of stairs or any difficulty in walking several city blocks) was again higher in women (58%) than in men (38.4%) in a representative cohort of Spanish population aged 60 years and more *(Guallar-Castillon, Sagardui-Villamor et al. 2007)*. Incidence data from the same cohort suggested that among those who were mobile at baseline, 43.3 % of women and 24.1% of men experienced mobility disability after two years of follow-up. In South Australia, baseline analysis of data from older adults ≥ 70 years old of the Australian Longitudinal Study of Ageing (ALSA) suggested that more women (5.2%) than men (2.7%) reported mobility

limitations defined as inability to walk up and down stairs to the second floor or walk half a mile without help *(Bannerman, Miller et al. 2002)*. In Canada, according to the 2012 Canadian Disability Survey, 6.2% of men and 8.2% of women older than 15 report mobility difficulty assessed by comparable questions on difficulty walking or climbing stairs. These figures reach to 14% in the age group 65 to 74 (Statistics Canada 2013).

Second, there are few studies conducted in low and middle income countries. In those studies, a larger gap in mobility disability between men and women is observed. The prevalence of mobility disability defined as having any difficulty walking 400 m without assistance was 51.7 % in women and 26.5% in men aged 50 and older in cross-sectional study conducted in Burkina Faso *(Onadja, Atchessi et al. 2013)*. Analysis of survey data from six Latin American and Caribbean cities showed that older women suffer more from mobility disability across cities (prevalence is 9.3—23.7% in older men, 23.3—42.9% in older women)*(Alvarado, Guerra et al. 2007)*. Similarly, women had higher prevalence of mobility difficulty than men aged 65 years and older in three West African countries (prevalence is 46—68% in men, 63—80% in women) *(Miszkurka, Zunzunegui et al. 2012)*. In Nigeria, Older women were more likely to report mobility disability than men (Prevalence rate ratio 1.60, 95 % CI 1.32–1.93, $P < 0.001$)(Balogun and Guntupalli 2016). Data from the World Health Survey (WHS) also suggest that the prevalence of mobility difficulty defined as the difficulty of moving around over the past 30 days was higher in women (38%) compared to men (27%) and the gender inequality in mobility difficulty was different by world region with largest inequality in the Eastern Mediterranean region and the smallest in the Western Pacific *(Mechakra-Tahiri, Freeman et al. 2012)*. Baseline analysis of data from the International Study of Mobility in Aging (IMIAS) in older adults between 65 and 74 years in 5 research

sites in Natal (Brazil), Manizales (Colombia), Tirana (Albania), Saint Hyacinthe (Quebec), and Kingston (Ontario) suggest that women compared to men had a statistically significant higher odds of mobility disability (defined as having difficulty in walking 400 meters or climbing a flight of stairs) in all research sites except in Kingston (Ontario) after controlling for age and occupation (Zunzunegui, Alvarado et al. 2015).

2.5 POSSIBLE EXPLANATIONS FOR SEX/GENDER INEQUALITIES IN MOBILITY DISABILITY

Several reasons for sex differences in physical function have been reported in the literature. Women generally live longer with greater functional limitations (Merrill, Seeman et al. 1997), which means they spend more years at risk of disabilities than men (Leveille, Resnick et al. 2000, Newman and Brach 2001), resulting in higher prevalence. It has been hypothesized that the greater prevalence among older women of osteoarthritis and musculoskeletal diseases, with their associated pain (Urwin, Symmons et al. 1998, Leveille, Fried et al. 2002) and depression (Forlani, Morri et al. 2013), may partly explain sex differences in mobility disability. Also, given the widespread use of conventional self-report tools for mobility assessment, differential reporting of mobility difficulty by men and women could contribute to the observed sex-based differences in mobility. These self-assessments can be improved by adding objective physical performance measures (Guralnik, Branch et al. 1989, Merrill, Seeman et al. 1997, Melzer, Lan et al. 2004)

The observed gender differences in physical function or mobility between men and women have been explained by gender inequalities that vary across times periods and world regions (Ahacic, Parker et al. 2000, Mechakra-Tahiri, Freeman et al. 2012, Onadja, Atchessi et al. 2013). These gender inequalities stem from social factors and behavioural responses that

depend on time and place. Social factors are expressed through norms and values imposed by a number of societal and cultural institutions, such as government laws, family roles and traditions, religion, and mass media, while behavioral responses are the expression of social norms and values through individual gender roles that contribute to health behaviors and psychosocial mechanisms such as low self-esteem, psychological distress, low decision making power, and low financial autonomy. Women in some societies lack power, do not enjoy equal rights and are more often exposed to economic adversities over the life course, domestic and gender violence and discrimination compared to men. Such factors may lead to physiological mechanisms and ultimately contribute to gender differences in mobility disability in old age.

Few studies have tested hypotheses to explain these gender differences. Part of the gender gap in physical function was explained by the lack of schooling, unskilled occupation, being a housewife, and lack of income and widowhood in women (Alvarado, Zunzunegui et al. 2008). However, in that study as well as in other similar studies conducted in other regions of the world (Lamb 1997, Onadja, Atchessi et al. 2013), lower socioeconomic status and economic resources of women do not completely explain the mobility gap between older men and women.

Women's experiences of violence during adulthood (including physical and sexual violence) were associated with functional limitations (Martin, Rentz et al. 2008). Older women who were exposed to intimate partner violence reported more frequently disability due to chronic diseases and mental disorders (Coker, Smith et al. 2005). Findings from the International Mobility in Aging study (IMIAS) suggest that exposure to physical violence at any point in life was associated with poor physical function and mobility disability in old age

(Guedes, Vafaei et al. 2016). For any given level of exposure to domestic violence women had higher risk of mobility disability than men. Meanwhile, the exposure to violence does not completely explain the mobility gender gap, even after controlling for all considered potential confounders. Older IMIAS adults who reported social adversities related to violence exposure in childhood were three times more likely to have low physical function (de Albuquerque Sousa, Guerra et al. 2014).

A third explanation is related to differences in reproductive history in women living in societies with varying degrees of gender equality. Lower physical performance has been observed in IMIAS's women who were younger at first birth and multiparous, two frequent factors among women living in poor and middle-income countries (Pirkle, de Albuquerque Sousa et al. 2014) that could also contribute to the varying mobility gap between older men and women. Up to the current knowledge, there has been no studies to examine the link between individual gender role orientation and measures of physical function in old age and whether these gender roles could explain partly gender difference in physical performance and mobility disability.

2.6 GENDER ROLE ORIENTATIONS

Gender role orientations (GRO) are defined as the social and cultural traits that different societies assign to males and females (WHO). They are not fixed and may change in geographical location and through historical times (Perry and Bussey 1979, Spence 1984). Moreover, they may influence the health of men and women throughout their life experiences (Annandale and Hunt 1990). These roles are conditioned by traditional social systems in which most men and women are expected to think and behave in relation to their socially

defined roles as "masculine" or "feminine" respectively ; however this is not always the case (Annandale and Hunt 1990).

Within each society, some personality characteristics, behaviours, attitudes, interests and roles are stereotyped as masculine while others are stereotyped as feminine (Williams and Best 1982). Masculinity is characterized by a cognitive focus on getting the job done and is related to instrumental behaviours and attitudes that are stereotyped as masculine such as aggressiveness, assertiveness, competitiveness and independence. Femininity is characterized by an affective concern for the welfare of others and is related to expressive behaviours and attitudes that are stereotyped as feminine such as submissiveness, dependence, deference, cooperation, caring and nurturing (Bem 1974, Williams and Best 1982).

Masculinity and femininity have long been conceptualized as opposite ends of a one-dimensional gender scale in which acting according one's own biological sex is advantageous (Gough 1952). This belief has been challenged by Constantinople (Constantinople 1973) who proposed a two-dimensional concept of gender in which masculinity and femininity are not two ends of a single scale, but rather, are best described as two independent dimensions on which individuals could be measured.

Sandra Bem (Bem 1974) built on Constantinople's conceptualization of masculinity and femininity as independent dimensions of gender role orientation with the development of an instrument known as BSRI (Bem's Sex Role Inventory). Bem referred to her inventory with sex roles because the term gender was relatively new at this time. It relies upon an individual's endorsement of a series of adjectives or characteristics on a scale from 1-- 'never or almost never true' to 7—'always or almost always true' which have been judged in USA to be culturally characteristic of either males or females.

Under the BSRI method, individuals are classified into one of four categories based on answers to a 60-item Likert-type scale comprised of three 20-item scales: Masculinity (BSRI-M), Femininity (BSRI-F) and Social Desirability. Individuals who score high on masculinity and low on femininity are classified as "masculine". Similarly, individuals are classified as "feminine" if they score high on femininity and low on masculinity. Individuals that score high on both masculinity and femininity are classified as "androgynous" and those scoring low on both are classified as "undifferentiated". Bem contended that androgyny is the best position of lifetime health because it offers an advantage of greater behavioural adaptability to the diverse situations a person may experience in daily life.

2.7 BSRI AND VALIDATION STUDIES

Bem has suggested a shorter version of BSRI (Bem 1981). Although many items have been omitted from the original BSRI because of either redundancy or low correlation with the corresponding scale, the masculine and feminine scales of the shorter BSRI were shown to be more internally consistent than those of original BSRI. The BSRI particularly the short form, has been widely used as a measure of gender role orientation among young students. Nevertheless, its construct validity for use among older adults to assess gender role orientation has not been established. Moreover, issues have been raised concerning its currency and validity across populations. The structure underlying responses to the BSRI has been investigated using various factor analysis methods.

A limitation, noted with respect to previous validity research, is that most of these studies have examined BSRI using exploratory factor analysis (EFA) approach. A meta-analysis of previous exploratory factor analysis studies indicate that with regard to feminine items, a single clean factor was most frequently reported while with the masculine items, there

were a tendency to observe two or three masculine factors (Choi and Fuqua 2003). This suggest that masculinity concepts may be more complex that those proposed by Bem. It has been well documented that there are several deficiencies associated the EFA approach to determine the validity of latent constructs/ concepts of a scale (factor validity)(Bollen 1989).

On the other hand, few confirmatory factor analysis (CFA) studies of the BSRI have been conducted. Implementation of CFA in validity studies is necessary because such methods test models that are falsifiable (Brown 2006). These CFA studies have yielded some contradictory results. For instance, among high school and university students from Australia, a two-factor model provided reasonable fit to the BSRI data (Marsh 1985), while findings from two samples of college and non-college participants in Midwestern state in US, suggested that a three factor model with one clean feminine factor and two complex masculine factors produced the best fit (Choi, Fuqua et al. 2009). Interestingly, results from a UK student sample demonstrated three factors too with a bipolar factor reflecting interpersonal sensitivity/dominance, a masculine factor reflecting personal agency, and a third factor indicating interpersonal expressiveness (Colley, Mulhern et al. 2009). Among 60 years old and older, a 2 factor model did not adequately fit the BSRI data (Windle and Sinnot 1985).

There has been several justifications for reasons behind existence of only two factors as Bem proposed or when more than two factors exist. Some researchers suggest that gender role orientations may vary across cultural settings or due to changes in the self-conceptions of gender roles over time in response to economic and political transitions. For instance, research findings from studies in US and Latin America suggest that stereotypes of women and women's self-perceptions had become more instrumental in line with their increasing participation in public roles (Diekman and Eagly 2000, Diekman, Eagly et al. 2005). Again,

the BSRI was developed to assess the extent to which culture's definitions of desirable females and male attributes are reflected in an individual's self-perception (Bem 1979). Therefore, we cannot exclude the possibility that North American respondents, upon which the BSRI originally was constructed, define masculinity and femininity concepts that are different from other populations. Other researchers suggest that the factor structure of BSRI may be more complex than what was proposed by Bem: masculine or feminine items split into two factors (Feather 1978, Ratliff and Conley 1981, Maznah and Choo 1986). This means that it may be inappropriate to define masculinity and femininity based on single factor when more than one factor represent them.

In 1991, Mateo and Fernández developed and tested a 12-items BSRI among a sample of university students from Madrid (Mateo and Fernández 1991). The validity of this 12-item BSRI has been demonstrated in pilot studies among Spanish and Brazilian older adults using exploratory factor analysis (Carver, Vafaei et al. 2013, Vafaei, Alvarado et al. 2014). All these previous researches have highlighted our need to study and assess the psychometric properties and construct validity the 12 item BSRI used in our study (6 items for Femininity and 6 items for Masculinity) across different research sites of IMIAS.

2.8 GENDER ROLE ORIENTATION AND HEALTH

Gender role orientation (GRO), along with the Bem Sex Role (BSRI) classification system, has been little used in health-related research. Empirical research findings on GRO and health suggest that, among men, ‘masculinity’ contributes to higher risk of chronic heart disease (CHD) mortality, while higher ‘femininity’ scores are associated with a lower risk of CHD death (Hunt, Lewars et al. 2007). Among men and women from the same study, ‘masculinity’ was negatively related to suicidal thoughts in early middle age, while

'femininity' was unrelated to serious suicidal thoughts at any age (Hunt, Sweeting et al. 2006). A small study of healthy middle-aged workers from Montreal, Canada, revealed that higher masculinity and female sex predicted increased physical complaints, with findings suggesting increased vulnerability to cardiovascular diseases (Juster and Lupien 2012). Higher femininity was associated with higher rates of recurrent acute coronary syndrome (ACS) and, among younger patients with ACS, with increased risk of hypertension, a family history of cardiovascular diseases, and depressive and anxious symptoms (Pelletier, Ditto et al. 2015, Pelletier, Khan et al. 2016). Androgynous gender roles (Vafaei, Ahmed et al. 2016) and higher masculinity scores (Price, Gregg et al. 2015) were associated with lower depressive symptoms in older adults.

Pain has been also linked to gender roles. A meta-analysis of thirteen studies showed masculinity was associated with higher pain threshold and pain tolerance, while femininity was associated with greater pain sensitivity response in healthy human participants. However, these results should be interpreted with caution given remarkable heterogeneity between studies (Alabas, Tashani et al. 2012). Among older adults, femininity was associated with greater pain perception in men and lower pain sensitivity in women (Campbell, Edwards et al. 2005).

Health services use is generally associated with being a woman. However, one study showed that both older men and women with increased masculinity visit health services more often (Sinnott, Rabin et al. 1986). Findings of a study among Tokyo metropolitan centenarians suggest that femininity is related to longevity and that androgyny may be related to successful aging (Shimonaka, Nakazato et al. 1996). None of the studies cited has examined the associations between gender roles and physical function in old age.

2.9 SUMMARY OF THE LITTERATURE AND STUDY RATIONALE

Women have higher prevalence and incidence of mobility disability than men. There are remarkable differences in the magnitude of these differences between men and women across countries. Gender differences in mobility disability among older adults have been observed in numerous studies, but they are not well understood. The majority of studies focused on describing and quantifying the differences in mobility disability between men and women but without examining and trying to understand the effects of gender or sex.

There is some existing literature demonstrating the link between gender roles and health outcomes. However, to the best of our knowledge, there have been no previous studies exploring the relationship between measures of gender roles and functional limitations in older adults. The remarkable increase in mobility disability onset among old women has highlighted the interest in whether mobility loss may be related to femininity and keeping mobile is related to masculinity.

CHAPTER 3. STUDY OBJECTIVES AND HYPOTHESIS

Using data from studies at different research sites of the population between 65 and 74 years of age, and based on the lack of literature on the possible link between gender roles and physical function in old age. I defined the following objectives and hypothesis.

- **GENERAL OBJECTIVE: To assess the relationship between masculinity and femininity and types of gender roles and measures of physical function in old age.**
  - **Hypothesis:** Gender gaps in mobility disability and physical performance in early old age can be explained by gender roles which act directly on mobility or indirectly through health behaviors, chronic conditions, and depression.
- **SPECIFIC OBJECTIVES:**

1. Examine the psychometric properties and the factor structure of the 12-items short form inventory of BSRI among older adults (Methods: Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) and how does the factor structure compare and contrast with Bem's conceptualization of masculinity and femininity).

- **Hypothesis:** 1- The BSRI is an internally consistent measure of gender role orientation. 2- The BSRI presents a factor structure of two dimensions which are masculinity and femininity as Bem proposed 3- The 12-item short form BSRI is a brief, robust, reliable, and psychometrically sound instrument in older adults.

2. Examine the cross-sectional relationship between gender roles and mobility disability and poor physical performance.

- **Hypothesis:** 1- Gender roles are associated with mobility disability and physical performance of the lower extremities in old age. 2- Compared to androgynous types, men and women who identify themselves with characteristics identified as ‘masculine’ have lower prevalence ratios of both mobility disability and low physical performance, while those

classified as ‘undifferentiated’ or ‘feminine’ have higher prevalence ratios. 3- The strength of associations between gender roles, mobility disability, and physical performance varies across societies.

3. To estimate the two-year incidence of poor physical performance according to gender roles and to examine mediating pathways related to health behaviors and chronic conditions.

- **Hypothesis:** Gender roles in men and women may contribute to health behaviors and chronic conditions that partly mediate the effects of gender roles on physical function in old age.

CHAPTER 4. METHODS

4.1 STUDY DESIGN

This research was conducted in the context of a 2010 grant by the Canadian Institutes of Health (grant number AAM 108751) on "Gender differences in mobility: what we can learn to improve mobility in old age." It involved the International Mobility in Aging Study (IMIAS). The IMIAS study was established in 2012 to investigate the effects of sex (biological), and gender (social roles, and identities) on the dynamics of mobility disability (prevalence, incidence, and recovery) in aging using a life course perspective and on the impact of potentially modifiable risk factors (Zunzunegui, Alvarado et al. 2015). This cohort is a longitudinal study that included 2004 non-institutionalized men and women aged between 65 and 74 years at baseline recruited between January and December 2012. Follow-ups phases were scheduled in 2014 and 2016. These participants were recruited from five sites: Natal, Brazil, Manizales, Colombia, Tirana, Albania, Kingston and Saint-Hyacinthe respectively in Ontario and Quebec, Canada. Below, I present contextual details of each site, with information about the local context affecting older adults.

Natal is the capital, and largest city the state of Rio Grande do Norte located in the northeast of Brazil. It has 862,044 inhabitants and is considered as one of the most deprived and in egalitarian provinces of Brazil ((IBGE) 2014). There was a major reorganization of the health system in Brazil in the early 1990s as a result of the 1988 constitution. Health has become a right of all citizens and a responsibility of the country (Victora, Matijasevich et al. 2010). Universal health care services are provided to the Brazilian population without user fees (Victora, Matijasevich et al. 2010). Never the less, about one-quarter of the population go for private insurance or out of private pocket providers to ensure easy access and because of

wide perception of their higher health care quality (Santos, Ugá et al. 2008, Victora, Matijasevich et al. 2010).

Manizales is a city and capital of Caldas and located in the Andean mountains of central Colombia. The city is the main production site of Colombian coffee and is considered as one of the affluent areas of the country. The city has 397,488 inhabitants. In Colombia, approximately 82% of adults over 60 years of age are covered under social security systems and subsidized public health programs (Gomez, Curcio et al. 2009).

Tirana is the capital and biggest city in Albania. It has around 700,000 inhabitants (30 % of the Albanian population). The capital is enjoying diversity regarding culture, religion, and income. Albania is an ex-communist country and one of the poorest countries in Europe. Albania has a universal health care system but primary health care and hospital care are underfunded. As of 2011, Albania was rated in the top ten countries of the world where people are emigrating compared to the total population (Vullnetari 2012). Since many of those migrating from the country bring with them their immediate families consisting of spouse and children, older generations are left behind, and they are more likely exposed to mental and physical health problems as they grow older (Ylli 2010).

Kingston and Saint-Hyacinthe are located in Canada. Canada has a universal health care system and primary care is the entry point. Kingston is a city in eastern Ontario, with approximately 123,363 inhabitants. The population is English- speaking and mostly Christian. Saint-Hyacinthe is a city in the province of Quebec, with nearly 50,000 inhabitants. The community of this city is mainly French-speaking and Catholic.

Table 1. Country basic statistics according to UNDP and WHO reports

Country basic statistics[1,2]							
	Population (millions)	**Life expectancy Men**	**Life expectancy women**	**Human Development Index**	**Gender equality rank**	**% women in Parliament**	**Per capita income**
Albania	2.8	75	81	0.716	45	21%	10260
Brazil	206	71	79	0.755	97	10%	11067
Canada	35	80	84	0.913	25	28%	42155
Colombia	48	71	78	0.72	92	21%	11000

1- These data were retrieved from the United Nations development programme website by searching for each country specific data http://www.undp.org and http://hdr.undp.org/en/composite/GII

2- These data were retrieved from the World Health organization website by searching for each country specific data www.who.int.

The selection of these cities for the IMIAS study was because of the relatively homogenous elderly populations regarding life opportunities, ethnicity, religion and national origins. Those cities are from countries that are aging very quickly and very little information is available on their aging population, except Canada. They represent societies that enjoy different gender inequality index. Table 1 present country specific characteristics according to the World Health organization and The United Nations Development Program recent reports in 2015.

The Gender Inequality Index (GII) is an index for measurement of imbalance in power and opportunities in life that was introduced in the 2010 Human Development Report 20th anniversary edition by the United Nations Development Programme (UNDP). According to the UNDP, this index is a composite measure which captures the loss of achievement within a country due to gender inequality. It uses three dimensions: reproductive health, empowerment, and labor market participation of women. The rank is calculated based on these three dimensions. Canada ranks 25th, Albania 45th, Brazil 97th and Colombia 92nd on the Gender Inequality Index published in 2015 ((UNDP) 2015). These positions can be used as approximations of the current national indicators of gender inequality for the participating cities. Moreover, they provide a wide range of gender-related exposure, mobility risk factors, and physical function outcomes. Thus, Canada is more egalitarian, followed by Albania, and then by Colombia and Brazil, sharing approximately the same position.

Recruitment and sampling

In Latin American and Albanian sites, participants were recruited randomly from registered citizens in neighborhood primary care centers, and interviewers contacted participants directly to invite them to participate in the study.

In Canadian sites, participants were recruited randomly, with replacement, from neighborhood family medicine clinics. Refusals were replaced by drawing another person from the sampling frame to replace the one who refused. Letters sent by family physicians to appropriate patients inviting them to contact the field coordinator for more information about the study. These procedures were done to comply with the ethics guidelines at Queen's University and the University of Montreal. In Saint-Hyacinthe, all patients came from the largest family medicine group clinic, with which more than 80% of physicians are affiliated

and which covers the whole territory of the city. In Kingston, the two clinics included in the study are large, covering the entire Central Kingston area. In Saint-Hyacinthe, the sample was stratified by neighborhood, which increased the representativeness of the study sample, while in Kingston such stratification was not possible.

In Canada, we had to use sampling with replacement but outside of Canada this was not necessary due to the large response rates in Latin American and Albanian sites (the response rates were close to 100 %). Approximately 30 % of those invited to participate in Canadian sites contacted the field coordinator to get information about the study, and 95% of them accepted the invitation. The research team expected that the response rate in Canadian sites would not be as high when compared to Latin American and Albanian sites, as suggested by existing literature (Helliwell, Aylesworth et al. 2001, Wong, Pelaez et al. 2006, Galea and Tracy 2007), mostly due to restrictions on direct access to participants.

In Saint-Hyacinthe, the sample of participants was representative of the community's older adult population as documented in the 2006 Canadian Census, regarding marital status, education, and income (Zunzunegui, Alvarado et al. 2015). In Kingston, participants are more highly educated than the community norm but are representative in terms of income and marital status (again, according to Canadian census data for Kingstonians, ages 65 to 74) (Appendix 5) (Zunzunegui, Alvarado et al. 2015).

Outside of Canada, samples were drawn at random, and the participation rate was higher than 90 % in all sites. There were no statistical differences in education or marital status between IMIAS participants and the census data in Manizales and Natal. We can conclude that our sample is more likely to represent the base population of these research sites (Appendix 6 and 7) (Zunzunegui, Alvarado et al. 2015).

4.2 PARTICIPANTS

A total of 2004 community-dwelling elderly people aged between 65 and 74 years were recruited in 2012. The sample was stratified by sex, consisting of approximately 200 men and 200 women from five research sites. Sample size calculations were performed assuming a baseline mobility disability prevalence ratio between men and women of 1.8, with a probability of type I error of 0.05 and a probability of type II error of 0.2 (Zunzunegui, Alvarado et al. 2015).

At baseline, potential participants were excluded if they had 4 or more errors in the Orientation Scale of the Leganes Cognitive Test (LCT) (De Yebenes, Otero et al. 2003), which was administered on initial contact. Low LCT score was considered indicative of an inability to meet the study requirements. Five people were excluded in Natal for this reason; that number was two people in Manizales, and one each in Saint-Hyacinthe and Tirana, and none in Kingston.

We used the cross-sectional data for article 1 and article 2, and longitudinal data for article 3. Thus, the sample sizes of empirical analysis differ.

Article 3 was based on both 2012 and 2014 data. This was done to estimate the incidence of poor physical performance. To qualify for this prospective analysis, I excluded: (1) the nine participants who had 4 or more errors in the Orientation Scale of the Leganes Cognitive Test (LCT) at baseline (De Yebenes, Otero et al. 2003), since they were considered to be unable to complete study procedures. (2) twenty-eight participants with any missing values on any of the BSRI scale items at baseline. (3) twenty-five participants who had missing physical performance measures at baseline. (4) Two hundred sixty-six participants who had a poor physical performance at baseline, defined by a score lower than 8 in the Short

Physical Performance Battery (SPPB). Among the 1676 participants who had a baseline SPPB score ≥8, N=37 died (2.21%) between 2012 and 2014, N=62 (3.7%) were lost to follow-up in 2014, and N=111 (6.62%) refused to participate in 2014 and 11 people had incomplete data in physical performance, leaving 1455 participants for whom complete data on both gender roles and physical performance were available. These participants served as the primary subjects for the analytical sample of this incidence research.

4.3 PROCEDURES

Responses to the IMIAS questionnaire were gathered through detailed structured face-to-face interviews that included a broad range of measures of demographic and socioeconomic variables, self-report of existing medical conditions, mobility and disability, medication inventory, life space assessment, health behaviours, quality of life and evaluations of physical performance of the lower extremities, grip strength, vision, cognitive function, depression and blood pressure. Fasting blood samples were collected at local hospitals for lipids, glucose, and inflammatory markers. All interviewers received standardized training at each site. All data collection procedures were carried out at the participants' homes, except in Manizales, where vision and physical performance tests were conducted at the local hospital. All procedures, including data collection documents and manuals, are available in local languages (English, French, Portuguese, Spanish and Albanian).

The IMIAS study was approved by the research ethics committees of the University of Montreal Hospital Research Centre (Canada), Queens University (Canada), the Albanian Institute of Public Health (Albania), University of Caldas (Colombia), the Universidad Federal do Rio Grande do Norte (Brazil).

A detailed informed consent has been provided for all participants in the baseline cross-sectional phase of the study (Appendix 1). As mentioned earlier, the use of two different recruitment methods was done to meet the requirements of the local ethical committees. It has been ensured that all respondents have enough information about the study before giving consents. They were informed that the study involves minimal risk and no risk to their physical or mental health.

The respondents were given assurance that the information they provide will remain confidential and that they have the possibility to withdraw from the study anytime. Personal identifying information will not be used while consolidating data for the purpose of statistical analysis or during the dissemination of results. Identifiable personal data such as names of individuals will not be entered in the database.

4.3 STUDY VARIABLES

4.3.1 Definition of Exposure

Gender role orientation. Gender roles were measured using the 12-item Short Form of the Bem Sex Role Inventory (BSRI), covering stereotyped traits. This tool was originally developed and tested among a sample of university students from Spain (Mateo and Fernández 1991). The validity of the 12-item BSRI has been demonstrated with Spanish and Brazilian older adults (Carver, Vafaei et al. 2013, Vafaei, Alvarado et al. 2014). The 'masculinity' and 'femininity' scores are each the **mean of six item ratings** (**'masculinity or instrumentality'** – has leadership abilities, acts like a leader, is dominant, has strong personality, defends own beliefs, makes decisions easily; **'femininity or expressiveness'**- tender, warm, affectionate, gentle, sympathetic, sensitive to others needs)

The median-split method recommended by Bem was used to dichotomize 'masculinity' and 'femininity' scores; thus, scores greater than or equal to the median score were classified as 'high', those with a score below the median as 'low'. This resulted in four distinct groups, depending on whether individuals scored higher or lower than the median on the 'masculinity' and 'femininity' scales: 'androgynous' [high 'femininity' score (F), high 'masculinity' score (M)]; 'masculine' [high M, low F]; 'feminine' [high F, low M]; or 'undifferentiated' [low M, low F] (Bem 1981) . We used the median value of each IMIAS research site to account for site-specific differences.

4.3.2 Definition of outcomes

4.3.2.1 Mobility disability

Mobility disability is self-reported difficulty in both walking 400 meters or climbing 10 stairs without resting. Both variables were coded into five categories from having difficulty to no difficulty at all (Nagi 1976). A person was considered mobility disabled if he or she reported any difficulty in any of these two tasks.

4.3.2.2 Poor physical performance

Physical performance was assessed using a battery of tests of lower extremity function, the Short Physical Performance Battery (SPPB). This objective measure is a strong predictor of mobility loss in older adults; individuals with low scores are more likely to suffer disability, hospitalizations, and mortality (Guralnik , Ferrucci et al. 1995, Keeler, Guralnik et al. 2010, Seidel, Brayne et al. 2011).

SPPB includes three timed tests of lower extremity function: a hierarchical test of standing balance, a four-meter walk, and five repetitive chair stands. For the

standing balance test, participants were instructed to maintain a bipedal stance in the tandem position for 10 seconds, followed by a semi-tandem stance for 10 seconds. The gait speed task involved timing a four-meter walk at the participants' normal pace. For those without a four-meter course in their home, a three-meter test was conducted and scoring adjusted accordingly. This test was repeated twice, with the faster of the two walks used. For the chair standing task, participants were first asked to demonstrate their ability to rise once from a chair. If they showed this ability, they have been invited to stand up and sit down five times as quickly as possible with their arms folded across their chests. Further details on administering these three tests have been published elsewhere (Guralnik, Simonsick et al. 1994, Guralnik, Ferrucci et al. 1995) and can be viewed on the SPPB website (http://www.grc.nia.nih.gov/branches/leps/sppb/index.htm).

Each of the three SPPB components (balance, gait, and chair stands) is scored from 0 to 4, with 0 indicating inability to perform the test, and 4 indicating the highest category of performance. A summary of participants' physical performance scores was obtained by adding up the scores of all three SPPB components for each participant. Total scores could thus vary from 0 to 12, with higher scores representing better physical performance.

The research team of IMIAS has validated SPPB in French, Spanish, and Portuguese during previous studies conducted in Quebec, Colombia, and Brazil (Freire, Guerra et al. 2012, Gómez, Curcio et al. 2013). For this study, poor physical performance was defined as a total SPPB score below 8 (da Camara, Alvarado et al. 2013, Zunzunegui, Alvarado et al. 2015).

4.3.3 Information on covariates

Age, sex, marital status, education, income, and study site were considered potential confounders for the association between gender roles and mobility disability in older adults. As people live longer, they are more likely to develop mobility limitations and disability (Guralnik, Lacroix et al. 1993, Ho, Woo et al. 1997, Tilvis, Lallukka et al. 1997). Since the IMIAS population ranges in age from 65 to 74 years, those who were older had greater life experience and belonged to earlier cohorts in their respective countries, which may have affected their personal views of gender role orientation.

Participants were asked if they were single, married, widowed, or divorced. Little is known about the association between gender roles and marital status, but there is a possible link between them. For instance, married men from Japan tended to have higher masculinity than unmarried men (Mori, Nakashima et al. 2002).

Socioeconomic status is associated with gender roles. Men and women with higher education levels and income endorse more egalitarian gender role orientations (Lackey 1989, Crompton and Lyonette 2005). Meanwhile, those endorsing traditional gender roles are characterized by low socioeconomic status (low income and education levels) (Bolzendahl and Myers 2004, Marks, Bun et al. 2009). We used education as a continuous variable to reduce residual confounding, since the mean years of schooling varied across sites. Sufficiency of income was self-reported using the following question: 'To what extent is your income sufficient to meet your ends?' The possible responses were very sufficient, sufficient, and insufficient.

Since IMIAS is carried out in five research sites with different cultural, political and economic backgrounds, adjustments were made by research sites in the multivariable models.

4.3.4 Information on mediators

We tested the mediation pathway between gender roles and poor physical performance using the following list of possible mediators: Body Mass Index (BMI), smoking status, alcohol consumption, physical activity, the number of chronic diseases, and depression status. Potential mediators were selected because they are recognized risk factors for poor physical function (LaCroix, Guralnik et al. 1993) and could be at least partly determined by gender roles.

BMI (weight(kg)/height (m^2)) was measured without shoes, using a stadiometer. Weight was measured using an electronic scale after removal of garments and shoes. We also used the World Health Organization categories: underweight (BMI <18.5), normal weight (BMI 18.5-24.99), overweight (BMI 25-29.99), class I obesity (BMI 30-34.99), and class II obesity and above (BMI ≥35).

Smoking status was assessed by categorizing participants as never smoker, former smoker and current smokers. We used also a measure of cumulative smoking over the past years. This variable was calculated as the number of cigarettes a participant smoked per day multiplied by the number years smoked.

Self-reported alcohol consumption was categorized into: 1-2 drinks/week, 3-4 drinks/week, and ≥5 drinks/week. A cumulative score of alcohol consumption over the past week was calculated using the number of days a participant drink per week multiplied by the average number of drinks per day. This score ranged from 0 to 30 with higher scores indicating heavy alcohol consumption.

Physical activity was assessed by the Mobility Assessment Tool-Walk (Marsh, Ip et al. 2011, Marsh, Janssen et al. 2015). Participants were asked to indicate using animated videos

the pace at which they typically walk if there is no rush to get somewhere (meter/second). The participants were then asked to indicate the number of days (0-7) over the past week in which they walked more than 10 minutes at this pace, along with the distance in meters they walked at this pace each day. From the previous question, we calculated the volume of walking per day at regular pace in kilometres over the past week. This variable was then transformed using a square root function to normalize the data (Marsh, Janssen et al. 2015).

Ongoing number of medical conditions were classified as a series of eight self-reported diagnoses which were hypertension, diabetes, lung diseases, cancer, stroke, heart diseases, arthritis, and osteoarthritis. The values of this variable ranges from 0 to 8. A categorical variable was created as presence of 0 or 1 as "no" and 2 or more diseases as "yes".

Depression symptoms were assessed by the Center for Epidemiologic Studies Depression Scale (CESD) (Radloff 1977), which has been previously translated from the original English version and validated in several IMIAS languages (English, French, Spanish, Portuguese) and has proven construct validity in IMIAS populations (Ylli, Miszkurka et al. 2016). The total scores range between 0 and 60. A categorical variable was created using a cut point of 16 or more which is recommended to screen for clinically relevant depression and used in our previous research (Ylli, Miszkurka et al. 2016).

4.4 STUDY POWER

There are no previous studies showing frequency values for gender role types by measures of physical function, but we have a sex-specific prevalence of mobility disability at the five different sites (ranging from 15 to 60 %).

First, we have assumed that prevalence in Canada reflect the prevalence of mobility disability in the androgynous types since Canada is the most sex-egalitarian society and a

culture that rewards androgynous behaviours, meaning behaviours that are both instrumental and emotional "gentle and receptive to the needs of others", as appropriate both for men and women. Although not exact, we have taken the average prevalence of mobility disability in Canadian subjects as a reflection of the mobility disability of the androgynous type (20%).

Second, we have the prevalence of mobility disability in the masculine type to be somewhat higher but not very different from the androgynous type (25%).

Third, we have assumed the prevalence of mobility disability in the women of Natal to reflect the prevalence of the feminine type (40%) since Natal represents the society with the stronger gender segregation out of the five research sites (Cardoso 2012).

Lastly, we have assumed that Albanian women could mirror the undifferentiated type (50%) since Albanian women have lived in a communist society with a Muslim tradition, characterized both by strong gender segregation with official equality between men and women.

We recognized that the research sites are not stereotypes of masculinity and femininity, but we expected to have different distributions of gender roles across sites which roughly correspond to the position of men and women in society as assessed by the United Nations Gender Inequality Index and similar indexes used in the international literature.

Power and sample size calculation were done using STATA 11 software and applying Bonferroni correction to have type I error of 0.017 based on multiple comparison tests of three different groups. Assuming equal distribution of population in the exposure group among men, we would have a power of 13.98 % to detect a prevalence difference of 5 % between masculine and androgynous groups, a power of 99.26 % to detect a prevalence difference of 20 % between feminine and androgynous groups, and a power of 100 % to detect a prevalence

difference of 30 % between undifferentiated and androgynous groups. Similarly, among women, we will have a power of 15.31 % to detect a prevalence difference of 5 % between masculine and androgynous groups, a power of 99.6 % to detect a prevalence difference of 20 % between feminine and androgynous groups, and a power of 100 % to detect a prevalence difference of 30 % between undifferentiated and androgynous groups. We have done power calculation assuming the unequal distribution of the population in the exposure group (30 % androgynous, 35 % masculine, 15 % feminine and 20 % undifferentiated) [Appendix 2].

4.5 STATISTICAL ANALYSES

4.5.1 Statistical methods, article 1

The preliminary statistical analysis was performed using SPSS 21. Participants with missing values on any item were excluded from the current analysis (n=45). The majority of those participants were from Manizales, Colombia (53.3%). They were not different from those included in the analysis in terms of age, sex, years of schooling, education level, occupation type, and income sufficiency.

For the purpose of this paper, the combined IMIAS population samples were randomly split into two datasets of approximately equal size a “training sample” (N=971) and a “holdout sample” (N=979).

Exploratory factor analysis (EFA)

EFA was conducted on the training sample. I performed Principle Component Analysis (PCA) which is of an exploratory nature to examine the link between the observed items and the latent constructs and to identify the factor structure (Tabachnick 2013). The inter-relationships between the BSRI inventory dimensions were assessed using Pearson correlation

coefficients. Identification of the potential number of factors was informed by Kaiser-Guttman rule of eigenvalues > 1, Cattell's scree plots, and parallel analysis (Kaiser 1960, Cattell 1966, Hayton, Allen et al. 2004). The internal consistency of BSRI dimensions was assessed using Cronbach's alpha reliability coefficient. Alpha values higher than 0.7 are considered acceptable (Tavakol and Dennick 2011).

Known group validity, which is the ability of the short form BSRI to distinguish participants of one group from another, was evaluated by comparing men and women using an independent t-test.

Confirmatory Factor Analysis (CFA)

The resulting model from EFA was confirmed on the holdout sample using CFA. This model was then compared with the original two-factor structure proposed by Bem. CFA was used to assess measurement models with respect to goodness of fit indices as well as convergent and discriminant validity.

Large and statistically significant factor loadings indicate that items associated with the same latent variables are highly inter-correlated, supporting convergent validity (O'Leary-Kelly and J. Vokurka 1998, Brown 2006, Kline 2011).

To assess discriminant validity, we used Chi-square difference testing to compare two models, one in which latent variables are correlated, and the other model in which they are not. Statistically significant differences in the Chi-square between the two models support discriminant validity (Segars 1997, Zait and Bereta 2011).

For these measurement models, we used Structural Equation Modeling (SEM) to assess relationships between factors and their observed measures using AMOS 19. First, I assessed the multivariate normality in the holdout dataset to determine the appropriate CFA

estimation method. Second, I employed the modification indices to measure the amount by which the overall model Chi-square would be reduced if a parameter that was previously fixed to zero was then estimated freely (Silvia and MacCallum 1988). Finally, the fit of the models was tested in the holdout sample, and for men and women.

I used AMOS 19 to assess the global fit of the models using fit statistics that possess different computational logic (Hoyle 2000). Six goodness-of-fit statistics were calculated which included Chi-square, goodness-of-fit index (GFI), Bentler Comparative fit index (CFI), root mean square error of approximation (RMSEA), Akaike's information criteria (AIC) and the Browne-Cudeck criterion (BCC).

It is generally accepted that a statistically non-significant Chi-square indicates a good model fit, while a statistically significant Chi-square suggest that the model has poor fit to data. However, the Chi-square test is sensitive to sample size, being almost always statistically significant in larger samples such as ours, which might erroneously suggest a poor fit (Schreiber, Nora et al. 2006). Therefore, other goodness-of-fit indices are recommended in addition to Chi-square.

GFI values close to 1 are indicative of good fit (Schreiber, Nora et al. 2006). Values for CFI around 0.90 are considered acceptable, whereas values around 0.95 suggest a good model fit (Bentler and Bonett 1980, Hu and Bentler 1999). RMSEA values below 0.05 indicate a good fit with values between 0.05 and 0.08 indicating a reasonable fit, those between 0.08 and 0.1 suggesting only a mediocre fit, and finally values greater than 0.10 indicating a poor model fit (Hu and Bentler 1999, Diamantopoulos and Siguaw 2000, Kahn 2006, Steiger 2007).

Afterwards, I compared the model resulting from EFA and the two-factor structure model of Bem. The AIC and the BCC were used as measures of the final model's likelihood of being replicated in other samples of a similar size and population (Hu and Bentler 1999, Byrne 2016). The model with the lowest values of both AIC and BCC is more likely to yield a good fit in other samples.

4.5.2 Statistical method, article 2

Data analysis was performed with the IBM Statistical Package for Social Sciences (SPSS) version 22.0 and with STATA version 11.0. We restricted our analyses to participants for whom no data was missing for any of the BSRI items or any of the covariates. Participants with missing values on any of the BSRI items (n=28) were not different from those included in data analyses in terms of age, sex, years of education, occupation type, income sufficiency, or research site ($p>0.05$). The final sample consisted of 1967 participants across the five IMIAS research sites. Descriptive statistics were obtained for the total sample by sex. Differences between gender role groups and other covariates by sex were examined statistically using Chi-square tests, T-tests, and ANOVA tests where appropriate. Bivariate statistics were used to investigate and assess the relationships between gender role groups and the covariates.

A series of Poisson regression models with robust variance was run for the whole IMIAS sample (Barros and Hirakata 2003). This method was chosen over logistic regression because logistic regression gives calculation of the Odds ratio that can importantly overestimate the prevalence ratio when analyzing common binary outcomes in cross-sectional data. Also Poisson regression provides an estimation of the prevalence ratios with more conservative confidence intervals that are easier to interpret than the odd ratio obtained through logistic regression (Barros and Hirakata 2003).

These models assessed the relationship between gender roles and self-reported mobility disability or low physical performance, using the androgynous role as the reference category and adjusting for potential covariates.

Multiplicative product terms were added to test for interactions between a) gender role groups and biological sex b) gender roles and research sites, at a statistical significance level of $p<0.05$.

4.5.3 Statistical methods, article 3

Differences between gender role groups, other covariates, and mediators by physical performance were statistically examined using Chi-square tests, T-tests, and ANOVA tests where appropriate.

We built a directed acyclic graph (DAG) to identify confounders and mediators of the relationship between gender roles and physical performance, using DAGitty software (Textor, Hardt et al. 2011). Vectors were drawn for each effect a variable is expected to have on other variables. The multivariable regression models were conducted using Poisson regression analysis with robust variance as the prevalence of poor physical performance is relatively high (13.7 %), meaning odds ratio produced through logistic regression will overestimate the risk ratio for poor physical performance (Barros and Hirakata 2003, Zou 2004). These multivariable Poisson regression models were performed in four steps using gender role groups or masculinity and femininity scores as independent variables: (1) model 1 : unadjusted model ; (2) model 2 : adjusted for sex; (3) model 3 (total effects): adjusted for confounders i.e. sex, age, marital status, years of education, income sufficiency, baseline SPPB scores and research sites; (4) model 4 (direct effects): adjusted for confounders and mediators i.e. BMI, smoking , alcohol consumption to estimate the direct effects (Textor, Hardt et al. 2011). All

statistical analyses were performed with the use of the IBM Statistical Package for Social Sciences (SPSS) version 22.0. The test is two tailed with α=0.05.

To examine whether the associations between gender roles and physical performance varies by sex or across cultural settings, we tested the significance of multiplicative interaction terms. Also, we conducted meta-analysis using random effects to tests for homogeneity of effects across different research sites of IMIAS. The resulting I-squared (I^2) indicates the percentage of variance in a meta-analysis that is attributable to study heterogeneity (Higgins, Thompson et al. 2003).

For the purpose of mediation analysis, I used an analytical technique which can simultaneously test the effects of multiple serial mediators and can determine the magnitude of the mediator's specific indirect effect in relation to each other (Preacher and Hayes 2008). This approach developed by Preacher and Hayes uses a bootstrapping technique for testing multiple mediations; it does not impose the assumption of normality distribution of the statistic of the indirect effect. It is recommended over the causal step strategy (Baron and Kenny 1986), which requires a large sample size to detect indirect effects or the Sobel test approach that is very conservative and require the assumption of multivariate normal distribution of the sample (Sobel 1982, Sobel 1986, MacKinnon, Warsi et al. 1995, MacKinnon, Lockwood et al. 2002, MacKinnon, Lockwood et al. 2004). The Preacher and Hayes approach ensures higher power and provides adequate control of type I error (Preacher and Hayes 2008). Meanwhile, it offers the advantage of testing single multiple serial mediation models instead of simple separate mediation models which allow assessing the relative magnitude of indirect effects associated with all mediators (Preacher and Hayes 2008).

We hypothesized and tested four serial mediation pathways based on the disablement model: (1) gender roles-----> BMI ------> Chronic diseases -----> Depression ----> physical performance; (2) gender roles-----> BMI ------> Physical activity -----> Chronic diseases ----> physical performance; (3) gender roles-----> cumulative smoking ------> Chronic diseases -----> Depression ----> physical performance; (4) gender roles-----> Volume of alcohol consumption ------> Chronic diseases -----> Depression ----> physical performance. The individual mediating effect of each of these mediators was determined after adjusting for potential confounders (sex, age, marital status, education, income, baseline SPPB scores and research sites.

Thus, I obtained the direct, indirect, and total effects of X (exposure) on Y (outcome). I bootstrapped the indirect effects gender roles on physical performance using the SPSS Process macro, a computation procedure for serial mediation analysis (Hayes 2012). The bootstrap estimates are based on 1000 bootstrap samples. I used 95% bias-corrected and accelerated confidence intervals to estimate the significant effect of serial mediators. In this mediation analysis, the outcome variable and mediators were used as continuous scores in the mediation models (Hayes 2012).

CHAPTER 5. RESULTS

5.1 ARTICLE 1: Bem Sex Role Inventory Validation in the International Mobility in Aging Study

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Bem Sex Role Inventory Validation in the International Mobility in Aging Study

Short title: Confirmatory Factor Analysis of BSRI

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5.1.1 Abstract

The measurement structure of the Bem Sex Role Inventory (BSRI) has been investigated using different factor analysis methods. In most previous studies about validity, the BSRI was examined using exploratory factor analysis (EFA) among samples of university students. Our aim was to assess the psychometric properties and construct validity of the 12-item short form BSRI in an international sample of older adults. The BSRI comprised 12 items and was administered to 1995 participants from wave 1 of the International Mobility in Aging Study (IMIAS). Cronbach's alpha was employed to assess internal consistency reliability, whereas the psychometric properties were assessed using exploratory and confirmatory factor analysis (CFA). The exploratory factor analysis revealed a three-factor model. This model was further confirmed by CFA and compared with the original two-factor structure model. CFA results showed that a two-factor solution (instrumentality-expressiveness) has satisfactory construct validity and a superior fit to data compared to the three-factor solution. Acceptable Cronbach's alphas values of 0.76 for the expressiveness factor and 0.75 for the instrumentality factor were observed. The two-factor solution confirms expected gender differences in IMIAS older adults. The 12-item BSRI provides a brief, valid, psychometrically sound and reliable instrument in international samples of older adults.

Keywords: BSRI, gender roles, gender stereotypes, Exploratory Factor Analysis, Confirmatory Factor Analysis, structure validation

5.1.2 Introduction

Although the original home for the concepts of gender identity and personality attributes was psychology, more recent research had indicated their relevance to broader health research. Gender identity is the extent to which individuals perceive themselves as masculine and/or feminine given what each of these social constructs means in a given context and regardless of the individual's biological sex (Spence 1985, Burke, Stets et al. 1988, Stets and Burke 2000). Gender roles are socially and culturally assigned personality attributes and behaviors expected of women and men (Lindsey 2005). Both gender identity and roles are not fixed and may change with changes in time and place (Perry and Bussey 1979, Spence 1984). Gender role orientation (GRO) or gender stereotypes are determined and constrained by social systems through widely accepted judgment or bias regarding expected masculine and feminine behaviors however not all men and women conform to these stereotypes (Annandale and Hunt 1990). Individually held stereotypes are reflected in gender role beliefs regarding the appropriate role of men and women in society (Eagly and Mladinic 1989, Bazik 2011).

Within any society, some personality characteristics, behaviors, interests, and roles are thought of as masculine while others are feminine (Williams and Best 1982). Traditionally, masculinity has been characterized by a cognitive focus on getting the job done and is related to instrumental/agentic behaviors and attributes such as aggressiveness, assertiveness, competitiveness, and independence. The traditional traits that typify femininity are more affective and include concern for the welfare of others and communal-expressive behaviors and attributes such as submissiveness, dependence, deference, cooperation, caring and nurturing (Bem 1974, Williams and Best 1982). A cross-cultural comparison of 14 countries showed that in egalitarian, more economically and socially developed countries, behavioral

differences between sexes and self-perceptions of men and women are less stereotypical in nature than in less affluent countries, but they do still exist (Williams and Best 1990).

Historically, masculinity and femininity were conceptualized as opposite ends of a continuum and linked to biological sex (Gough 1952). The congruence between sex and sex roles was challenged by Constantinople (Constantinople 1973) who proposed a two-dimensional concept of gender in which masculinity and femininity are not two ends of a single scale, but instead independent characteristics that could co-exist in an individual. Sandra Bem (Bem 1974) built on this, developing the Bem Sex Role Inventory (BSRI) to measure masculinity and femininity. This tool relies upon an individual's endorsement of a series of adjectives which have been judged as culturally characteristic of either males or females in the USA, on a scale from 1-- 'never or almost never true' to 7—'always or almost always true'. In its current form, the BSRI includes four categories based on answers to a 60-item Likert-type scale, which comprises three 20-item scales about Masculinity (BSRI-M), Femininity (BSRI-F) and Social Desirability. Individuals who score high on masculinity and low on femininity are classified as "masculine". Similarly, individuals are classified as "feminine" if they score high on femininity and low on masculinity. High scorers on both the masculinity and femininity scales are classified as "androgynous", while those scoring low on both are classified as "undifferentiated".

Bem has suggested and validated an abbreviated 30-items version of the original BSRI that consisted of three subscales with ten items each. Items were omitted from the longer BSRI if they were redundant or showed low correlation with the corresponding scale. The masculine and feminine scales of the 30-items BSRI appear to be more internally consistent than those of original BSRI (Bem 1981). Later on, the 30-items BSRI, and many other abbreviated versions

were developed to arrive at norms suited with different cultural settings and populations (Mateo and Fernández 1991, Katsurada and Sugihara 1999, Özkan and Lajunen 2005). These abbreviated versions of BSRI have been widely used among students. But their construct validity and research findings using abbreviated scales among older adults are limited. Moreover, issues have been raised concerning its cross-cultural relevance and validity (Ballardreisch and Elton 1992, Holt 1998, Hoffman and Borders 2001, Zhang, Norvilitis et al. 2001).

The measurement structure of the BSRI has been investigated using various methods of factor analysis. However, most of these studies were limited to exploratory factor analysis (EFA) among samples of university students. A meta-analysis of previous exploratory factor analysis studies indicated that with regard to feminine items, a single factor was most frequently found, while with the masculine items there were two or three factors (Choi and Fuqua 2003). This suggests that the concept of masculinity may be more complex than that proposed by Bem. Interestingly, findings from studies among populations of older adults in Spain and Brazil supported the original BSRI two factor structure of masculinity-femininity (Carver, Vafaei et al. 2013, Vafaei, Alvarado et al. 2014) but in both studies no statistically significance association was observed between BSRI and biological sex.

Using EFA to determine the validity of latent constructs or concepts (factor validity) raises methodological issues (Bollen 1989). Implementation of confirmatory factor analysis (CFA) in validity studies is important because such methods test models that are falsifiable (Brown 2006). The few existing CFA studies on the BSRI have yielded some contradictory results. For instance, among high school and university students from Australia, a two-factor model provided reasonable fit to the BSRI data (Marsh 1985), while findings from two

samples of young adults and another of middle age participants in Midwestern US states suggested a three-factor model with one feminine factor and two complex masculine factors produced the best fit (Choi, Fuqua et al. 2009). Interestingly, results obtained with a sample of students from the UK also demonstrated a three-factor structure, with a bipolar factor reflecting interpersonal sensitivity/dominance, a masculine factor reflecting personal agency and a third-factor reflecting interpersonal expressiveness (Colley, Mulhern et al. 2009). Among populations over age 60, it is unclear whether a two-factor model adequately fits the BSRI data (Windle and Sinnot 1985). Secondary findings from both waves of the longitudinal Social Relations and Mental Health over the Life Course Study suggest that the two-factor solution proposed by Bem fits the data well using a 40 items version in the first wave and an abbreviated 22 items version in the second wave of the study (Sellars 2008). In summary, an overview of previous research highlights ongoing ambiguities in measuring gender roles across cultures, among older populations and using shorter versions of the inventory.

In this study, we use a 12-item BSRI short form. This abbreviated version of BSRI was initially tested for validity in a sample of university students from Spain (Mateo and Fernández 1991) and has been re-examined in two separate pilot studies of Spanish and Brazilian population older adults by means of exploratory factor analysis and shown as a valid tool to measure gender role stereotypes (Carver, Vafaei et al. 2013, Vafaei, Alvarado et al. 2014).

Our aim was to examine the psychometric properties, as well as the convergent and discriminant validity of the 12-item BSRI short form (6 items measuring femininity and 6 for masculinity), in an international sample of older adults via both exploratory and confirmatory factor analysis.

5.1.3 Methods

5.1.3.1 Participants

The study subjects were part of wave 1 of the International Mobility in Aging study (IMIAS) project. IMIAS is a prospective cohort study of 1995 non-institutionalized men and women aged between 65 and 74 years (as of 2012) from five sites: Natal, Brazil (n=402), Manizales, Colombia (n=400), Tirana, Albania (n=394), Kingston (n=398) and Saint-Hyacinthe (n=401) respectively in Ontario and Quebec, Canada.

Baseline data were collected in 2012 with follow-ups in 2014 and 2016. In Latin American and Albanian sites, participants were recruited randomly from their neighborhood primary care centers. In Canadian sites, letters sent by family physicians to appropriate patients inviting them to contact the field coordinator for more information about the study. This was done to comply with the ethics guidelines at Queen's University and the University of Montreal. Approximately 30 % of those invited to participate in Canadian sites contacted the field coordinator to get information about the study. Of those, 95 % enrolled. In Latin American and Albanian sites, the response rates were almost 100 %. We expected that the response rate in Canadian sites would not be as high when compared to Latin American and Albanian sites, as suggested by existing literature (Helliwell, Aylesworth et al. 2001, Wong, Pelaez et al. 2006, Galea and Tracy 2007). In Saint-Hyacinthe, the sample of participants was representative of the community's older adult population as documented in the 2006 Canadian Census, in terms of marital status, education, and income. In Kingston, participants are more highly educated than the community norm but are representative in terms of income and marital status (again, according to Canadian census data for Kingstonians, ages 65 to 74).

Data collection was carried out at all sites through structured face-to-face interviews at the participants' homes unless they requested otherwise. IMIAS Questionnaire comprised detailed structured interview and included a wide range of measures of personal and social circumstances, self-report of existing medical conditions, health behaviours, quality of life, physical development and functioning, along with assessment of grip strength, vision and blood pressure. Standardized training was offered to all interviewers at each site. All procedures, including data collection documents and manuals were available in local site languages. Potential participants were excluded if they had 4 or more errors in the Orientation Scale of the Leganes Cognitive Test (LGT) (De Yebenes, Otero et al. 2003), which was administered on initial contact. Low LCT score were considered indicative of an inability to meet the study requirements. Five people were excluded in Natal for this reason; that number was three people in Manizales and Tirana, and zero in Kingston and Saint-Hyacinthe.

5.1.3.2 Measures of study

Since our questions on gender roles were only a part of a large project of mobility in aging, we privileged the use of a shorter version of the BSRI in older adults. For the purpose of this study, gender-stereotyped traits were measured using the 12-item BSRI short form initially utilized in the Spanish population (Mateo and Fernández 1991). The masculinity scale consists of 6 traits that are traditionally related to instrumental behaviors and attitudes that are characterized, and perhaps, stereotyped, as masculine. These traits are: acting as a leader, being dominant, having leadership abilities, having a strong personality, defending one's beliefs, and making decisions easily. The femininity scale consists of 6 traits that are traditionally related to expressive behaviors and attitudes that are characterized/stereotyped as

feminine, specifically: being gentle, warm, sympathetic, tender, affectionate, and sensitive to other's needs.

Participants were asked to rate the extent to which these items describe themselves using a seven-point Likert scale. This part of the IMIAS questionnaire took approximately 10 minutes to complete. The short form of BSRI used in this study was translated into French, Portuguese, and Albanian languages by two bilingual researchers from each IMIAS site. All the translated versions were then back-translated into English by a native English speaker to ensure accuracy and conceptual equivalency of items (Brislin, Thorndike et al. 1973) (Table 1). These measures were done to ensure that the BSRI questions had the same general meanings in all IMIAS sites.

5.1.3.3 Statistical analysis

Preliminary statistical analysis was performed using SPSS 21. Participants with missing values on any item were excluded from the current analysis (n=45). The majority of those participants were from Manizales, Colombia (53.3%). They were not different from those included in the analysis in terms of age, sex, years of schooling, education level, occupation type, and income sufficiency. Table 2 shows the socio-demographic characteristics of participants included in the study.

For the purpose of this paper, the combined IMIAS population samples were randomly split into two datasets of approximately equal size a "training sample" (N=971) and a "holdout sample" (N=979). Exploratory factor analysis was conducted on the training sample. We performed Principle Component Analysis (PCA) which is of an exploratory nature to examine the link between the observed items and the latent constructs and to identify the factor

structure (Tabachnick 2013). The inter-relationships between the BSRI inventory dimensions were assessed using Pearson correlation coefficients. Identification of the potential number of factors was informed by Kaiser-Guttman rule of eigenvalues > 1, Cattell's scree plots, and parallel analysis (Kaiser 1960, Cattell 1966, Hayton, Allen et al. 2004). The internal consistency of BSRI dimensions was assessed using Cronbach's alpha reliability coefficient. Alpha values higher than 0.7 are considered acceptable (Tavakol and Dennick 2011).

Known group validity, which is the ability of the short form BSRI to distinguish participants of one group from another, was evaluated by comparing men and women using an two sample t-test.

The resulting model from EFA was confirmed on the holdout sample using CFA. This model was then compared with the original two-factor structure proposed by Bem. CFA was used to assess measurement models with respect to goodness of fit indices as well as convergent and discriminant validity. Large and statistically significant factor loadings indicate that items associated with the same latent variables are highly inter-correlated, supporting convergent validity (O'Leary-Kelly and J. Vokurka 1998, Brown 2006, Kline 2011). To assess discriminant validity, we used Chi-square difference testing to compare two models, one in which latent variables are correlated, and the other model in which they are not. Statistically significant differences in the Chi-square between the two models support discriminant validity (Segars 1997, Zait and Bereta 2011). For these measurement models, we used Structural Equation Modeling (SEM) to assess relationships between factors and their observed measures using AMOS 19. First, we evaluated the multivariate normality in the holdout dataset to determine the appropriate CFA estimation method. Second, we employed the modification indices to measure the amount by which the over-all model Chi-square would

be reduced if a parameter that was previously fixed to zero was then estimated freely (Silvia and MacCallum 1988). Finally, the fit of the models was tested in the holdout sample, and for men and women.

5.1.3.4 Assessing the degree of model fit

We used AMOS 19 to assess the global fit of the models using fit statistics that possess different computational logic (Hoyle 2000). Six goodness-of-fit statistics were calculated which included Chi-square, goodness-of-fit index (GFI), Bentler Comparative fit index (CFI), root mean square error of approximation (RMSEA), Akaike's information criteria (AIC) and the Browne-Cudeck criterion (BCC).

It is generally accepted that a statistically non-significant Chi-square indicates a good model fit, while a statistically significant Chi-square suggest that the model has poor fit to data. However, the Chi square test is sensitive to sample size, being almost always statistically significant in larger samples such as ours, which might erroneously suggest a poor fit (Schreiber, Nora et al. 2006). Therefore, other goodness-of-fit indices are recommended in addition to Chi-square. GFI values close to 1 are indicative of good fit (Schreiber, Nora et al. 2006). Values for CFI around 0.90 are considered acceptable, whereas values around 0.95 suggest a good model fit (Bentler and Bonett 1980, Hu and Bentler 1999). RMSEA values below 0.05 indicate a good fit with values between 0.05 and 0.08 indicating a reasonable fit, those between 0.08 and 0.1 suggesting only a mediocre fit, and finally values greater than 0.10 indicating a poor model fit (Hu and Bentler 1999, Diamantopoulos and Siguaw 2000, Kahn 2006, Steiger 2007).

We compared the model resulting from EFA and the two-factor structure model of Bem. The AIC and the BCC were used as measures of the final model's likelihood of being

replicated in other samples of a similar size and population (Hu and Bentler 1999, Byrne 2016). The model with the lowest values of both AIC and BCC is more likely to yield a good fit in other samples.

5.1.4 Results

5.1.4.1 Principle component analysis

As preliminary steps for the PCA, we carried out the Kaiser Meyer-Olkin test of sampling adequacy and Bartlett's test of sphericity on the training sample. The KMO index (0.745) is greater than 0.60-0.70 which means the dataset is adequate for analyzing EFA results (Netemeyer 2003). Bartlett's test rejects the hypothesis that the correlation matrix is an identity matrix, without significant correlations between variables (at $p<0.001$) (Tabachnick and Fidell 2001). Both tests confirm that the training sample is suitable for factor analysis.

Based on the guidance of the Kaiser-Guttman rule, scree plot, and parallel analysis test (Figure 1), a three-factor structure was most appropriate.

Oblique rotations using the Promax method (Kappa=4) were generated to assist in factor structure interpretation because we found that factors 1 and 3, and factors 2 and 3 were slightly correlated (Table 3) (Hendrickson and White 1964).

Inspection of the pattern matrix revealed a three-factor structure. All of the 12 items had factor loadings greater than 0.45 following the criteria of Comrey and Lee (Comrey and Lee 1992), communalities were greater than or equal to 0.43, and no items failed to show salient loadings on any of the factors. The three factors accounted for 56.8% of variance in scores. Factor 1 (femininity or expressiveness factor) accounted for 25.94% of the variance (eigenvalue=3.11). Factor 2 (masculinity or instrumentality factor) accounted 20.60% of the

variance (eigenvalue=2.47). Factor 3 (mixed factor) accounted for 10.26% of the variance (eigenvalue=1.23). The expressiveness factor had 5 items, the instrumentality factor had 4 items, and the mixed factor had 3 items. Factor loadings, communalities, and mean score and standard deviation of each item are shown in Table 4

5.1.4.2 Confirmatory factor analysis

A CFA framework was applied to the whole holdout sample, also to the aggregate holdout sample of men and women. The holdout sample showed a multivariate non-normal distribution with a value of more than 5 for Mardia's coefficient. We used the asymptomatic distribution-free (ADF) estimation which is a trustworthy estimation method recommended for CFAs under non-normal conditions, provided that the sample size is adequate (Raykov and Marcoulides 2006).

Before doing CFA, internal consistency for the three factors was calculated. Cronbach's alphas were 0.77, 0.78, and 0.47 for expressiveness, instrumentality, and the mixed factor respectively. The first two factors showed acceptable reliability, while for the third-factor reliability was poor (Tavakol and Dennick 2011). We also calculated the reliability coefficients for the two factors structure as proposed by Bem, and found alphas values of 0.76 for the expressiveness factor, and 0.75 for the instrumentality factor. These values indicate acceptable alphas for the two-factor model.

Next, the three-factor model consistent with factor structure from the EFA (model 1), along with the two-factor model (model 2) proposed by Bem were considered using CFA to assess how well data fit both models. One common assumption in these models is that a parameter is fixed at zero (e.g. in a two-factor model, items related to one factor are free to load on it while restricted to have zero loadings on the other factor). Modification indices were

employed to assess how reasonable these assumptions were when they were relaxed (Silvia and MacCallum 1988).

The results indicated that a two-factor structure (model 2) had a satisfactory fit, and clearly demonstrated better fit than a three-factor solution (model 1). Specifically, the fit indices for model 2 in the whole holdout sample are: Chi-square=125.34, GFI=0.96, CFI=0.93, and RMSEA=0.046. The same goodness of fit indices for model 1 are: in sequence 218.99, 0.93, 0.86, 0.06. We obtained similar results when fitting models for men and women separately (Table 5). Model 2 showed that all un-standardized factor loadings were statistically significant at $p<0.001$, rejecting the null hypothesis that the unconstrained loadings are zero. All standardized factor loadings showed moderate to high values, indicating that each item is at least moderately related to its corresponding latent variable (Figure 2). Only item 10 ("defends own beliefs") showed low standardized factor loading (0.22). We assessed a model without this item, but the goodness of fit indices were worse compared to the 12-item, two-factor model. Therefore, we consider model 2 with acceptable convergent validity. Using the entire IMIAS dataset, we compared CFA results of model 2 in which the two latent variables correlate, with the same model in which they did not correlate. The Chi-square difference test ($\chi_1^2 - \chi_2^2=32.82$; $df_1-df_2=1$) was statistically significant ($p<0.001$) indicating discriminant validity.

5.1.4.3 Known group validity

Known group validity was used to determine the extent to which the two-factor structure of the 12-item BSRI revealed known differences in gender role stereotypes between men and women. In the whole sample, we found statistically significant differences between men and women on both dimensions using independent samples t-tests. In general, higher

mean values were found for expressiveness among women and instrumentality for men in the aggregate sample and when data were disaggregated by site (Table 6). Mean masculinity scores were higher in men compared to women in Tirana, St-Hyacinthe, and Kingston ($p<0.05$), while mean femininity score were higher in women than men in Manizales, Tirana, and Kingston ($p<0.05$).

5.1.5 Discussion

According to previous literature, the original and the abbreviated versions of the BSRI have both been used primarily among younger populations, and knowledge about validity in older adult populations is limited. We decided to use Bem Sex Role Inventory as a measure of gender stereotyped traits because of recent evidence on the salience of these traditional gender roles in Latin America and Southern Europe (Chant and Craske 2003, Silova and Magno 2004, Miluka 2009, Stecklov, Carletto et al. 2010, Särnhult 2014). In addition, research findings obtained from a sample of older adults from Canada refer to these same gender roles as personality attributes having significant effects on general wellness and life satisfaction in older women (Gale-Ross, Baird et al. 2009). We hypothesized that gender roles maybe more applicable to older generations than to younger populations who have more opportunity to choose or to explore more flexible gender roles, and this hypothesis needs to be investigated. The purpose of this analysis was to evaluate the psychometric properties and construct validity of the 12-item short form BSRI in older adults and in developing as well as developed countries.

We conducted an exploratory and then confirmatory factor analyses of the 12-item BSRI. The exploratory factor analysis revealed a three-factor model. This model was further confirmed by CFA and compared with the two-factor model initially proposed by Bem. The

CFA revealed that the two-factor solution showed satisfactory construct validity and superior fit compared with the three-factor solution, according to the standard recommendations of structural equation modeling literature (Hu and Bentler 1999, Diamantopoulos and Siguaw 2000, Kahn 2006, Steiger 2007). In addition, the two-factor model showed the lowest values of both AIC and BCC, indicating that it is more likely to reproduce findings in other samples of similar populations. The discrepancy between results from exploratory and confirmative factor analysis is not surprising because EFA is data driven and involves a number of subjective decisions (Brown 2006). In terms of reliability, the CFA two-factor solution showed higher than the recommended cut-off point of 0.70 (Bland and Altman 1997, Tavakol and Dennick 2011), indicating acceptable internal consistency for the whole IMIAS sample (α =0.75, and α=0.76 for instrumentality and expressiveness items respectively) and for men and women separately (α ranged between 0.73 and 0.78). A significant gender difference was found in the two factors. Men tended to have significantly higher instrumentality and lower expressiveness scores than women. These findings confirmed expected differences in gender stereotype compositions assumed by men and women.

There are several justifications for the existence of two factors as proposed by Bem, even where more than two factors exist. Gender role orientations may vary across cultural settings or due to changes in self-concepts of gender roles over time and in response to economic, social, and political transitions. For instance, research findings from studies in the US and Latin America suggest that stereotypes of women and women's self-perceptions have become more instrumental in line with their increasing emancipation and participation in public life (Diekman and Eagly 2000, Diekman, Eagly et al. 2005). Again, the BSRI was developed to assess the extent to which traditional cultural norms of desirable female and male

attributes reflect individual self-perceptions (Bem 1979). It could be argued that the North American norms of the 1970s, upon which the BSRI was constructed, may define concepts of masculinity and femininity that are no longer applicable in North America and whose applicability elsewhere was never established. However, in this work, we provided evidence for all four gender roles in both Canadian cities and also in very different international contexts supporting the ubiquitous existence of these four types. Other researchers suggest that the factor structure of BSRI may be more complex than Bem's proposal of masculine or feminine items split into two factors (Feather 1978, Ratliff and Conley 1981, Maznah and Choo 1986). This means that it may be inappropriate to define masculinity and femininity based on single factors when more than one factor might be embedded in each concept. Despite these concerns, our findings support Bem's two-factor model and are consistent with most of the recent literature on BSRI validation using CFA in a sample where older adults were overrepresented (Sellars 2008).

One of the major strengths of this study is a large sample size (n=1950). Furthermore, a sample size of 971 participants was used for exploratory factor analysis. A high ratio of participants to BSRI items (ratio 81:1) ensured that stable factors could be identified using EFA (Gorsuch 1983). CFA was conducted with a separate, large sample (n=979). Our findings therefore provide strong support for the 12-item short form BSRI as a valid measure of gender roles as reflected by individual sex roles among older adults.

The results of this paper strongly support the psychometric properties and construct validity of the 12-item short form BSRI among an international sample of older adults. However, limitations of the study must be acknowledged. First, in less educated participants, BSRI may contribute to measurement errors and information bias. We attempted to minimize

these errors by administering the BSRI at all sites using response visual aids. Second, the Kingston sample was overeducated compared with the 2006 Kingston population census data for this 65-74 age group. Consequently, participants included in the study from Kingston may not be representative of their community, and generalization of results from this specific site may be of limited validity. However, the diverse samples provide a wide range of distribution of social variables for analysis, reinforcing the validity of the instrument. Finally, the instrument is a self-reported measure that allows participants to rate themselves in some aspects of common cultural values. We cannot exclude possible social desirability bias because we cannot determine the extent to which responses accurately reflect participants' actual characteristics, behaviors, and experiences.

5.1.6 Conclusions

The 12-item short form BSRI appears to be a brief, robust, reliable, and psychometrically sound instrument that can be readily implemented in studies to assess gender roles. It offers a method for beginning to study whether gender norms, expectations and constraints have an impact on outcomes such as mental and physical health. Further use of the current 12-item BSRI is justified and will provide additional evidence to refine and compare its psychometric properties and construct validity among older adult populations.

5.1.7 Tables and figures

Table 1. English items of the 12 item Short Form of BSRI used in this study along with French, Spanish, Portuguese and Albanian translations

	English	French	Spanish	Portuguese	Albanian
Femininity	Gentle	Doux(ce)	Gentil	Educado	Xhentil
(expressiveness)	Sympathetic	Sympathique	Simpatico	Compreensivo	I kuptueshem me shqetesimet e te tjereve
	Tender	Tendre	Tierno	Gentil	I bute
	Warm	Chalereux(se)	Calido	Entusiasmado	I ngrohet
	Affectionate	Affectueux (se)	Afectuoso	Carinhoso	I dashur
	Sensitive to other needs	Attentif(ve) aux besoins des autres	Sensible a las necesidades de los demás	Sensivel as necessidades dos outros	I ndjeshem ne nevojat e te tjereve
Masculinity	Has leadership ability	Avoir des qualités de chef (leader)	Con Madera de lider	Capacidade de liderança	Me aftesi drejtuese
(instrumentality)	Acts as a leader	Se comporter comme un leader	Actua como lider	Age como líder	Sillet si lider
	Dominant	Dominant (e)	Dominante	Dominante	Dominues
	Strong personality	Personnalité forte	Personalidad fuerte	Personalidade Forte	Me personalitet te forte
	Defends own beliefs	Deféndre ses croyances	Defensor de las propias ideas	Defende as próprias crenças	Mbron idete e veta
	Makes decisions easily	Prendre facilement des décisions	Toma decisiones facilmente	Toma decisões facilmente	Merr vendime lehte.

Table 2. Distribution of study participants according to demographic and socio-economic characteristics (n=1950)

	Natal (Brazil)		Manizales (Colombia)		Tirana (Albania)		Saint Hyacinthe (Quebec)		Kingston (Ontario)	
Variables	Men (n=192)	Women (n=210)	Men (n=187)	Women (n=189)	Men (n=183)	Women (n=204)	Men (n=188)	Women (n=204)	Men (n=184)	Women (n=209)
Age		**P=0.591***		**P=0.252**		**P=0.279**		**P=0.338**		**P=0.183**
65-69	52.1	54.8	56.7	50.8	46.40	52.0	66.0	61.8	59.8	53.1
70-74	47.9	45.2	43.3	49.2	53.60	48.0	34.0	38.2	40.2	46.9
Education		**P=0.002**		**P<0.001**		**P<0.001**		**P=0.299**		**P=0.265**
Less than secondary	70.3	84.8	68.4	77.8	7.7	14.2	7.4	6.9	1.1	0.0
Secondary	22.9	12.9	13.4	17.5	19.7	38.8	38.8	46.6	23.4	21.1
Post secondary	6.8	2.4	18.2	4.8	72.7	52.9	53.7	46.6	75.5	78.9
Income sufficiency		**P=0.246**		**P=0.737**		**P=0.017**		**P=0.004**		**P=0.226**
Very sufficient	4.7	3.3	5.9	4.2	42.6	32.8	52.7	37.3	62.5	60.3
Sufficient	25.0	19.0	25.1	24.3	42.1	40.7	42.6	52.5	34.2	32.5
Insufficient	70.3	77.6	69.0	71.4	15.3	26.5	4.8	10.3	3.3	7.2
Living arrangements		**P=0.014**		**P=0.020**		**P<0.001**		**P<0.001**		**P<0.001**
Alone	5.2	7.6	15.0	13.2	3.3	16.2	14.4	36.8	19.6	41.6
Only spouse	25.0	13.8	23.0	12.7	50.8	38.2	74.5	57.8	43.5	46.4
Children with or w/o spouse	69.8	78.6	62.0	74.1	45.9	45.6	11.2	5.4	37.0	12.0
Longest held occupation		**P=0.002**		**P<0.001**		**P=0.118**		**P=0.372**		**P=0.049**
No Skilled Manual	35.9	52.9	29.9	50.8	8.2	6.9	23.4	26.0	15.8	12.4

Skilled manual	53.6	36.7	50.3	36.5	61.2	52.5	29.8	23.5	13.0	6.7
Non Manual	10.4	10.5	19.8	12.7	30.6	40.7	46.8	50.5	71.2	80.9
Work situation (last week)		**P<0.001**		**P<0.001**		**P=0.472**		**P=0.122**		**P=0.133**
Worked	22.4	44.8	30.5	56.1	5.5	3.9	22.9	16.7	19.0	25.4
Not working	77.6	55.2	69.5	43.9	94.5	96.1	77.1	83.8	81.0	74.6

*p –values comparing men and women at each research site

Table 3. Correlation matrix of the three-factor structure of the 12 items Short Form BSRI in training sample (n=971)

Dimension	Factor 1	Factor 2	Factor 3
Factor 1		0.01	0.16*
Factor 2	0.01		0.25*
Factor 3	0.16*	0.25*	

- **The factor label components are as follows: F1, femininity (expressiveness) factor; F2, masculinity (instrumental) factor, F3 mixed factor * $p < 0.05$**

Table 4. Principle component analysis of the 12 items short form BSRI with communalities (h2) of each item in training sample (n=971)

No.	Item	Factor 1	Factor 2	Factor 3	h2	Mean	SD
1	Gentle	0.68	0.00	0.00	0.48	5.86	1.30
2	Sympathetic	0.72	0.00	0.00	0.53	6.03	1.12
6	Tender	0.79	0.00	0.00	0.60	5.53	1.44
7	Warm	0.59	0.00	0.00	0.43	5.38	1.65
8	Affectionate	0.78	0.00	0.00	0.61	5.61	1.51
3	Has leadership abilities	0.00	0.92	0.00	0.82	4.38	2.01
4	Act as a leader	0.00	0.92	0.00	0.81	4.09	1.96
5	Dominant	0.00	0.58	0.00	0.48	3.61	1.88
9	Strong personality	0.00	0.48	0.00	0.53	4.94	1.77
10	Defends own beliefs	0.00	0.00	0.78	0.60	5.79	1.40
11	Sensitive to others needs	0.00	0.00	0.51	0.45	5.99	1.22
12	Make decisions easily	0.00	0.00	0.63	0.48	4.96	1.69
	% of variance	**25.94**	**20.60**	**10.26**			
	Alpha	**0.77**	**0.78**	**0.47**			

- **The factor label components are as follows: F1, femininity (expressiveness) factor; F2, masculinity (instrumental) factor, F3 mixed factor**
- **The factor pattern coefficients of 0.45 and below were replaced by zeros**
- **Items were scored (Never/almost never true=1, almost/always true=7)**

Table 5. Goodness-of-fit indices for the three-factor and the two-factor models of the 12 items short form BSRI in the holdout sample of IMIAS population.

Model 1	**Three factor model** Number of Parameters = 30							
	χ^2	**df**	**p**	**GFI**	**CFI**	**RMSEA**	**AIC**	**BCC**
Total sample (n=979)	218.99	48	0.00	0.93	0.86	0.06	278.98	279.79
Men (n=462)	112.49	48	0.00	0.93	0.89	0.054	172.49	174.23
Women (n=517)	155.11	48	0.00	0.93	0.86	0.066	215.11	216.66

Model 2	**Two factor model** Number of Parameters = 37							
	χ^2	**df**	**p**	**GFI**	**CFI**	**RMSEA**	**AIC**	**BCC**
Total sample (n=979)	125.34	41	0.00	0.96	0.93	0.046	199.34	200.33
Men (n=462)	68.48	41	0.01	0.96	0.95	0.038	142.48	144.63
Women (n=517)	107.54	41	0.00	0.95	0.91	0.056	181.54	183.46

*** $\Delta\chi^2$ between model 1 and 2 are 93.65 , 44.01, and 47.57 for the total sample, men and women respectively ($p < 0.001$).**

Table 6. Comparison between men (n=462) and women (n=517) responses on 2 factor model of the 12-item short form of Bem sex role inventory in the confirmatory holdout sample of IMIAS population.

Dimension	Men	Women	t
	Mean (SD)	Mean (SD)	
All sample			
Femininity (expressiveness)	5.62 (0.96)	5.88 (0.88)	-4.43*
Masculinity (instrumentality)	4.77 (1.13)	4.49 (1.20)	3.68*
Natal (Brazil)			
Femininity (expressiveness)	5.29 (1.04)	5.34 (0.92)	-0.31
Masculinity (instrumentality)	4.36 (1.3)	4.18 (1.3)	0.93
Manizales (Colombia)			
Femininity (expressiveness)	5.62 (1.17)	6.09 (0.99)	-2.92*
Masculinity (instrumentality)	4.32 (1.1)	4.28 (1.1)	0.22
Tirana (Albania)			
Femininity (expressiveness)	6.03 (0.77)	6.35 (0.62)	-3.19*
Masculinity (instrumentality)	5.07 (1.05)	4.43 (1.1)	4.13*
Saint Hyacinthe (Quebec)			
Femininity (expressiveness)	5.72 (0.77)	5.78 (0.72)	-0.58
Masculinity (instrumentality)	4.89 (1.01)	4.39 (1.14)	3.27*
Kingston (Ontario)			
Femininity (expressiveness)	5.41 (0.80)	5.83 (0.82)	-3.63*
Masculinity (instrumentality)	5.22 (0.82)	5.09 (1.05)	0.96

*** $p < 0.05$**

Figure 1. Difference in eigenvalues from parallel analysis.

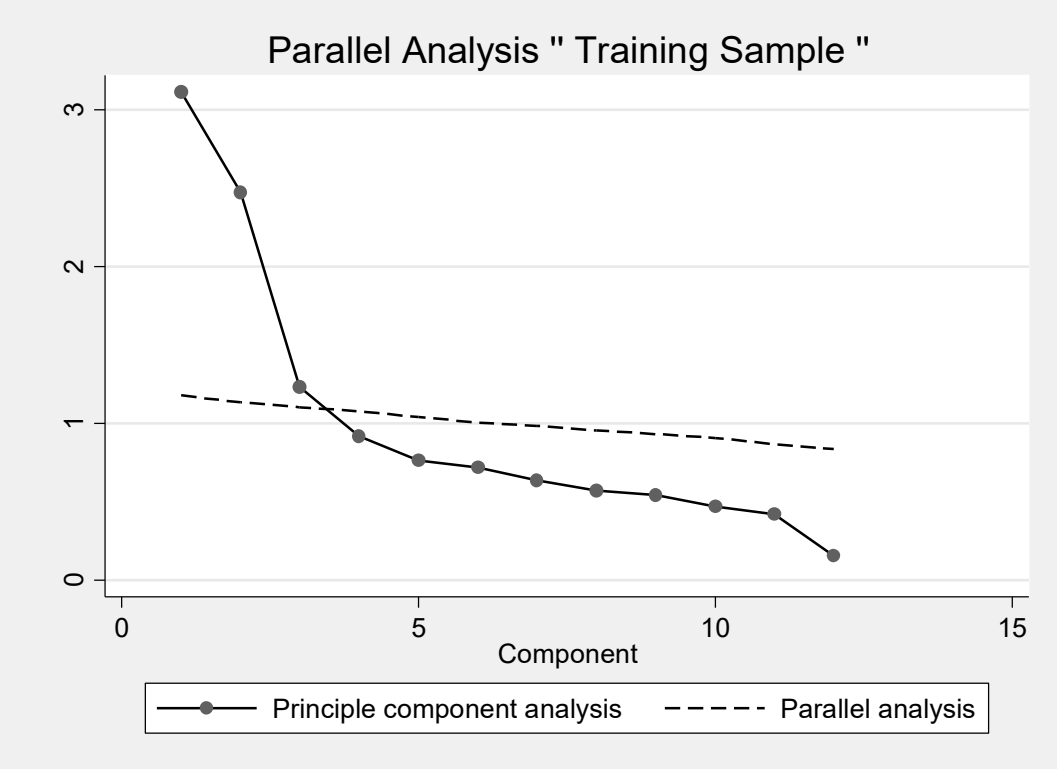
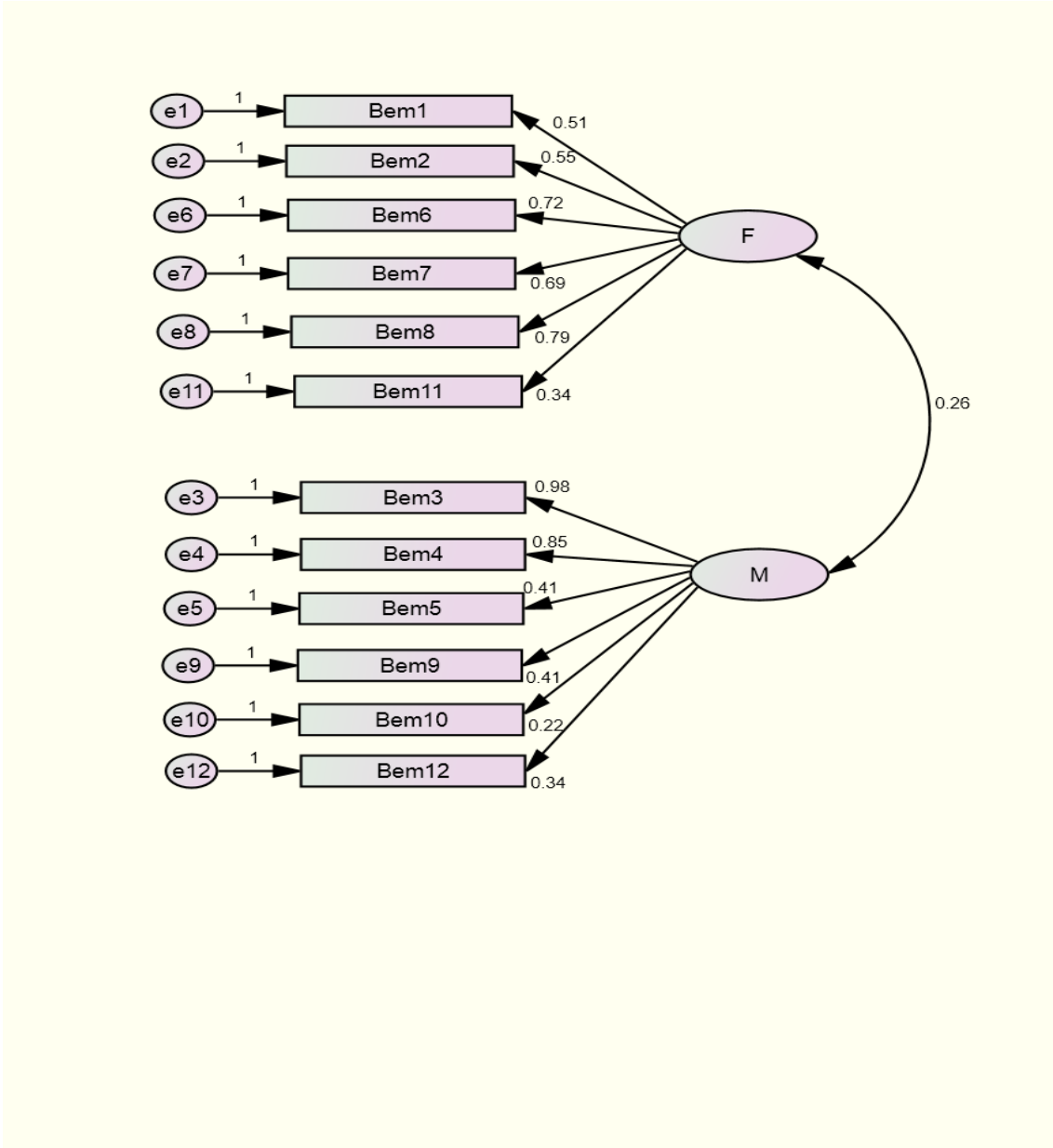


Figure 2. Hypothesised 2 factor model (model 2) of factorial structure of Bem sex role inventory (n=979).

Bem 1= Gentle; Bem 2= Sympathetic; Bem 3= Has leadership abilities; Bem 4= Act as a leader; Bem 5= Dominant; Bem 6= Tender; Bem 7= Warm; Bem 8= Affectionate; Bem 9= Strong personality; Bem 10= Defends own belief; Bem 11= Sensitive to others needs; Bem 12= Make decisions easily. Standardized factor loadings appear on the lines. All loadings are statistically significant at $p < 0.001$.



5.2 ARTICLE 2: Gender roles and physical function in older adults: Cross-sectional analysis of the International Mobility in Aging Study (IMIAS)

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Gender roles and physical function in older adults: Cross-sectional analysis of the International Mobility in Aging Study (IMIAS)

Short title: Gender roles and physical function in early old age

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5.2.1 Abstract

Objectives

To examine the relationships between physical function and gender-stereotyped traits and whether these relationships are modified by sex or social context.

Methods

A total of 1995 community-dwelling older adults from the International Mobility in Aging Study (IMIAS) aged 65 to 74 years were recruited in Natal (Brazil), Manizales (Colombia), Tirana (Albania), Kingston (Ontario, Canada), and Saint-Hyacinthe (Quebec, Canada). We performed a cross-sectional analysis. Study outcomes were mobility disability, defined as having difficulty in walking 400 meters without assistance or climbing a flight of stairs without resting, and low physical performance, defined as a score < 8 on the Short Physical Performance Battery. The 12-item Bem Sex Role Inventory (BSRI) was used to classify participants into four gender roles (Masculine, Feminine, Androgynous, and Undifferentiated) using site-specific medians of femininity and masculinity as cut-off points. Poisson regression models were used to estimate prevalence rate ratios (PRR) of mobility disability and poor physical performance according to gender roles.

Results

In models adjusted for sex, marital status, education, income, and research site, when comparing to the androgynous role, we found higher prevalence of mobility disability and poor physical performance among participants endorsing the feminine role (PRR=1.20, 95% confidence interval (CI) 1.03–1.39 and PRR=1.37, CI 1.01–1.88, respectively) or the undifferentiated role (PRR=1.23, 95% CI 1.07–1.42 and PRR=1.58, CI 1.18–2.12,

respectively). Participants classified as masculine did not differ from androgynous participants in prevalence rates of mobility disability or low physical performance. None of the multiplicative interactions by sex and research site were significant.

Conclusion

Feminine and undifferentiated gender roles are associated with mobility disability and low physical performance in older adults. Longitudinal research is needed to assess the mediation pathways through which gender-stereotyped traits influence functional limitations and to investigate the longitudinal nature of these relationships.

Keywords: Gender role orientation, Bem Sex Role inventory, sex, gender, physical function, mobility disability, physical performance of lower extremities, global aging.

5.2.2 Introduction

Mobility is fundamental for autonomy, independence, and high quality of life (Shumway-Cook, Ciol et al. 2005, Webber, Porter et al. 2010, Bentley, Brown et al. 2013). It is associated with time spent outside the home and overall health perceptions among older adults (Wilkie, Peat et al. 2007). As population ageing is a notable phenomenon in both developed and developing countries, mobility loss will remain a significant public health challenge (Siren and Hakamies-Blomqvist 2009) for the foreseeable future, as it is a risk factor for falling, disability, hospitalization, long-term health care costs, and mortality.

Gender refers to the array of socially constructed roles and relationships, personality traits, attitudes, behaviours, values, relative power, and influence that society ascribes to men and women on a differential basis (CIHR 2010). Sex is a biological construct that refers to the biological differences between females and males and is distinct from, and not interchangeable with, gender (Krieger 2003). Gender differences in mobility disability among older adults have been observed in numerous studies, but are not well understood. Most studies focused on understanding the biological differences in mobility disability between men and women, but not the differences due to interrelationships of sex and gender. Many studies have demonstrated that women have greater prevalence and incidence of mobility disability than men (Merrill, Seeman et al. 1997, Beland and Zunzunegui 1999, Leveille, Penninx et al. 2000, Bannerman, Miller et al. 2002, Guallar-Castillon, Sagardui-Villamor et al. 2007). Interestingly, the magnitude of difference in mobility disability between older men and women varies across studies and locations worldwide (Mechakra-Tahiri, Freeman et al. 2012).

In the few studies conducted in low and middle income countries, a larger gap in mobility disability between men and women has been observed (Alvarado, Guerra et al. 2007,

Miszkurka, Zunzunegui et al. 2012, Onadja, Atchessi et al. 2013). Baseline analysis of data from the International Study of Mobility in Aging (IMIAS) on older adults between 65 and 74 years at five research sites in Natal (Brazil), Manizales (Colombia), Tirana (Albania), Saint-Hyacinthe (Quebec), and Kingston (Ontario) suggests that women had a statistically significant higher odds of mobility disability (defined as having difficulty in walking 400 meters or climbing a flight of stairs) at all research sites except Kingston (Ontario) (Zunzunegui, Alvarado et al. 2015).

Several reasons for these gender differences have been reported in the literature. Women generally live longer with greater functional limitations (Merrill, Seeman et al. 1997), which means they spend more years at risk of disabilities than men (Leveille, Resnick et al. 2000, Newman and Brach 2001), resulting in higher prevalence. It has been hypothesized that the greater prevalence among older women of osteoarthritis and musculoskeletal diseases, with their associated pain (Urwin, Symmons et al. 1998, Leveille, Fried et al. 2002) and depression (Forlani, Morri et al. 2013), may partly explain gender differences in mobility disability.

Given the widespread use of conventional self-report tools for mobility assessment, differential reporting of mobility difficulty by men and women could contribute to the observed sex-based differences in mobility. These self-assessments can be improved by adding objective physical performance measures (Guralnik, Branch et al. 1989, Merrill, Seeman et al. 1997, Melzer, Lan et al. 2004). Lower physical performance has been observed in women who are younger at first birth and multiparous, two frequent factors among women living in poor and middle income countries (Pirkle, de Albuquerque Sousa et al. 2014) that could explain the varying mobility gap between older men and women. Differences in

mobility between men and women have been also explained by gender roles that vary across times periods and world regions (Ahacic, Parker et al. 2000, Mechakra-Tahiri, Freeman et al. 2012, Onadja, Atchessi et al. 2013). Differences in the social construction of gender stem from social factors and behavioural responses that depend on time and place. Social factors are expressed through norms and values imposed by a number of societal and cultural institutions, such as government laws, family roles and traditions, religion, and mass media, while behavioral responses are the expression of social norms and values through individual attitudes and behaviours. Women in some societies do not enjoy equal rights and are more often exposed to violence, discrimination and stigmatization compared to men. Such adverse living conditions may lead to physiological mechanisms and ultimately contribute to gender differences in mobility disability in early old age.

Over the past few years, the concept of gender role orientation (GRO) has been introduced as a psychological measure for studying gender differences in health. According to the androgyny model, individuals who endorse high masculinity and femininity are classified as 'androgynous', those high in masculinity and low in femininity as 'masculine', those high in femininity and low in masculinity as 'feminine', and those low in both as 'undifferentiated' (Bem 1981). The association between biological sex and gender role orientation is not consistent across previous studies reported in the literature. For instance, results from studies conducted among young German nurses do not support sex differences regarding gender roles (Kada 2010). In two pilot studies conducted by our team in Brazil and Spain, gender roles were not statistically associated with biological sex in older adults (Carver, Vafaei et al. 2013, Vafaei, Alvarado et al. 2014). It is worth noting that the sample sizes of all of the aforementioned studies were small. Meanwhile, findings from the oldest cohort of the

longitudinal study of social patterning of health from Scotland showed small but significant sex differences regarding gender roles ($p<0.05$) (Hunt, Lewars et al. 2007).

GRO, along with the Bem Sex Role (BSRI) classification system, has been little used in health-related research. Empirical research findings on GRO and health suggest that, among men, 'masculinity' contributes to higher risk of chronic heart disease (CHD) mortality, while higher 'femininity' scores are associated with a lower risk of CHD death (Hunt, Lewars et al. 2007). Among men and women from the same study, 'masculinity' was negatively related to suicidal thoughts in early middle age, while 'femininity' was unrelated to serious suicidal thoughts at any age (Hunt, Sweeting et al. 2006). A small study of healthy middle-aged workers from Montreal, Canada, revealed that higher masculinity and female sex predicted increased physical complaints, with findings suggesting increased vulnerability to cardiovascular diseases (Juster and Lupien 2012). Higher femininity was associated with higher rates of recurrent acute coronary syndrome (ACS) and, among younger patients with ACS, with increased risk of hypertension, a family history of cardiovascular diseases, and depressive and anxious symptoms (Pelletier, Ditto et al. 2015, Pelletier, Khan et al. 2016). Androgynous gender roles (Vafaei, Ahmed et al. 2016) and higher masculinity scores (Price, Gregg et al. 2015) were associated with lower depressive symptoms in older adults.

Pain has been also linked to gender roles. A meta-analysis of thirteen studies showed masculinity was associated with higher pain threshold and pain tolerance, while femininity was associated with greater pain sensitivity response in healthy human participants. However, these results should be interpreted with caution given remarkable heterogeneity between studies (Alabas, Tashani et al. 2012). Among older adults, femininity was associated with

greater pain perception in men and lower pain sensitivity in women (Campbell, Edwards et al. 2005).

Health services use is generally associated with being a woman. However, one study showed that both older men and women with increased masculinity visit health services more often (Sinnott, Rabin et al. 1986). Findings of a study among Tokyo metropolitan centenarians suggest that femininity is related to longevity and that androgyny may be related to successful aging (Shimonaka, Nakazato et al. 1996).

None of the studies cited has examined the associations between gender roles and physical function in old age. The unusual variability of the sex gap in mobility disability worldwide has raised the question of whether mobility loss is related to femininity while good physical function is related to masculinity. Therefore, we developed the following hypotheses:

1- Gender roles are associated with mobility disability and physical performance of the lower extremities in old age.

2- Compared to androgynous types, men and women who identify themselves with characteristics identified as ‘masculine’ have lower prevalence ratios of both mobility disability and low physical performance, while those identified as ‘undifferentiated’ or ‘feminine’ have higher prevalence ratios.

3- The strength of associations between gender roles, mobility disability, and physical performance varies across societies.

5.2.3 Methods

5.2.3.1 Population and samples

Participants are from the baseline survey of the International Mobility in Aging Study (IMIAS). The aim of the study is to examine gender differences in mobility using a life course perspective. The IMIAS was conducted in five cities located in countries with different degrees of gender equity to provide a wide range of gender-related exposure, mobility risk factors, and physical function outcomes. The rationale for the study has been explained in previous publications (Zunzunegui, 2015). Briefly, the study took place in two Canadian cities (Kingston, Ontario, and Saint-Hyacinthe, Quebec), one city in the Colombian Andes (Manizales), one city in northeastern Brazil, and Tirana in Albania. The majority of older adult populations in Brazil, Albania, and Canada are registered in national public health systems that provide universal health insurance coverage. In Colombia, approximately 82% of adults over 60 years of age are covered under social security systems and subsidized public health programs (Gomez, Curcio et al. 2009).

A total of 1995 community-dwelling elderly people aged between 65 and 74 years were recruited in 2012. The sample was stratified by sex, consisting of approximately 200 men and 200 women from five research sites: Natal (Brazil), Manizales (Colombia), Tirana (Albania), Kingston (Ontario, Canada), and Saint-Hyacinthe (Quebec, Canada). Sample size calculations were performed assuming a baseline mobility disability prevalence ratio between men and women of 1.8, with a type I error of 0.05 and type II error of 0.2.

Recruitment strategies.

Recruitment has been described in previously published reports (Zunzunegui, Alvarado et al. 2015, Doulougou, Gomez et al. 2016). Briefly, two recruitment methods were used. In

Natal, Tirana, and Manizales participants were selected randomly through their neighborhood primary care centers, and interviewers contacted participants directly to invite them to participate in the study.

Participants from Canadian sites were recruited randomly, with replacement, from neighborhood family medicine clinics. Family doctors sent invitation letters to their patients to contact our field coordinator for information about the study. In Saint-Hyacinthe, all patients came from the largest family medicine group clinic, with which more than 80% of physicians are affiliated and which covers the whole territory of the city. In Kingston, the two clinics included in the study are large, covering the whole Central Kingston area. In Saint-Hyacinthe the sample was stratified by neighbourhood, which increased the representativeness of the study sample, while in Kingston such stratification was not possible. As a result, the Saint-Hyacinthe sample was representative of the community's older adult populations aged between 65 and 75 years in terms of marital status, education and income, as compared to the 2006 Canadian census. In Kingston, participants were more educated than the general census population of that site, but had similar marital status and income.

These indirect methods of recruitment in the Canadian cities were necessary because the ethics committees for the Canadian sites did not authorize researchers to communicate directly with potential participants to invite them to participate.

While the response rate was close to 100% at the Latin American sites and greater than 90% at the Albanian site, the response rate at Canadian sites was approximately 30%. Existing literature suggests that response rates can be expected to be lower at Canadian sites than at other participating research sites (Wong, Pelaez et al. 2006, Galea and Tracy 2007), mostly due to restrictions on direct access to participants.

Data collection methods

Responses to the IMIAS questionnaire were gathered through detailed structured interviews that included a wide range of measures of demographic and socioeconomic variables, self-report of existing medical conditions, life space assessment, health behaviours, quality of life, physical activity, physical development and tests of cognitive function, as well as an assessment of grip strength, vision, and blood pressure. All interviewers received standardized training at each site. All data collection procedures were carried out at the participants' homes, except in Manizales, where vision and physical performance tests were carried out at the local hospital. All procedures, including data collection documents and manuals, are available in local languages.

Exclusion criteria

Participants were excluded if they had four or more errors on the Orientation Scale of the Leganes Cognitive Test (LGT) (De Yebenes, Otero et al. 2003), administered at the beginning of the interview, since in that case they were considered to be incapable of completing the study procedures. In all, nine participants were excluded for this reason: five in Natal, two in Manizales, one each in Saint-Hyacinthe and Tirana, and none in Kingston.

Ethical considerations

The IMIAS study was approved by the research ethics committees of the University of Caldas (Colombia), the Universidad Federal do Rio Grande do Norte (Brazil), the Albanian Institute of Public Health (Albania), Queens University (Canada), and the University of Montreal Hospital Research Centre (Canada). Written informed consent was obtained from all subjects before their participation.

5.2.3.2 Outcomes

This study has two outcomes: mobility disability and poor physical performance. Mobility disability is self-reported difficulty in walking 400 meters or climbing a flight of stairs without resting (Nagi 1976).

Physical performance was assessed using a battery of tests of lower extremity function, the Short Physical Performance Battery (SPPB). This objective measure is a strong predictor of mobility loss in older adults; individuals with low scores are more likely to suffer disability, hospitalizations, and mortality (Guralnik , Ferrucci et al. 1995, Keeler, Guralnik et al. 2010, Seidel, Brayne et al. 2011). SPPB includes three timed tests of lower extremity function: a hierarchical test of standing balance, a four-meter walk, and five repetitive chair stands. For the standing balance test, participants were instructed to maintain a bipedal stance for 10 seconds, followed by a semi-tandem stance for 10 seconds. The gait speed task involved timing a four-meter walk at the participants' normal pace. For those without a four-meter course in their home, a three-meter test was conducted and scoring adjusted accordingly. This test was repeated twice, with the faster of the two walks used. For the chair standing task, participants were first asked to demonstrate their ability to rise once from a chair. If they demonstrated this ability, they were asked to stand up and sit down five times as quickly as possible with their arms folded across their chests. Further details on administering these three tests have been published elsewhere (Guralnik, Simonsick et al. 1994, Guralnik, Ferrucci et al. 1995) and can be viewed on the SPPB website (http://www.grc.nia.nih.gov/branches/leps/sppb/index.htm). Each of the three SPPB components (balance, gait, and chair stands) is scored from 0 to 4,

with 0 indicating inability to perform the test, and 4 indicating the highest category of performance. A summary of participants' physical performance scores was obtained by adding up the scores of all three SPPB components for each participant. Total scores could thus vary from 0 to 12, with higher scores representing better physical performance.

We have validated SPPB in French, Spanish, and Portuguese during previous studies conducted in Quebec, Colombia, and Brazil (Freire, Guerra et al. 2012, Gómez, Curcio et al. 2013). For this study, poor physical performance was defined as a total SPPB score below 8 (Zunzunegui, Alvarado et al. 2015).

5.2.3.3 Exposure

Gender role orientation

Gender roles were measured using the 12-item Short Form of the Bem Sex Role Inventory (BSRI), covering stereotyped traits. This tool was originally developed and tested among a sample of university students from Spain (Mateo and Fernández 1991). The validity of the 12-item BSRI has been demonstrated with Spanish and Brazilian older adults (Carver, Vafaei et al. 2013, Vafaei, Alvarado et al. 2014). In confirmatory factor analysis using IMIAS data, two-factor solutions were extracted from the 12-item BSRI, and the final model has demonstrated acceptable convergent and construct validity for measuring gender roles in older adults .

The 'masculinity' and 'femininity' scores are each the **mean of six item ratings** (**'masculinity or instrumentality'** – has leadership abilities, acts like a leader, is dominant, has strong personality, defends own beliefs, makes decisions easily; **'femininity or**

expressiveness'- tender, warm, affectionate, gentle, sympathetic, sensitive to others needs) (Table 1).

The internal reliability of both scales was acceptable, with Cronbach's α=0.75, and α=0.76 for instrumentality and expressiveness items respectively and for men and women separately (α ranged between 0.73 and 0.78) (Ahmed, Vafaei et al. 2016). BSRI questions were administered to participants using visual aids illustrating a scale from 1 ('never or almost never true') to 7 ('always or almost always true') for each item. The median-split method recommended by Bem was used to dichotomize 'masculinity' and 'femininity' scores; thus, scores greater than or equal to the median score were classified as 'high', those with a score below the median as 'low'. This resulted in four distinct groups, depending on whether individuals scored higher or lower than the median on the 'masculinity' and 'femininity' scales: 'androgynous' [high 'femininity' score (F), high 'masculinity' score (M)]; 'masculine' [high M, low F]; 'feminine' [high F, low M]; or 'undifferentiated' [low M, low F] (Bem 1981). We used the median value of each IMIAS research site to account for site-specific differences.

5.2.3.4 Covariates

Age, sex, marital status, education, income, and study site were considered potential confounders for the association between gender roles and mobility disability in older adults. As people live longer, they are more likely to develop mobility limitations and disability (Guralnik, Lacroix et al. 1993, Ho, Woo et al. 1997, Tilvis, Lallukka et al. 1997). Since the IMIAS population ranges in age from 65 to 74 years, those who were older had greater life experience and belonged to earlier cohorts in their respective countries, which may have affected their personal views of gender role orientation.

Participants were asked if they were single, married, widowed, or divorced. Little is known about the association between gender roles and marital status, but there is a possible link between them. For instance, married men from Japan tended to have higher masculinity than unmarried men (Mori, Nakashima et al. 2002).

Socioeconomic status is associated with gender roles. Men and women with higher education levels and income endorse more egalitarian gender role orientations (Lackey 1989, Crompton and Lyonette 2005). Meanwhile, those endorsing traditional gender roles are characterized by low socioeconomic status (low income and education levels) (Bolzendahl and Myers 2004, Marks, Bun et al. 2009). We used education as a continuous variable to eliminate residual confounding, since the mean years of education varied across sites. Sufficiency of income was self-reported using the following question: 'To what extent is your income sufficient to meet your ends?' The possible responses were very sufficient, sufficient, and insufficient.

Since IMIAS is carried out in five research sites with different cultural, political and economic backgrounds, adjustments were made by research site.

5.2.3.4 Statistical analysis

Data analysis was performed with the IBM Statistical Package for Social Sciences (SPSS) version 22.0 and with STATA version 11.0. We restricted our analyses to participants for whom no data was missing data for any of the BSRI items or any of the covariates. Participants with missing values on any of the BSRI items (n=28) were not different from those included in data analyses in terms of age, sex, years of education, occupation type, income sufficiency, or research site ($p>0.05$). The final sample consisted of 1967 participants across the five IMIAS research sites. Descriptive statistics were obtained for the total sample

by sex. Differences between gender role groups and other covariates by sex were examined statistically using Chi-square tests, T-tests, and ANOVA tests where appropriate.

Bivariate statistics were used to investigate and assess the relationships between gender role groups and the co-variates. A series of Poisson regression models with robust variance was run for the whole IMIAS sample. Poisson regression is preferred over logistic regression when analyzing common binary outcomes in cross-sectional data, because it provides estimation of the prevalence rate ratios with more conservative confidence intervals (Barros and Hirakata 2003). These models assessed the relationship between gender roles and self-reported mobility disability or low physical performance, using the androgynous role as the reference category and adjusting for potential covariates. Multiplicative product terms were added to test for interactions between a) gender role groups and biological sex b) gender roles and research sites, at a statistical significance level of $p<0.05$.

5.2.4 Results

All of the 1967 participants (1025 women and 942 men) were born between 1938 and 1947, and the mean age for men (69.13, 2.92 SD) and women (69.10, 2.80 SD) was approximately similar (Table 2).

The distribution of men and women was not different across research sites ($p=0.95$). Mean years of education was slightly higher for men (10.36, 2.92 SD) than for women (9.06, 5.43 SD). Marital status of participants varied significantly by sex, with fewer men than women reported as single (4.4% vs.7.7%), more men than women married (80% vs. 50.7%), fewer men than women widowed (4.7% vs. 27.4%), and fewer men than women divorced (10.9% vs. 14.4%). Income sufficiency varied significantly by sex: more men than women

reported very sufficient income (33.1% vs. 27.7%), equal proportions of men and women reported barely sufficient income (33.7%), and fewer men than women reported insufficient income (33.2% vs. 38.6%). Men reported higher scores on the masculinity scale than women (mean 4.78 vs. 4.49, $p<0.001$) and lower scores on the femininity scale than women (mean 5.60 vs. 5.88, $p<0.001$).

Gender roles varied significantly by biological sex ($p<0.001$). More men than women were classified as masculine (26% vs. 14.9%) and undifferentiated (28.3% vs 25.4%), and fewer as feminine (14.4% vs 27%). Approximately similar proportions of men and women were classified as androgynous (31.2% vs 32.7%). At all IMIAS research sites, women reported higher prevalence of mobility disability and low physical performance, with the highest prevalence in Tirana, and the lowest at Canadian sites ($p<0.001$) (Figure 1).

Table 3 shows the sex-specific relationships between gender role groups, functional limitations, and all potential confounders. In men, low physical performance was more frequent for the undifferentiated gender role; having very sufficient income was more frequent among the androgynous and masculine types. In women, mobility disability and poor physical performance were more frequent in the undifferentiated type; years of education were highest in the androgynous and lowest in the undifferentiated types; and having very sufficient income was more frequent among androgynous women and less frequent among those in the undifferentiated type.

Table 4 reports the associations between gender roles, mobility disability, and SPPB<8. As information on mobility disability was not available for four people, the sample size for this analysis was n=1963. The unadjusted model shows that, taking androgynous as the reference category, those endorsing the feminine role and those endorsing the

undifferentiated roles were more likely to have mobility disability, with PRR=1.35 (95% CI 1.15;1.58) and PRR=1.34 (95% CI 1.15;1.56) respectively. These prevalence rate ratios changed very little after adjustment by sex.

After adjustment for potential confounders, prevalence rates of mobility disability for participants endorsing undifferentiated roles were higher than for those endorsing androgynous gender roles (adjusted prevalence rate ratio PRR=1.23, 95% CI 1.07-1.42). Similarly, participants endorsing feminine gender roles had higher prevalence rates of mobility disability compared to those with androgynous roles (adjusted PRR=1.19, 95% CI 1.03-1.39). Prevalence rates of participants classified as masculine did not differ from those of androgynous participants (adjusted PRR=1.09, 95% CI 0.93-1.29). To examine whether the associations between gender roles and self-reported mobility varied by sex or across cultural settings, we tested the significance of multiplicative interaction terms. No evidence of interaction between gender roles and sex or research site was detected (p value of multiplicative interaction terms > 0.05). Factors independently associated with mobility disability were being a woman, being single, lower education, insufficient income, and study site. It is noteworthy that controlling for sex did not alter the associations of gender roles and mobility disability. Further adjustment by marital status, education, income and research site slightly decreased the association between gender roles and mobility disability, but did not alter the significance of the results.

Analyses on physical performance were based on 1942 individuals, because 25 subjects were not assessed at the hospital in Manizales. Prevalence rates of poor physical performance for participants endorsing undifferentiated gender roles were higher than for those classified as androgynous (unadjusted PRR=1.57, CI 1.14-2.18). Similarly, those

endorsing feminine gender roles had higher prevalence rates than did androgynous participants (unadjusted PRR=1.79, CI 1.33-2.41). As with the mobility disability models, prevalence rates for participants classified as masculine did not differ from those for androgynous participants. These prevalence ratios estimates changed little after adjusting by sex and remained strong and significant after adjusting for all potential covariates. There was no evidence of multiplicative interaction by sex or research sites.

As age was not associated with gender roles, it was not included in the multivariable regression models.

5.2.5 Discussion

Summary of results

There is abundant evidence showing that women have higher prevalence and incidence of self-reported mobility disability and poor physical performance compared to men. Moreover, the gap between women and men is greater in low and middle income countries, compared with high income countries. However, little is known on whether these sex differences can be explained by gender-stereotyped traits.

In the present study, we were able to test three hypotheses. First, there were significant associations of gender roles with mobility and physical performance of the lower extremities. Second, compared with the androgynous type, feminine or undifferentiated gender roles were positively associated with mobility disability and poor physical performance in older men and women. Contrary to our hypothesis, the endorsement of masculinity traits was not associated with less mobility disability or better physical performance compared to endorsement of the androgynous role. Our findings may be explained by the nature of BSRI-masculinity scale

items which mostly capture positive, culturally desirable self-reported masculine or instrumental traits (e.g., leadership abilities, defend owns beliefs). These traits are not limited or conceptually equal to the term hegemonic masculinity that refers to a dominant type of masculinity among a minority of men, which has helped sustain dominance over women (Connell and Messerschmidt 2005) and has been linked to a variety of risky or unhealthy behaviors (Courtenay 2000). Third, contrary to our hypothesis, these relationships are not modified by sex or by IMIAS research site.

Relevance of study findings

The current findings lend support to the androgyny model (Bem 1974, Bem 1977, Bem 1981), according to which individuals endorsing androgynous roles are expected to exhibit the best overall lifetime health, while those with undifferentiated roles are expected to show the worst health status. Endorsing androgynous roles offers an advantage of greater behavioral adaptability to the diverse situations a person may experience in daily life.

Previous research demonstrates the persistence of traditional gender roles in populations from Canada, Latin America, and South Eastern Europe, with more women adopting socially desirable instrumental traits due to their active participation in the labor force and their communities (Chant and Craske 2003, Silova and Magno 2004, Gale-Ross, Baird et al. 2009, Miluka 2009, Stecklov, Carletto et al. 2010, Särnhult 2014). Based on our results, we hypothesize that older men and women who are endorsing expressive (feminine) traits or undifferentiated gender roles may not be fulfilling their society's expectations, may experience loss of mastery over their own lives, may be more likely to adopt poor health behaviors, and have higher risks of chronic diseases and depression. Consequently, they experience more functional limitations.

Our findings suggest that the strength of the associations between gender roles and mobility and physical function change very little after sex adjustment. Thus, gender-related characteristics do not explain sex differences in functional limitations, but are associated independently with them through different pathways. Therefore, future studies should test other hypotheses on the mediation pathways between gender roles and functional limitations.

The IMIAS study provides an opportunity to examine the association between gender roles and functional limitations in five international samples of older adults. Its international design enables us to examine a wide range of exposures and mobility and physical performance outcomes, Moreover, it allows us to compare prevalence rates and identify the causes for differences in population prevalence rates (Schwartz and Carpenter 1999, Rose 2001). The countries where our research sites are located differed in gender inequality. Canada ranks 25th, Albania 45th, Brazil 97th and Colombia 92nd on the Gender Inequality Index published in 2015 ((UNDP) 2015). These rankings can be used as approximations of the current national indicators of gender inequality for the participating cities. Thus, Canada is more egalitarian, followed by Albania, and then by Colombia and Brazil, sharing approximately the same position.

Contrary to our hypothesis, heterogeneity of effects across research sites was not observed. In a separate stratified analysis by study site (results not shown), gender roles and both measures of functional limitations of lower extremity function were statistically associated, but wider 95% confidence intervals of the PRR were observed, which is expected due to smaller sample sizes.

Strengths and limitations

To the best of our knowledge, this is the first study to investigate the potential contribution of gender roles toward understanding the relationship between gender and functional limitations of the lower extremities in a large international sample of older adults. We used measures of gender role and physical function that were validated either in the IMIAS population or in populations similar to those of the IMIAS study (Nagi 1976, Freire, Guerra et al. 2012, Ahmed, Vafaei et al. 2016). We used both self-reported and objectively assessed measures of physical function of the lower extremities and obtained consistent results.

However, the present study should be considered in light of some limitations. First, as in most cross-sectional studies, we cannot firmly establish the temporal relationship between cause and effect. However, as gender roles are constructed and formed over one's lifetime, from childhood through adulthood to the early old age period, they probably precede the onset of mobility disability and functional decline.

Second, survival bias may have occurred, since life expectancy at birth in the Latin American populations was very low for the included birth cohorts (it was less than 35 years for the IMIAS cohort of men and women in Natal, Brazil) (IBGE 1987). The participants in the study may be the hardiest of their cohorts, and may have an overrepresentation of physically fit and androgynous individuals.

Third, as explained in the methods section, the sample at Kingston (Canada) was overeducated compared with the 2006 Canadian census of this city for the same age group, which may limit the validity of our results in Kingston.

Finally, we cannot exclude possible social desirability bias, since the BSRI allows people to rate themselves on various aspects of common cultural values.

5.2.6 Conclusions

Feminine and undifferentiated gender roles are associated with functional limitations of the lower extremities in older adults. Our findings suggest that gender roles stemming from the social construction of gender are linked to physical function and mobility in early old age. This study sheds light on how gender roles are associated with mobility disability and poor physical performance in older adults. Further research is needed to examine the mediation pathways through which gender-stereotyped traits influence functional limitations, as well as to investigate the longitudinal nature of these associations.

5.2.7 Tables and figures

Table 1. Distribution of Masculinity and femininity scores in IMIAS sample (n=1967).

	Masculinity scores[a] mean (SD) median	**Femininity scores[a] mean (SD) median**
	All sample (n=1967)	**All sample** (n=1967)
Study site		
Kingston (n=393)	5.14 (0.96) 5.17	5.62 (0.85) 5.67
St Hyacinthe (n=392)	4.75 (1.14) 4.83	5.74 (0.75) 5.83
Tirana (n=387)	4.74 (1.12) 4.83	6.15 (0.74) 6.33
Manizales (n=393)	4.22 (1.14) 4.17	5.92 (1.08) 6.33
Natal (n=402)	4.28 (1.30) 4.17	5.32 (0.99) 5.33
	P <0.001[b]	P <0.001[b]

[a] Masculinity and femininity scores were calculated as means of ratings of the 6 items in each scale.
[b] One-way ANOVA for equality of means by study site.

Table 2. Distribution of IMIAS participants according to gender roles and covariates by sex.

	Men (n=942)			Women (n=1025)			
	n	%	Mean (SD)	n	%	Mean (SD)	p-value
Masculinity score	942		4.78 (1.15)	1025		4.49 (1.21)	<0.001
Femininity score	942		5.60 (0.97)	1025		5.88 (0.88)	<0.001
Median split method							<0.001
''Feminine''	136	14.4		277	27.0		
''Masculine''	245	26.0		153	14.9		
''Undifferentiated''	267	28.3		260	25.4		
''Androgen''	294	31.2		335	32.7		
Age	942		69.13 (2.92)	1025		69.10 (2.80)	0.79
Years of education	942		10.36 (6.07)	1025		9.06 (5.43)	<0.001
Marital status							<0.001
Single	41	4.4		79	7.7		
Married	754	80.0		517	50.7		
Widowed	44	4.7		281	27.4		
Divorced	103	10.9		148	14.4		
Income sufficiency							0.01
Very sufficient	312	33.1		284	27.7		
Barely sufficient	317	33.7		345	33.7		

Insufficient	313	33.2	396	38.6	
Study site					0.95
Kingston	184	19.5	209	20.4	
St-Hyacinthe	188	20.0	204	19.9	
Natal	192	20.4	210	20.5	
Manizales	195	20.7	198	19.3	
Tirana	183	19.4	204	19.9	

Table 3. Relationship between BSRI 4 –fold classification, measures of functional limitations, and covariates by sex.

	Men (n= 942)									Women (n= 1025)								
	Feminine		Masculine		Undifferentiated		Androgynous		P value	Feminine		Masculine		Undifferentiated		Androgynous		P value
	n	%	n	%	n	%	n	%		n	%	n	%	n	%	n	%	
Mobility disability [a]																		0.002
Difficulty	41	30.1	64	26.1	80	30.2	66	22.4	0.156	137	49.5	72	47.4	146	56.2	135	40.4	
No difficulty	95	69.9	181	73.9	185	69.8	228	77.6		140	50.5	80	52.6	114	43.8	199	59.6	
Physical performance SPPB [a]									0.04									0.006
< 8	10	7.4	20	8.3	36	13.7	21	7.3		55	20.3	23	15.1	59	22.7	42	12.6	
≥ 8	126	92.6	220	91.7	226	86.3	267	92.7		216	79.7	129	84.9	201	78.7	291	88.4	
Age [b]	136	69.24 (2.97)	245	69.17 (2.89)	267	69.07 (2.88)	294	69.12 (2.97)	0.952	277	69.26 (2.84)	153	69.07 (2.89)	260	68.99 (2.69)	335	69.07 (2.83)	0.702
Marital status [a]									0.152									0.33
Single	6	4.4	8	3.3	17	6.4	10	3.4		19	6.9	15	9.8	24	9.2	21	6.3	
Married	103	75.7	201	82.0	220	82.4	230	78.2		142	51.3	82	53.6	124	47.7	169	50.4	
Widowed	8	5.9	14	5.7	6	2.2	16	5.4		84	30.3	38	24.8	65	25.0	94	28.1	
Divorced	19	14.0	22	9.0	24	9.0	38	12.9		32	11.6	18	11.8	47	18.1	51	15.2	
Years of education [b]	136	10.13 (5.82)	245	10.42 (6.17)	267	9.79 (6.20)	294	10.93 (5.96)	0.158	277	8.90 (5.00)	153	9.11 (5.67)	260	8.38 (5.46)	335	9.70 (5.59)	0.029
Income sufficiency [a]									0.014									0.002
Very sufficient	35	25.7	98	40.0	75	28.1	104	35.4		81	29.2	40	26.1	52	20.0	111	33.1	
Barely sufficient	56	41.2	65	26.5	101	37.8	95	32.3		99	35.7	42	27.5	90	34.6	114	34.0	
Insufficient	45	33.1	82	33.5	91	34.1	95	32.3		97	35	71	46.4	118	45.4	110	32.8	
Study site [a]									0.065									0.203
Kingston	26	19.1	38	15.5	63	23.6	57	19.4		54	19.5	29	19.0	43	16.5	83	24.8	
St-Hyacinthe	32	23.5	48	19.6	42	15.7	66	22.4		59	21.3	34	22.2	55	21.2	56	16.7	
Natal	27	19.9	42	17.1	52	19.5	71	24.1		46	16.6	32	20.9	60	23.1	72	21.5	
Manizales	28	20.6	57	23.3	61	22.8	49	16.7		56	20.2	33	21.6	44	16.9	65	19.4	
Tirana	23	16.9	60	24.5	49	18.4	51	17.3		62	22.4	25	16.3	58	22.3	59	17.6	

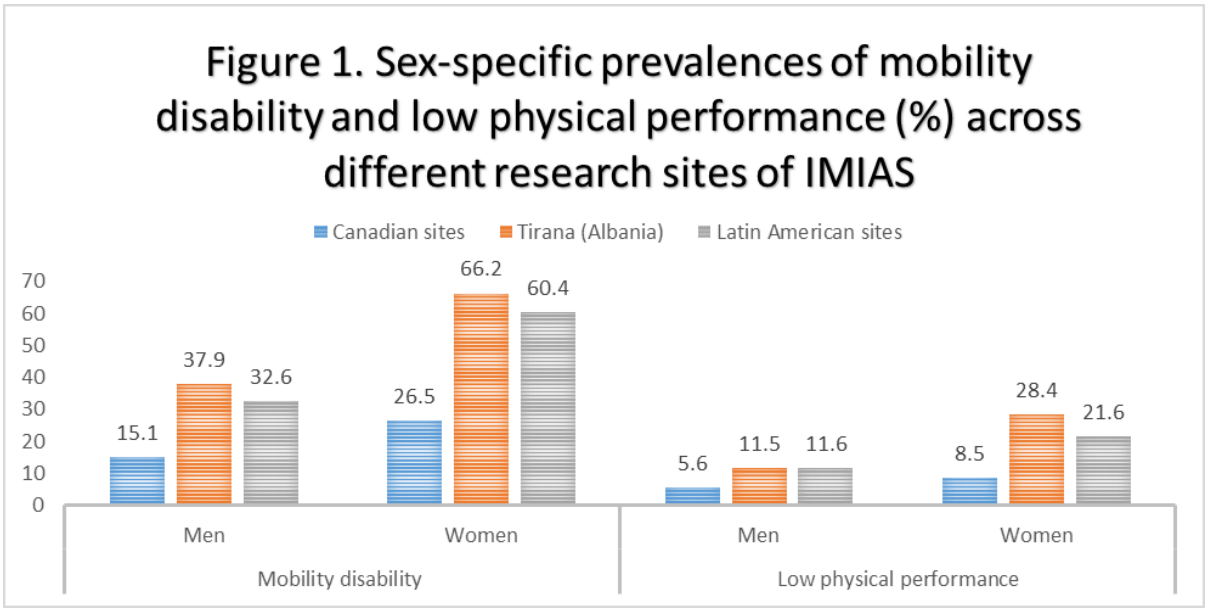
Table 4. Prevalence ratios (95 % confidence interval) for the relationship between gender roles and self-reported mobility disability or poor physical performance using Poisson regression with robust variance.

	Prevalence ratio (95%CI) of self-reported mobility limitations			Prevalence ratio (95%CI) of poor physical performance		
Variables	Unadjusted	Adjusted by sex [a]	Adjusted by all covariates [b]	Unadjusted	Adjusted by sex [a]	Adjusted by all covariates [b]
Gender roles (ref, androgynous)						
Feminine	**1.35 (1.15 – 1.58)*** **	**1.25 (1.07 – 1.46)** **	**1.19 (1.03 – 1.39)***	**1.57 (1.14 – 2.18)** **	**1.46 (1.06 – 2.02)***	**1.42 (1.04 – 1.94)***
Masculine	1.07 (0.90 – 1.28)	1.17 (0.98 – 1.39)	1.09 (0.93 – 1.29)	1.08 (0.75 – 1.56)	1.18 (0.82 – 1.70)	1.13 (0.79 – 1.61)
Undifferentiated	**1.34 (1.15 – 1.56)*** **	**1.37 (1.19 – 1.59)*** **	**1.23 (1.07 – 1.42)** **	**1.79 (1.33 – 2.41)*** **	**1.84 (1.37 – 2.46)*** **	**1.61 (1.20 – 2.15)** **
Sex (ref, men)		**1.79 (1.58 - 2.03)*** **	**1.61 (1.41 – 1.83)*** **		**1.86 (1.46 – 2.36)*** **	**1.53 (1.19 – 1.98)*** **
Marital status (ref, married)						
Single			**1.23 (1.01 – 1.50)***			1.27 (0.80 – 2.02)
Widowed			1.13 (0.99 – 1.28)			1.27 (0.96 – 1.67)
Divorced			1.11 (0.92 – 1.33)			1.31 (0.93 – 1.83)
Years of education			**0.97 (0.96 – 0.99)*** **			**0.96 (0.93 – 0.99)** **
Income sufficiency (ref, very sufficient)						
Barely sufficient			**1.28 (1.07 – 1.52)** **			1.43 (1.00 – 2.06)

Insufficient	**1.57 (1.30 – 1.89)*** **	**1.90 (1.27 – 2.80)** **
Study site (ref, Kingston)		
St-Hyacinthe	0.97 (0.74 – 1.28)	0.73 (0.44 – 1.21)
Tirana	**2.08 (1.63 – 2.63)*** **	**1.88 (1.21 – 2.92)** **
Manizales	1.34 (1.00 – 1.79)	0.64 (0.35 – 1.14)
Natal	1.30 (0.97 – 1.75)	1.28 (0.72 – 2.27)

***p<0.05**
****p<0.01**
*****p<0.001**
[a] Model adjusted for sex only
[b] Model adjusted for sex, marital status, years of education, income sufficiency, and research site.

Figure 1. Sex specific prevalence of mobility disability and low physical performance (%) across different sites of IMIAS.



5.3 ARTICLE 3: Health behaviours and chronic conditions mediate the protective effects of masculinity for physical performance in older adults

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Health behaviours and chronic conditions mediate the protective effects of masculinity for physical performance in older adults

Short title: Gender roles and physical performance in early old age

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5.3.1 Abstract

Background

Associations between gender and physical function have seldom been examined. We estimated the two-year incidence of poor physical performance according to gender roles and examined mediating pathways related to health behaviors and chronic conditions.

Methods

We used data from the International Mobility in Aging Study (n=1676). Masculinity and femininity scores obtained with the Bem Sex Role Inventory were used to classify participants into four gender roles as "Masculine", "Feminine", "Androgynous", and "Undifferentiated". Physical performance was assessed by the Short Physical Performance Battery. Poisson regression models were used to estimate incidence rate ratios (IRR) of poor physical performance according to gender roles. Body mass index, smoking, alcohol consumption, physical activity, chronic diseases, and depression were tested as mediators.

Results

We found a higher incidence of poor physical performance among participants endorsing the feminine role (adj. IRR=2.36, 95% confidence interval (CI) 1.55-3.60) or the undifferentiated role (adj. IRR =2.19, 95% CI 1.45-3.30) compared to the androgynous role. Masculine participants did not differ in the incidence rates from androgynous participants. An increase of one unit in the masculinity score was associated with lower incidence of poor physical performance (adj. IRR=0.76, 95% confidence interval (CI) 0.67-0.87). Cumulative smoking, physical activity, number of chronic diseases, high body mass index and depression were mediating pathways of this association.

Conclusion

This study provides evidence that gender roles are independently associated with physical performance and masculinity may be protective. Gender roles influence health behaviors which in turn lead to chronic conditions and faster decline of physical performance.

Keywords

Gender roles, Bem Sex Role Inventory, physical function, longitudinal studies, mediation analysis, global health, aging.

5.3.2 Introduction

Functional limitations are defined as restrictions in performing fundamental physical actions (Verbrugge and Jette 1994). Two aspects have been differentiated: restrictions associated with upper extremity function (e.g., reaching up) and lower extremity function (e.g., walking) (Lawrence and Jette 1996). Lower extremity functional limitation is a precursor of further functional decline (Guralnik, Ferrucci et al. 1995, Lawrence and Jette 1996, Dunlop, Hughes et al. 1997). According to Verbrugge and Jette 's disablement model, those who experience mobility limitations are prone to develop severe disability (Verbrugge and Jette 1994, Gill, Williams et al. 1995, Guralnik, Ferrucci et al. 1995).

Verbrugge and Jette introduced innovations and extensions to previous works developed by Nagi (Nagi 1981) in a conceptual model called " The disablement process" that included envirnonmental factors (Verbrugge and Jette 1994). The main pathway in the disablement process is described as follows: Pathology leads to impairment, which in turn leads to functional limitations, which leads to disability (Guralnik and Simonsick 1993, Ostir, Carlson et al. 1999). Because poor physical performance of lower extremities precedes disability, a full understanding of its predictors is potentially useful for better understanding of the disablement process. Verbrugge and Jette demonstrated in their model that there are intra- and inter-individual factors that can play a role in slowing or delaying the progression from pathology to functional limitations and consequently to disability (Verbrugge and Jette 1994). Intra-individual factors include behaviors such as smoking, leisure activities, physical activity, psychosocial and coping attributes (e.g., self-efficacy, social engagement, and gender roles), and activity accommodation. Inter-individual factors include variations in medical care &

rehabilitation, therapeutic regimens, medications, social networks, adaptive equipment, modifications at work or home, and public transportation.

Alternative frameworks to examine disability have been recently reviewed (Guralnik, Patel et al. 2012). In 2001, the World H-ealth Organization (WHO) has updated a model called the International Classification of Functioning, Disability, and Health (ICF) that illustrated disability and handicap with a framework that incorporates new terminology and less focused on the disablement process (WHO 2001, Jette 2006). More recently in 2011, research teams of the National Health and Aging Trend Study (NHATS) developed a new model that is based on both Nagi and the WHO framework (Freedman 2009). In this work, we use the original Verbrugge & Jette model of the disablement process.

Over the past decades, the concept of gender role orientation has been introduced as a psychological measure when studying gender differences in health. Gender role orientation refers to masculinity and femininity as co-existing self-concepts and not the opposite poles of a continuum. According to the Bem Sex Role Inventory (BSRI), individuals who endorse high masculinity and femininity are classified as "androgynous", high masculinity and low femininity as"masculine," high femininity and low masculinity as "feminine", and those low in both as "undifferentiated" (Bem 1981).

Little is known about the longitudinal relationship and the mediating pathways between gender roles and physical performance of lower extremities. Baseline cross-sectional analysis of the International Mobility in Aging Study (IMIAS) showed that compared to androgynous gender roles, undifferentiated and feminine roles are associated with a higher prevalence rate of mobility disability and poor physical performance (Ahmed, Vafaei et al. 2016). Because poor physical performance is a stage that precedes disability within the context

of the disablement model (Verbrugge and Jette 1994) , the objective of this paper is to examine the incidence of poor physical performance associated with gender roles and mediating pathways related to health behaviors and chronic conditions after two years of follow-up in the IMIAS study.

5.3.3 Methods

5.3.3.1 Study design and recruitment

We use data from IMIAS. Objectives and study design have been reported in previous publications (Belanger, Ahmed et al. 2015, Zunzunegui, Alvarado et al. 2015, Ahmed, Vafaei et al. 2016). The purpose of the IMIAS study is to assess and examine gender differences in mobility and physical function using a life course perspective and a longitudinal design. Briefly, baseline data were collected in 2012, with follow-up in 2014 and a second ongoing follow up in 2016 at the time of this writing. Participants with ages between 65 and 74 were recruited from five sites (Kingston, and Saint-Hyacinthe, Canada; Tirana, Albania; Manizales, Colombia; and Natal, Brazil) from lists of registered people at local health neighborhood centers.

Study Samples. Research site contextual information and details of the sample recruitment were published previously (Zunzunegui, Alvarado et al. 2015). The 2012 baseline sample included 2004 participants. In this paper, analysis of 2014 follow-up cohort study was conducted (Figure 1).

To qualify for this prospective analysis, we excluded: (1) nine participants who had 4 or more errors in the Orientation Scale of the Leganes Cognitive Test (LCT) at baseline (De Yebenes, Otero et al. 2003), since they were considered to be unable to complete study

procedures. (2) twenty-eight participants with any missing values on any of the BSRI scale items at baseline. (3) twenty-five participants who had missing physical performance measures at baseline. (4) Two hundred sixty-six participants who had a poor physical performance at baseline, defined by a score lower than 8 in the Short Physical Performance Battery (SPPB). Among the 1676 participants who had a baseline SPPB score ≥8, thirty-seven (2.21%) had died between 2012 and 2014. Sixty-two participants (3.7%) were lost to follow-up in 2014, and one hundred eleven (6.62%) refused to participate in 2014, leaving 1455 participants for whom complete data on both gender roles and physical performance were available.

5.3.3.2 Exposure Assessment

Gender roles were measured using an abbreviated 12-item Short Form of the Bem Sex Role Inventory (BSRI) (Mateo and Fernández 1991). Acceptable validity and psychometric properties of this inventory have been demonstrated in two pilot studies (Carver, Vafaei et al. 2013, Vafaei, Alvarado et al. 2014) and among IMIAS participants (Ahmed, Vafaei et al. 2016).

BSRI was administered to participants using a card with visual aids demonstrating a scale from 1-- 'never or almost never true' to 7--'always or almost always true' for each item; it comprises six items denoted as masculine or instrumental scale (leadership abilities, act like a leader, dominant, strong personality, defend own beliefs, make decisions easily) and six items denoted as feminine or expressive scale (affectionate, gentle, sympathetic, sensitive to others needs, tender, warm). The Cronbach's alpha reliability coefficient for the masculine scale was 0.75 and for the feminine scale was 0.76, demonstrating acceptable internal reliability (Ahmed, Vafaei et al. 2016). The masculinity and femininity scores are each the

mean ratings of the six items of the corresponding scale. Four groups were created using the median split method as proposed by Bem (Bem 1981). Scores higher than or equal to the median were classified as 'high' and those below the median as 'low'. The resulting groups are: Masculine (high masculinity, low femininity); Feminine (high femininity, low masculinity); androgynous (high masculinity and femininity); and undifferentiated (low masculinity and femininity) (Bem 1981). We used the median value of each research site of IMIAS to account for site-specific differences.

5.3.3.3 Outcome assessment

Lower-extremity function was assessed using the Short Physical Performance Battery (SPPB) (Guralnik, Ferrucci et al. 1995). Participants were evaluated on timed tests of standing balance, walking speed, and rising from a chair five times. More details on the administration of the SPPB have been published elsewhere (Guralnik, Simonsick et al. 1994, Guralnik, Ferrucci et al. 1995); it can be consulted on its website (http://www.grc.nia.nih.gov/branches/leps/sppb/index.htm). Each component provides a score from 0 to 4. When the three domains are added to form a summary score, the range is 0 to 12 points, with higher scores indicating better function. We have previously used SPPB < 8 to distinguish the lower end of the physical performance distribution (Pirkle, de Albuquerque Sousa et al. 2014, Sousa, Guerra et al. 2014, Zunzunegui, Alvarado et al. 2015).

5.3.3.4 Covariates

The following potential confounders collected at baseline were used as covariates in all analyses: sex, age group (65-69, 70-74 years), education, income sufficiency, baseline SPPB scores and research site. School education was categorized into primary, secondary, and post-

secondary. Income sufficiency was coded from the answer to the question: To what extent is your income sufficient to meet your ends? Possible answers were very sufficient, sufficient, and insufficient.

5.3.3.5 Mediators

We tested the mediation pathways between gender roles and poor physical performance for Body Mass Index (BMI), smoking status (number of cigarettes smoked in lifetime), alcohol consumption (number of drinks/day multiplied by number of days per week), physical activity (volume of walking per day at a regular pace in kilometers over the past week; This variable was then transformed using a square root function to normalize the data) (Marsh, Ip et al. 2011, Marsh, Janssen et al. 2015) , the number of self-reported chronic diseases (hypertension, diabetes, lung diseases, cancer, stroke, heart diseases, arthritis, and osteoarthritis) and depression status assessed by the CES-D (Radloff 1977). Potential mediators were selected because they are recognized risk factors for poor physical performance (LaCroix, Guralnik et al. 1993) and could be at least partly determined by gender roles.

5.3.3.6 Statistical analysis

Differences between gender role groups, covariates, and mediators by physical performance were examined using Chi-square tests, and T-tests where appropriate. Covariates and mediators were assessed as predictors of incident poor physical performance at 2014 follow-up, using univariate Poisson regression analysis with robust variance. We built a directed acyclic graph (DAG) to identify confounders and mediators of the relationship between gender roles and physical performance, using DAGitty (S1 Fig) (Textor, Hardt et al.

2011). Vectors were drawn for each effect a variable is expected to have on other variables.The multivariate Poisson regression models were performed in four steps using gender role groups or masculinity and femininity scores as independent variables: (1) model 1 : unadjusted model ; (2) model 2 : adjusted for sex; (3) model 3 (total effects): adjusted for confounders i.e. sex, age, marital status, years of education, income sufficiency, baseline SPPB scores and research sites; (4) model 4 (direct effects): adjusted for confounders and mediators i.e. BMI, smoking , alcohol consumption to estimate the direct effects (Textor, Hardt et al. 2011). All statistical analyses were performed using the IBM Statistical Package for Social Sciences (SPSS) v22.0. A two-tailed $p < 0.05$ indicated statistical significance. To examine whether the associations between gender roles and physical performance were modified by sex or across research sites, we tested the significance of multiplicative interaction terms. Lastly, taking account the possible differences in associations between countries, we have conducted a meta-analysis to estimate overall effects of masculinity and femininity scores on physical performance based on the five distinct studies using identical methods.

For mediation analysis, we used an analytical technique which can simultaneously test the effects of multiple serial mediators and can determine the magnitude of the mediator's specific indirect effect in relation to each other (Preacher and Hayes 2008). This approach, developed by Preacher and Hayes, uses a bootstrapping technique for testing multiple mediation that does not impose the assumption of a normal distribution of the sample and ensures high power and adequate control for type I error (MacKinnon, Lockwood et al. 2002, MacKinnon, Lockwood et al. 2004, Preacher and Hayes 2008).

We tested four serial mediation pathways based on the disablement model (Verbrugge and Jette 1994): (1) Gender roles-----> BMI ------> Chronic diseases -----> Depression ----> Physical performance; (2) Gender roles-----> BMI ------> Physical activity -----> Chronic diseases ----> Physical performance; (3) Gender roles-----> cumulative smoking ------> Chronic diseases -----> Depression ----> Physical performance; (4) Gender roles-----> Alcohol consumption ------> Chronic diseases -----> Depression ----> Physical performance. Mediating effects were estimated after adjusting for potential confounders (S2 Fig)

We obtained the direct, indirect, and total effects of X (exposure) on Y (outcome). We bootstrapped the indirect effects of gender roles on physical performance using the SPSS Process macro, a computation procedure for serial mediation analysis (Hayes 2012). The bootstrap estimates are based on 1000 bootstrap samples. We used 95% bias-corrected and accelerated confidence intervals to estimate the significant effect of serial mediators. (Hayes 2012).

5.3.4 Results

5.3.4.1 Baseline characteristics and incidence rate of poor physical performance

A total of 1455 participants were included in the study; 717 (49.3%) men and 738 (50.7%) women. (Table 1).

About half of the participants (45.1%) had finished post-secondary education and finished secondary school (23.5%). More than half of the participants were married (67.3%). About one-third of participants had insufficient (32.6 %) or barely sufficient income (34.3%). The distribution of gender roles was as follow: undifferentiated (26.4%); masculine (20.7%); feminine (20.9%) and androgynous type (32%). At the 2012 baseline, the prevalence of BMI ≥

25, current smoking, ≥ 5 alcoholic drinks/week, multimorbidity, and depression among study participants were 69.3%, 10.3%, 15.5%, 84%, and 15.3%, respectively. Baseline distributions of gender roles, masculinity and femininity scores, education, marital status, income, SPPB, BMI, smoking status, alcohol consumption, physical activity, chronic diseases, and depression showed significant differences between men and women ($p<0.05$)).

5.3.4.2 Univariate analyses

Higher age, being single, having only primary school education, having insufficient income, being from Tirana, Manizales, or Natal, having class II obesity and above (BMI ≥35), consuming ≥ 5 alcoholic drinks per week, having chronic diseases, or depression were significantly associated with incident poorer physical performance (Table 2).

A one-unit increase in the walking distance (in kilometer) over the past week or the baseline SPPB score were significantly associated with lower incidence of poor physical performance. Sex and smoking did not show significant associations with incident poor physical performance ($p>0.05$).

5.3.4.3 Multivariable analyses

In multivariable Poisson regression models, incidence rates of poor physical performance in those participants endorsing undifferentiated gender roles were higher than those classified as androgynous (unadjusted incidence rate ratio; IRR=2.65, CI 1.72-4.1) (Table 3).

Similarly, those endorsing feminine gender roles were higher in incidence rates compared to androgynous participants (unadjusted IRR=2.78, CI 1.78-4.35). Participants classified as masculine did not differ in the incidence rates from androgynous participants.

Higher masculinity but not femininity scores were associated with lower risk of poor physical performance (unadjusted IRR of poor physical performance per one-unit increase in the masculinity scores =0.69, CI 0.61-0.79). Incidence ratios estimates changed little after adjusting for sex and remained strong and significant after adjusting for all potential confounders and mediators. Multiplicative interactions by sex or research settings were not observed (p-value of multiplicative interactions > 0.05). In the meta-analysis of site-specific analyses, masculinity scores predicted good physical performance after adjusting for femininity scores, age, sex, marital status, education, income, and baseline scores in the SPPB. The pooled incidence rate ratio was IRR = 0.77 (95% CI = [0.68, 0.87]; *p*-heterogeneity = .657); the corresponding figures for femininity scores were IRR = 1.02 (95% CI = [0.86, 1.21]; *p*-heterogeneity = .331) adjusting for masculinity scores and other potential confounders (see S3 and S4 figures).

5.3.4.4 Mediation analyses

Since only higher masculinity scores were associated with lower risk of poor physical performance, we tested four serial mediation pathways between masculinity scores and physical performance. Figure 2, 3, 4, and 5 show the estimated coefficients' total effects, direct effects, and statistically significant indirect pathways after adjusting for confounders.

Higher masculinity scores were statistically associated with higher physical performance (total and direct effects). By examining 95% bias-corrected estimates of the confidence intervals, masculinity has an indirect effect on physical performance in three pathways through BMI, chronic diseases, and depression (Figure 2). In the first statistically significant pathway, a one-unit increase in masculinity was associated with an increase in the

BMI (estimated coefficient=0.3449) which consequently led to lower SPPB scores (estimated coefficient=-0.0289) with an overall indirect effect of -0.01 (CI -0.0218, -0.0032). The association between masculinity and physical performance was statistically significant through the serial mediating effect of BMI---> chronic diseases -----> depression, or through depression only. Similarly, masculinity has an indirect effect on physical performance in three pathways through BMI, and physical activity (Figure 3). Cumulative smoking was another significant indirect pathway (Figure 4). The serial mediating effect of cumulative smoking and depression was also significant. Alcohol consumption was not a significant mediator of the pathway between masculinity and physical performance (Figure 5).

5.3.5 Discussion

We examined the associations between gender role orientations and transition to poor physical performance and explored possible pathways explaining these associations. Consistent with our previous cross-sectional study (Ahmed, Vafaei et al. 2016), gender roles predicted physical performance of the lower extremities. Compared with the androgynous role, endorsing feminine or undifferentiated gender roles at baseline predicted poor physical performance after two years in a population with fair, good or very good physical performance at baseline (SPPB ≥8). Those who identified with masculine roles were not different from androgynous participants in two-year risk of poor physical performance. Higher masculinity but not femininity scores predicted good physical performance two years later. Examining pathways described in the disablement model (Verbrugge and Jette 1994), gender role orientations were associated with physical performance through behavioral and pathological mechanisms. Gender roles predicted poor physical performance through statistically significant direct and indirect pathways. Cumulative smoking, BMI, physical

activity, multimorbidity, and depression were serial mediators explaining the indirect effect of gender roles on physical performance. A major finding of the current study is that the intermediate behavioral and pathological pathways only partially mediated the observed associations. None of the potential serial mediators in the present study could completely account for the association between gender roles and physical performance.

Lending further support to the disablement model, high BMI was associated with lower physical activity level, which in turn contributed to a higher number of chronic diseases (Warburton, Nicol et al. 2006, Han, Tajar et al. 2011), depression (Strawbridge, Deleger et al. 2002) and finally to functional limitations (LaCroix, Guralnik et al. 1993). Smoking was also associated with chronic diseases (Strong, Mathers et al. 2005) and depression (Almeida and Pfaff 2005) which in turn led to functional limitations (LaCroix, Guralnik et al. 1993). Consistent with previous research (LaCroix, Guralnik et al. 1993), we found an association between high alcohol consumption and poor physical performance of the lower extremities in the bivariate analysis. However, our mediation model did not support that alcohol consumption is a pathway between gender roles and physical performance.

Results from the current study lend further credence to the androgyny model (Bem 1974, Bem 1977, Bem 1981), and provide insights into the contribution of gender roles to physical performance in old age. Our findings highlight the need to target gender-related characteristics in the prevention of poor physical performance and subsequent disability, in addition to a well-established set of risk factors.

To the best of our knowledge, this is the first prospective study to demonstrate these findings, showing prospective associations and examining pathways between gender role orientations and physical functioning in an international sample. We used validated measures

of both gender roles and physical performance in older adults (Guralnik, Ferrucci et al. 1995, Freire, Guerra et al. 2012, Ahmed, Vafaei et al. 2016). Given the relatively large sample size of the IMIAS population and the prospective design, we were able to exclude those with baseline poor physical performance. These, in turn, diminished the likelihood of reverse causality after adjustment by potential confounders. Furthermore, our potential serial mediators were selected following the concepts outlined in the disablement model.

Never the less, the present study does have limitations. First, as gender roles and the potential mediators were measured at the same time point, and the outcome was measured two years later, we cannot completely disentangle the direction of causality. Future observational studies with multiple time-points are warranted to further assess these pathways and confirm the results of our mediation analysis. Second, although a range of potential confounders was considered, residual confounding might exist for those measurements that relied on self-reported variables of categorical nature. In an attempt to minimize it, we used continuous variables in the multivariate models (Szklo and Nieto 2012). Third, we cannot exclude possible highest survival with possible over-representation of the physically fittest and androgynous subjects (IBGE 1987). Fourth, confidence intervals for the relative risk estimated in site-specific analyses are sometimes wide. Sample size at each research site (n ranging between 248 and 315) may be insufficient to examine associations in models with a large number of co-variables and can lead to imprecision. Despite these limitations, meta-analysis results demonstrated consistency of associations across research sites of IMIAS with absence of heterogeneity of effects.

In conclusion, feminine and undifferentiated gender roles were associated with incident poor physical performance, while higher masculinity scores predicted good physical

performance. Prospective associations of gender roles with physical performance was independent of biological sex, age, marital status, education, income, baseline physical performance, and research sites. Furthermore, a range of intermediate behavioral and pathological risk factors only partially mediated these associations. Further prospective population-based studies, with longer duration of follow-up, are needed to extend and confirm present results.

Ethical considerations. IMIAS was approved by the research ethics boards of the University of Montreal Hospital Research Centre, Queens University, the Albanian Institute of Public Health, Universidad de Caldas, the Universidade Federal do Rio Grande do Norte. Written informed consent was obtained from all research subjects before their participation.

KEY MESSAGES

What is already known:

- Women have higher prevalence and incidence of functional limitations of the lower extremities than men.
- There are significant differences in the magnitude of these differences between men and women across countries.
- Gender roles have been associated with mobility disability and poor physical performance in the previous baseline survey of our longitudinal study.

What this article adds:

- Participants who identify with gender role traits defined as “feminine” or “undifferentiated” are at higher risk of poor physical function compared with those who are “androgynous”.
- High masculinity scores predict good physical performance two years later.
- Biological sex and social context are not effect modifiers in these prospective relationships.
- Gender roles influence health behaviors which in turn lead to chronic diseases and decline in physical function of lower extremities.
- Gender roles have direct effects on physical performance, in addition to the identified mediation pathways.

5.3.6 Tables and figures

Table 1. Sample characteristics of study participants according to poor physical performance at 2 years follow up.

	Poor physical performance (SPPB <8) (n=1455)						
Variables	**Total**		**No**		**Yes**		**P value**
	n	**%**	**n**	**%**	**n**	**%**	
Gender roles							**<0.001**
Undifferentiated	384	26.4	325	25	59	38.1	
Masculine	301	20.7	281	21.6	20	12.9	
Feminine	304	20.9	255	19.6	49	31.6	
Androgynous	466	32	439	33.8	27	17.4	
Confounders							
Age							**0.001**
64-69	833	57.3	763	58.7	70	45.2	
70-75	622	42.7	537	41.3	85	54.8	
Sex							**0.154**
Men	717	49.3	649	49.9	68	43.9	
Women	738	50.7	651	50.1	87	56.1	
Marital status							**0.04**
Single	89	6.1	72	5.5	17	11	
Married	979	67.3	877	67.5	102	65.8	
Widowed	218	15.0	195	15	23	14.8	
Divorced	169	11.6	156	12	13	8.4	
Education							**<0.001**
Primary	457	31.4	384	29.5	73	47.1	
Secondary	342	23.5	308	23.7	34	21.9	

Post-secondary	656	45.1	608	46.8	48	31	
Income sufficiency							**<0.001**
Very sufficient	481	33.1	446	34.3	35	22.6	
Barely sufficient	499	34.3	454	34.9	45	29	
Insufficient	475	32.6	400	30.8	75	48.4	
Baseline SPPB scores			1300	10.49 [b] (1.21)	155	9.18[b] (1.18)	**<0.001**
Study site							**<0.001**
Kingston	300	20.6	283	21.8	17	11	
St-Hyacinthe	315	21.6	303	23.3	12	7.7	
Tirana	286	19.7	243	18.7	43	27.7	
Manizales	306	21	249	19.2	57	36.8	
Natal	248	17	222	17.1	26	16.8	
Mediators							
BMI							**0.008**
< 18.5	29	2.0	24	1.9	5	3.3	
18.5-24.9	409	28.6	374	29.3	35	23	
25-29.9	619	43.3	562	44	57	37.5	
30-34.9	272	19	236	18.5	36	23.7	
≥ 35	100	7	81	6.3	19	12.5	
Smoking status							**0.06**
Never	681	46.8	605	46.6	76	49	
Former	623	42.8	567	43.6	56	36.1	
Current	150	10.3	127	9.8	23	14.8	

Alcohol consumption							**0.024**
1-2 drinks/week	769	72.4	707	73.6	62	61.4	
3-4 drinks/week	128	12.1	113	11.8	15	14.9	
≥ 5 drinks/week	165	15.5	141	14.7	24	23.8	
Physical activity[a]			1248	2.58[b] (1.65)	152	1.91[b] (1.36)	**<0.001**
History of chronic diseases							**0.001**
No (0-1)	233	16	222	17.1	11	7.1	
Yes (2+)	1222	84	1078	82.9	144	92.9	
Depression status							**<0.001**
CESD < 16	1233	84.7	1121	82.6	112	72.3	
CESD ≥ 16	222	15.3	179	13.8	43	27.7	

[a] physical activity was calculated as the square root of the volume of walking at usual pace in km over the past week

[b] Mean (SD)

Table 2. Predictors of incident poor physical performance at 2-years follow up in IMIAS.

Poor physical performance (SPPB<8)					
Variables	Total	Incidence	Univariate Poisson regression analysis		
	n	(%)	IRR	(95% CI)	p
Confounders					
Age					
64-69	833	8.4	1	(reference)	
70-75	622	13.7	1.56	(1.16-2.10)	**0.003**
Sex					
Men	717	9.5	1	(reference)	
Women	738	11.8	1.25	(0.93-1.68)	**0.145**
Marital status					
Single	89	19.1	1.83	(1.15-2.92)	**0.011**
Married	979	10.4	1	(reference)	
Widowed	218	10.6	1.05	(0.69-1.60)	**0.810**
Divorced	169	7.7	0.78	(0.46-1.33)	**0.363**
Education					
Primary	457	16.0	2.16	(1.53-3.04)	**<0.001**
Secondary	342	9.9	1.35	(0.89-2.06)	**0.156**
Post-secondary	656	7.3	1	(reference)	
Income sufficiency					
Very sufficient	481	7.3	1	(reference)	
Barely sufficient	499	9.0	1.23	(0.81-1.88)	**0.334**
Insufficient	475	15.8	2.18	(1.49-3.19)	**<0.001**
Baseline SPPB scores			0.48	(0.43-0.55)	**<0.001**

Study site					
Kingston	300	5.7	1	(reference)	
St-Hyacinthe	315	3.8	0.67	(0.33-1.38)	**0.281**
Tirana	286	15.0	2.65	(1.55-4.54)	**<0.001**
Manizales	306	18.6	3.20	(1.91-5.37)	**<0.001**
Natal	248	10.5	1.85	(1.03-3.33)	**0.04**
Mediators					
BMI					
< 18.5	29	17.2	1.93	(0.82-4.54)	**0.131**
18.5-24.9	409	8.6	1	(reference)	
25-29.9	619	9.2	1.01	(0.68-1.50)	**0.954**
30-34.9	272	13.2	1.48	(0.96-2.29)	**0.074**
≥ 35	100	19.0	2.13	(1.28-3.54)	**0.004**
Smoking status					
Never	681	11.2	1	(reference)	
Former	623	9.0	0.81	(0.58-1.12)	**0.193**
Current	150	15.3	1.34	(0.87-2.07)	**0.180**
Alcohol consumption					
1-2 drinks/week	769	8.1	1	(reference)	
3-4 drinks/week	128	11.7	1.45	(0.85-2.48)	**0.169**
≥ 5 drinks/week	165	14.5	1.71	(1.10-2.67)	**0.017**
Physical activity [a]			0.95	(0.93-0.98)	**0.001**
History of chronic diseases					
No (0-1)	233	4.7	1	(reference)	
Yes (2+)	1222	11.8	2.57	(1.41-4.67)	**0.002**

Depression status					
CESD < 16	1233	9.1	1	(reference)	
CESD ≥ 16	222	19.4	2.16	(1.57-2.97)	**<0.001**

[a] physical activity was calculated as the square root of the volume of walking at usual pace in km over the past week

Table 3. Incidence ratios (95 % confidence interval) for the relationship between gender roles (four-fold classification and continuous scores) and poor physical performance after 2 years of follow-up using Poisson regression with robust variance.

Incidence rate ratio IRR (95%CI) of poor physical performance (n=1455)								
	Model 1 [a]		Model 2 [b]		Model 3 [c]		Model 4 [d]	
	Unadjusted IRR (confidence interval)		Adjusted IRR (confidence interval)		Adjusted IRR (confidence interval)		Adjusted IRR (confidence interval)	
	(p value)		(p value)		(p value)		(p value)	
"Four-fold Classification"								
"Androgynous"	**1.00**		**1.00**		**1.00**		**1.00**	
"Undifferentiated"	**2.65 (1.72 – 4.10)**	(<0.001)	**2.67 (1.73 – 4.14)**	(<0.001)	**2.19 (1.45 – 3.30)**	(<0.001)	**2.09 (1.28 – 3.40)**	(0.003)
"Masculine"	1.15 (0.66 – 2.01)	(0.632)	1.17 (0.67 – 2.05)	(0.581)	1.04 (0.61 – 1.79)	(0.884)	0.88 (0.46 – 1.67)	(0.686)
"Feminine"	**2.78 (1.78 – 4.35)**	(<0.001)	**2.72 (1.74 – 4.27)**	(<0.001)	**2.36 (1.55 – 3.60)**	(<0.001)	1.71 (0.98 – 2.99)	(0.061)
"Continuous scores"								
Masculinity score [e]	**0.69 (0.61 – 0.79)**	(<0.001)	**0.70 (0.61 – 0.79)**	(<0.001)	**0.76 (0.67 – 0.87)**	(<0.001)	**0.75 (0.63 – 0.90)**	(0.002)
Femininity score [e]	1.10 (0.92 – 1.31)	(0.282)	1.09 (0.82 – 1.51)	(0.342)	1.03 (0.88 – 1.21)	(0.698)	0.99 (0.81 – 1.22)	(0.954)

[a] Model 1: unadjusted model.
[b] Model 2: adjusted for sex.
[c] Model 3 (total effects): adjusted for sex, Age, marital status, years of education, income sufficiency, research site and baseline SPPB scores.
[d] Model 4 (direct effects): adjusted for sex, Age, marital status, years of education, income sufficiency, research site, baseline SPPB scores, BMI, smoking status, alcohol consumption.
[e] Masculinity and femininity scores were calculated as means of ratings of the 6 items in each scale.

Figure 1. Flow of participants through the IMIAS study.

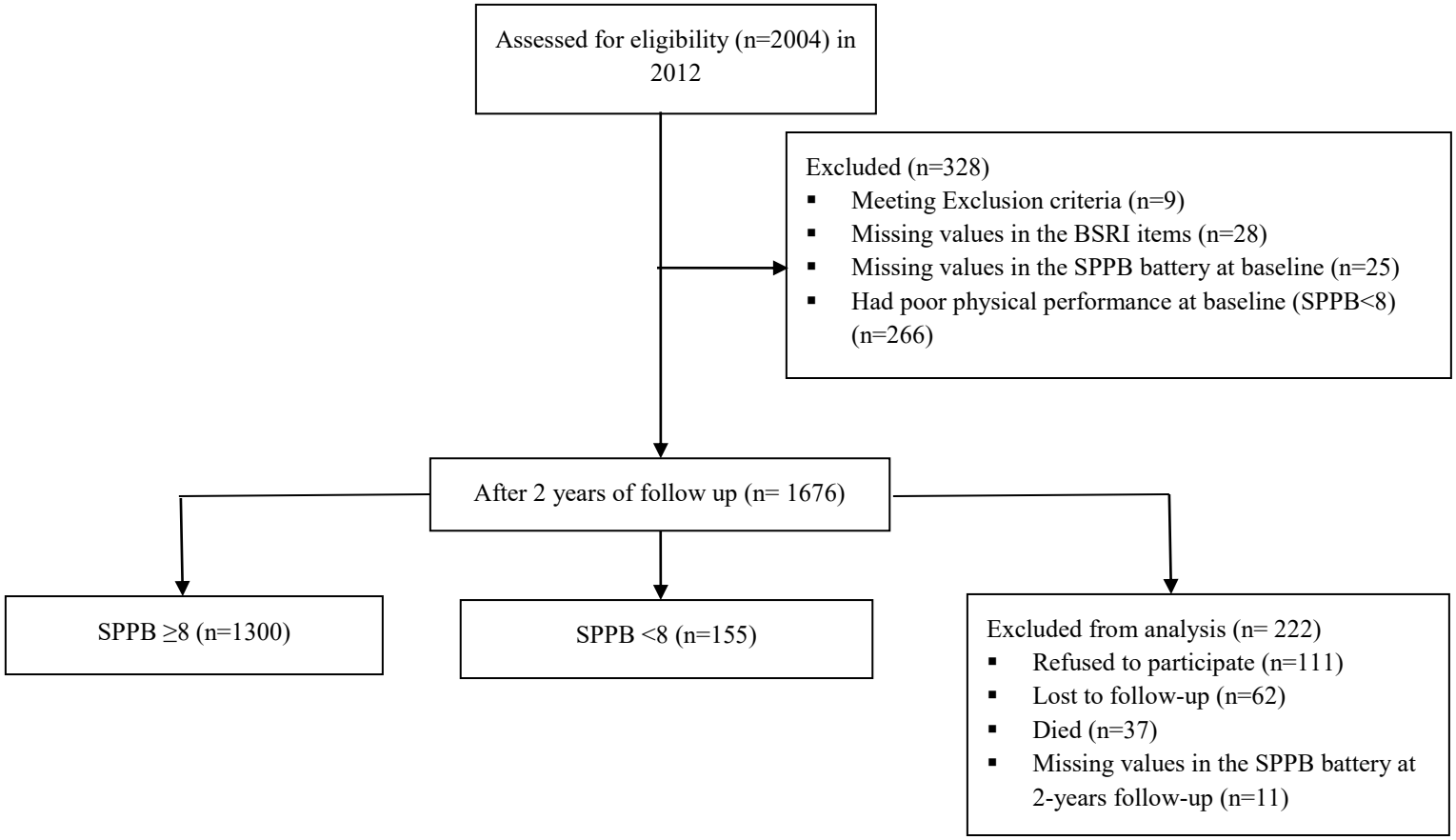


Figure 2. Results of the serial mediation analysis of the pathways between masculinity and physical performance scores through BMI, chronic diseases, and depression.

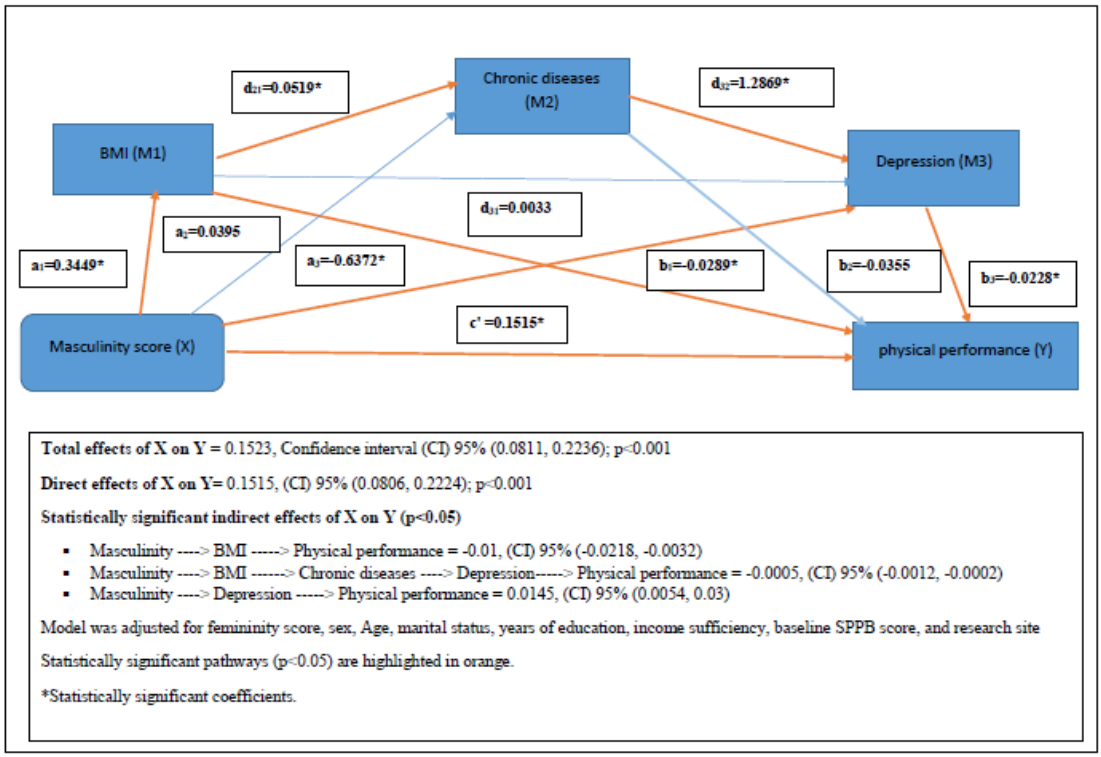


Figure 3. Results of the serial mediation analysis of the pathways between masculinity and physical performance scores through BMI, physical activity, and chronic diseases.

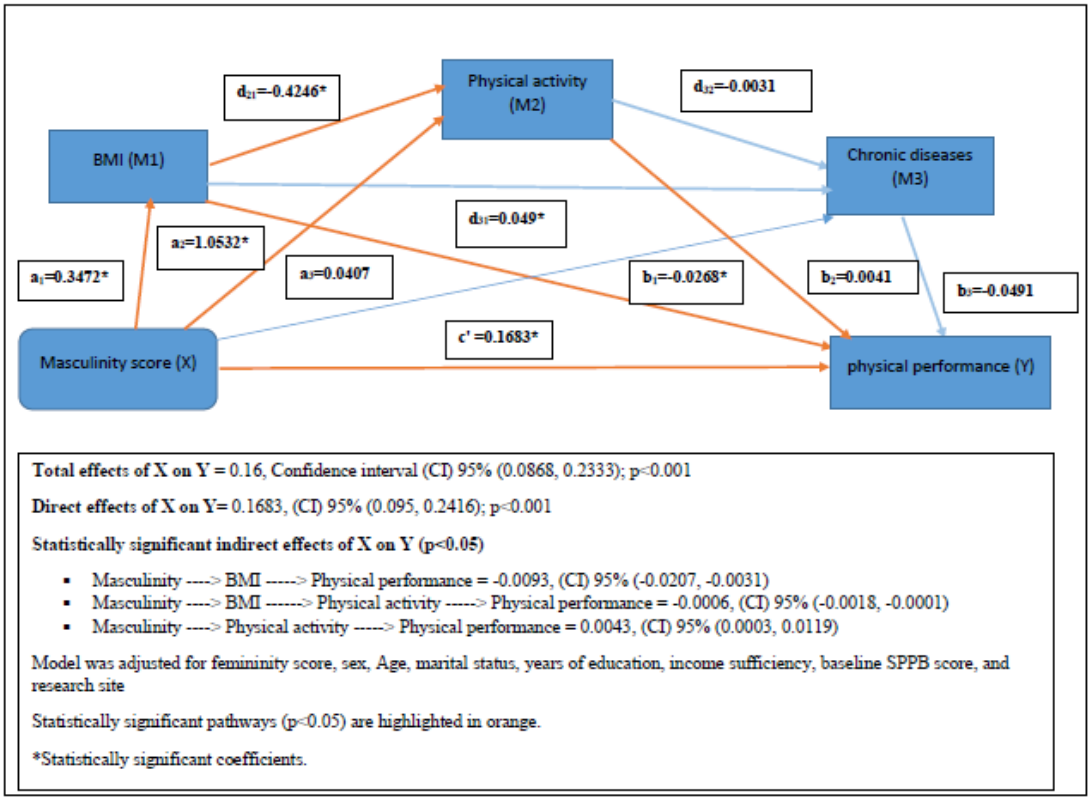


Figure 4. Results of the serial mediation analysis of the pathways between masculinity and physical performance scores through cumulative smoking over the past years, chronic diseases, and depression.

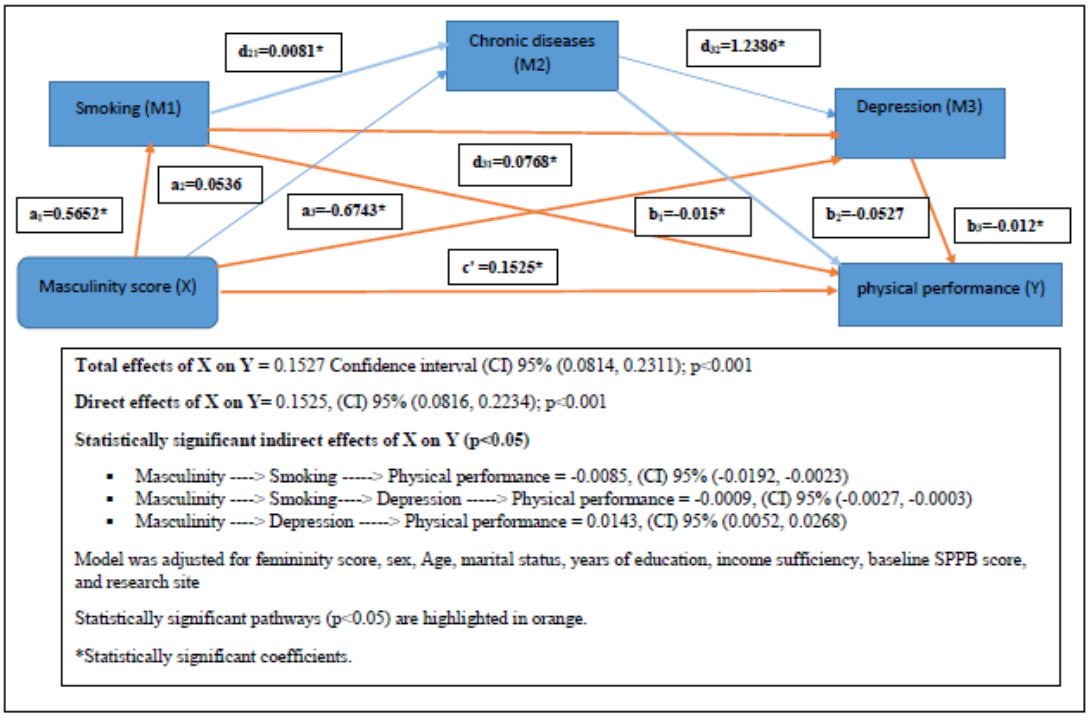
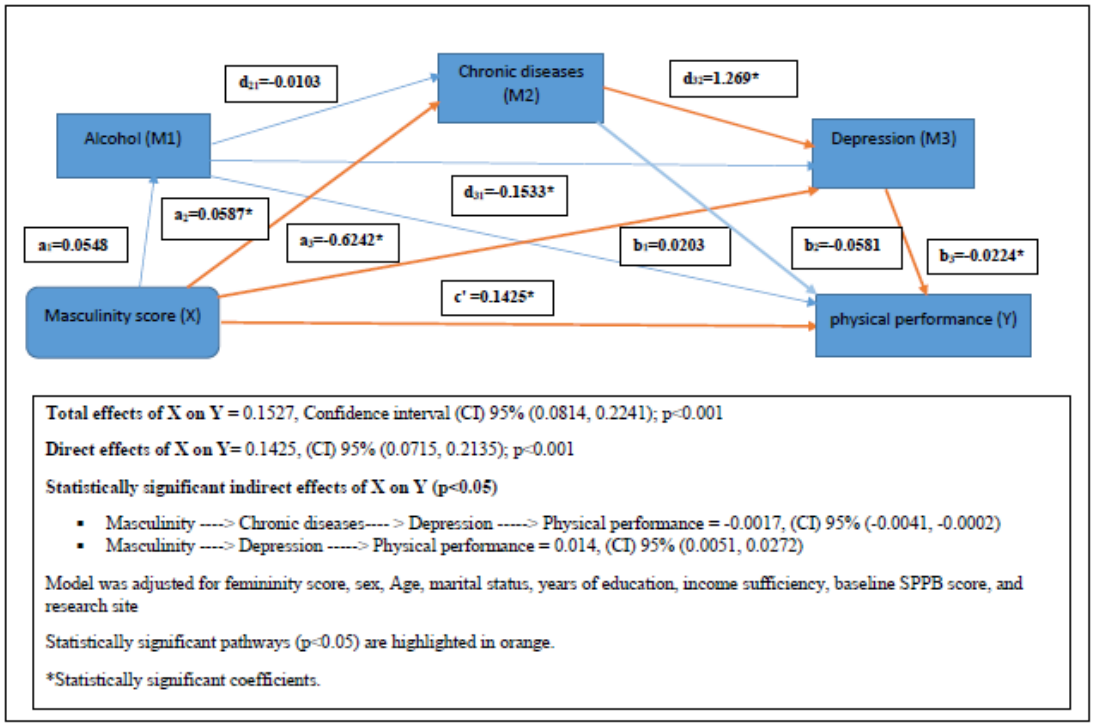


Figure 5. Results of the serial mediation analysis of the pathways between masculinity and physical performance scores through the volume of alcohol consumed over the past week, chronic diseases and depression.



Total effects of X on Y = 0.1527, Confidence interval (CI) 95% (0.0814, 0.2241); p<0.001

Direct effects of X on Y= 0.1425, (CI) 95% (0.0715, 0.2135); p<0.001

Statistically significant indirect effects of X on Y (p<0.05)

- Masculinity ----> Chronic diseases----- > Depression -----> Physical performance = -0.0017, (CI) 95% (-0.0041, -0.0002)
- Masculinity ----> Depression -----> Physical performance = 0.014, (CI) 95% (0.0051, 0.0272)

Model was adjusted for femininity score, sex, Age, marital status, years of education, income sufficiency, baseline SPPB score, and research site

Statistically significant pathways (p<0.05) are highlighted in orange.

*Statistically significant coefficients.

Figure S1. DAG for Masculinity physical performance. Red arrows: open biasing paths; green arrows: open causal paths; pink oval: ancestor of exposure; blue ovals: ancestor of outcome.

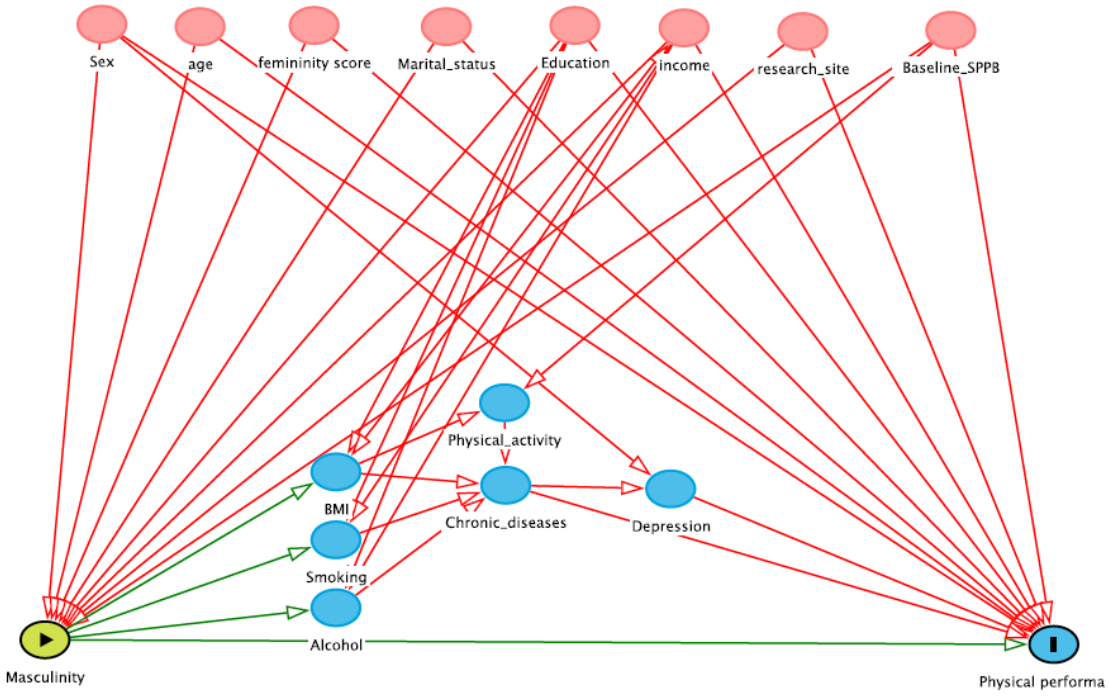


Figure S2. Hypothesized mediation pathways between gender roles and physical performance among IMIAS participants

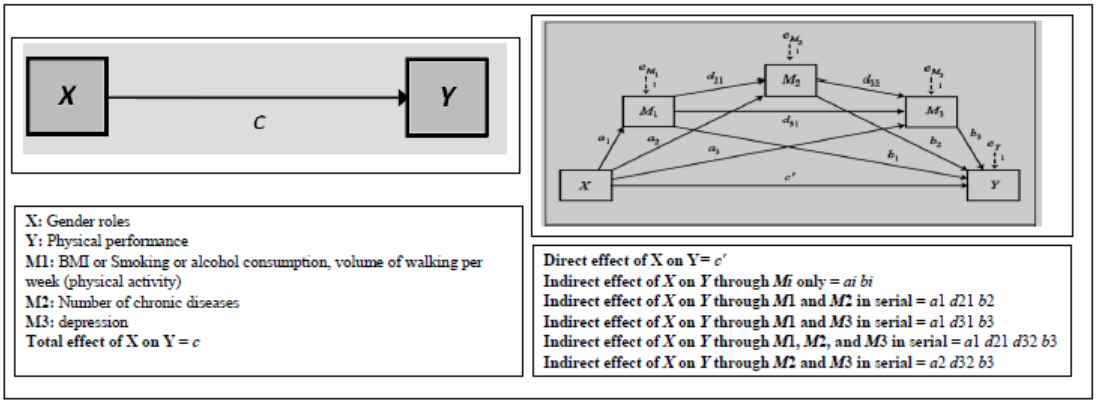


Figure S3. Results of meta-analyses of five sites of IMIAS showing the incidence rate ratios of the association between masculinity scores and physical performance

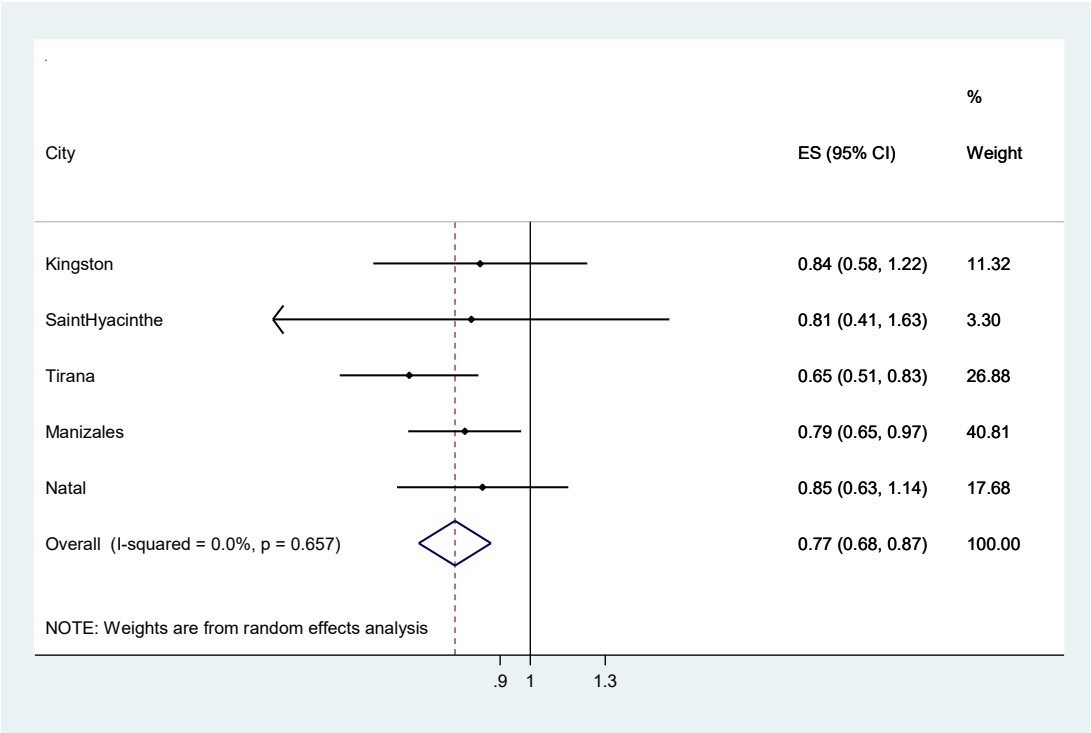
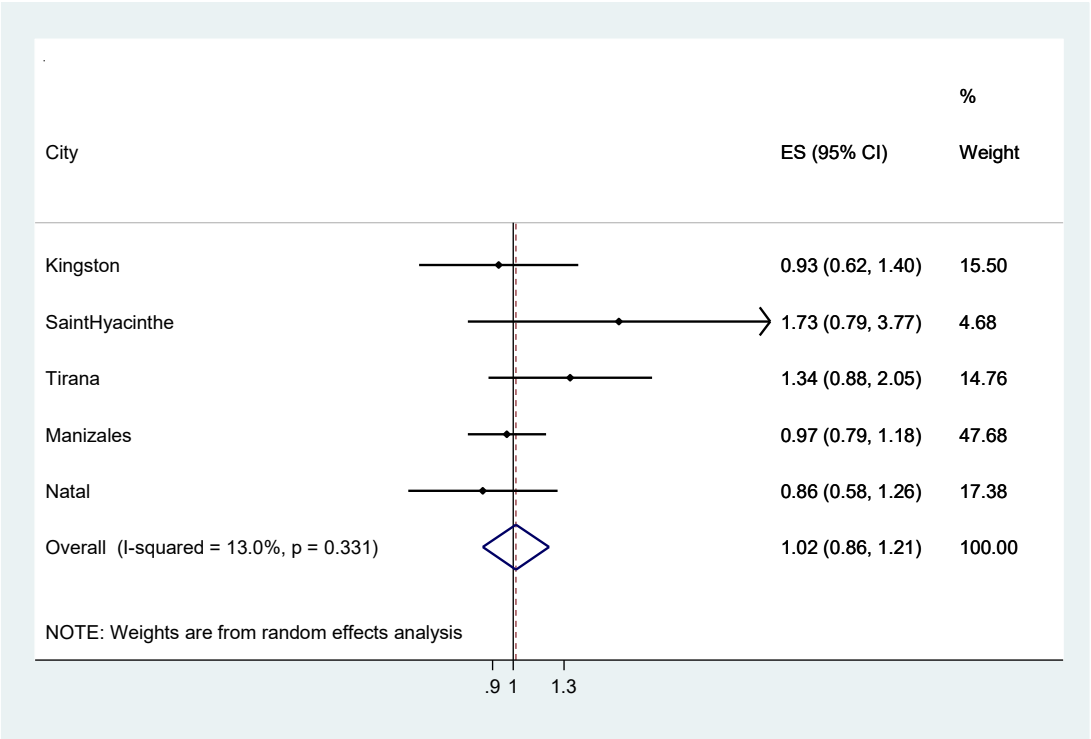


Figure S4. Results of meta-analyses of five sites of IMIAS showing the incidence rate ratios of the association between femininity scores and physical performance.



CHAPTER 6. DISCUSSION AND CONCLUSION

The research in this thesis addressed important gaps identified in the literature including limited data on the validity of Bem Sex Role inventory in old age and whether gender roles are associated with mobility disability and poor physical function in older adults from diverse populations. After establishing the cross-sectional and longitudinal associations between physical function and gender roles, we examined the mediation pathways explaining these associations. In this chapter, we complement the discussions' sections previously presented in the three research articles that compose much of this thesis. In the following paragraphs, an overview of the main findings, their significance, and potential contributions will be presented, followed by a discussion of the limitations and strengths of the dissertation, and directions for future research.

6.1 GENERAL SUMMARY OF RESULTS

This thesis comprised three articles that allowed to progress from testing the current validity of the 12-items short form Bem Sex Role Inventory in older adults (first study), to assessment of the cross-sectional association between gender roles and two measures of physical function (second study), to the examination of the longitudinal relationship between gender roles and physical performance in old age and the mediation pathways in this association (third study).

While most of the previous studies that examined the validity of the BSRI as a measure of gender roles, were conducted among university students, addressing the first objective of this thesis involved an exploration of the current validity of a short form (12-items BSRI) in older adult population. We assessed for the first time the psychometric properties and construct validity of this abbreviated version in older adults from diverse populations. Results of both exploratory and confirmatory factor analysis provided evidence of both convergent

and discriminant validity of the short form BSRI in older adults. Our findings supported a two-factor structure model with one factor referred as masculinity or instrumentality and the other factor denoted as femininity or expressiveness factor. This abbreviated version of the BSRI showed acceptable internal consistency in the IMIAS population and in men and women separately. In addition, the scale confirmed the expected gender differences where men tended to report significantly higher instrumentality and lower expressiveness, while women reported higher expressiveness and lower instrumentality. As expected more women tend to endorse feminine roles and more men tend to fall in the masculine group (table in the first article). These findings suggest the salience of these traditional gender roles among older adults from Canada, Latin America, and Eastern Europe. However, it is noteworthy that the androgynous type is the most frequent gender role type at all sites and in men and women. This finding support previous research that suggests that as individuals age, they are more likely to be androgynous (Gutmann 1987, Sinnott and Shifren 2001). With this validated abbreviated version of the BSRI in older adult population, we were able to move forward with the study towards the second and third objectives of the thesis.

The second article used this validated 12-items short form BSRI to examine the cross-sectional associations between gender roles and two measures of physical function in old age. We were able to test the three hypothesis mentioned in the objectives chapter. First, we found significant associations of gender roles with mobility and physical performance of the lower extremities after adjustment for sex and other possible confounders. Second, compared with the androgynous type, feminine or undifferentiated gender roles were positively associated with mobility disability and poor physical performance in older adults. Contrary to our hypothesis, the endorsement of masculinity traits was not associated with less mobility

disability or better physical performance compared to endorsement of the androgynous role. Our findings may be explained by the nature of BSRI-masculinity scale items which mostly capture positive, desirable self-reported masculine or instrumental traits (e.g., leadership abilities, defend owns beliefs). These traits are not limited or conceptually equal to the term hegemonic masculinity that refers to a dominant type of masculinity among a population of men, which has helped sustain dominance over women (Connell and Messerschmidt 2005) and has been linked to a variety of risky or unhealthy behaviors (Courtenay 2000). Third, contrary to our hypothesis, the effect of gender roles on physical function does not vary by sex or research site. We found no evidence of effect modification when testing for multiplicative interactions by sex or by IMIAS research site.

Based on the results of the second study, and the notion that poor physical performance is a precursor of mobility disability in old age, we attempted to examine relationship between gender role orientations and transition to poor physical performance after two years of follow-up. Furthermore, we explored possible mediation pathways explaining these associations. Consistent with our previous cross-sectional study, gender roles predicted physical performance of the lower extremities. Compared with the androgynous role, endorsing feminine or undifferentiated gender roles at baseline predicted poor physical performance (SPPB <8) after two years in a population with fair, good or very good physical function at baseline (SPPB ≥ 8). Those who identified with masculine roles at baseline were not different from androgynous participants in two-year risk of poor physical performance. Higher masculinity but not femininity scores predicted good physical performance two years later. This may indicate that the individual self-perception of higher masculinity as a proxy of goal oriented traits may be desirable in old age against the deterioration of physical function.

Examining pathways described in the disablement model (Verbrugge and Jette 1994), gender role orientations were associated with functional limitations through behavioral and pathological mechanisms. Gender roles predicted poor physical performance through statistically significant direct and indirect pathways. Cumulative smoking, BMI, physical activity, multimorbidity, and depression were serial mediators explaining the indirect effect of gender roles on physical performance. A major finding of the current study is that the intermediate behavioral and pathological pathways only partially mediated the observed associations. None of the potential serial mediators in the present study could completely account for the association between gender roles and physical performance.

Finally we attempted to answer whether sex differences in mobility and physical performance in old age could be partially explained by gender roles. In the cross-sectional analysis, biological sex was statistically associated with the two measures of physical function (undjusted PRR of mobility disability =1.79, CI 1.58-2.03; undjusted PRR of poor physical perfomance =1.88, CI 1.47-2.38). These estimates changed very little after adjusting for gender roles in the model. While in the longitudial analysis, women tended to report higher incidence of poor physical performance compared to men, the association between being a woman and higher incidence of poor physical performance was not statistically significant (unadjusted IRR= 1.24, CI 0.92-1.68). From these findings, we can conclude that differences between men and women in mobility loss may not be explained by gender related characteristics. Gender roles exert their effect on mobility and physical performance through an independent pathway.

6.2 STRENGHTHS AND LIMITATIONS OF THE STUDY

Detailed descriptions of the limitations and strengths pertaining to the three analyses of this thesis are provided in the three manuscripts included in Chapter 5. This section provides a general overview of, first, the limitations and, second, the strengths of this research. As methodological limitations, we will first discuss the possible selection, misclassification and confounding sources of bias. Second we will consider the limitations imposed by the relatively small sample size by research site.

Selection bias

Potential selection bias induced by differential probability of participation at baseline. Selection bias would be possible if and only if those participating in the study were different from those not participating in relation to gender roles and mobility loss. For instance, those with an undifferentiated or with feminine orientation could be less interested in study participation (with more apathy or less prone to decide to participate) and according to our results they have higher prevalence of mobility disability and poor physical performance together with higher incidence of poor physical performance. Under these assumptions, we would expect underestimation of the magnitude of the associations between these gender role types and measures of mobility loss and physical decline in the cross-sectional study.

Potential selection bias induced by losses to follow up was also examine. Among the 1676 participants who had a baseline SPPB score ≥8, thirty-seven (2.21%) had died between 2012 and 2014. Sixty-two participants (3.7%) were lost to follow-up between 2012 and 2014. Neither gender roles nor the baseline score in the SPPB predicted loss to follow up from the cohort in 2014 (Appendix 4).

Potential selection bias induced by refusals to follow up was assessed. One hundred eleven (6.62%) refused to participate in 2014 (Appendix 4). This is a rather small percentage. In addition, although masculine and androgynous individuals were more likely to refuse to participate in the second wave, baseline score in the SPPB did not predict refusal to participate in the study. Therefore, we can conclude that refusal to participate in 2014 is not a collider (common effect of both exposure and outcome), and there is no evidence of collider-stratification bias (Greenland 2003, Cole, Platt et al. 2010).

We restricted our cross-sectional and longitudinal analyses to participants for whom no data was missing data for any of the BSRI items. Participants with missing values on any of the BSRI items (n=28) were not different from those included in data analyses in terms of age, sex, years of education, occupation type, income sufficiency, or research site ($p>0.05$).

Residual confounding

Residual confounding as a result of using categorical variables remains possible (Royston, Altman et al. 2006). Categorization of variables may lead to information loss and reduced statistical power (Royston, Altman et al. 2006). However, we attempted to reduce this residual confounding in the multi-variate models by using continuous scores of the confounders.

Misclassification bias

According to pilot studies among IMIAS population (Carver, Vafaei et al. 2013, Vafaei, Alvarado et al. 2014), BSRI may contribute more to information bias in illiterate people. In an attempt to minimize these measurement errors, the short form of BSRI was administered to participants on all site using visual aids [Appendix 3] demonstrating a scale from 1-7 for each item on the scale and we adjusted for education in the multivariable models.

We cannot exclude possible social desirability bias since the BSRI allows people to rate themselves in some aspect of common cultural values. For instance, participants may be motivated to bias their responses in the BSRI to the degree to which masculinity and femininity is strongly desirable in each society. We are unable to estimate the extent of this bias but we have no reasons to believe that it would depend on physical function. If the measurement bias introduced by social desirability is non-differential according to physical function, it may attenuate the strength of the of association of interest.

Strengths of this study

The IMIAS study provides a unique opportunity to investigate the association between gender roles and physical function in old age in samples from diverse populations. We have detailed socio-demographic, behavioral, life style, and chronic diseases information from all participants which allowed for extensive adjustment of potential confounders and examination of mediating pathways between gender roles and physical function in old age.

Mobility loss as outcome was assessed using two different tools. They were both validated in populations similar to those of IMIAS and since they have been widely used in epidemiologic studies of aging, our results can be compared to those of other studies (Nagi 1976, Freire, Guerra et al. 2012). The first tool assesses self-reported mobility which is a predictor of future more severe disability and it is affected by mental health and the contextual physical and social environment. The second one assesses objective physical function which is the result of the physiological status of the person, including muscle strength, balance and functions of the central nervous system. Both are related to gender roles.

Another strength of this dissertation is the consistency between the cross-sectional and the longitudinal results indicating that endorsing feminine or undifferentiated roles in old age contribute to poor physical performance.

Lastly, follow up of the five cohorts had very high retention rates at the five sites (overall retention rates of 88%) with few losses to follow-up and few refusals between 2012 and 2014.

6.3 PUBLIC HEALTH IMPLICATIONS OF THE CURRENT THESIS

6.3.1 Contribution of this study to Public Health knowledge base

The concepts of masculinity and femininity were the focus of much social research in the last decades of the XXth century but literature linking these personality characteristics to health status is scant. We have found no more than three studies linking masculinity and femininity to mental health (Hunt, Sweeting et al. 2006, Price, Gregg et al. 2015, Vafaei, Ahmed et al. 2016), and five research papers linking cardiovascular health to gender roles (Hunt, Lewars et al. 2007, Juster and Lupien 2012, Pelletier, Ditto et al. 2015, Pelletier, Khan et al. 2016). A few studies have also examined the link between gender roles and pain (Campbell, Edwards et al. 2005, Alabas, Tashani et al. 2012).

Our study contributes to this literature and adds empirical support for the current validity of an abbreviated short form of the Bem Sex Role Inventory in old age. It also demonstrates the salience of traditional gender roles orientations among older adults from Canada, Latin America, and Eastern Europe. The four gender roles are present in all five research sites and although there are differences in their distributions across cities, these differences are not very large.

As far as we know, this is the first study to assess the potential contribution of gender role orientation to understanding the relationship between gender and measures of physical function in old age.

It also investigates one of the possible pathways that could explain gender differences in physical function in old age identifying several mediators of the impact of gender roles orientation on physical function in old age. Our study found that certain health behaviors (tobacco smoking, physical inactivity), elevated body mass index (overweight/obesity), chronic diseases and depression are on the causal pathway between gender roles and physical performance of the lower-extremities in older adults from Canada, Latin America and Eastern Europe.

Another contribution to the base knowledge of this field is to point out the protective effects of androgyny. These results are also consistent with previous studies on other health outcomes showing the beneficial effects of androgyny (Shimonaka, Nakazato et al. 1996, Vafaei, Ahmed et al. 2016).

This research aimed at providing evidence on the extent of the influence of gender roles in the genesis of physical disability in older populations; more specifically, it demonstrates that physical disability may be more frequent among older adults who adopt the traditional feminine roles or the undifferentiated gender roles compared with the androgynous types. These results, if confirmed by future studies, could help guide public policy towards maintaining physical function throughout the life course.

6.3.2 Public health implications of our findings

We believe that the state of knowledge on the associations between gender roles and physical and mental health does not allow to make strong claims to intervene at the population

level promoting androgyny. First, we cannot affirm that androgyny provides protection beyond masculinity. Second in our research, femininity scores are unrelated to physical function, while masculinity scores are consistently related to good physical function. Third, these findings are preliminary and although based on diverse international populations they would need to be replicated to attain external validity.

More research on gender roles orientations and health outcomes would be needed before translating the results of the current study into public health actions promoting androgyny.

6.4 FUTURE DIRECTIONS

Research on the relationships between gender roles and physical function in old age is still young. First, indeed more research is warranted to accumulate evidence on the relationships reported in this thesis across populations in varying social contexts. We have shown that these relationships hold in populations of North and South America and one city in Southern East Europe. Knowledge from African and Asian countries with different levels of gender equality would be needed to extend these results. In addition, further research would be needed to examine the intersect of social class, ethnicity and gender within populations.

Second, whether older adults do change or maintain their gender roles endorsement over time should be further explored using longitudinal designs and by integrating BSRI items in ongoing cohorts at different age stages. Findings from a PhD thesis of one longitudinal study suggest that around 50% of a cohort in which older adults were overrepresented, changed their gender roles classification over the course of twelve years (Sellars 2008). The association of gender roles and mortality should be also examined since survival advantage of

androgynous subjects is possible and should be considered in the interpretation of longitudinal results.

Third, whether androgyny provides protection over masculine gender roles for adverse health outcomes such physical function, mental health, and mortality in older adults should be examined in future research.

Fourth, we have identified several pathways between gender roles and physical function (depression, chronic conditions, physical activity, BMI and smoking). These pathways could be avenues of future research to explore the mechanisms explaining these relationships and add to the scant literature in this field.

Fifth, only one study examined the associations between gender roles and structural and quality aspects of social relations (Sellars 2008). The study demonstrated that androgyny is related to positive relationship quality, larger social networks, and higher proportion of family within the network. it would be interesting to assess the associations between gender roles and other psychosocial variables such as resilience, and locus of control.

Sixth, future studies should continue to use a life course approach to understanding the underlying biological mediation pathways by which these gender-related characteristics influence physical function in old age. This may be achieved by using the concept of allostatic load that has been recommended as a comprehensive, multisystem view of the cumulative physiological toll that may be exacted on the body over the course of a lifetime in attempts to adapt to life's demands (Mcewen and Stellar 1993, McEwen 1998). Gender roles may explain the effects of this cumulative physiological wear and tear in old age. Moreover, better understanding of biological mechanisms will provide evidence of pathophysiological

processes that eventually contribute to physical disability through these gender-related characteristics.

Seventh, future studies should investigate whether gender roles-physical performance relationship is bidirectional. That is, do people with chronic low performance or disability report less masculinity over time – maybe this would be seen only in men or older adults with high masculinity at baseline.

Finally, a promising avenue for future research lies in longitudinal studies with multiple points of measurements of the change in the scores of the masculinity and femininity may be necessary to identify individual transitions to mobility disability and poor physical performance in old age.

6.5 CONCLUSION

This thesis examined the influence of gender roles on measures of physical function in old age. It offered a base for understanding how gender roles that stem from the social construction of gender are linked to physical function and mobility in old age. Meanwhile, this dissertation provides a first empirical evidence on the contribution of gender roles in the genesis of physical disability in older populations.

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Appendix 1. IMIAS Consent form

CHUM
CENTRE DE RECHERCHE

INFORMATION AND CONSENT FORM

TITLE OF THE RESEARCH PROJECT:
Gender differences in mobility: what we can learn about improving mobility in old age.

Sub-title: Study on the differences between men and women with regards to risk and protective factors which influence age-related mobility loss.

RESEARCHERS AND COLLABORATORS:
11/01/2011

PRINCIPAL RESEARCHERS & CO-RESEARCHERS	TITRE	AFFILIATIONS
Maria-Victoria Zunzunegui (principal investigator)	PhD	Centre de recherche du centre hospitalier de l'Université de Montréal (CR-CHUM), Montréal, Canada
Beatriz E Alvarado (researcher)	PhD	Queens University, Kingston, Canada
Ellen E Freeman (researcher)	PhD	Université de Montréal, Montréal, Canada
Angela Garcia (researcher)	MD, PhD	Queen's University, Kingston, Canada
Susan P Phillips (researcher)	MD	Queen's University, Kingston, Canada
Carmen Lucia Curcio (co-researcher)	PhD	University Caldas, Manizales, Colombie
Jose-Fernando Gomez (co-researcher)	MD	University Caldas, Manizales, Colombie
Ricardo Guerra (co-researcher)	PhD	Universidad Rio Grande du Nord, Natal, Brésil
Jack M Guralnik (co-researcher)	PhD, MD	National Institute of Health (NIA), Bethesda, État-Unis
Slim Haddad (co-researcher)	PhD	Centre de recherche du centre hospitalier de l'Université de Montréal (CR-CHUM), Montréal, Canada
Catherine Lord (co-researcher)	PhD	Université de Montréal, Montréal, Canada

GRANTING AGENCY: Canadian Institutes of Health Research (CIHR)

1. Preamble

We are soliciting your participation in a research project in order to better understand sex difference in age-related mobility loss. However, before accepting to participate in this project and signing the information/consent form, take the time to read, understand and carefully examine the following information.

This form may contain words that you do not understand. We are inviting you to ask any question that you may have to the researcher or to other members of the team in charge of the research project, and ask them to explain to you any word or information that is unclear to you.

2. Nature and objectives of the research project

We observe an aging of the population at present and this on a worldwide scale. In order to improve the living conditions of these aging populations, we urgently need research identifying the origin of age-related health problems.

Mobility, the ability to move through one's environment without assistance, is essential for the proper functioning of any human being. There are however a loss of mobility with age. After 50 years mobility disabilities are frequent and more present among women than men of comparable age. We also know that many health problems associated with aging are related to early childhood and adolescence experiences. These experiences are often very different according to the social context and there is considerable variability between countries.

This study aims to better understand the effects of sex (biological) and gender (identity and social roles) on mobility disability. Several factors such as lack of physical exercise, poverty, social isolation and social context and / or domestic violence are known to increase the risk of loss of mobility. These risk factors have certainly a negative influence on the biology of the body, specifically on the stress system. The main objectives are: 1) examine the impact of life experiences on mobility of men and women in old ages 2) to study the sex-specific inflammatory and hormonal responses in aging 3) identify whether men and women differ with respect to the relationship between selected chronic conditions and loss of mobility.

This study will extend over 5 years and we will recruit 200 men and 200 women aged between 65 and 74 per site. We will compare the population of 4 towns, two in Canada (St-Hyacinthe, Quebec and Kingston, Ontario) and two in Latin America (Manizales, Colombia and Natal, Brazil). Your participation in this study will help determine why women have more mobility problems than men and what are the risk and protective factors that contribute to this condition.

3. Procedures of the research project

Your participation in this study requires the completion of a questionnaire and some objective tests. These tests and the questionnaire will be administered by a research professional at your home on two separate occasions. During the first visit you will complete the questionnaire with the assistance of research professional and the objective tests that include anthropometric measurements (height, weight, waist circumference), blood pressure, a measure of physical performance and samples of saliva and hair. A

blood sample is planned for the second visit to take levels of certain hormones and biomarkers related to stress.

If you agree to participate in this study, a research professional will visit you at your home on two occasions over a period of two weeks. The schedule of activities planned for each visit is as follows:

Visit schedule:

	1st visit	2nd visite
Consent Form	X	
Questionnaires	X	
Anthropometric measures	X	
Physical performance	X	
Hair and saliva sample		X
Blood sample		X
Estimated duration of visit	maximum 2 hours	30 minutes

The questionnaire will help us understand your health history, physical and emotional health and your lifestyle. The entire administration of the questionnaire will take about 2 hours.

The anthropometric measurements and blood pressure will help to measure physical function. Taking these measures will require the use of a scale, tape, and a tensiometer.

The measurement of **physical performance** includes four simple tests to assess your physical function: equilibrium, gait speed, grip strength and leg strength.

Saliva and hair samples will be collected to study how certain factors of your hormonal system vary throughout the day and past months. We ask you to provide three hair and five saliva samples per day on two different days. The research professional will collect the samples at the 2nd visit.

The blood sample which serve for the analysis of markers of general health and inflammation will be used to study how these factors are related to physical fitness and emotional health. If you wish to participate in this part of the study, a nurse will take a blood sample the morning of the 2nd visit. We will collect the equivalent of 3 tablespoons of blood, **54.5-66.5 ml.**

We will keep your samples in the Douglas University Center affiliated with McGill University for a maximum of 5 years. Your samples will be de-identified and their confidentiality will be ensured by the principal investigator, Dr. Maria-Victoria Zunzunegui.

4. Collaboration of the subject in the research project

For the saliva samples we ask that you avoid:
1) brushing your teeth
2) flossing
3) eating
4) drinking anything else but water

at least 30 minutes before taking each saliva sample. If you wish, however, you can drink water 15 minutes before collection.

5. Risks associated with the research project

There is no apparent risk that could arise from completing the questionnaire, anthropometric measures, measures of physical performance or samples of saliva and hair. The blood test may cause some discomfort due to the insertion of the needle, it has a low risk of bruising and a very low risk of infection.

6. Disadvantages associated with the research project

Following your participation in this research project you may suffer some disadvantages, such as anxiety or fatigue related to the anthropometric measurements, biological or physical performance tests. In addition, this study requires that we visit your home twice and you could also feel the frustration related to time spent participating in the study.

7. Advantages

You will not get any personal benefit from your participation in this research project. However, the study results will assist in the advancement of knowledge in this field.

8. Voluntary participation and possibility to withdraw

Your participation in this research project is voluntary. You are therefore free to refuse to participate. You can also withdraw from the project at any time, without giving any reason, by informing the researcher in charge of the project or one of the members of the research team.

9. Interruption of the study by the research team

The researcher in charge of the research project, the research ethics committee of the CHUM or the granting agency could put an end to your participation, without your consent, if new findings or information indicate that your participation is no longer in your interest, if you do not follow the research project instructions, or for administrative reasons that would force ending the project.

10. Confidentiality

During your participation in this project, the project researcher and his team will collect and record the information concerning you in a study file. Only the data required to meet the scientific goals of the project would be collected.

This data could include information contained in your medical files concerning your past and present health condition, your lifestyle, as well as the results of your tests, exams and procedures that you would have to undergo during this research project. Your file could also contain other information such as your name, sex, date of birth and ethnic origin.
All this information collected during the research project will remain strictly confidential to the extent prescribed by the law. In order to protect your identity and the confidentiality of this information, only a code number will identify you. The key to the code linking your name to your study file will be kept by the project researcher.
The project researcher would use this data for research purposes, in order to achieve the project scientific goals, described in the information/consent form. This data would be kept by the researcher in charge of the project for 5 years.

The data could be published in medical specialized magazines or shared by other individuals during scientific meetings; however, it would not be possible to identify you.

For surveillance and control purposes, your study file as well as your medical files could be examined by a person mandated by the Ethics Research Board of the CHUM. All these individuals agree with the privacy policy.

For security purposes, especially to be able to communicate with you rapidly, your family name, first name, coordinates and the start and end date of participation in the project would be stored during one year after the completion of the project in a separate registry maintained by the researcher in charge of the project or by the institution.

You have the right to consult your study file in order to verify the information gathered and to rectify it if necessary, as long as the project researcher or the institution holds this information. However, in order to protect the scientific integrity of the research project, you would have access to certain information only once this project has come to an end.

11. Funding of the research project

The researcher in charge of the project received funding from a the Canadian Institutes of Health Research (CIHR) for the successful completion of the research project.

12. Compensation in case of injury and rights of the research subject

By accepting to participate in this project, you are not waiving any of your legal rights nor discharging the researchers, the sponsor [if applicable] or the institution of their civil and professional responsibility.

13. Compensation

You will not receive financial compensation for your participation in the study.

14. Identification of contact persons

If you have questions concerning the research project or if you feel you have a problem related to your participation in the research project, you can communicate with the project researcher at the following numbers:

- **Maria-Victoria Zunzunegui** PhD (professeure titulaire à l'Université de Montréal) : **514 343-6086**

For any question concerning your rights as a research subject participating in this research project or if you have comments or wish to file a complaint, you can communicate with the Hôtel Dieu Hospital Complaint Commissioner at the following number: Mme Rita Crisante (commissaire adjointe):

- **Rita Crisante 514 890-8000 poste 12761**
- commissaire.local.chum@ssss.gouv.qc.ca

15. Control of the ethical aspects of the research project

The Research Ethics Board of the CHUM approved this research project and is responsible for ensuring its monitoring. Any change or amendment made to the information/consent form or to the study protocol must first be approved by the Research Ethics Board.

CONSENT

TITLE OF THE RESEARCH PROJECT:
Gender differences in mobility: what we can learn about improving mobility in old age.

I have reviewed of the information/consent form. I acknowledge that the research project was explained to me, that my questions were answered to my satisfaction, and that I was given sufficient time to make a decision.

I agree to participate in this research project according to the conditions stated above. A dated and signed copy of the present information/consent form was given to me.

_____ _____
Signature of the research subject Date

_____
Name (capital letters)

I consent freely and voluntarily to participate in the 2nd visit which consist of a blood test.

□ yes □ no

_____ _____
Signature of the research subject Date

_____
Name (capital letters)

I hereby authorize the retention of my samples once they have been analyzed for the study. They will be kept frozen and stored up to five years after the end of the study.

□ yes □ no

_____ _____
Signature of the research subject Date

_____
Name (capital letters)

SIGNATURE OF THE PERSON WHO OBTAINED THE CONSENT IF DIFFERENT FROM THE RESEARCHER IN CHARGE OF THE RESEARCH PROJECT

I have explained to the research subject the terms of the present information/consent form and I answered all his questions.

_____ _____

Name and signature of the person who obtains the consent Date

_____

Name (capital letters)

SIGNATURE AND COMMITMENT OF THE RESEARCHER IN CHARGE OF THE PROJECT

I hereby certify that I have explained to the research subject the terms of the present information/consent form, that I have answered the questions that the subject had in that respect and that we have clearly indicated that he remains free to withdraw from the study, without suffering any prejudice.

I commit myself, as well as the research team, to respect what was agreed upon in the information/consent form and to give a signed copy of this form to the research subject.

_____ _____

Signature du Chercheur Date

_____

Name (capital letters)

This form must be signed in two copies: one copy for the researcher and one copy for the subject.

Appendix 2. Power and sample size calculations

Power calculation and sample size calculation of 955 men and 1040 women. Assumption: equal distribution of population in exposure groups (25%, 25%, 25%, and 25%).

Men:

Power	N	Prevalence in Androgynous group (unexposed group)	Prevalence in Masculine group (exposed group 1)	Prevalence in Feminine group (exposed group 2)	Prevalence in Undifferentiated group (exposed group 3)	Odds Ratio	Prevalence difference	Alpha
0.6352	955	15	25			1.33	10	0.017
0.9999	955	15		40		2.67	25	0.017
1	955	15			50	4	35	0.017
0.1398	955	20	25			1.33	5	0.017
0.9926	955	20		40		2.67	20	0.017
1	955	20			50	4	30	0.017
0.0085	955	25	25			1.33	0	0.017
0.8697	955	25		40		2.67	15	0.017
0.9996	955	25			50	4	25	0.017

Women:

Power	N	Prevalence in Androgynous group (unexposed group)	Prevalence in Masculine group (exposed group 1)	Prevalence in Feminine group (exposed group 2)	Prevalence in Undifferentiated group (exposed group 3)	Odds Ratio	Prevalence difference	Alpha
0.6799	1040	15	25			1.33	10	0.017
1	1040	15		40		2.67	25	0.017
1	1040	15			50	4	35	0.017
0.1531	1040	20	25			1.33	5	0.017
0.9960	1040	20		40		2.67	20	0.017
1	1040	20			50	4	30	0.017
0.0085	1040	25	25			1.33	0	0.017
0.9	1040	25		40		2.67	15	0.017
0.9999	1040	25			50	4	25	0.017

Power calculation and sample size calculation of 955 men and 1040 women. Assumption: unequal distribution of population in exposure groups (30% androgynous, 35% masculine, 15% feminine, and 20% undifferentiated).

Men:

Power	N	Prevalence in Androgynous group (unexposed group)	Prevalence in Masculine group (exposed group 1)	Prevalence in Feminine group (exposed group 2)	Prevalence in Undifferentiated group (exposed group 3)	Odds Ratio	Prevalence difference	Alpha
0.7622	955	15	25			1.33	10	0.017
0.9993	955	15		40		2.67	25	0.017
1	955	15			50	4	35	0.017
0.1813	955	20	25			1.33	5	0.017
0.9741	955	20		40		2.67	20	0.017
1	955	20			50	4	30	0.017
0.0085	955	25	25			1.33	0	0.017
0.7847	955	25		40		2.67	15	0.017
0.9994	955	25			50	4	25	0.017

Women:

Power	N	Prevalence in Androgynous group (unexposed group)	Prevalence in Masculine group (exposed group 1)	Prevalence in Feminine group (exposed group 2)	Prevalence in Undifferentiated group (exposed group 3)	Odds Ratio	Prevalence difference	Alpha
0.8022	1040	15	25			1.33	10	0.017
0.9997	1040	15		40		2.67	25	0.017
1	1040	15			50	4	35	0.017
0.1988	1040	20	25			1.33	5	0.017
0.9834	1040	20		40		2.67	20	0.017
1	1040	20			50	4	30	0.017
0.0085	1040	25	25			1.33	0	0.017
0.8223	1040	25		40		2.67	15	0.017
0.9998	1040	25			50	4	25	0.017

Report definitions:

* Power is the probability of rejecting a false null hypothesis. It should be close to 1. Power Calculation is based on normal approximation.

* N is the size of the sample drawn from the population.

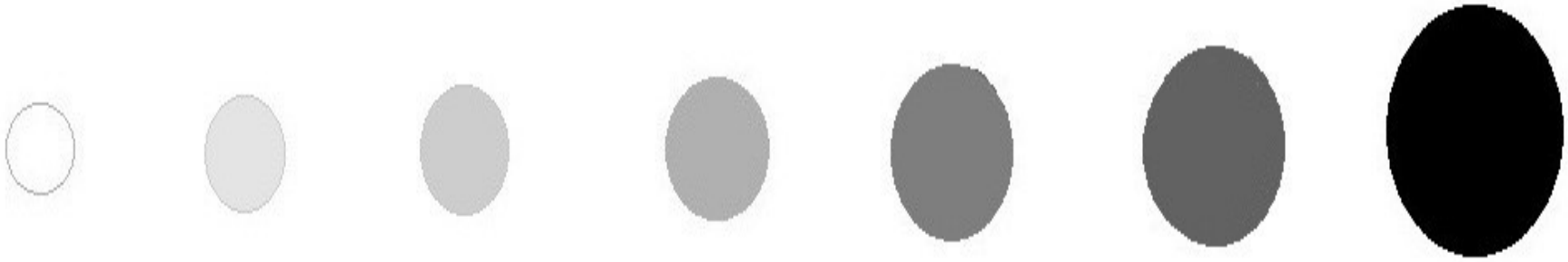
* Odds ratio is the odds ratio. That is , it is [prevalence of mobility loss among exposed group / (1- prevalence of mobility loss among exposed group)] / [prevalence of mobility loss among unexposed group / (1- prevalence of mobility loss among unexposed group)]

* Alpha is the probability of rejecting a true null hypothesis. It is calculated based on multiple comparison of 3 tests using Bonferroni correction.

Appendix 3. Scale of gender roles (BSRI Visual aid)

Never or almost never true	Usually not true	Sometimes but frequently true	Occasionally true	Often true	Usually true	Almost always true

The degree to which that WORD describes your behaviour or attitude



Appendix 4. Distribution of gender roles by research site at baseline in 2012

	Undifferentiated		Masculine		Feminine		Androgynous		P value
	n	%	n	%	n	%	n	%	
Study site [a]									0.284
Kingston	106	20.1	67	16.8	80	19.4	140	22.3	
St-Hyacinthe	97	18.4	82	20.6	91	22	122	19.4	
Tirana	107	20.3	85	21.4	85	20.6	110	17.5	
Manizales	105	19.9	90	22.6	84	20.3	114	18.1	
Natal	112	21.3	74	18.6	73	17.7	143	22.7	

Appendix 5. Distribution of gender roles by sex according to research sites of IMIAS in 2012

Kingston	Men (n=184)			Women (n=209)			
	n	%	Mean (SD)	n	%	Mean (SD)	p-value
Masculinity score	184		5.18 (0.89)	209		5.09 (1.02)	0.38
Femininity score	184		5.4 (0.86)	209		5.82 (0.80)	<0.001
Median split method							<0.001
''Undifferentiated''	63	34.2		43	20.6		
''Masculine''	38	20.7		29	13.9		
''Feminine''	26	14.1		54	25.8		
''Androgen''	57	31		83	39.7		
Sainte Hyacinthe	**Men (n=188)**			**Women (n=204)**			
	n	%	Mean (SD)	n	%	Mean (SD)	p-value
Masculinity score	188		5.01 (1.04)	204		4.51 (1.18)	<0.001
Femininity score	188		5.72 (0.77)	204		5.75 (0.72)	0.71
Median split method							0.006
''Undifferentiated''	42	22.3		55	27		
''Masculine''	48	25.5		34	16.7		
''Feminine''	32	17		59	28.9		
''Androgen''	66	35.1		56	27.5		
Tirana	**Men (n=183)**			**Women (n=204)**			
	n	%	Mean (SD)	n	%	Mean (SD)	p-value
Masculinity score	183		5.07 (1.09)	204		4.46 (1.08)	<0.001
Femininity score	183		5.99 (0.75)	204		6.28 (0.72)	<0.001
Median split method							<0.001
''Undifferentiated''	49	26.8		58	28.4		
''Masculine''	60	32.8		25	12.3		
''Feminine''	23	12.6		62	30.4		
''Androgen''	51	27.9		59	28.9		
Manizales	**Men (n=195)**			**Women (n=198)**			
	n	%	Mean (SD)	n	%	Mean (SD)	p-value
Masculinity score	195		4.28 (1.13)	198		4.17 (1.15)	0.37
Femininity score	195		5.67 (1.12)	198		6.17 (0.98)	<0.001
Median split method							<0.001
''Undifferentiated''	61	31.3		44	22.2		
''Masculine''	57	29.2		33	16.7		
''Feminine''	28	14.4		56	28.3		
''Androgen''	49	25.1		65	32.8		
Natal	**Men (n=192)**			**Women (n=210)**			
	n	%	Mean (SD)	n	%	Mean (SD)	p-value
Masculinity score	192		4.37 (1.23)	210		4.2 (1.35)	0.19
Femininity score	192		5.22 (1.07)	210		5.41 (0.9)	0.05
Median split method							0.11
''Undifferentiated''	52	27.1		60	28.6		
''Masculine''	42	21.9		32	15.2		
''Feminine''	27	14.1		46	21.9		
''Androgen''	71	37		72	34.3		

Appendix 6. Distribution of lost to follow-up and refusals to participate in the second wave of IMIAS by research site

Research site	Refusal to participate (n=111)	Lost to follow-up (n= 62)
Kingston	31 (27.9%)	23 (37.1%)
Sainte-Hyacinthe	40 (36 %)	2 (3.2 %)
Tirana	8 (7.2%)	5 (9.7%)
Manizales	2 (1.8%)	11 (17.7 %)
Natal	30 (27%)	20 (32.3 %)

Appendix 7. Incidence ratios (95 % confidence interval) for the relationship between gender roles, baseline score in the SPPB and either lost to follow-up or refusal to participate in the second wave of IMIAS data using Poisson regression.

	Incidence rate ratio IRR (95%CI) of loss to follow-up and refusal to participate in the second wave of the study (n=1455)			
	Loss to follow-up		Refusal to participate	
	Unadjusted IRR (confidence interval)		Unadjusted IRR (confidence interval)	
	(p value)		(p value)	
Gender roles				
Undifferentiated and feminine roles	**1.00**		**1.00**	
Masculine and androgynous roles	1.40 (0.83 – 2.37)	(0.2)	1.57 (1.05 – 2.34)	(0.03)
Baseline SPPB score	1.01 (0.82 – 1.23)	(0.94)	1.05 (0.90 – 1.23)	(0.53)

Appendix 8. Distributions of education. income and marital status in the 65-74 years old Kingston and Saint-Hyacinthe samples: Comparisons with Canadian 2006 Census and 2011 Canadian National Household Survey.

	2006 Census	National Household Survey.			2012 IMIAS					
									P-value	
	Total	Total	Men	Women	Total	Men	Women	p-value	Men	Women
Education (%)										
More than High School										
Kingston	**55.0**	59.0	67.0	52.0	**77.0**	75.0	79.0	<0.001	-	-
Saint-Hyacinthe	**46.0**	36.0	42.0	31.0	**50.0**	54.0	47.0	0.110	-	-
Income (%)										
Kingston										
<10000$	-	-	-	-		<1.0	6.0	-	-	-
10000-20000	-	-	-	-		6.0	25.0	-	-	-
30% de pauvre	-	3.5	-	-		-	-	-	-	-
Under poverty threshold	**11.0**	-	-	-		**9.0**	**12.0**	-	-	-
Saint-Hyacinthe										
<10000$	-	-	-	-		5.0	8.0	-	-	-
10000-20000	-	-	-	-		18.0	50.0			
30% de pauvre	-	9.0	-	-		-	-			
Under poverty threshold	**11.0**	-	-	-		**11.0**	**11.0**			
Married or cohabiting										
Kingston	-	-	**80.0**	**60.0**		**75.0**	**51.0**	-	0.121	0.010
Saint-Hyacinthe	-	-	**77.0**	**53.0**		**80.0**	**60.0**	-	0.322	0.045

* p-values comparing IMIAS and Census (for education) or NHS (for marital status) proportions separately for men and women

Appendix 9. Distribution of education and marital status for the population aged 65 to 74 years in IMIAS Manizales: Comparison with the 2005 Colombian Census for Manizales in that age group

	2005 Census	2012 IMIAS	p-value
Education (%)			
None	10.1	5.0	0.001
O to 1 years	**14.4**	**9.8**	0.040
Marital status (%)			
Married or cohabiting	51.0	49.8	0.317

Appendix 10. Distribution of education and marital status for the population aged 65 to 74 years in IMIAS Natal: Comparison with the 2010 Brazilian Census for Natal in that age group

	2010 Census		IMIAS		p-value*	
	Men	Women	Men	Women	Men	Women
Education (%)					0.24	0.16
None	**21.0**	**21.0**	-	-		
0-1 years	-	-	**19.0**	**24.0**		
Marital status (%)					0.104	0.003
Married	**81.0**	**57.0**	**84.4**	**47.6**		

*p-value for comparisons in men and in women, separately.

Appendix 11. Copies of the Ethics' Certificates

CHUM

Comité d'éthique de la recherche
Édifice Cooper
3981, boulevard St-Laurent, Mezz 2
Montréal (Québec) H2W 1Y5

Le 9 juin 2011

Dre Maria-Victoria Zunzunegui
Département médecine sociale et préventive

a/s Mme Catherine Lord
Hôtel-Dieu du CHUM
Unité de Santé Internationale

courriel: catherine.lord@crchum.qc.ca

Objet: **10.277 – Approbation FINALE CÉR**

Différences de genre en mobilité: que pouvons nous apprendre sur comment améliorer la mobilité au cours du vieillissement.

Chère Docteure,

J'accuse réception, en date du 6 juin 2011, de votre lettre datée du 3 juin 2011 ainsi que du formulaire d'information et de consentement français modifié – version du 3 juin 2011 en vue de l'approbation finale de l'étude décrite en rubrique.

À la lecture de tous les documents reçus, le tout est jugé satisfaisant. Je vous retourne sous pli une copie du formulaire portant l'estampille d'approbation du comité. Seul ce formulaire devra être utilisé pour signature par les sujets.

La présente constitue l'approbation finale, **valide pour un an à compter du 15 mars 2011,** date de l'approbation initiale. Je vous rappelle que toute modification au protocole et/ou au formulaire de consentement en cours d'étude, doit être soumise pour approbation du comité d'éthique.

Cette approbation suppose que vous vous engagiez :

1. à **respecter la présente décision**;
2. à respecter les moyens de **suivi continu** (cf Statuts et Règlements)
3. à **conserver les dossiers de recherche** pendant la période requise par les textes réglementaires, suivant la fin du projet, afin permettre leur éventuelle vérification par une instance déléguée par le comité;

CENTRE HOSPITALIER DE L'UNIVERSITÉ DE MONTRÉAL

HÔTEL-DIEU (Siège social)
3840, rue Saint-Urbain
Montréal (Québec)
H2W 1T8

HÔPITAL NOTRE-DAME
1560, rue Sherbrooke Est
Montréal (Québec)
H2L 4M1

HÔPITAL SAINT-LUC
1058, rue Saint-Denis
Montréal (Québec)
H2X 3J4

4. à respecter les modalités arrêtées au regard du **mécanisme d'identification des sujets de recherche** dans l'établissement.

Le comité suit les règles de constitution et de fonctionnement de l'Énoncé de Politique des trois Conseils et des Bonnes pratiques cliniques de la CIH.

Pour toute question relative à cette correspondance, veuillez communiquer avec la soussignée à l'adresse courriel suivante : **marie.josee.bernardi.chum@ssss.gouv.qc.ca**, ou avec sa collaboratrice, par téléphone ou courriel : **lynda.ferlatte.chum@ssss.gouv.qc.ca – 514 890-8000 poste 14030.**

Vous souhaitant la meilleure des chances dans la poursuite de vos travaux, je vous prie d'accepter, Cher Docteur, mes salutations distinguées.

Me Marie-Josée Bernardi, avocate
Vice-présidente
Comité d'éthique de la recherche du CHUM

MJB/lf

P. j. Formulaire de consentement français approuvé et estampillé

Cc : Par numérisation au Bureau des contrats
Centre de recherche
Hôtel-Dieu du CHUM – Pavillon Masson

Appendix 12. IMIAS questionnaire

Cluster 1
1. Contact info
2. Personal info
3. Demographics
4. ***Orientation scale (PCL #1)***
5. QOL (QUALITY OF LIFE)

Cluster 2 -SES
6. Education
7. Work History
8. Income
9. Social Activities
10. Physical and Social Environment
11. Friends-Family Networks
12. Life-Space Assessment
13. ***Blood pressure measurements***
14. Early Life Circumstances (first 15 years) and Childhood adversity

Cluster 3 - medical condition
15. Reproductive history
16. Chronic conditions
17. Medication
18. Depression (CESD)
19. ***Vision test***
20. ***PCL #2***
21. Health Behaviors: Tobacco-Alcohol-Drugs
22. ***PCL delayed recall #3***
23. Access & Utilization of Health Care

Cluster 4 - mobility
24. Functional limitations - Nagi questionnaire
25. ***MAT videos (mobility)***
26. ***MOCA***
27. Disability (ADL)
28. Falls Efficacy Scale International (FESI) and Falls history
29. ***Short Physical Performance Battery (SPPB)***

Cluster 5 – behavior
30. ***Physical activity videos***
31. BEM –Sex roles inventory
32. Decision Autonomy
33. Victimization
34. HITS
35. ***Grip strength***
36. ***Anthropometric measurements (height, weight, waist circumference)***

Cluster 6- Saliva and blood instructions
37. Saliva samples explanations
38. Blood samples explanations

I) CONTACT INFORMATION

Participant Identification No. | | | | | | | |

Contact Person Information (Not cohabiting)

Relationship to participant		
Last name		
First name		
Full address		
Telephone number		
	Area Code	Number

CONSENT FORM SIGNED **YES** **NO**

KEEP THIS SHEET WITH THE CONSENT FORM, SEPARATED FROM THE FOLLOWING QUESTIONNAIRE

PERSONAL INFORMATION:

INTERVIEWER

Interviewer Identification No. | | | | |

Interview Date: 2 0 | | | | | | | |
Year Month Day

Time start interview: | | | | |
Hours(24) Min

PARTICIPANT

Participant Identification No. | | | | | | | |

Language of the questionnaire French □ **English** □ Portuguese □ Spanish □

Was the person alone or with somebody? Who is present ?

- ☐ Alone
- ☐ Wife/Husband/Life partner
- ☐ Daughter
- ☐ Son
- ☐ Other family member
- ☐ Other non-family member

Demographics

Date of birth of the participant	| | | | | | | | | Year Month Day
Participants age	| | |
Sex of the participant Check the appropriate box without asking the question	1 □ male 2 □ female
What is your marital status?	1 □ single (never married) 2 □ married / common law 3 □ widow/ widower 4 □ separated/ divorced 5 □ nun/ monk
Were you born in this country?	1 □ yes (go to next page) 2 □ no (if no, answer 2 next questions)
Where were you born:	
How old were you when you immigrated to	| | |

Canada?	Years
How many years have you lived in **Kingston?** **(Write 1 if less than a year)**	☐☐☐ Years
How many years have you lived at this address? **(Write 1 if less than a year)**	☐☐☐ Years
What language do you usually speak at home? 1 □ French 2□ English 3 □ Portuguese 4 □ Spanish 5□ other Specify_____	

Do you live alone?	1 Alone (if yes, the next question should be skipped)	☐ yes	☐ no
Who do you live with?… Check all that apply	2 Spouse/partner	☐ yes	☐ no
	3 Child/Children	☐ yes	☐ no
	4 Grandchildren	☐ yes	☐ no
	5 Relatives, brother, sister	☐ yes	☐ no
	6 Friends	☐ yes	☐ no
	7 Others, specify: _____		
How many people live with you (excluding yourself)?		☐☐☐	

IV) COGNITIVE DECLINE (PCL)

"The following questions must be answered by you, without help from someone else."

What is today's date?	☐ Right	☐ Wrong
What time is it?	☐ Right	☐ Wrong
What day of the week is it?	☐ Right	☐ Wrong
What is your complete address?	☐ Right	☐ Wrong
What city are we in?	☐ Right	☐ Wrong
What is your age?	☐ Right	☐ Wrong
What is your birthday?	☐ Right	☐ Wrong
What was your mother's first name?	☐ Right	☐ Wrong

4 errors or more means that the interview is over

QUALITY OF LIFE

Please mark with an X the appropriate place within the bar below to indicate your rating of the quality of your life **in the past 2 weeks?**

Worse possible quality _____ **Best possible quality**

EDUCATION

Do you know how to read and write?	1 ☐ No, I do not know how to read and write 2 ☐ I understand what I read, but I cannot write 3 ☐ Yes, I understand what I read and I know how to write
How many years of school have you **completed**?	☐☐ (if 0, go to work history)
What is the highest level of schooling that you have completed?	1 ☐ Primary school uncompleted 2 ☐ Primary school completed 3 ☐ Secondary school uncompleted 4 ☐ Secondary school completed 5 ☐ Post secondary certificate or specialized diploma uncompleted 6 ☐ Post secondary certificate or specialized diploma completed 7 ☐ Post secondary college-technical degree uncompleted 8 ☐ Post secondary college-technical degree completed 9 ☐ University degree (bachelors or above) uncompleted 10 ☐ University degree (bachelors or above) completed 11 ☐ No response

WORK HISTORY

During the last week, you… Read all the options until you obtain an affirmative response	1 ☐ worked 2 ☐ had a job, but did not work 3 ☐ worked helping in a family business, estate or ranch without receiving payment 4 ☐ looked for a job 5 ☐ primarily did housework 6 ☐ were retired or pensioned 7 ☐ were temporarily disabled and could not work 9 ☐ were permanently disabled and could not work 10 ☐ did not work 11 ☐ does not know 12 ☐ no response
What was the occupation that you had for the majority of your life?	Textual: _____ 1 ☐ Does not know 2 ☐ No response

INCOME

Do you receive an income ?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response if 2, 3 or 4 go to next page about social activities
Do you receive income from	0 ☐ work 1 ☐ Retirement or pension (includes CPP, OAS, etc) 2 ☐ Help from family in another country 3 ☐ Help from family here 4 ☐ Rental or investment income 5 ☐ Government assistance (Ontario Works (welfare), Disability, ODSP) 6 ☐ Other_____specify
What is your individual annual income before taxes?	1 ☐ None 2 ☐ Less than $5000 3 ☐ $5001-$10000 4 ☐ $10001-$20000 5 ☐ $20001-$30000 6 ☐ $30001-$40000 7 ☐ $40001-$50000 8 ☐ $50001-$60000 9 ☐ $60001-$80000 10 ☐ $80001-$100000 11 ☐ More than $100000
To what extent does your income allow you to meet your needs?	1 ☐ Very well 2 ☐ Suitably 3 ☐ Not very well 4 ☐ Not at all
How many people depend partially or totally on your income (excluding yourself)?	☐☐

To what extent in your neighbourhood are the following situations a problem?	Major	Minor	Not a problem	Don't Know
Tensions between racial, ethnic or religious groups				
Garbage, litter, broken glass in the street, road, sidewalk or in yards				
Selling or use of drugs				
Excessive drinking in public				
Gangs				
Inadequate lighting				
Crime				
Excessive noise				
Heavy traffic				
Vacant or shabby houses and buildings				

How often in your neighbourhood:				
	Often	Sometimes	Rarely/ NEVER	Don't Know
Do you see neighbours and friends talking outside in the yard or on the street?				
Do you see neighbours taking care of each other, such as doing yard work or watching children?				
Do you see neighbours watching out for each other, such as calling if they see a problem?				
Do you feel it is unsafe to walk around your neighbourhood?				

SOCIAL NETWORKS *CUE – USE VISUAL AID HERE*

FRIENDS

In general, how many friends do you have? (people who you feel at ease with, who you can talk about anything with or ask for help)
(are not a member of your family) |___|___|
(if answer is 0, switch to next section)

How many friends do you see at least once a month? |___|___|

How many of them do you speak to by phone or internet at least once a month? |___|___|

How much time does it take you to go to the home of your friend who lives nearest? (write 999 if other country, 888 if lives in same house) |___|___|___| mins

How many friends do you have a very good relationship with? |___|___|

Do you feel that you're loved and appreciated by your friends?

1 ☐ Never 2 ☐ Rarely 3 ☐ Sometimes 4 ☐ Frequently 5 ☐ Always

Do your friends listen to you when you need to talk about your problems or preoccupations?

1 ☐ Never 2 ☐ Rarely 3 ☐ Sometimes 4 ☐ Frequently 5 ☐ Always

Do you help your friends?

1 ☐ Never 2 ☐ Rarely 3 ☐ Sometimes 4 ☐ Frequently 5 ☐ Always

Do you feel that you play an important role in your friends lives?

1 ☐ Never 2 ☐ Rarely 3 ☐ Sometimes 4 ☐ Frequently 5 ☐ Always

Do you feel useful to your friends?

1 ☐ Never 2 ☐ Rarely 3 ☐ Sometimes 4 ☐ Frequently 5 ☐ Always

In regard to all of this, would you consider yourself satisfied with the relationships that you have with your friends?

1 ☐ Very satisfied 2 ☐ Satisfied 3 ☐ Moderately satisfied 4 ☐ Not very satisfied 5 ☐ Not at all satisfied

CHILDREN

How many biological or adopted children to you have? |___|___|
(if answer is 0, switch to next section)

How many children do you see at least once a month? |___|___|

How many of them do you speak to by phone or internet at least once a month? |___|___|

How much time does it take you to go to the home of your child who lives nearest? (write 999 if other country, 888 if lives same house) |___|___|___| minutes

How many of your children do you have a very good relationship with? |___|___|

Do you feel that you are loved and appreciated by your children?

1 ☐ Never 2 ☐ Rarely 3 ☐ Sometimes 4 ☐ Frequently 5 ☐ Always

Do your children listen to you when you need to talk about your own problems or preoccupations?

1 ☐ Never 2 ☐ Rarely 3 ☐ Sometimes 4 ☐ Frequently 5 ☐ Always

Do you help your children from time to time?

1 ☐ Never 2 ☐ Rarely 3 ☐ Sometimes 4 ☐ Frequently 5 ☐ Always

Do you feel that you play an important role in your children lives?

1 ☐ Never 2 ☐ Rarely 3 ☐ Sometimes 4 ☐ Frequently 5 ☐ Always

Do you feel useful to your children?

1 ☐ Never 2 ☐ Rarely 3 ☐ Sometimes 4 ☐ Frequently 5 ☐ Always

In regards to all of this, would you consider yourself satisfied with the relationships that you have with your children?

1 ☐ Very satisfied 2 ☐ Satisfied 3 ☐ Moderately satisfied 4 ☐ Not very satisfied 5 ☐ Not at all satisfied

STEP CHILDREN

How many step children to you have? |___|___|

(if answer is 0, switch to next section)

How many step children do you see at least once a month? |___|___|

How many of them do you speak to by phone or internet at least once a month? |___|___|

How much time does it take you to go to the home of your step child who lives nearest? (write 999 if other country, 888 if live same house) |__|___||___| minutes

How many of your step children do you have a very good relationship with? |___|___|

BROTHERS / SISTERS

How many brothers and sisters do you have? |___|___|

(if answer is 0, switch to next section)

How many brothers and sisters do you see at least once a month? |___|___|

How many of them do you speak to by phone or internet at least once a month? |___|___|

How much time does it take you to go to the home of your brother or sister who lives nearest? (write 999 if other country, 888 if live same house) |___|___||___| minutes

How many brothers and sisters do you have a very good relationship with? |___|___|

NEPHEWS / NIECES

How many nephews and nieces do you have on your family side? |___|___|

(if answer is 0, switch to next section)

How many nephews and nieces do you see at least once a month? |___|___|

How many of them do you speak to by phone or internet at least once a month? |___|___|

How much time does it take you to go to the home of your nephew or niece who lives nearest? (write 999 if other country, 888 if live same house) |___||___| minutes

How many nephews and nieces do you have a very good relationship with? |___|___|

CONFIDANTS AND DEAR ONES

Is there a special person with whom you share private thoughts and feelings, somebody who you trust a great deal?

1 ☐ Yes 2 ☐ No (do not ask 2 next questions)

What is your relationship with that person?

1 ☐ Husband (wife)/life partner
2 ☐ Daughter
3 ☐ Son
4 ☐ Sister
5 ☐ Brother
6 ☐ Other female member of the family
07 ☐ Other male member of the family
08 ☐ Female friend
09 ☐ Male friend
10 ☐ Professional
11 ☐ Other

How often do you see that person?

1 ☐ Every day
2 ☐ Every week
3 ☐ Every month
4 ☐ Several times per year
5 ☐ Once a year

Have you suffered the loss of one or more people very close to you during the last two years?

1 ☐ Yes 2 ☐ No (do not ask next question)

This (these) person(s) was (were) your:

Yes	No		Yes	No	
1 ☐	2 ☐	Father/mother	1 ☐	2 ☐	Other member of the family
1 ☐	2 ☐	Life partner	1 ☐	2 ☐	Friend
1 ☐	2 ☐	Son/daughter	1 ☐	2 ☐	Professional
1 ☐	2 ☐	Brother/sister	1 ☐	2 ☐	Other
1 ☐	2 ☐	Nephew/niece			

EARLY LIFE CIRCUMSTANCES AND CHILDHOOD ADVERSITY

"Now I would like to ask you some questions about the first 15 years of your life.

During the majority of the first 15 years of your life, what was the economic situation of your family?	1 ☐ Good 2 ☐ Average 3 ☐ Poor 4 ☐ Does not know 5 ☐ No response
Did your mother, father or both parents die during the first 15 years of your life?	1☐ NO 2☐ Mother 3☐ Father 4☐ Both parents 5 ☐ Does not know 6 ☐ No response
What was your father's occupation for the majority of your childhood (the first 15 years of your life)?	---------- ☐ Did not work ☐ Does not know ☐ No response
What was your mother's occupation for the majority of your childhood (the first 15 years of your life)?	---------- ☐ Did not work ☐ Does not know ☐ No response
During the majority of the first 15 years of your life, would you say that your health was excellent, good, or poor?	1 ☐ Excellent 2 ☐ Good 3 ☐ Poor 4 ☐ Does not know 5 ☐ No response

During the first 15 years of your life, do you remember having any of the following illnesses?	Yes	No	Does not know	No Response
a) Nephritis (kidney disease)				
b) Hepatitis (liver disease or jaundice)				
c) Measles				
d) Tuberculosis				
e) Rheumatic fever				
f) Asthma				
g) Chronic bronchitis				

Did you have any others? Record up to 3 more sicknesses that were important for the respondent	1. 2. 3.
During the first 15 years of your life, were you confined to a bed for a month or more because of a health problem?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response

During the first 15 years of your life, would you say that there was a time in which you did not eat enough and that you were hungry?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response

Now I would like to ask you some questions about difficulties you and your family have experienced during the first 15 years of your life.

Did your father or mother not have a job for a long time when they wanted to be working?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response
Did either of your parents drink or use drugs so often that it caused problems for the family?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response
Did your parents get a divorce?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response
Did you ever witness physical violence between those close to you (such as between your parents, or your parents and siblings)?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response
Were you ever physically abused by someone close to you?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response

REPRODUCTIVE HISTORY (FOR WOMEN ONLY)

How old were you when you had your last menstrual period?	1 Age ☐☐ 2 Does not know 3 No response
At what age did you have your first menstrual period?	1 Age ☐☐ 2 Does not know 3 No response
Have you ever been pregnant?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response if 2, 3 or 4 skip the 4 next questions
How many times have you been pregnant?	☐☐ times ☐ Does not know ☐ No response
How many times have you given birth to a child *Please count stillbirths, as well as live births.*	☐☐ times ☐ Does not know ☐ No response
At what age did you give birth to your first child?	1 Age ☐☐ 2 Does not know 3 No response
At what age did you give birth to your last child?	1 Age ☐☐ 2 Does not know 3 No response
Have you ever had a hysterectomy, that is, surgery to remove your uterus and ovaries or your uterus only? Read categories to participant.	1a ☐ Yes, uterus and ovaries 1b ☐ Yes, uterus only 1c ☐ Yes, but I don't know what was removed 2 ☐ No 3 ☐ Does not know 4 ☐ No response if 2, 3 or 4 skip the next question
How old were you when you had your hysterectomy?	1 Age ☐☐
Have you ever used, or do you now use hormone replacement therapy (in the form of a pill, patch, or cream)?	1 ☐ Yes, estrogen replacement 2 ☐ Yes, estrogen and progesterone replacement 3 ☐ Yes, but I don't know the type of hormone in it. 4 ☐ No 5 ☐ Does not know 6 ☐ No response If 4, 5 or 6 skip the next page
*At what age did you **start** taking hormone replacement therapy?*	1 Age ☐☐
*At what age did you **stop** taking hormone replacement therapy?*	1 Age ☐☐
How many years have you been taking hormone replacement therapy? (please only count the years that you took it)	1 ☐☐ *Yrs*
Are you still taking hormone replacement therapy?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response

CHRONIC CONDITIONS
"*I would like to ask you some questions about your health*"

Would you say that your health is very good, good, fair, poor, very poor?	1 ☐ Very good 2 ☐ Good 3 ☐ Fair 4 ☐ Poor 5 ☐ Very poor 6 ☐ Does not know 7 ☐ No response
Have you lost 5 kg (10 lbs) or more unintentionally in the last 12 months?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response
Has a doctor or nurse ever told you that you have high blood pressure or hypertension?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response
Has a doctor or nurse ever told you that you have diabetes, that is to say, high blood sugar levels?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response
Has a doctor or nurse ever told you that you have cancer or a malignant tumour, excluding minor skin cancers?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response
Has a doctor or nurse ever told you that you have chronic lung disease such as chronic bronchitis, emphysema, or asthma?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response
Has a doctor or nurse ever told you that you had a heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response
Has a doctor or nurse ever told you that you have had a cerebral embolism, stroke, attack or thrombosis?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response
Has a doctor or nurse ever told you that you have arthritis, rheumatism, or osteoarthritis?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response
Has a doctor or nurse ever told you that you have osteoporosis?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response

Medication

We are interested in all medications that you took during the past 2 weeks including pills, dermal patches, eye drops, creams, inhalers and injections. We are also interested in drugs not usually prescribed by a doctor, such as supplements, vitamins, pain medications, laxatives or bowel medicines, cold and cough medications, antacids or stomach medicines, and ointments or inhalers.

1. **Did the participant take any prescription or non-prescription medications in the past 2 weeks?**

   ☐ Yes
   ☐ No
   ☐ Don't know
   ☐ Refused

If YES : Please, can you get your medication containers, I will record the name of all your medication.

2. **List of medications : Please record the complete drug name exactly as written on the container label.**

   1. _____
   2. _____
   3. _____
   4. _____
   5. _____
   6. _____
   7. _____
   8. _____
   9. _____

3. **List of over-the-counter medications and supplements :Please record the complete drug name exactly as written on the container label.**

   1. _____
   2. _____
   3. _____
   4. _____
   5. _____

DEPRESSION- CESD

"I am going to read a list of ways you may have felt or behaved in the past week. For each, I will ask you if you felt or behaved this way 1) rarely or none of the time 2) some or a little of the time , 3) occasionally or a moderate amount of time, 4) most or all of the time **Please use the response aid card**."

	During the past week…	Rarely or none of the time (less than 1 day)	Some or a little of the time (1-2 days)	Occasionally or a moderate amount of the time (3-4 days)	Most or all of the time (5-7 days)
1	I was bothered by things that don't usually bother me.				
2	I did not feel like eating; my appetite was poor.				
3	I felt that I could not shake off the blues even with the help of my family and friends				
4	I felt that I was just as good as other people				
5	I had trouble keeping my mind on what I was doing.				
6	I felt depressed				
7	I felt that everything I did was an effort				
8	I felt hopeful about the future				
9	I thought my life had been a failure				
10	I felt fearful				
11	My sleep was restless				
12	I was happy				
13	I talked less than usual				
14	I felt lonely				
15	People were unfriendly				
16	I enjoyed life				
17	I had crying spells				
18	I felt sad				
19	I felt that people disliked me				
20	I could not get going				

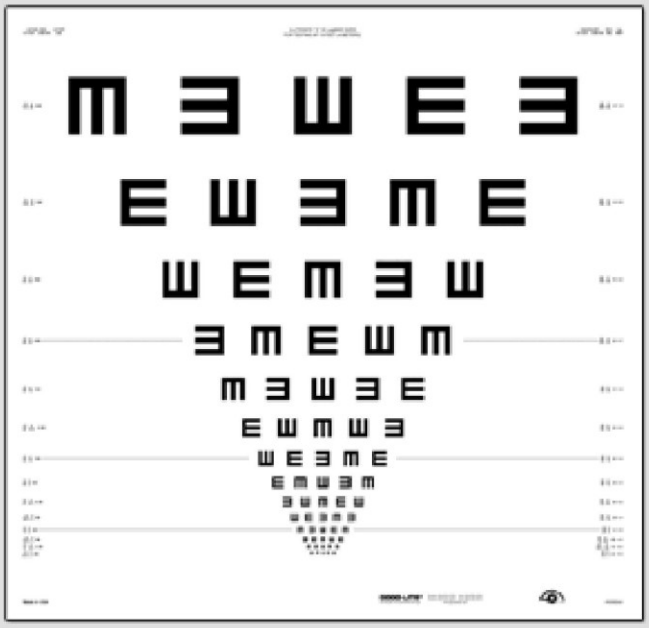
EYE HEALTH AND VISION

"***Now I would like to ask you about your eyes and vision."***

1	Do you use eyeglasses or contact lenses or both to see far away? if 2, 3 or 4 skip the next question	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response
2	*Would you say that your ability to see things far away is very good, good, fair, or poor, very poor using your glasses or corrective lenses ?*	2 ☐ Very good 3 ☐ Good 4 ☐ Fair 4 ☐ Poor 5 ☐ Very poor 6 ☐ Does not know 7 ☐ No response
3	During the last 12 months, did you receive any medical care or treatment from an ophthalmologist/ optometrist or other vision expert?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response

Tumbling E Chart Test Instructions

1. Test the patients while they wear their normal glasses that they wear for distance.
2. The chart must be used at a 2 meter test distance (2 meters from the person's face to the chart).
3. The chart should be used in a fully lighted room.
4. Test both eyes together (binocular). Do not test each eye separately.
5. Starting on the first line, ask the person to indicate the direction that the arms of each E are pointing (right, left, up, or down).
6. Using a score sheet identical to the chart, circle each E the person reads correctly. At the end of the test, count up the total number of E's that are correct.
7. Stopping rule: If the person gets 4 out of 5 E's on one line wrong, the person can then stop the test.
8. If a person says that they cannot see the E's anymore, ask them to guess until they miss 4 out of 5 on one line (forced choice procedure).
9. If a person does not do the test- write 999
10. If a person cannot read any E's on the first line of the chart, follow normal stopping procedures (stop after 1 line).



NUMBER OF CORRECT RESPONSES with glasses: _____

COGNITIVE DECLINE (PCL)

"Memory problems worry many older people and their physicians, but many people complain of memory problems while in fact, they have a good memory. We have a test which is composed of a series of questions that help us to detect memory problems. Would you agree to answer these questions?"

☐ YES ☐ NO (skip to next section)

"Now, I am going to show you some drawings and ask you to tell me what they are."

Show the participant each of the images and check if the participant's response is right or wrong.

Cow	☐ Right 1	☐ Wrong 0
Ship	☐ Right 1	☐ Wrong 0
Spoon	☐ Right 1	☐ Wrong 0
Airplane	☐ Right 1	☐ Wrong 0
Bottle	☐ Right 1	☐ Wrong 0
Truck	☐ Right 1	☐ Wrong 0

"Please, repeat the objects you have seen and try to remember them, because I am going to ask you to repeat them a little bit later. Repeat them, please."

Cow	☐ Right 1	☐ Wrong 0
Ship	☐ Right 1	☐ Wrong 0
Spoon	☐ Right 1	☐ Wrong 0
Airplane	☐ Right 1	☐ Wrong 0
Bottle	☐ Right 1	☐ Wrong 0
Truck	☐ Right 1	☐ Wrong 0

"I am going to tell you a short story. Please be attentive, because I am going to read it only once. When I finish, I will wait a few seconds and than I will ask you to tell me what you remember about it. The story is (*read slowly*):

Three children were alone in a house and the house caught on fire. A brave firefighter was able to enter through a back window and took them to a safe place. Except for a few cuts and scratches, the children were fine."

(Give the participant at least two minutes to tell what he/she remembers of the story)

Three children	☐ Right 1	☐ Wrong 0
House on fire	☐ Right 1	☐ Wrong 0
Firefighter came in	☐ Right 1	☐ Wrong 0
Children were rescued	☐ Right 1	☐ Wrong 0
A few cuts and scratches	☐ Right 1	☐ Wrong 0
Were fine	☐ Right 1	☐ Wrong 0

HEALTH BEHAVIORS : TOBACCO, DRUG AND ALCOHOL

TOBACCO

Tobacco

A. Do you currently smoke ?

1 ☐ Yes, regularly
2 ☐ Yes, occasionally
3 ☐ NO, but I used to smoke
4 ☐ NO, I have never smoked *(GO TO DRUG)*

B. How many years have you smoked? |___|___|

C. How many cigarettes per day? |___|___|___|

D. If used to smoke only, how many years ago did you quit smoking? |___|___|___| years

DRUG :

Did you ever smoke marijuana?	Do you smoke marijuana now?
1. Yes (ask questions to the right) 2. No 3. No response	1. yes 2. No 3. No response

Did you ever use other drugs like cocaine or heroin?	Did you ever use cocaine?	Did you ever use heroin?	Did you ever use other drugs?
1. Yes (ask questions to the right) 2. No 3. No response	1. Yes 2. No 3. No response	1. Yes 2. No 3. No response	1. Yes 2. No 3. No response
	Do you currently use cocaine? 1. Yes 2. No 3. No response	Do you currently use heroin? 1. Yes 2. No 3. No response	Do you currently use other drugs? 1. Yes 2. No 3. No response

ALCOHOL

How often do you usually drink alcohol

1. I have never drunk alcohol in my life *(skip to next section, PCL)*
2. I never drink alcohol, but I have in the past
3. I drink rarely
4. Less than once a week
5. On 1 or 2 days a week
6. On 3 or 4 days a week
7. On 5 or 6 days a week
8. Every day

On a day when you drink alcohol, how many drinks do you usually have?

1. 1 or 2 drinks per day
2. 3 or 4 drinks per day
3. 5 to 8 drinks per day
4. 9 or more drinks per day

How often do you have five or more drinks of alcohol on one occasion?

1. Never
2. Less than once a month
3. About once a month
4. About once a week
5. More than once a week

1	Ever felt you ought to cut down on your drinking?	1 ☐ Yes 2 ☐ No 3 ☐ No response
2	Have people annoyed you by criticizing your drinking?	1 ☐ Yes 2 ☐ No 3 ☐ No response
3	Ever felt bad or guilty about your drinking?	1 ☐ Yes 2 ☐ No 3 ☐ No response
4	Ever had an eye-opener to steady nerves in the morning?	1 ☐ Yes 2 ☐ No 3 ☐ No response

COGNITIVE DECLINE (PCL) (ask if completed the previous part of the PCL)

"Could you tell me which objects you saw a while ago?"

Cow	☐ Right 1	☐ Wrong 0
Ship	☐ Right 1	☐ Wrong 0
Spoon	☐ Right 1	☐ Wrong 0
Airplane	☐ Right 1	☐ Wrong 0
Bottle	☐ Right 1	☐ Wrong 0
Truck	☐ Right 1	☐ Wrong 0

ACCESS & UTILISATION OF HEALTH CARE

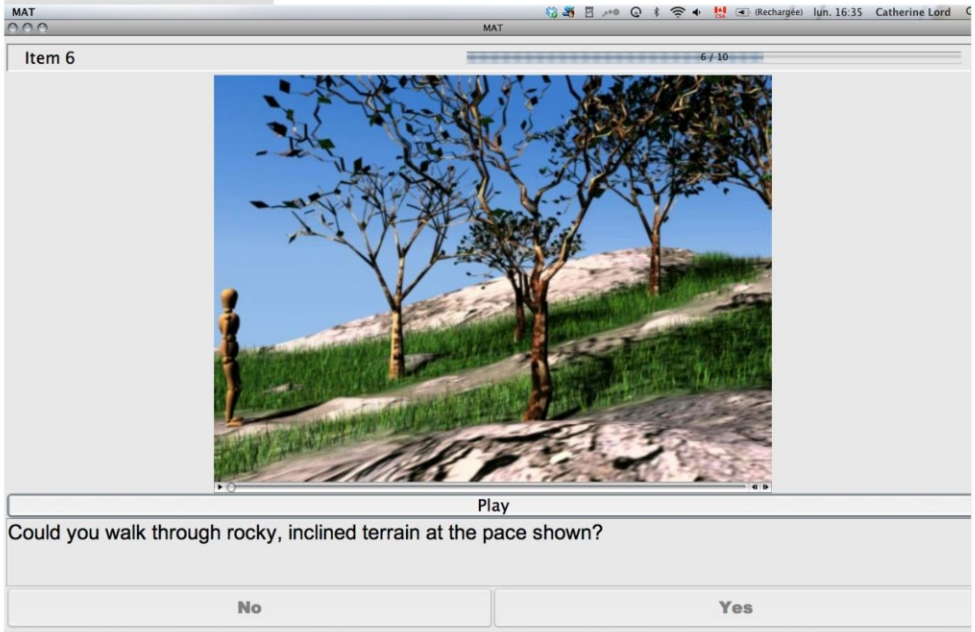
The last time you needed medical care, did you get medical care?	1☐ Yes *(skip next question)* 2☐ No
Which reasons best described why you did NOT get medical care?	1☐ No transport 2☐ Could not afford the cost of transport 3☐ You were previously badly treated 4☐ Could not take time off work or had other family commitments 5☐ You did not know where to go 6☐ Could not afford the cost of visit 7☐ Other
Do you have a regular medical doctor or clinic for medical care?	1☐ Yes *(skip next question)* 2☐ No
Reasons for not having a doctor?	1☐ No one available in the area 2☐ Medical doctors in the area are not taking new patients 3☐ Have not tried to contact one 4☐ Had a medical doctor who left/retired 5☐ Other
How many times have you gone to the doctor in the last year?	☐☐ times

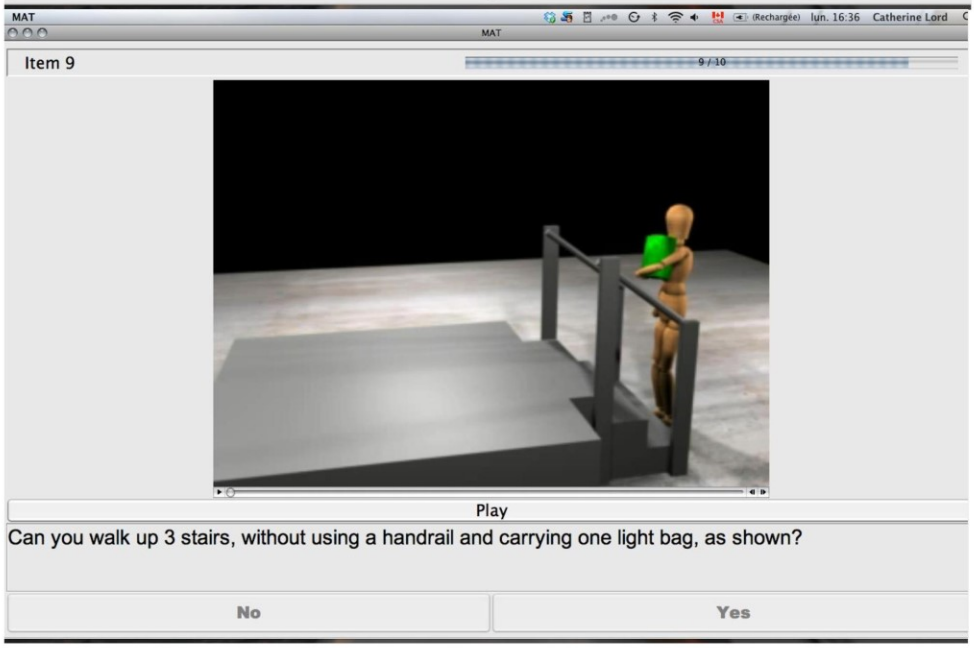
FUNCTIONAL LIMITATIONS –NAGI QUESTIONNAIRE

1	Do you have difficulties climbing a single flight (10 steps) of stairs without resting?	1 ☐ None at all 2 ☐ A little 3 ☐ Some 4 ☐ A lot 5 ☐ Unable to do
1a	Do you use any assistive devices to help you walk up stairs?	1 ☐ Yes (please specify) 2 ☐ No 3 ☐ Does not know 4 ☐ No response
1b	*What type of equipment do you use?*	_____ _____ _____ _____ _____

2	Do you have difficulties walking 400 metres (1/4 mile)?	1 ☐ None at all 2 ☐ A little 3 ☐ Some 4 ☐ A lot 5 ☐ Unable to do
2a	Do you use any assistive devices to help you walk 400 metres (1/4 mile)?	1 ☐ Yes (please specify) 2 ☐ No 3 ☐ Does not know 4 ☐ No response
2b	*What type of equipment do you use?*	_____ _____ _____ _____ _____

MAT VIDEOS EXEMPLES:

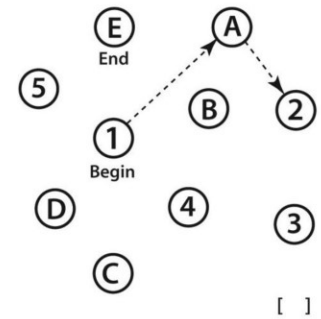




MONTREAL COGNITIVE ASSESSMENT (MOCA)
Version 7.1 Original Version

NAME :
Education : Date of birth :
Sex : DATE :

VISUOSPATIAL / EXECUTIVE — POINTS



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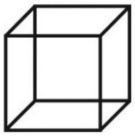
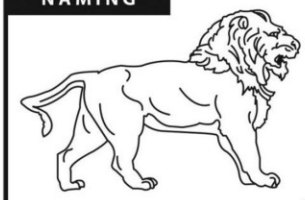


Draw CLOCK (Ten past eleven)
(3 points)

[ ] Contour [ ] Numbers [ ] Hands

__/5

NAMING



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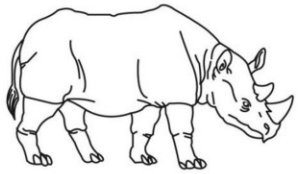

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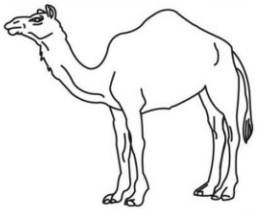


[ ]

__/3

MEMORY Read list of words, subject must repeat them. Do 2 trials, even if 1st trial is successful. Do a recall after 5 minutes.

	FACE	VELVET	CHURCH	DAISY	RED
1st trial					
2nd trial					

No points

ATTENTION Read list of digits (1 digit/ sec.).

Subject has to repeat them in the forward order [ ] 2 1 8 5 4

Subject has to repeat them in the backward order [ ] 7 4 2

__/2

Read list of letters. The subject must tap with his hand at each letter A. No points if ≥ 2 errors

[ ] F B A C M N A A J K L B A F A K D E A A A J A M O F A A B

__/1

Serial 7 subtraction starting at 100 [ ] 93 [ ] 86 [ ] 79 [ ] 72 [ ] 65

4 or 5 correct subtractions: **3 pts**, 2 or 3 correct: **2 pts**, 1 correct: **1 pt**, 0 correct: **0 pt**

__/3

LANGUAGE Repeat : I only know that John is the one to help today. [ ]
The cat always hid under the couch when dogs were in the room. [ ]

__/2

Fluency / Name maximum number of words in one minute that begin with the letter F [ ] _____ (N ≥ 11 words)

__/1

ABSTRACTION Similarity between e.g. banana - orange = fruit [ ] train – bicycle [ ] watch - ruler

__/2

DELAYED RECALL

	FACE	VELVET	CHURCH	DAISY	RED	Points for UNCUED recall only
Has to recall words **WITH NO CUE**	[ ]	[ ]	[ ]	[ ]	[ ]	
Optional Category cue						
Optional Multiple choice cue						

__/5

ORIENTATION [ ] Date [ ] Month [ ] Year [ ] Day [ ] Place [ ] City

__/6

www.mocatest.org

Normal ≥ 26 / 30

TOTAL __/30

Add 1 point if ≤ 12 yr edu

Administered by: _____

SEE INSTRUCTIONS in Procedure manual

DISABILITY (ADL/IADL)

"Here are a few everyday activities. Please tell me if you have any difficulty with these because of a HEALTH OR PHYSICAL PROBLEM. Exclude any difficulties that you expect to last less than three months."

Do you have difficulty with walking across a room?	1 ☐ None at all 2 ☐ A little 3 ☐ Some 4 ☐ A lot 5 ☐ Unable to do
Do you use any equipment or devices when walking across a room?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response
What type of equipment do you use? Read all of the answers and circle all that the participant mentions	1 ☐ Walker 2 ☐ Cane 3 ☐ Crutches 4 ☐ Brace (leg or back) or Prosthesis 5 ☐ Wheelchair or cart 6 ☐ Other_____
Does anyone help you with walking across a room?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response
Do you have difficulty with dressing (including putting on shoes and socks/stockings)?	1 ☐ None at all 2 ☐ A little 3 ☐ Some 4 ☐ A lot 5 ☐ Unable to do
Does anyone help you dress?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response
Do you have difficulty bathing/showering (including getting in and out of the tub or shower)?	1 ☐ None at all 2 ☐ A little 3 ☐ Some 4 ☐ A lot 5 ☐ Unable to do
Do you use any equipment or devices while bathing/showering (such as a rail or a stool)?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response
Does anyone help you with bathing?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response
Do you have difficulty eating (including cutting food, filling glasses, holding a fork, etc.)?	1 ☐ None at all 2 ☐ A little 3 ☐ Some 4 ☐ A lot 5 ☐ Unable to do

Does anyone help you with eating?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response
Do you have difficulty getting in and out of bed or chairs?	1 ☐ None at all 2 ☐ A little 3 ☐ Some 4 ☐ A lot 5 ☐ Unable to do
Do you use any equipment or devices when getting in and out of bed or chairs?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response
Does anyone help you with getting in or out of bed or chairs?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response
Do you have difficulty with using the toilet (including getting up or down from the toilet)?	1 ☐ None at all 2 ☐ A little 3 ☐ Some 4 ☐ A lot 5 ☐ Unable to do
Do you use any equipment or devices when using the toilet?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response
Does anyone help you with using the toilet?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response

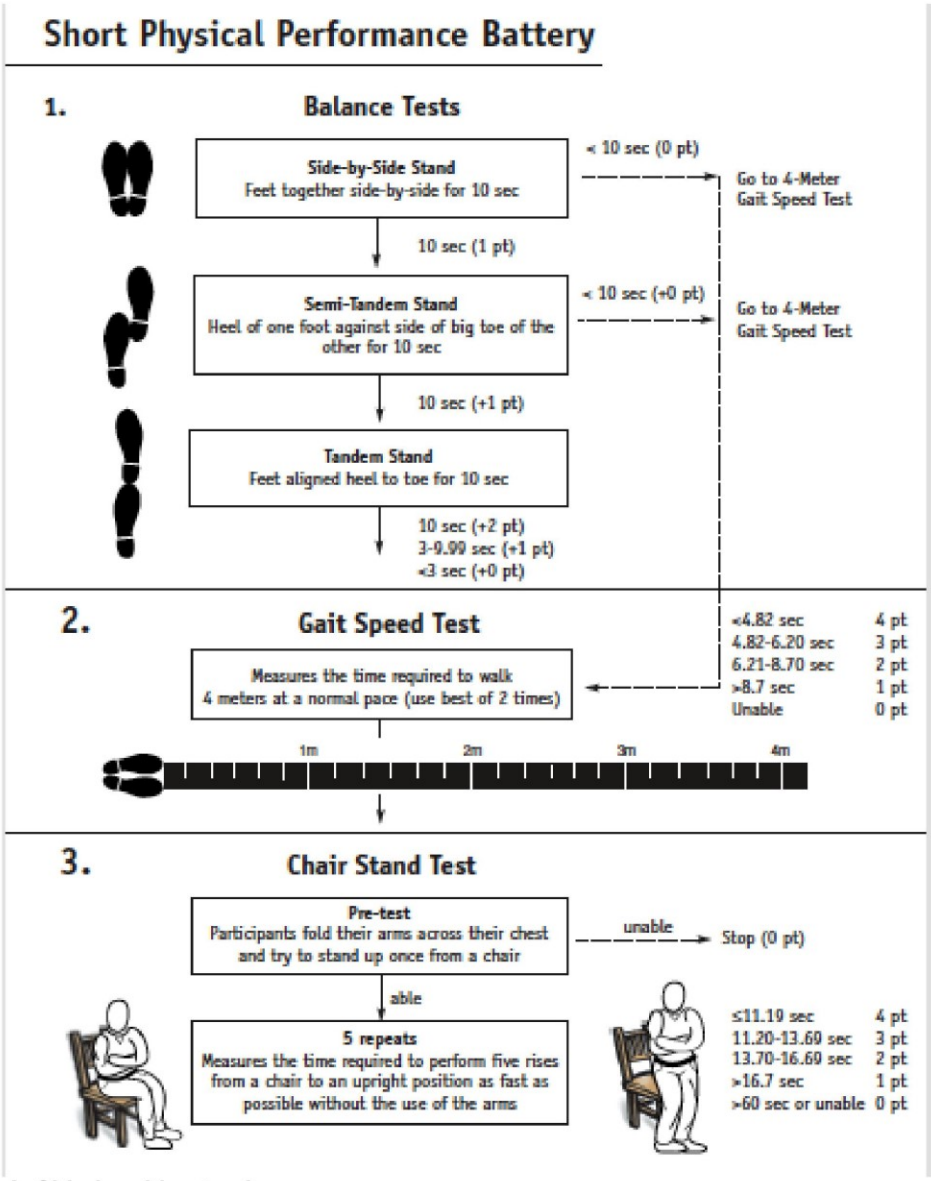
XXIV) **FALLS EFFICACY SCALE INTERNATIONAL (FES-I)**

*"Now we would like to ask some questions about how concerned you are about the possibility of falling. Please reply thinking about how you usually do the activity. If you currently do not do the activity (e.g. if someone does your shopping for you), please answer to show whether you think you would be concerned about falling **IF** you did the activity. For each of the following activities, please tick the box which is closest to your own opinion to show how concerned you are that you might fall if you did this activity.*

Read each response category to the participant.

	Not at all concerned	*Somewhat concerned*	*Fairly concerned*	*Very concerned*
1) Cleaning the house (e.g. sweeping, vacuuming or dusting)	☐	☐	☐	☐
2) Getting dressed or undressed	☐	☐	☐	☐
3) Preparing simple meals	☐	☐	☐	☐
4) Taking a bath or shower	☐	☐	☐	☐
5) Going to the shop	☐	☐	☐	☐
6) Getting in or out of a chair	☐	☐	☐	☐
7) Going up or down stairs	☐	☐	☐	☐
8) Walking around in the neighbourhood	☐	☐	☐	☐
9) Reaching for something above your head or on the ground	☐	☐	☐	☐
10) Going to answer the telephone before it stops ringing	☐	☐	☐	☐
11) Walking on a slippery surface (e.g. wet or icy)	☐	☐	☐	☐
12) Visiting a friend or relative	☐	☐	☐	☐
13) Walking in a place with crowds	☐	☐	☐	☐
14) Walking on an uneven surface (e.g. rocky ground, poorly maintained pavement)	☐	☐	☐	☐
15) Walking up or down a slope	☐	☐	☐	☐
16) Going out to a social event (e.g. religious service, family gathering or club meeting)	☐	☐	☐	☐

Have you fallen in the last 12 months? Falls include falling on the ground or at some other level, like from a chair involuntarily.	1 ☐ Yes 2 ☐ No (go to next section) 3 ☐ Does not know 4 ☐ No response
How many times have you fallen in the last 12 months?	_____ Times
In the past 12 months:	
What has been your most serious injury or problem due to any fall(s)?	1 ☐ Never injured 2 ☐ Bruises 3 ☐ Cuts 4 ☐ Discomfort 5 ☐ Fracture of leg 6 ☐ Fracture of wrist 7 ☐ Fracture of back/Vertebra 8 ☐ Fracture of the hip 9 ☐ Head injury Other (specify) _____ _____
Because of any of these falls, did you injure yourself seriously enough to need medical treatment?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response
Were you hospitalized because of a fall?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response
As a consequence of a fall, were you unable to:	1 ☐ Walk around the house 2 ☐ Do housework as usual 3 ☐ Do errands outside the house as usual
Think about the last fall you had, where were you when you fell?	1 ☐ At home 2 ☐ In the street 3 ☐ In a public place 4 ☐ Other: _____ 5 ☐ NEVER fell 6 ☐ While practicing a sport (at the gym, on the mountain, …)
Did you need help from someone to get up from the floor?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response
How long were you on the floor/ground: minutes and seconds.	☐☐ ☐☐ Minutes seconds



A. Side-by-side-stand

Held for 10 sec ☑ 1 point
Not held for 10 sec ☑ 0 points
Not attempted ☑ 0 points
If 0 points, end Balance Tests

Number of seconds held if less than 10 sec: ____. ____sec

B. Semi-Tandem Stand

Held for 10 sec ☑ 1 point
Not held for 10 sec ☑ 0 points
Not attempted ☑ 0 points *(circle reason above)*
If 0 points, end Balance Tests

If participant did not attempt test or failed, circle why:

Tried but unable	1
Participant could not hold position unassisted	2
Not attempted, you felt unsafe	3
Not attempted, participant felt unsafe	4
Participant unable to understand instructions	5
Other (specify) _____	6
Participant refused	7

Number of seconds held if
less than 10 sec: ____. _____sec

If participant did not attempt test or failed, circle why:	
Tried but unable	1
Participant could not hold position unassisted	2
Not attempted, you felt unsafe	3
Not attempted, participant felt unsafe	4
Participant unable to understand instructions	5
Other (specify) _____	6
Participant refused	7

C. Tandem Stand

Held for 10 sec ☑ 2 points
Held for 3 to 9.99 sec ☑ 1 point
Held for < than 3 sec ☑ 0 points
Not attempted ☑ 0 points (circle reason above)

Number of seconds held if less than 10 sec: _____. _____sec

If participant did not attempt test or failed, circle why:	
Tried but unable	1
Participant could not hold position unassisted	2
Not attempted, you felt unsafe	3
Not attempted, participant felt unsafe	4
Participant unable to understand instructions	5
Other (specify) _____	6
Participant refused	7

D. Total Balance Tests score _____(sum points)

GAIT SPEED TEST SCORING:

Length of walk test course: Four meters ☑ Three meters ☑

A. Time for First Gait Speed Test (sec)

1. Time for 3 or 4 meters _____. _____sec

2. If participant did not attempt test or failed, circle why:

Tried but unable	1
Participant could not walk unassisted	2
Not attempted, you felt unsafe	3
Not attempted, participant felt unsafe	4
Participant unable to understand instructions	5
Other (Specify)	6
Participant refused	7

Complete score sheet and go to chair stand test

3. Aids for first walk……None ☑ Cane ☑ Other ☑

Comments:

_____

B. Time for Second Gait Speed Test (sec)

1. Time for 3 or 4 meters . sec

2. If participant did not attempt test or failed, circle why:

Tried but unable	1
Participant could not walk unassisted	2
Not attempted, you felt unsafe	3
Not attempted, participant felt unsafe	4
Participant unable to understand instructions	5
Other (Specify)	6
Participant refused	7

3. Aids for second walk…… None ☑ Cane ☑ Other ☑

What is the time for the faster of the two walks?
Record the shorter of the two times _____._____ sec
[If only 1 walk done, record that time] _____._____ sec

If the participant was unable to do the walk: ☑ **0 points**

For 4-Meter Walk:
If time is more than 8.70 sec: ☑ **1 point**
If time is 6.21 to 8.70 sec: ☑ **2 points**
If time is 4.82 to 6.20 sec: ☑ **3 points**
If time is less than 4.82 sec: ☑ **4 points**

For 3-Meter Walk:
If time is more than 6.52 sec: ☑ **1 point**
If time is 4.66 to 6.52 sec: ☑ **2 points**
If time is 3.62 to 4.65 sec: ☑ **3 points**
If time is less than 3.62 sec: ☑ **4 points**

Single Chair Stand Test
A. Safe to stand without help **YES** ☑ **NO** ☑

B. Results:
Participant stood without using arms ☑ → Go to Repeated Chair Stand Test
Participant used arms to stand ☑ → End test; score as 0 points
Test not completed ☑ → End test; score as 0 points

C. If participant did not attempt test or failed, circle why:

Tried but unable	1
Participant could not stand unassisted	2
Not attempted, you felt unsafe	3
Not attempted, participant felt unsafe	4
Participant unable to understand instructions	5
Other (Specify)	6
Participant refused	7

Repeated Chair Stand Test
A. Safe to stand five times **YES** ☑ **NO** ☑

B. If five stands done successfully, record time in seconds.
Time to complete five stands _____._____ sec

C. If participant did not attempt test or failed, circle why:

Tried but unable	1
Participant could not stand unassisted	2
Not attempted, you felt unsafe	3
Not attempted, participant felt unsafe	4
Participant unable to understand instructions	5
Other (Specify)	6
Participant refused	7

Scoring the Repeated Chair Test

Participant unable to complete 5 chair stands or completes stands in >60 sec:	☑ 0 points
If chair stand time is 16.70 sec or more:	☑ 1 points
If chair stand time is 13.70 to 16.69 sec:	☑ 2 points
If chair stand time is 11.20 to 13.69 sec:	☑ 3 points
If chair stand time is 11.19 sec or less:	☑ 4 points

Scoring for Complete Short Physical Performance Battery

Test Scores

Total Balance Test score _____ points
Gait Speed Test score _____ points
Chair Stand Test score _____ points

Total Score _____ points (sum of points above)

START THE PHYSICAL ACTIVITY VIDEOS HERE

BEM SEX ROLES INVENTORY (USE VISUAL AID)

Instructions: From 1 to 7 tell me the degrees to which that Word describes your behaviour or attitude. Please ask if you do not know the meaning or understand the concept of a particular word or phrases

(1) Never or almost never true
(2) Usually not true
(3) Sometimes but infrequently true
(4) Occasionally true
(5) Often true
(6) Usually true
(7) Almost always true

	Never/ almost never true	2	3	4	5	6	Almost always true
Gentle	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Sympathetic	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Has leadership abilities	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Acts like a leader	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Dominant	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Tender	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Warm	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Affectionate	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Strong personality	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Defends own beleifs	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Sentitive to others needs	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Make decisions easily	**1**	**2**	**3**	**4**	**5**	**6**	**7**

DECISION AUTONOMY

"Now I would like to ask you some questions about financial autonomy."	
Do you have any money of your own that you alone can decide how to use?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response
Do you have a bank account or an account in any other savings institution in your own name or jointly with someone else?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response
Do you yourself operate the account, that is, sign checks or deposit and withdraw money?	1 ☐ Yes 2 ☐ No 3 ☐ Does not know 4 ☐ No response

"Now I would like to get your opinion on some aspects of family life. Please tell me if you agree or disagree with each statement:"	
If the wife is working outside the home, then the husband should help her with household chores.	1 ☐ Agree 2 ☐ Disagree 3 ☐ Depends
A married woman should be allowed to work outside the home if she wants to.	1 ☐ Agree 2 ☐ Disagree 3 ☐ Depends
The important decisions in the family should be made only by the men of the family.	1 ☐ Agree 2 ☐ Disagree 3 ☐ Depends
The wife has a right to express her opinion even when she disagrees with what her husband is saying.	1 ☐ Agree 2 ☐ Disagree 3 ☐ Depends

VICTIMIZATION

In the past 12 months, have you been insulted or threatened by a stranger?	☐ YES ☐ NO (skip next question)
Because of this event, did you need medical attention (did you go to the emergency room or need to see a doctor/nurse?)	☐ YES ☐ NO
In the past 12 months, have you been robbed by a stranger?	☐ YES ☐ NO (skip next question)
Because of this event, did you need medical attention (did you go to the emergency room or need to see a doctor/nurse?)	☐ YES ☐ NO
In the past 12 months, have you been attacked by a stranger?	☐ YES ☐ NO (skip next question)
Because of this event, did you need medical attention (did you go to the emergency room or need to see a doctor/nurse?)	☐ YES ☐ NO

INTIMATE PARTNER VIOLENCE (HITS)

1	HAVE YOU EVER HAD A FAMILY MEMBER WHO:					
		Never	**Rarely**	**Sometimes**	**Fairly often**	**Frequently**
	Screamed or cursed at you?					
	Insulted you or talk down to you?					
	Threatened you with harm?					
	Physically hurt you?					
2	**HAVE YOU EVER HAD A PARTNER WHO:**					
		Never	**Rarely**	**Sometimes**	**Fairly often**	**Frequently**
	Screamed or cursed at you?					
	Insulted you or talk down to you?					
	Threatened you with harm?					
	Physically hurt you?					

2	DURING THE PAST 6 MONTHS HOW often has someone in your family…					
		Never	**Rarely**	**Sometimes**	**Fairly often**	**Frequently**
	Screamed or cursed at you?					
	Insulted you or talk down to you?					
	Threatened you with harm?					
	Physically hurt you?					

1	DURING THE PAST 6 MONTHS HOW often has your partner…					
		Never	**Rarely**	**Sometimes**	**Fairly often**	**Frequently**
	Screamed or cursed at you?					
	Insulted you or talk down to you?					
	Threatened you with harm?					
	Physically hurt you?					

GRIP STRENGTH

- **Could not measure grip strength because of:**

A) Acute hand or wrist pain ☐
B) Dominant hand arthritis ☐
C) Dominant hand tendinitis ☐
D) Other reasons, specify _____

Measures :

1)_____Kg	2)_____Kg	3)_____Kg

ANTHROPOMETRIC MEASUREMENTS

- **Weight could not be measured because of:**

A) The person could not stand on the scale ☐
B) Other reasons, specify_____

- **Height could not be measured because of:**

A) The person could not stand on the stadiometer ☐
B) Other reasons, specify_____

1) Weight : _____.___ Kg

2) Height : _____.___ cm

3) Waist circumference: ____.___ cm

THANK YOU FOR YOUR TIME THIS IS THE END OF THE QUESTIONNAIRE

END TIME _____ :_____(HH :MM)