Factors associated with the deterioration of intrinsic capacity in older people in Mexico and Colombia.

Claudia Liliana Valencia Rico (1), Nora Hilda González Quirarte (2), Lidia Guadalupe Compeán Ortiz (2), Hortensia Castañeda Hidalgo (2), Sandra Milena Campiño Valderrama (3), Lilia Fletes Rayas (4).


4) Universidad de Guadalajara. México.

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**Background:** Intrinsic capacity (IC) is defined as "all the physical and mental attributes possessed by the older person." This concept has gained momentum in recent years because it provides insights into the changes in the functional capacity of individuals during their life. This study examined common factors associated with IC decline among older adults in Mexico and Colombia.

**Methods:** This cross-sectional, correlational study included 348 community-dwelling older adults. Sociodemographic, clinical, and family conditions were assessed as possible associated factors, and IC was analyzed across five domains: cognitive, locomotor, psychological, vitality (malnutrition through deficiency and excess), and sensory (visual and auditory). Parametric and non-parametric statistical analyses were performed.

**Results:** The common factors associated with impairment according to domain were family dysfunctionality (cognitive domain); myocardial infarction, family dysfunctionality, age >80 years, home occupation, and not having a partner (locomotor domain); dysfunctional family and risk of falls (psychological domain); age >80 years and not having a partner (malnutrition by deficiency domain); age 60–79 years, walking <7,500 steps/day, and peripheral vascular disease (malnutrition by excess domain); risk of falling and being female (visual sensory domain); risk of falling (auditory sensory domain); and dysfunctional family and risk of falling (total intrinsic capacity).

**Conclusion:** Both populations had common sociodemographic, clinical, and familial factors that directly affected total IC stocks and their domains.

**Key words:** Intrinsic Capacity, Risk Factor, Geriatric Assessment, Older Person

**INTRODUCTION**

The World Health Organization operationally defines intrinsic capacity (IC) as “all the physical and mental attributes possessed by the older person”\(^1\). This construct is based on a longitudinal pattern consistent with the continuous process of individual aging, which must be assessed through multiple observations over time rather than a single assessment\(^2\). This concept has gained momentum in recent years because it provides an understanding of changes in the functional capacity of individuals during their life. IC is also based on a positive health perspective and although its clinical application always seeks to measure deficits, its main objective is to guide preventive interventions tailored to the individual needs of older adults, overcoming limiting paradigms such as chronological age or the presence of diseases\(^3\).
Reserves and deficits in IC occur in different ways among older adults, making them difficult to study and address. Recently, studies have analyzed the five IC domains (cognitive, locomotor, psychological, vitality, and sensory) and their relationship with sociodemographic and clinical conditions in older adults. IC has also been identified as a predictor of all-cause mortality and adverse events as well as incidents in older people. Likewise, three patterns of IC in community-dwelling older people have been identified: 1) those who are relatively healthy; 2) those with acute decline in the sensory domain; and 3) those with acute decline in the locomotion, psychological, cognitive, and vitality domains, a finding that is considered valuable for better stratification of groups of older people.

In Latin American countries such as Mexico, all IC domains tend to decline with age, especially among women. Self-rated health, chronic diseases, number of doctor visits in the last year, and ≥2 affected activities of daily living are consistently associated with more affected IC domains. In contrast, in Colombia, individuals with optimal grip strength have better IC compared with their weaker counterparts; likewise, altered IC domains act as mediators between a fear of falling and the built environment, with increasing fear of falling reported among people living in neighborhoods with structural limitations and social problems.

While some clinical factors associated with IC decline have been identified separately in Mexico and Colombia, sociodemographic and familial determinants that may influence the decline in IC reserves have not been explored. Moreover, whether similar factors of decline exist in both countries among community-dwelling older adults who are independent in their daily living basic and instrumental activities but live in different conditions and culture remains undetermined.

Therefore, this study assessed IC considering the personal, clinical, and family characteristics of people >60 years of age living in Colombia and Mexico.

**MATERIALS AND METHODS**

**Participants**

Older community members were enrolled from Ciudad Madero, Tamaulipas (Mexico) and Manizales (Colombia). Participants from Mexico were recruited through the community clubs for older adult members of the “Adults in Action Programme.” Participants from Colombia were recruited from the Primary Care Programs operating in the city's health centers. All participants were characterized by age >60 years and regular attendance of primary care programs. We determined a random sample by applying the formula for the estimation of averages with a known sampling frame, assuming a type I error of 0.05, precision of 0.03, and standard deviation of 0.3. Therefore, minimums of 280 and 297 individuals from Mexico and Colombia, respectively, were required. The final sample included a total of 348 older people (226 from Mexico and 122 from Colombia) who participated in this study.
Measurements

Sociodemographic, clinical, and family characteristics

We investigated sociodemographic characteristics including age, sex, marital status, and level of schooling. Clinical variables were identified by asking about the presence or absence of diseases with a predominance of cardiovascular, brain, and vascular diseases, as well as alcohol and tobacco consumption. Additionally, we assessed fall risk using the Downton scale. The number of steps walked per day was determined by providing pedometer and recording for 7 d, using the cut-off points proposed by Tudor-Locke and Bassett\(^7\) as reference. We assessed family functionality and support using the Family Functionality Effectiveness Scale A-EFF-22 by Friedemann and Alcorta\(^{18, 19}\).

IC

We analyzed the five domains separately. Each domain was interpreted by considering the cutoff points established in the validated instruments and subsequently recoded as a dichotomous response to identify preservation or impairment in each domain as follows: the cognitive domain was assessed using the Pfeiffer questionnaire\(^{20}\), in which some level of intellectual impairment was considered cognitive impairment and normal scores as preserved cognitive domain. The locomotion domain was assessed using the Tinetti Scale, with minimal and high risks defined as balance or gait impairment and no risk as preserved locomotor domain. The psychological domain was assessed using the Yesavage Scale\(^{21, 22}\), in which levels of mild and established depression were considered depressive symptoms, and the absence of symptoms was considered preserved psychological domain. The vitality domain was assessed using the Mini Nutritional Assessment (MNA)\(^{23}\) and anthropometric measurements (weight/height) were used to determine the body mass index (BMI) (as the MNA does not identify overweight or obesity). After each result was obtained separately, two new variables were created to determine malnutrition deficiency and excess. The first was obtained by defining MNA scores <24 and BMI scores <27 kg/m\(^2\) as deficit malnutrition and the remaining scores as not having deficit malnutrition. The second variable defined MNA results >24 and BMI scores ≥27 kg/m\(^2\) as excess malnutrition, with the remaining scores defined as no excess malnutrition. The sensory domain was assessed by self-reporting the presence or absence of visual and auditory impairments. Finally, the total IC was calculated by summing all the domains under a theoretical scale of 0–7 points (considering that two aspects were assessed in the sensory domain), where each impaired domain contributed one point (0 and 1 points for the preserved and impaired domains, respectively). Thus, the higher the score, the greater the IC impairment. The variable was then dichotomized using the following cutoff points: 0–2 = preserved IC (for those with up to two impaired domains) and >3 points = impaired IC (for those with three or more impaired domains).

Ethical aspects

This project was developed under the ethical and legal considerations for research in Mexico and Colombia. This proposal was approved by the ethics committees of the educational institutions of the authors (Colombia IRB: 122/ 25 /06/2018. México IRB: 301.511-6/17-
We obtained informed consent from the participants and complied with bioethical principles (autonomy, beneficence, non-maleficence, and justice).

**Data analysis**

Data were processed using IBM SPSS Statistics for Windows, version 24.0. Sociodemographic, clinical, and family characteristics were analyzed as frequencies, percentages, and measures of central tendency (for scale variables), and cross-tables were constructed by comparing the proportions for each country and applying the chi-square test. We proceeded in the same way for the characterization of the IC domains to identify the proportions of deterioration or conservation of each domain according to country. Finally, to identify the associated factors as possible predictors, we explored binary logistic regression models using the backward method and only the independent variables that were statistically significant in the bivariate analysis. We identified predictors jointly for both populations.

**RESULTS**

For the whole sample, the age range was 60–92 years (average 70 ± 6 years, median 69 years). Age discrimination by category showed statistically significant differences, with a higher proportion of older people in the 60–79-year age group in both countries. We also observed significant differences in the distributions by sex and level of education, with higher proportions of women and individuals with a low level of education (no education or primary education) in both countries. Marital status and occupation did not differ significantly between countries (Table 1). Regarding the clinical conditions of older people in each country, Mexico had significantly higher prevalence rates of peripheral vascular disease (43.4%) and alcohol consumption (25.2%), whereas older adults in Colombia demonstrated significantly higher prevalence rates of hypertension (75.4%) and dyslipidemia (46.7%) (Table 1).

The IC domains showed no significant sex differences, except in the visual sensory domain, where self-reported visual impairment prevailed in 56.9% of women (p = 0.016). Total IC was impaired in 32.3 and 28.4% of females and males, with no statistically significant differences.

We observed statistically significant differences for all domains according to country, except for the psychological domain. In older adults in Mexico, the three domains that reported the greatest deterioration were vitality (excess malnutrition, 59.3%), followed by the sensory (self-reported visual impairment, 57.5%) and locomotor (balance/gait impairment, 26%) domains. In Colombia, the main impaired domains were the locomotor (balance/gait impairment, 46.7%), sensory (self-reported visual impairment, 45.1%), and vitality (malnutrition due to excess, 32.0%) domains. We observed no significant differences in total IC impairment between the countries (Table 2).

Binary regression (for all participants) revealed factors associated with impairment in all domains and total IC. The locomotor domain had the highest number of associated factors, followed by excess malnutrition. Fall risk was the most frequent clinical condition associated
with impairment in four of the eight models. Similarly, within the family-related variables, family dysfunctionality was associated with impairment in four predictor models, followed by sociodemographic characteristics such as age, sex, and marital status (Table 3).

**DISCUSSION**

This study identified sociodemographic, family, and clinical factors that synergistically increased the deterioration of individual domains and total IC. A dysfunctional family environment was the main factor in the cognitive domain, which is consistent with recent findings in another study showing a lower prevalence of family functioning among groups of families with older people with mild cognitive impairment compared with their counterparts without cognitive impairment (59.3 vs. 89.7%) 24. Family functionality implies coherence between the relationships of its members; individuation mechanisms that improve communication, knowledge, and growth of its members; and adaptation to changes in situations to guarantee security, independence, and greater autonomy. Thus, older individuals present a decline in cognition when they lack sufficient resources within their family group to conserve and enhance the individual’s cognitive reserve.

The locomotor domain showed the highest number of factors in this study. Among these factors, myocardial infarction demonstrated the greatest effect. Myocardial infarction has been reported as a cause of physical deterioration (especially in females) and presents as slower walking speed and frailty 25. Herein, the prevalence of myocardial infarction in the two countries was only 10.5%; however, 66.7% of these patients were females. We identified family functionality as the second factor, in which 16.4% of people living with dysfunctional family processes showed impairments in this domain. The third factor associated with locomotor impairment was age, in which 5.5% of people aged ≥80 years had impaired balance and gait. Another factor associated with the deterioration of this domain was related to dedicating oneself solely to household chores (vs working or studying). In this case, the decrease in locomotion is explained by restricted mobility in the living space, with the consequent limitation of instrumental and social activities in the neighborhood and city in which the individual lives 26. However, herein, being single was associated with increased locomotor deterioration. The influence of a partner on the performance of physical activity and, consequently, on the conservation of locomotor reserves, has been demonstrated 27; likewise, physical activity interventions for older people in which a partner participates facilitate a substantial increase in this activity over time, more so than when it is performed alone 28. Hence, living as a couple and engaging in all types of activities (not just physical activity) together can promote a lifestyle that is active enough to preserve locomotor reserve.

The main associated factor in the psychological domain was living in a dysfunctional family. Other studies have demonstrated a relationship between family functionality, the perception of health, and the presence of depressive symptoms in nonagenarians and centenarians 29-31. Our findings demonstrated a dysfunctional family environment was associated with a 6.7-fold increased likelihood of deterioration in the psychological domain in older adults, making this a significant finding. Likewise, the risk of falls was associated with the deterioration of
the psychological domain, which is consistent with other studies reporting two-way associations, in which the risk of falls increases depressive symptoms over time, which subsequently, increases the incidence of multiple falls\textsuperscript{32}.

In the vitality domain, we observed a greater number of factors associated with excess malnutrition, including age (60–79 years), which is consistent with the findings of another study in South America reporting a higher risk of obesity in women in the same age group (odds ratio [OR] = 1.88; 95% confidence interval [CI]: 1.16–3.04)\textsuperscript{33}. We observed a higher risk in the present study, (OR = 4.1), which can be explained by the fact that the overweight and obese groups were analyzed together. Another factor related to deterioration in this domain was walking <7,499 steps/day, which, according to Tudor-Locke, et al\textsuperscript{17}, corresponds to a group of people with basal or low physical activity, in whom the number of steps is not sufficient for weight control. Finally, peripheral vascular disease was a predictor of overweight or obesity, which may be explained by the relationship between peripheral vascular disease and cardiometabolic syndrome\textsuperscript{34,35}.

Two factors were associated with malnutrition deficiency; First, age ≥80 years, which is a condition arising from the aging process, such that as time progresses, anorexia, underweight, sarcopenia, and frailty develop\textsuperscript{46,37}. Second, single adults were at a higher risk of deficit malnutrition, which is consistent with the findings of another South American study\textsuperscript{39}. This is explained by the lifestyle and different eating habits of older persons living alone, which may involve cultural practices, personal tastes, or simply not having sufficient resources or independence to care for themselves during the feeding process.

Factors such as being female and at a higher risk of falls were significantly related to impairment in the sensory domain. The causes of visual impairment (cataracts and corrected refractive errors) are associated with demographic transition; likewise, women aged ≥50 years show a higher prevalence of visual impairment\textsuperscript{38}. In the present study, 80% of older adults who reported having some type of visual impairment were females. Regarding the risk of falls, the relationship between visual and hearing impairments and postural control is well known. However, in this study, these two conditions showed the opposite relationship, in which the risk of falls could be a factor that does not allow sufficient physiological integration between movement, vision, and hearing to perform daily activities.

Finally, the results of the total IC revealed three factors, the most significant being a dysfunctional family environment. Family living conditions can be a protective factor that contributes to member support and well-being; however, problematic conditions are also associated with stress and health impairment\textsuperscript{39}. The results of the present study revealed that family dysfunctionality can lead to a 5.7-fold higher probability of IC deterioration in older individuals. These findings provide significant data to inform health interventions, particularly nursing interventions that aim to preserve the intrinsic reserves necessary for adaptation to the environment and performance of the maximum number of possible activities in daily life. Moreover, not having a partner decreased the total IC; thus, this condition can lead to unfavorable or disadvantageous situations over time, with the consequent loss of intrinsic and health reserves. Previous studies have reported higher
relative mortality rates among divorced, widowed, and single individuals compared with married individuals. Additionally, the risk of falls increased the probability of the deterioration of total IC by 3.0-fold; however, this was the only geriatric syndrome that was considered a possible risk factor. Therefore, additional studies comparing the most prevalent geriatric conditions in their entirety are needed to identify those conditions with the greatest impact on IC.

In summary, our results provide new evidence regarding the deterioration of intrinsic reserves via socio-demographic and family variables that synergize with different health changes, enhancing dependence in various domains. Therefore, health promotion and maintenance should be performed on different fronts and not only from the medical-therapeutic aspects. Moreover, interventions should address aspects related to the family environment of older individuals, considering that the loss of reserves is an individual and heterogeneous phenomenon that is not only attributed to comorbidities and clinical conditions.

The limitations of this study are that, as it is a cross-sectional study with a small sample population per country, the validity of the predictors observed may be reduced. Although, the factors identified for each IC domain showed a synergistic interest phenomenon; namely, the interaction of clinical and socio-demographic factors and family living conditions, longitudinal measurements are needed to determine whether these variables are predictive factors of IC. In addition, each country must be considered as a covariate in future analyses to determine which factors contribute to IC decline regardless of the area in which older people live.

CONFLICT OF INTEREST

None.

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AUTHOR CONTRIBUTIONS

Study conception and design; data acquisition, analysis and interpretation, and manuscript writing: CL, NH, and SM. Project administration and critical revision for important intellectual content: LG, H, and LF.