Frailty Index in the Colonias of the Rio Grande Valley: A Preliminary Report

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Research note

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Abstract

Objectives

The Frailty index (FI) calculates frailty as the sum of health deficits divided by the total number of variables and reflects biopsychosocial and cultural determinants of well-being. A Colonia is a predominantly Hispanic, economically distressed, unincorporated neighborhood and varies in resources according to geographic location and contributors to social determinants of health. We report baseline Frailty Index data from two Colonias in South Texas. This information serves as a starting point for further investigation into frailty in Hispanic immigrants in South Texas

Results

FI against age separately in males (n=272) and females (n=622) was regressed. Females had a significantly higher starting frailty and males had a significantly greater rate of change with age. FI against age for two Colonias was regressed. We calculated a significantly higher starting FI in Indian Hills Colonia and a significantly greater rate of change with age in residents in Cameron Park Colonia

Introduction

Frailty is an aging process and relates to a reversible decline in both cognitive and physical competence. The interaction of environmental stressors, health-related conditions, and contributors to quality of life, influence vulnerability to physical and psychological decline. Frailty can predict morbidity, mortality, quality of life, and life satisfaction, and relates to a multi-system decline in function and an increased vulnerability (as well as decreased resilience) to external stressors. 1–3 Frailty indices consider multiple variables, including age, physical health, mental health, life satisfaction, interacting physical, psychological, and social factors. The FI is related to age, sex, obesity, lower socioeconomic level (SES), lower level of education, less exercise, smoking, alcohol use, and social determinants of health. 4,5 A reduction in Frailty can improve quality of life, reduce social vulnerability as well as, affect morbidity and mortality. 6,7,8

One in three people in the South Texas Rio Grande Valley (US-Mexico border) are uninsured/underinsured, and 40 percent of families in the region live below the poverty level. 9 The area comprises a large number of Colonias, (unincorporated Hispanic neighborhoods that may lack in resources) and is characterized by nutritious-food deserts, greater exposure to infectious disease, limited transportation capacity, poor internet capacity, social vulnerability, and low social capital.10–14 Obesity (53.8%); hypertension (38.9%); diabetes (28.8%); and depression (21.8%) are epidemic in the area.14,15 The prevalence and predictors of Frailty in the Colonias are unknown.

Computed as the sum of biopsychosocial health deficits (H.D.s), divided by the total number of variables measured, the Frailty Index (F.I.) provides a measure of overall health-related well-being from variables

routinely collected in primary care. Our aim is to provide a baseline F.I. and define possible predictors of frailty, for the Colonia population.

Methods

The patients were self-selected of all patients, older than 18 years old, that presented to care in two Colonias located in South Texas. Cameron Park is an older Colonia (characterized as a low public health risk), approximate to the border, with 15 years of intermittent health-related services. Geographically isolated, Indian Hills is a younger Colonia (Colonias with potable water and adequate wastewater disposal, but without road paving, drainage, or solid waste disposal that are at intermediate health risk) with poor access to healthcare.

After missing data imputation to account for missing data for the variables studied, we analyzed 894 charts for baseline prevalence, associations, and contributing factors. We measured seven physiological health variables (obesity, diabetes, hypertension, high triglycerides, low HDL (high density Lipoprotein), high LDL (low density lipoprotein), high total cholesterol), and two survey instruments. The Duke Health Profile, a 17-item self-report questionnaire covering 11 domains, measures health-related quality-of-life (reliability .30-.78). 16 The Patient Health Questionnaire (PHQ-9) (reliability .89) is a nine-item instrument that measures depression.¹⁷ To calculate the FI, we used 19 variables—the seven physiological health variables, 11 domain scores of the Duke Health Profile, and the PHQ-9 score,^{18,19} Regressions of the Frailty Index against age were performed in subsamples of males, females, Cameron Park patients, and Indian Hills patients. We compared sex and Colonia, using the difference between slope and intercept tests.²⁰

Using a complementary multivariate test, we examined the difference between the vectors of means for all the variables considered by way of Hotelling's T^2 given as the squared difference of mean vectors scaled against the sample covariance matrix while taking sample size differences into account. Hotelling's T^2 was computed and then transformed into an F-statistic for statistical inference in r Version 3.2.3).

Results

Obesity, diabetes, hypertension, and depression are highly prevalent in both Colonias. Table 1 lists the variables used to calculate the Frailty Index with corresponding prevalence, standard deviation, and p values. Across biometric measurements, males score worse on five of the six domains that measure function (i.e., physical health, mental health, social health, general health, perceived health). For the five domains that measure dysfunction (i.e., anxiety, depression, anxiety-depression, pain), women score worse than men, except on pain. If we look across Colonias (Fig. 1), Cameron Park is older ($P < .001$), with higher systolic blood pressure (SBP), Hemoglobin A1C (HbA1C), lower HDL, and higher Cholesterol measurements. Residents of the two Colonias score similarly between 10 of the 11 domains of the Duke Profile other than perceived health (Indian Hills score higher).

Table 1
Total and Sex-Specific Prevalence Statistics for Clinical Outcomes

Trait	Males (N = 272)		Females (N = 622)		p-value*
	Prevalence	S.D.	Prevalence	S.D.	
Norm Wt.	17	0.02	14	0.01	0.161
Over. Wt.	31	0.03	29	0.02	0.335
BMI 26–29					
Obese	53	0.03	57	0.02	0.156
BMI > 30					
Norm.	39	0.03	37	0.02	0.280
HbA1c < 5.5					
Pre-DM	29	0.03	31	0.02	0.280
HbA1C 5.5–6.5					
DM	32	0.03	33	0.02	0.488
HbA1C ≥ 6.5					
HTN ≥ 140/90	46	0.03	36	0.02	0.002
Cholesterol ≥ 200	7	0.02	6	0.01	0.187
Triglycerides	60	0.03	48	0.02	0.000
≥ 200 mg/DL	7	0.02	6	0.01	0.187
Low HDL-C ≤ 40 mg/DL					
Depression	33	0.03	20	0.02	< 0.000
PHQ9 ≥ 10	17	0.02	19	0.02	0.232
* Prevalence differences were tested using a difference of proportion Z-statistic that is normally distributed for a one-tailed test. S.D. = Standard Deviation					

Frailty increases with age and peaks at 40–60 years old. The proportion of patients with a non-zero Frailty Index increased significantly ($p < .001$) from the younger to older age groups (20–45 vs. 46–93). The starting Frailty Index for women is higher than men, but as men age, they decline faster than women. The mean Frailty Index for women is higher than that for men ($p < .01$), which is consistent with their significantly different mean vectors as inferred from the Hotelling's T-squared result ($p < .001$). The Frailty Index in Indian Hills remained stable with increasing age when compared to Cameron Park ($p < .001$) and the Frailty Index was significantly higher in Cameron Park ($p < .02$), consistent with their significantly different mean vector ($p < 0.001$) (Fig. 2).

Discussion

We describe the use of a Frailty Index based on two surveys (including valid holistic measurements of health-related quality of life (HrQOL) and depression) as well as seven physiologic measurements commonly used in primary care clinics. This Frailty Index is a highly reproducible, multi-dimensional measurement of the well-being of individuals, and conceptualizes the health of a biologic system. 20–25 We report the baseline level of Frailty, as well as gender and Colonia differences. We believe that the Frailty Index characterizes many of the unique contributors to HrQOL and Frailty in the Hispanic population of the Colonias and postulate multifactorial reasons for the results and variations.

A cross-sectional representation of residents of Indian Hills showed little change of Frailty with advancing age, whereas Frailty increased dramatically with age in the more established Cameron Park, with the peak frailty index scores between 40–60 years old. Deficit accumulation—such as poverty, reduced healthcare access, less education, physical decline due to manual labor, reduced social capital, environmental toxins, and genetic changes— affect health and well-being. 26,27–30

Frailty Index calculated against age and Colonia was regressed against age. Indian Hills had a significantly higher starting frailty however, Cameron Park had a significantly greater rate of change with age. Indian Hills is a younger Colonia, more transient, and with fewer established, multi-generational families. Prior researchers note positive contributors to Frailty in Hispanic dense, cultural and language congruent neighborhoods that suggest that social capital, positive cultural protection, reduced social vulnerability, and proximity to language and cultural-based assistance, protect against Frailty.^{31–33} Perhaps an immigrant paradox protects the health of families in Indian Hills; families that we cared for in Indian Hills may be more willing to seek medical care, be more supportive for the elderly, or are newer immigrants.

We found that women score higher in Frailty than men when young, but the FI for men worsened rapidly with advancing age. Earlier studies attempt to explain gender-based differences found in Frailty. In our sample, women and men have the same prevalence of disease (except triglycerides), yet the frailty indices are higher for women. ^{30,34,35} Socio-behavioral explanations include cultural differences why men may not seek care or accept disability or disease. Hispanic men in the Colonias are involved in more physical labor, their diet is calorically high, and aside from work, they do not participate in a planned exercise program. Women may suffer from more adverse psychosocial stressors at a young age (as seen by the five domains of the Duke Profile that measure dysfunction). Teen pregnancy, large families, intimate partner violence, and women's role in the family structure may explain variance in Frailty in younger women. We did not measure education level, alcohol, and substance abuse, tobacco use, social determinants of health, or adverse childhood events that could potentially change the Frailty Index.

It is also interesting that Cameron Park residents not only score higher Frailty Indices at an earlier age but deteriorate quicker than Indian Hills residents. Maybe living in an area within a city exposes residents to worse food choices, social isolation, social vulnerability, or housing insecurity, that Cameron Park has a higher relative in-equality, or that city living includes less nutritious food choices. The rate of decline in

Frailty in Cameron Park may relate to social factors, overall age, job types, immigration status, and increased availability to high caloric foods that contribute to the advanced decline. Residents of Indian Hills may retain more of their traditional diet, whereas by comparison Cameron Park has adopted unhealthier modernized/urbanized dietary practices (e.g., fast food, junk food, unprecedented access to sugary drinks).

Conclusion

The Frailty Index is easy to use and comprise variables that most clinicians already gather. Hispanic patients that seek healthcare from a mobile clinic serving Colonias in South Texas, an area rich in immigrants, suffer from a high prevalence of diabetes, hypertension, obesity, depression, hypertriglyceridemia, and score low on health-related quality of life measures. Given that the Hispanic population is rapidly growing in the United States, it is essential to determine whether there are modifiable social factors related to Frailty in this group. Future research needs to incorporate measures of stressors and social support in examining those who become frail, especially in minority populations. What stressors affect Frailty in Hispanics that Live in Colonias? Are underserved, immigrant populations differentially affected by experienced life stressors? Although social determinants of health and health equity are strong predictors of chronic disease, it is crucial to study how these stressors affect immigrants living in underserved areas.

Limitations

The findings in this report are subject to several limitations; the data are cross-sectional and retrospective, and the cohort may not represent the Colonia population at large. A longitudinal study may better represent change over time. For example, the acute decline of Frailty in men could be related to other factors such as early death, moves, decreased healthcare access, and healthy lifestyle acceptance and healthier life choices by women. The power of a retrospective review of data is not as reliable as a prospective, randomized control trial based on implementation science theories and frameworks. Further studies of known and suspected contributors to Frailty such as genetic contributors, adverse child events, social determinants of health, level of education, access to healthcare, cultural differences about health are necessary.

Abbreviations

Frailty index (FI)

Socioeconomic Level (SEL),

High density Lipoprotein (HDL)

Low Density Lipoprotein (LDL)

Patient Health Questionnaire 9 (PHQ-9)

Health Related Quality of Life (HrQOL)

Systolic Blood Pressure (SBP)

Hemoglobin A1C (HbA1C),

Declarations

Ethics and Consent

The Institutional Review Board of the University of Texas Rio Grande Valley approved the study. The study adhered to the ethical guidelines of the Declaration of Helsinki. All participants signed a consent to participate.

Consent for Publication

N/A

Trial Registration

N/A

Availability of Data and Materials

The datasets generated and/or analyzed during the current study are available in the Mendeley Data at <https://data.mendeley.com/drafts/repository>

Standards for Reporting

This manuscript followed Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines

Competing Interests

The authors declare that they have no competing interest

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Authors' Contributions

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

EM is principle Investigator on the grant, collected data, analyzed data, wrote and was substantially involved in editing the manuscript

CG analyzed data, wrote and was substantially involved in editing the manuscript

VD analyzed data, completed the statistical analysis, was substantially involved in Editing.

GMM Analyzed data, contributed to manuscript, and was substantially involved in editing

SWB analyzed data and was substantially involved in editing

FF is Co-PI for the grant, analyzed data, and was substantially involved in editing

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Figures

Figure 1

The plot of the difference of means as calculated by Hotelling T2 is the squared difference of mean vectors scaled against the co-variance matrix for age (yrs), SBP (systolic blood pressure), A1c (HbA1C), HDL, Chol (Cholesterol), physical health, social health, perceived health, anxiety, A_D (anxiety-depression), pain, and disability. Above zero reflects a greater value in CP (red) and below zero reflects a greater value in Indian Hills (orange).

Figure 2

Frailty Index calculated against age/sex and age/Colonia. FI was regressed against sex and age for two Colonias, namely Cameron Park (CP; N=330) and Indian Hills (IH; N=325) Females begin with a higher FI, both increase with age, but Males FI increase more with age. IH had a significantly higher starting frailty ($p < 0.001$) CP had a significantly greater rate of change with age ($p < 0.001$).

Supplementary Files

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