ORIGINAL ARTICLE

A Descriptive Study of the Nutritional and Frailty Status of Working and Retired Employees within an Academic Community in the Philippines

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ABSTRACT

Objectives. This study aims to describe the sociodemographic and clinical profile of working and retired staff and faculty age 55 years and older in an academic community living in Laguna, Philippines; to determine the proportion of participants with Type 2 Diabetes Mellitus (T2DM); and to describe the nutritional and frailty status of working and retired participants with T2DM.

Methods. The study utilized a cross-sectional study design. The participants are current employees and retired faculty and staff of an academic community living in Bay and Los Baños, Laguna, Philippines. Stratified random sampling according to working status and gender was utilized. Participants with T2DM were determined and assessed based on their nutritional and frailty status using the comprehensive geriatric assessment (CGA), laboratory analysis, and mini nutritional assessment (MNA). Descriptive statistics were calculated for all continuous and categorical variables measured.

Results. A total of 109 participants agreed to participate and completed the CGA, with 93.6% undergone blood extraction for laboratory analysis. The mean age of the participants was 63.7 (±5.8) and 57.8% belonged to the young-old subgroup. There were more working (60.6%) than the retired (39.4%) and more females (61.5%) than males (38.5%). There was a low level of malnutrition (0.9%) in this cohort. However, many had abdominal obesity and elevated low-density lipoprotein (LDL). Low vitamin D was prevalent. Type 2 Diabetes Mellitus was present among 14.7% of participants of which 93.8% were pre-frail and 6.3% were at risk for malnutrition.

Conclusion. Although malnutrition and frailty were not prevalent among those with T2DM in this cohort, more participants were pre-frail and at risk for malnutrition. There are many opportunities to reduce the risk of malnutrition and frailty in the community. Early screening and interventions are recommended to improve the health and wellbeing of the working and retired participants.

Key Words: aged, Filipinos, academic, nutrition, frailty, Type 2 Diabetes Mellitus

INTRODUCTION

The Philippines, as with other developing countries, has a greater proportion of younger Filipinos compared to the older individuals aged 60 years above, comprising 7.5% of the population.[1] It is estimated that the older population of the Philippines would increase by 4.2% among 60 years and older from 2010 to 2030. The improvement in life expectancy has been attributed to advances in public health and medical care interventions.[2] This increasing life expectancy raises the

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burden of providing healthcare and support services for the older population in the country.[3] For older persons to achieve active aging, dietary and nutritional, lifestyle needs, and maintenance of a healthy body weight must be all met towards optimum health, functional dependence, and quality of life. Furthermore, maintaining good nutrition has a significant role in achieving health and wellbeing, and preventing the development of diseases and their complications.

Malnutrition is associated with physical and cognitive impairment, poor quality of life, morbidity, and mortality in older individuals. This is further affected by inadequate, excessive, or imbalance of energy or nutrient consumption.[4] Frailty has been referred to as an age-associated biological syndrome characterized by decreased biological reserves, due to dysregulation of several physiological systems, which puts an individual at risk when facing minor stressors, and is associated with poor outcomes (i.e. disability, hospitalization, and death). Frailty is further defined as a clinical syndrome with increased vulnerability in which three or more of the following criteria were present: unintentional weight loss (4.5 kg in the past year), self-reported exhaustion, weakness (grip strength), slow walking speed, and low level of physical activity. The prevalence of frailty in people older than 65 years is high, ranging from 7 to 16.3% and the prevalence increases with age, and is greater in women than in men.[5-7] The unintended decreased food intake resulting in weight loss is one frailty criteria that are usually associated with anorexia due to recent physiologic stress or depression, which can lead to the syndrome of frailty. Inadequate dietary intake may also affect the level of physical activity, muscle strength, and exercise tolerance through several mechanisms. Pre-frailty is an intermediary stage between being robust and frail. There is no clear characterization of pre-frailty. Instead, it is best described as the presence of 1 or 2 of the Fried's Frailty Criteria. Early recognition of pre-frail individuals is necessary because of their increased vulnerability to frailty and subsequent functional decline. Hence, it is significant to identify frailty in its early stage for appropriate nutritional or medical interventions aimed at preventing or delaying the progression of such clinical consequences.[8]

Diabetes mellitus continues to be a public health concern as its fast increases in developing countries leading to more cardiovascular deaths and microvascular complications. With a national prevalence of 7.2% (6.5-7.9), diabetes among the Filipino older persons is highly prevalent at 13.0% from ages 50-59, and 16.1 % from ages 60-69.[9] The etiology of type 2 Diabetes Mellitus (T2DM) among older persons can be attributed to both a.) changes in metabolism due to increased insulin resistance and decreased insulin production, and b.) changes in weight and physical activity.[10] Nutritional factors have a vital role in the development of atherosclerotic diseases, especially among this group of aging individuals. There is an existing overlap of malnutrition and glucose intolerance which increases with frailty and physical disability and dependence. Furthermore, malnutrition includes both overnutrition, due to excessive input or food intake and lack or limited physical output or activity, and under-nutrition, due to nutrient deficiency.[11]

Diabetes mellitus is suggested to be linked with increased risk of frailty.[12-15] Among community-dwelling older people, frailty and pre-frailty were significant and independent predictors of T2DM, a major and potentially preventable risk factor for multiple comorbidities.[16] Casals et al. reported that frailty syndrome was a higher proportion in patients with diabetes compared with those in the general population over 65 years of age. Frailty was related to lower systolic blood pressure, higher triglycerides concentrations, poorer nutritional status, and lower independence to perform instrumental activities of daily living and poorer balance.[17]

There is a paucity of objective data on nutritional status, diabetes mellitus, and frailty among older persons in the Philippines, such as the use of biomarkers and objective health measures. Data for this paper was derived from the UP Wellness Initiative for Seniors and Elders (UPWISE). Utilizing a community-based participatory approach, this study aims to address data gaps in the experience of working and retired older persons in an academic community.

METHODS

This study (Project 4) was the final part of four projects conducted under the UPWISE Program. The UPWISE program utilized a community-based participatory approach to develop a framework on health and wellness for older persons that will be useful to the UP leadership, community, policymakers, and development partners.

The UPWISE Program was conducted in two universities for two years to describe the demographic profile and assess the Active Aging needs of working and retired employees ages 55 years and above in both urban and rural-urban academic communities and describe the health determinants of active aging and assess for frailty. This particular study obtained objective measures of health through the Comprehensive Geriatric Assessment (CGA) performed by trained Geriatricians, laboratory tests, and operationally defined measures of frailty. The ethics review approval code for the UPWISE Project 4 UP Los Baños Health Determinants of Active Aging and Frailty Assessment was UPMREB 2018-141-01.

Study Setting and Participants

The University of the Philippines Los Baños (UPLB), an agricultural and environmental sciences campus, is one of eight constituent universities of the University of the Philippines (UP) system which is located approximately 68 kilometers south of Manila. This academic community (pertaining to people in higher educational institutions engaging in core intellectual activities such as teaching, learning, extension and research including lecturers, students, researchers and extension workers who interact for

scholarly purpose and in co- and extracurricularr activities) is strategically located at the foot of Mount Makiling Forest Reserve and the Laguna Lake. It is very close to agricultural farmlands and experimental stations. It offers a vast area for outdoor recreation and leisure activities for family members of all ages.

Participants were 55 years and older, current or retired employees and faculty personnel, living in seven *barangays* (villages) within a seven-kilometer radius from the campus in the rural-urban towns in the province of Laguna. A stratified systematic sampling procedure was employed, with participants stratified according to employment status. A list of eligible respondents was requested from the Human Resources and Development Office (HRDO) and supplemented by a separate field list and referrals from colleagues, barangay office, senior citizen's organization. The household listing, mapping, and validation of participants were performed before random sampling. The final list of participants comprised of 451 working employees and community-dwelling older persons. Criteria for exclusion were the inability to communicate and respond to questions personally, and lack of commitment to follow up on subsequent visits. Homebound patients were included and visited for data collection. However, only 109 completed the comprehensive geriatric assessment and physical examination with the final merged count. Among these participants, only 103 with blood extracted, final merged count 102, had the corresponding laboratory analysis due to reasons of refusal after the 3rd project, i.e., aimed at determining the sociodemographic profile and perceptions of successful and active aging, disqualification, dropping out from the CGA interview and laboratory evaluation. Procedures were done under the approved ethical clearance sought from the UP Manila Research Ethics Board (UPMREB).

Data Collection Procedures

Comprehensive Geriatric Assessment (CGA)

The CGA is a multidimensional, multidisciplinary diagnostic instrument designed to collect data on the medical, psychosocial, and functional capabilities and limitations to uncover medical and functional conditions, and risk factors that have not been previously identified and treated.[18] The CGA for community-dwelling Filipinos was developed by the Committee on Aging of the National Institutes of Health (NIH) in 2005. It was further refined and internally validated by the Philippine College of Geriatric Medicine and the Department of Health. Several pre-tests were performed after translation from English to Filipino. A medication review consisted of listing prescription and over-the-counter medications, including herbal and alternative medications taken two weeks before the interview. The physical and neurological evaluation was performed by research trained and board-certified geriatrician. The final diagnosis was adjudicated by a senior geriatrician.

Nutritional Assessment

The Filipino Food and Nutrition Research Institute (FNRI) Mini Nutritional Assessment (MNA) was used to identify the risk of malnutrition. The MNA Tool is a validated screening tool developed to help identify older persons who are malnourished or at risk of malnutrition. It is considered as the gold standard for ambulatory living older persons and those living in long-term care facilities.[19] An individual is assessed as having a *normal nutritional status* if the Malnutrition Indicator Score (MIS) is 24-30 points, *at risk of malnutrition* with MIS 17-23.5 points, and *malnourished* with MIS less than 17 points.

In this study, the selected biochemical parameters used to determine an older person's nutritional statuses were LDL, hemoglobin, vitamins D, and B12.

Anthropometric Assessment

Each respondent was anthropometrically examined by the trained researchers using standardized methodology. The following measurements were taken of study participants: weight in kilograms, height in centimeters, waist, and hip circumference in centimeters. The indices Body Mass Index (BMI), Waist -hip ratio (WHR) were derived using these anthropometric measurements.

Biochemical Assessment

Blood analysis by a Department of Health (DOH) certified laboratory was also conducted. The laboratory parameters with the nutritional screening augment the comprehensive geriatric assessment. A complete blood count, fasting blood glucose, blood chemistry analysis were done. Laboratory assessments included: hemoglobin, vitamin B12, vitamin D, lipid profile, Fasting Blood Sugar (FBS). The lipid profile was divided into total cholesterol, low-density lipoprotein, very low-density lipoprotein, high-density lipoprotein, and triglycerides. These were compared to the standard range of normal values for the identified parameters and participants were divided into normal, high, or low values categories.

Frailty Assessment

A modification of the Fried's Phenotype for Frailty was used as a tool to assess frailty in older persons.[20] This simple five-question scale is an excellent screening test for clinicians to identify frail persons at risk of developing disability as well as a decline in health functioning and mortality. Using a five-point scoring system, ambulation was measured through the Timed Up and Go Test; resistance through Handgrip Strength; fatigue, number of illnesses (greater than five), and loss of weight were derived from the CGA interview. Frailty scores range from 0 to 5 (i.e., 1 point for each component; 0 = best to 5 = worst) and represent frail (3-5), pre-frail (1-2), and robust (0) health status. Handgrip strength, an indicator of general muscle strength, was measured using the Jamar analog hand dynamometer. The

Timed Up and Go Test and Functional Reach tests were performed using standardized procedures.

Data Analysis

The quantitative method using the CGA was done among the 109 participants in the community to determine their nutritional status, anthropometric data, and frailty status. STATA SE 14 was used to generate and analyze disaggregated data. Descriptive statistics (means, standard deviations, medians) and frequency distributions were calculated for all continuous and categorical variables measured.

RESULTS

Sociodemographic Profile

One hundred nine participants (109) completed the Geriatrician physical and neurological examinations, MNA, and Handgrip tests. The mean age was 63.7 (±5.8) years (range 55 years and above). There were more females than males, with greater working than retired participants and the majority were living as couples. A big majority of the participants were educated beyond the graduate level. The most common type of work was academics, followed by administrative, and service (Table 1).

The majority, 91% and 98% of the working and retired participants, respectively, were living with others particularly with family members such as spouses, children, grandchildren, and relatives. Only less than 10% of the UPWISE participants lived alone. Almost all of the working and retired participants lived with their families and relatives. All of the working participants had health insurance in contrast to 98% of the retired participants (Table 1).

Only 2.3% of the total participants had a primary caregiver, most of whom are retired. Only a minimum of number (1%) was also taking care of a family member whether as a companion during a visit to health facilities, as the provider of financial support, as an assistant to activities of daily living, and other forms of care support (Table 1).

Table 1. Sociodemographic and Clinical Profile of Participants by Work Status and Sex, 2018-2019

Profile	Total		Working	Retired	Male	Female
	f	%	%	%	%	%
N of cases	109	100	66	43	42	67
Age (mean ±SD)	63.7 (±5.8)		60.0 (±2.8)	69.3 (±4.4)	63.7 (±5.5)	63.6 (±6.0)
55-59	30	27.5	45.5	0	26.2	28.4
60-69	63	57.8	54.5	62.8	59.5	56.7
70-79	15	13.8	0	34.9	14.3	13.4
80 and above	1	0.9	0	2.3	0	1.5
Civil status						
Married/Live in	81	74.3	78.8	67.4	85.7	67.2
Widowed	16	14.7	7.6	25.6	4.8	20.9
Single (Never married)	10	9.2	13.6	2.3	9.5	8.9
Divorced /separated	2	1.8	0	4.7	0	3
Education (mean no. of yrs ±SD)	14.6 (±3.8)		14.6 (±3.8)	14.7 (±3.7)	12.1 (±4.4)	16.2 (±2.2)
High school or less	18	16.5	18.2	5.3	40.5	1.5
With post-secondary/ vocational	4	3.7	4.5	72.3	7.1	1.5
With college	22	20.2	21.2	18.6	16.7	22.4
With MS	26	23.9	16.7	34.9	14.3	29.9
With PhD/Post-doctoral	39	35.8	39.4	30.2	21.4	44.8
Type of work						
Academe	58	53.2	57.6	46.5	31	67.2
Administrative	28	25.7	22.7	30.2	16.7	31.3
Service	23	21.1	19.7	23.3	52.4	1.5
Living arrangement						
Living alone	7	6.4	9.1	2.3	4.8	7.5
Living with others	102	93.6	90.9	97.7	95.2	92.5
Nuclear family	92	84.4	84.9	83.7	90.5	80.6
Grandchildren	24	22	18.2	27.9	26.2	19.4
Other relatives	12	11	12.1	9.3	4.8	14.9
Health insurance	108	99.1	100	97.7	97.6	100
Primary caregiver	1	0.9	0	2.3	0	1.5
Caring for family	28	25.7	31.8	16.3	23.8	26.9

Table 2. Nutritional and Frailty Status of Participants, 2018-2019

Characteristics	Total		Working	Retired	Male	Female
	f	%	%	%	%	%
BMI						
Normal (18.5-22.9 kg/m²)	44	40.4	37.9	44.2	38.1	41.8
Obese (≥25 kg/m²)	31	28.4	28.8	27.9	28.6	28.4
Overweight (23.0-24.9 kg/m²)	26	23.9	27.3	18.6	21.4	25.4
Underweight (<18.5 kg/m²)	7	6.4	6.1	7.00	9.5	4.5
No data	1	0.9	0.0	2.3	2.4	0.0
WHR						
At risk	76	69.7	68.2	72.1	66.7	71.6
Normal	33	30.3	31.8	27.9	33.3	28.4
Nutritional status (MNA)*						
Normal	84	77.1	75.8	79.1	64.3	85.1
At risk of malnutrition	22	20.2	21.2	18.6	28.5	14.9
Malnourished	1	0.9	1.5	0.0	2.4	0.0
Incomplete data	2	1.8	1.5	2.3	4.8	0.0
Frailty status						
Robust	11	10.1	10.6	9.3	14.3	7.5
Pre-frail	89	81.6	81.8	81.4	78.6	83.6
Frail	9	8.3	7.6	9.3	7.1	9.0

** 1 participant had no information on BMI and 1 had no calf and mid upper arm circumference*

Clinical profile

Most of the participants had normal BMI values with 37.9% and 44.2% for the working and retired participants, respectively. This was followed by participants who were classified as obese (28.8% and 27.9% for working and retired groups, respectively), followed by overweight and then underweight. There was no noted significant difference in BMI between the working and retired groups, respectively. As for WHR, both working and retired groups had a majority at risk (68.2% and 72.1%), respectively.

Based on MNA, it can be seen that the retired group is slightly healthier than the working group as it has more members with normal nutritional status and fewer members at risk and malnourished. However, there is still no significant difference between the two groups (Table 2).

Most participants had normal hemoglobin and vitamin B12. All of the participants, however, had lower than normal vitamin D levels. Table 3 shows that more than half (53.7%) of the retired participants had normal LDL levels while only 42% of the working participants had normal LDL levels. A majority (58%) of the participants in the working had higher than normal LDL levels.

As for hemoglobin, the working group and the retired group had a majority within the normal range, 94%, and 75%, respectively. The same case goes for vitamin B12 with both groups falling for the working and retired groups. However, both groups are way below the normal value for vitamin D. All the biochemical parameters showed that there are no significant differences between the two groups except for hemoglobin levels being significantly higher among the working group.

Table 3. Distribution of Biochemical Results of Participants by Work Status, 2018-2019

Biochemical markers	Interpretation	Working (%)	Retired (%)
LDL (mg/dL)	High	36 (58.0)	19 (46.3)
	Normal	26 (42.0)	22 (53.7)
Hemoglobin (g/L)	High	0 (0)	0 (0)
	Normal	58 (93.5)	31 (75.6)
	Low	4 (6.5)	10 (24.4)
Vitamin D (nmol/L)	High	0 (0)	0 (0)
	Normal	0 (0)	0 (0)
	Low	62 (100.0)	41 (100.0)
Vitamin B12 (pg/mL)	High	7 (11.3)	5 (12.2)
	Normal	48 (77.4)	32 (78.0)
	Low	7 (11.3)	4 (9.8)
FBS (mg/dL	Type 2 DM	3 (4.9)	4 (9.8)
	IFG	6 (9.8)	7 (17.1)
	Normal	52 (85.3)	30 (73.2)

The anemia prevalence among the working and retired participants were 7% and 24%, respectively. Vitamin B12 deficiency was low in this study. On the other hand, deficiency in vitamin D was found in all participants in this study.

Prevalence of T2DM

Sixteen (14.7%) participants were diagnosed with T2DM. The study noted that T2DM ranked 9th of the top ten medical diagnoses by a senior geriatrician affecting the working and the retired participants (Table 4). The participants were identified to have T2DM from a previous diagnosis with the participants' primary care doctors. This

Table 4. Top Ten Geriatrician's Diagnosis from the Overall Assessment of Participants, 2018-2019

Rank	Disease	Total		Working	Retired	Male	Female
		f	%	%	%	%	%
1	Error of refraction	81	74.3	83.3	60.5	59.5	83.6
2	Presbyopia	79	72.5	78.8	62.8	61.9	79.1
3	Dyslipidemia	66	60.6	62.1	58.1	52.4	65.7
4	Hypertension	61	56.0	51.5	62.8	59.5	53.7
5	Osteoarthritis	50	45.9	39.4	55.8	33.3	53.7
6	Dry Eye	22	20.2	19.7	20.9	16.7	22.4
7	Ischemic Heart Disease	21	19.3	19.7	18.6	21.4	17.9
8	Obesity	17	15.6	19.7	9.3	14.3	16.4
9	Benign Prostatic Hyperplasia	16	14.7	15.2	14	38.1	0
9	**Type II Diabetes Mellitus**	**16**	**14.7**	**10.6**	**20.9**	**11.9**	**16.4**
10	Hearing impairment	15	13.8	9.1	20.9	9.5	16.4

Table 5. Frailty and Nutritional Status Participants with and without Type 2 Diabetes Mellitus, 2018-2019

Characteristics	With T2DM	Without T2DM	N (%)
	f (%)	f (%)	
Frailty status	16 (14.7)	93 (85.3)	109 (100.0)
Frail	1 (11.1)	8 (88.9)	9 (100.0)
Pre-frail	15 (16.8)	74 (83.2)	89 (100.0)
Robust	0 (0.0)	11 (100.0)	11 (100.0)
Nutritional status	16 (14.7)	93 (85.3)	109 (100.0)
Malnourished	0 (0.0)	1 (100.0)	1 (100.0)
At risk for malnutrition	1 (4.6)	21 (95.4)	22 (100.0)
Normal	15 (17.9)	69 (82.1)	84 (100.0)

disease was observed more among the retired (21%) compared to the working group (10.6%). This was further supported by the higher FBS (> 125 mg/dL and 110-125 mg/dL) levels in the retired group as shown in Table 3. This indicates that the retired group is more likely to have glucose intolerance. Other biochemical markers related to T2DM are cholesterol particularly Low-Density Lipoprotein (LDL) which was noted to be lower in the retired group.

Nutritional and Frailty Status among participants

The majority of the participants (70%) have a larger Waist-Hip Ratio with a slightly higher percentage among the retired group (72.1%) compared to the working group (68.2%). Table 5 shows the nutritional status of selected participants diagnosed with and without T2DM. Although there was no significant difference (p=0.842), it was noted that T2DM individuals who were 16% of the total participants had lesser number of diabetics at risk for malnutrition (5.6%), more having normal nutritional status (18%), and none malnourished; compared to those participants without diabetes (84%), having more participants at risk for malnutrition (94%), with normal nutrition (82%) with one individual being malnourished. The frailty status of selected participants diagnosed with and without T2DM showed that despite that there was no significant difference (p=0.291), there were no robust individuals with T2DM compared to those with no diabetes. Both groups had greater pre-frail individuals compared to frail (Table 5).

DISCUSSION

The socio-demographic profile of the participants, specifically, the benefits of social resources, such as Filipino family support, noted in this study were similar to other local data. Despite the physical and functional decline of older persons, they can still maintain an optimistic attitude toward aging, i.e., a period of increased productivity and positive experiences due to their social support system. This helps them consider the process of aging positively with respect and dignity as they mature.[3]

Malnutrition is defined by the European Society for Clinical Nutrition and Metabolism as "a state resulting from lack of uptake or intake of nutrition causing altered body composition (decreased fat-free mass and body cell mass), leading to diminished physical and mental function and impaired outcome from the disease." In older persons, malnutrition has been shown to contribute to loss of autonomy, lower quality of life, higher frequency of hospital admissions, and mortality.[21]

Older persons are also at risk of nutritional deficiencies due to aging with its accumulation of diseases and impairments such as cognitive and physical decline, depressive symptoms, emotional variations, and poor oral health, along with socioeconomic changes. All of these factors may directly affect nutritional needs and intake. Even in cases of adequate nutrient and energy intake, the nutritional status of older persons can be impaired by a compromised nutrient metabolism (such as absorption, distribution, storage, utilization, and excretion), drug-nutrient interactions, or altered nutrient needs.[22]

Elevated LDL has been documented to be a known risk factor for the development of the atherosclerotic cardiovascular disease. Furthermore, a study noted that LDL

level has been shown to predict a first coronary heart disease event among senior patients especially those with increased levels of lipoprotein A.[23] Hence, indicating practical considerations in the clinical management of LDL among older persons.

A majority (58%) of the participants in the working had higher than normal LDL levels similar to other studies.[24,25] This was mostly noted in older persons with T2DM, such that statin intake is beneficial for primary prevention of all older individuals after a shared decision-making process that takes polypharmacy, frailty, and potential adverse effects into consideration.[25,26]

The resulting anemia prevalence among the working (7%) and retired participants (24%) were found to be close to the World Health Organization (WHO) prevalence of 12% in community-living older persons. Causes of anemia in the older persons are divided into three broad groups, i.e., nutritional deficiency, anemia of chronic disease (ACD), and unexplained anemia (UA).[27] These groups are not mutually exclusive. In any older person, several causes may co-exist and may each contribute independently to the anemia. Nutritional deficiencies represent a treatable subgroup and include lack of iron, vitamin B12, or folate.

Vitamin B12 deficiency is found to be low in this study (11% in the working group and 10% in the retired group) with greater available food choices or supplementation for the older person in the community. It was noted in another study that dietary deficiency of cobalamin is rare among healthy individuals and limited to older persons who are strict vegetarians and malnourished.[28] Elderly people are particularly at risk of vitamin B12 deficiency due to the high prevalence of atrophic gastritis-associated food-cobalamin (vitamin B12) malabsorption, and the increasing prevalence of pernicious anemia with advancing age.[29] It is recommended that all people over 65 years of age who are malnourished, people in institutions or psychiatric hospitals, and people with hematological or neuropsychiatric manifestations of cobalamin deficiency should have their serum cobalamin levels measured. This deficiency can be treated by dietary modification and parenteral administration if not caused by dietary deficiency.[30,31]

A lipid profile would better illustrate the cholesterol changes in diabetics as T2DM tends to increase LDL and triglyceride (TG) while decreasing high-density lipoprotein (HDL) increasing the risk for cardiovascular diseases such as coronary heart disease, atherosclerosis, and stroke often referred to as diabetic dyslipidemia.

The majority of the participants (70%) have a larger WHR with a slightly higher percentage among the retired group (72.1%) compared to the working group (68.2%). This indicates a higher risk of developing metabolic abnormalities and cardiovascular risk. Such that individuals with greater abdominal adipose tissue or central adiposity are related to decreased glucose tolerance, reduced insulin sensitivity and adverse lipid profiles which have been identified as risk factors for T2DM, hypertension and cardiovascular disease.[30,32]

The prevalence of T2DM in this study was consistent with literature since the prevalence of diabetes increases and is the highest beyond the age of 60 years. With aging comes a significant reduction in the rate of metabolism which could be attributed to a decrease in lean body mass, a more sedentary lifestyle leading to a decreased daily energy requirement. Factors affecting glucose metabolism with age are noted as insulin resistance to glucose uptake; progressive reduction of pancreatic insulin secretion; changes in body composition with increased adipose tissue relative to the muscle mass; changes in food intake, timing, and composition; decreased mobility and physical activity; psychological factors such as stress and isolation, use of medications which alter insulin sensitivity, release or action; and genetic and ethnic factors.[11]

In terms of malnutrition, the results of the study were contrary to those found in literature, 50% of the older patients were suffering from malnutrition, and 20% had normal nutritional status, and approximately 30% were exposed to malnutrition. Older patients with diabetes suffering from malnutrition are more likely due to lower levels of caloric intake that can be easily corrected by nutritional intervention. This prompts the identification of at-risk individuals to improve the status of diabetic older patients and with malnutrition by administering appropriate nutritional interventions and special attention.[29]

Another study done in rural areas on assessing the nutritional status of older persons aged over 60 years, showed similar results as in this study with none of the subjects having malnutrition. Although 16% of the older women and men exposed to malnutrition, low energy diet was observed in the whole group (an average of 1312.1 kcal among women and 173.3 kcal in men).[31] Regardless of having diabetes or not, the number of people at risk of malnutrition should be given special attention as these people are potentially at risk of malnutrition and its consequences.[30]

Table 5 also shows the frailty status of selected participants diagnosed with and without T2DM. Despite that there was no significant difference (p=0.291), it was noted that there were no robust individuals with T2DM compared to those with no diabetes. Both groups had greater pre-frail individuals compared to frail individuals. The study results were similar to the prevalence of frailty in the community which varies from 4-59% and among individuals with T2DM reported to be between 5-48%.[31] According to studies, many components are contributing to the development of frailty and sarcopenia among older persons with DM and non-DM patients. These factors include hormones, inflammation, neurologic factors, nutrition, and activity components. Frailty related to nutritional status among older people can be attributed to insufficient dietary intakes or protein intakes, resulting in a reduction in lean body mass and increased functional disability by sarcopenia, hence, frailty.[33-35]

Early detection among older individuals with or without diabetes of frailty status is necessary for proper immediate nutritional and medical interventions. Studies have shown that a low protein diet resulted in a significant decline in muscle mass and strength in older women. Early screening for frailty must be observed among community-dwelling older subjects with DM who are noted to be at risk of malnutrition compared with those without DM, suggesting a causal relationship between malnutrition and functional decline in DM patients.[36] Other nutrient deficiencies related to T2DM are vitamin B12 and vitamin D. Vitamin B12 deficiency, especially among those taking metformin, is known to cause neurogenic disorders including bathyanesthesia (Loss of deep sensibility, i.e., from muscles, ligaments, tendons, bones, and joints) and muscle weakness, thus increasing the likelihood of falling over. Vitamin D levels were shown to be relatively lower in those with DM, suggesting that vitamin D deficiency may contribute to β-cell dysfunction, insulin resistance and inflammation that may result in T2 DM.[35,37]

An earlier study has shown that poor nutritional intake is an important factor associated with frailty syndrome. Frailty was associated with an intake of energy ≤21 kcal/kg/day and a low intake of more than three nutrients (poor nutritional score: protein, iron, folate, calcium, vitamins A, C, D, E, and zinc) was significantly associated with frailty, independent of energy intake and other potential confounders. Poor nutritional score was associated with a feeling of exhaustion and poor muscle strength, which indicate frailty. The study has also shown that the quality of diet is significant in muscle strength and efficiency.[34] Exercise training, proper nutrition, and educational interventions, and less strict glycemic control appear as the most effective strategies to reduce frailty in diabetic older people. [38,39]

Although most participants had normal BMI, the majority had abdominal obesity as indicated by WHR. This puts the older persons at risk for developing non-communicable diseases such as hypertension, metabolic syndrome, diabetes, and cardiovascular diseases. Furthermore, WHR indicates a greater impact on mortality due to central obesity.[34]

Studies have shown that transition to retirement is accompanied by favorable and unfavorable lifestyle changes which depend on the type of lifestyle, lifestyle indicator, and the personal situation of the retiree or employee.[37] The working older persons being in the pre-retirement period offer a suitable opportunity for proactive preventive action by engaging in activities that provide them with better choices for food, activities and lifestyle modification, even stress management in the workplace while they are still productive in the workforce. These opportunities for lifestyle change including nutrition must be made available in the university.

One of the initiatives conducted in the university for the older persons is the Elderly Development Program. This program is participated by working and retired university staff older persons (age 60 years above) on a regular monthly basis offered by the College of Human Ecology. Likewise, senior citizen employees and community members participate in this program, subscribing to a holistic approach to maintaining healthy aging guided by the WHO principles of active aging. Activities participated by older persons are blood pressure and glucose monitoring, nutrition screening and counseling services in partnership with the Institute of Human Nutrition and Food and the University Health Service. Furthermore, the program offers social support, physical, cognitive, and medical support for active aging.

Retirement is a life-course transition in late adult life that is marked by major changes that may affect healthy lifestyles. Despite having the retired older persons with lesser work and restrictions in lifestyle choices, they have more flexible time during this period. Yet other factors threaten the health and well-being of the older person. Such that they are still at risk for malnutrition and frailty, accompanied by financial, social, and reorientation to health. Some studies have shown that the absence of work activities and restrictions affect daily routines and time availability. Moreover, retirement is often accompanied by changes in identity and changes in social contacts and social activities. Also, retirement may lead to a decrease in income. Hence, the retirees' priorities, way of life, and healthy lifestyles are likely to change as one age. Such major life transitions present a window of opportunity for enhanced prevention. This can be conducted through heightening awareness on health care and disease prevention, lifestyle modification. Studies have likewise shown that people are more proactive and receptive to health messages during these major life transitions.[37]

Living in a semi-rural or "rurban" area may have advantages for the retired, who may have more opportunities for physical activity, thus the robustness. Along with accessing the health services of the University Health Service offering Diabetes Care, the UPLB Elderly Development Program provides a holistic approach to support active aging in the academic community. It can have a key role in providing opportunities for health education, physical activities, and socialization which must further be explored and made available to more older employees and retired staff of the university.

Deficiency in vitamin D was found in all participants in this study. This is in contrast to other studies that found only a significant proportion of vitamin D deficiency in older persons from 40 % to 65 %.[40,41] Vitamin D deficiency was found to be associated with several known geriatric syndromes as well as a strong association between vitamin D deficiency and increased risk of heart failure and cortical bone loss and fractures in the older person's oral, gastro-intestinal, urinary, ocular, and respiratory infections.[40,42]

The two main sources of vitamin D are the dietary and the endogenous synthesis.[41] Vitamin D2 (ergocalciferol) is obtained from plants and a small quantity of vitamin D3 (cholecalciferol) is from animal-derived food, the main natural vitamin D source is skin synthesis during

sunlight exposure (exposure to ultraviolet B). Living in a tropical country, it would be expected that most people would have normal vitamin D levels. However, this study has shown that the low levels of vitamin D in most of the retired participants were not optimal. The participants may have poor dietary sources or that most of these retired generally avoid going outside when the weather is sunny.

CONCLUSION

This study described the sociodemographic and clinical profile of working and retired employees in an academic rural community. Type 2 DM affects a limited number of older persons. Although malnutrition and frailty were not prevalent among those with T2DM in this cohort, more participants were pre-frail and at risk for malnutrition. There are many opportunities to reduce the risk of malnutrition and frailty in the community. Early screening and medical and holistic interventions are recommended to improve the health and wellbeing of the working and retired participants.

Recommendations

The following are the recommendations from the study; A) use of valid and reliable screening tools to identify those at risk for malnutrition to make early effective interventions, B) health promotion and education activities during a major life transition from working to retirement such opportunities for lifestyle change including nutrition and physical activity shall be made available in the University, C) existing health services of the University Health Service offering Diabetes Care and the UPLB Elderly Development Program which provide a holistic approach to support active aging in the academic community shall be made available to more older employees and retired staff of the University, and D) further research on nutritional biochemical markers such as Vitamin D and B12 and its effect to functional status.

Study limitations

The identified limitations of this study include having significant drop-out rates and attrition rates. However, this has been observed to be consistent with international studies involving older persons. Specifics of the determinants of Health and Disease that were not included in this study are continuity of care; long-term care and the status of mental health care. More research is needed to describe these.

Acknowledgments

1. Project Research Assistants and NIH Administrative Assistant
2. Project Manager: Dr. Myles Benigno
3. Statisticians: Dr. Ma. Lourdes Amarillo, Ms. Olivia Sison, and Ms. Sarah Jane Fabito
4. UP VPAA Dr. Ma. Cynthia Rose B. Bautista
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14. UP Manila Chancellor Dr. Carmencita Padilla
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16. NIH UP Manila Executive Director Eva C. De la Paz
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All authors participated in data collection and analysis, and approved the final version submitted.

Author Disclosure

All authors declared no conflicts of interest.

Funding Source

The study was funded by the Emerging Interdisciplinary Research Program of the Office of the Vice President for Academic Affairs, University of the Philippines.

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