ORIGINAL RESEARCH

Geriatric Functional Impairment Using the Integrated Care for Older People (ICOPE) Approach in Community-Dwelling Elderly and Its Association with Dyslipidemia

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Background: The World Health Organization (WHO) proposed the integrated care for older people (ICOPE) screening tool to identify functional impairment. We explore the association of geriatric functional impairment and hypertension, diabetes, dyslipidemia in the community-dwelling elderly.

Methods: We enrolled individuals aged at least 65 with hypertension, diabetes, or dyslipidemia; or those aged at least 75 from May to July 2019. We applied ICOPE tools to evaluate six function assessments: cognitive decline, limited mobility, malnutrition, visual impairment, hearing loss, and depressive symptoms. Factors were analyzed using stepwise multivariable linear regression for ICOPE scores and logistic regression for geriatric functional impairment. All analyses were adjusted for age and glomerular filtration rate.

Results: We enrolled 457 participants including 303 (66.3%) participants with hypertension, 296 (64.8%) diabetes, and 221 (48.4%) dyslipidemia. Seventy-eight (17.1%) participants have at least one geriatric functional impairment, including 41 (25.9%) participants aged ≥ 75 and 37 (12.4%) aged 65–74. The ICOPE score (0.4 ± 0.6) of participants aged at least 75 was higher than that (0.1 ± 0.4) of the participants aged 65–74 ($p < 0.001$). Dyslipidemia ($p = 0.002$) was positively associated with ICOPE score. Dyslipidemia (odds ratio: 2.15, 95% confidence interval: 1.27–3.70, $p = 0.005$), not hypertension ($p = 0.3$) and diabetes ($p = 0.9$), was associated with geriatric functional impairment. Visual impairment was the most common function impairment. Female was linked to limited mobility, renal function was associated with mobility ($p < 0.001$) and nutrition ($p = 0.02$).

Conclusion: Dyslipidemia but not hypertension, diabetes is linked to geriatric functional impairment in community-dwelling elderly. Lower renal function is associated with decreased mobility and nutrition. More studies are needed to determine if treatment of dyslipidemia reduces geriatric functional impairment.

Keywords: aging, elderly, function impairment, geriatric functional impairment, ICOPE, renal function

Background

The increased aging population is a major global phenomenon and increases the health care burden worldwide. The World Health Organization (WHO) defines healthy aging as helping people develop and maintain the functional ability that enables wellbeing. A functional approach to older people's healthcare needs was proposed in recent years.[1] The WHO proposed a novel model, ICOPE (integrated

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care for older people guidelines), for healthy aging in 2017.[2] ICOPE tool evaluates physical and mental function in six domains: cognitive decline, limited mobility, malnutrition, visual impairment, hearing loss, and depressive symptoms. Few pieces of evidence on the clinical applications using the ICOPE tool are available.[3]

Geriatric functional impairment is linked to falls,[4] hospitalization, and emergency department visits.[5] Geriatric functional impairment is common in patients with diabetes,[6] hypertension,[7] and chronic kidney disease.[8,9] The association between geriatric functional impairment and chronic diseases is not clear. We aimed to explore the ICOPE tool's application in the community-dwelling elderly in Taiwan and the association of geriatric functional impairment and chronic diseases.

Methods

The recruitment complied with the Declaration of Helsinki and was approved by the institutional review board of Ditmanson Medical Foundation Chia-Yi Christian Hospital (IRB NO 2020141). The Ditmanson Medical Foundation Chia-Yi Christian Hospital's institutional review board waived the need for informed consent because of the de-identified data and the retrospective nature. Inclusion criteria were as follows: age at least 65 with hypertension, diabetes, dyslipidemia, or at least 75, and sign informed consent. Exclusion criteria were younger than 65 or younger than 75 with no hypertension, diabetes, or dyslipidemia. The Health Promotion Administration of the Ministry of Health and Welfare of Taiwan proposed the ICOPE scale in 2019.

We recruited 457 individuals from May to July 2019. The ICOPE tools include six function assessments: cognitive decline, limited mobility, malnutrition, visual impairment, hearing loss, and depressive symptoms. Cognitive decline was determined if participants provided an incorrect response to either of the two questions on orientation in time and space or could not recall the three words they were asked to remember. Limited mobility was defined as being unable to complete five chair rises within 14 seconds. Malnutrition was defined as weight loss (more than 3 kg over the previous three months) or appetite loss. Visual impairment was defined as any problems experienced with their eyes, difficulties in seeing far, reading, eye diseases, or current medical treatment (for example, hypertension and diabetes). Hearing loss was defined as failing to hear whispers in the whisper test. Depressive symptoms were defined as the participants being bothered

by feeling down, feeling depressed or hopeless, or having little interest or pleasure in doing things over two weeks.[3] The impairment of each item was scored as one point with a maximum of six points. ICOPE score was defined as the sum of six functional impairments. Higher scores indicate more function impairments. Geriatric functional impairment was defined as any loss of the six functions.

Hypertension was defined as an average systolic blood pressure $\geq$ 140 mmHg or an average diastolic blood pressure $\geq$ 90 mmHg, or currently using blood pressure-lowering medication.[10] Diabetes was defined as individuals being told so by a doctor or nurse or receiving insulin or oral antidiabetic agents.[11] Dyslipidemia was defined as a serum total cholesterol $\geq$ 200 mg/dL, triglycerides $\geq$ 150 mg/dL, or high-density lipoprotein cholesterol (HDL) < 40 mg/dL in men or < 50 mg/dL in women, or low-density lipoprotein cholesterol (LDL) $\geq$ 130 mg/dL, or currently taking antilipemic agents.[12] Body mass index (BMI), HbA1c, fasting glucose, creatinine, low-density lipoprotein were measured in one month of recruitment. The estimated glomerular filtration rate (eGFR) was calculated using the CKD-EPI formula.

Statistical Analysis

All descriptive statistics are presented as frequencies, percentages for categorical variables, and means, standard deviations for continuous variables. The association of ICOPE scores and variables was analyzed using stepwise multivariable linear regression. The association of geriatric functional impairment was analyzed using stepwise multivariable logistic regression, and the odds ratio (OR) of variable and 95% confidence interval (CI) of OR were calculated. Age and eGFR were included in all analyses. All analysis was done using R version 3.6.2 (R Foundation for Statistical Computing, Vienna, Austria). A p < 0.05 was considered statistically significant.

Results

A total of 457 participants, including 299 (65.4%) participants aged 65–74 and 158 (34.6%) participants aged $\geq$ 75, were enrolled (Table 1). 55.1% of the participants were female, 64.8% had diabetes, 66.3% hypertension, and 48.4% dyslipidemia. The percentages of participants with diabetes, hypertension were higher in participants aged 65–74. The number of comorbidities was higher among participants aged 65–74. 37 (12.4%) of the participants aged 65–74 and 41 (25.9%) of the participants aged $\geq$ 75 had at least one geriatric functional impairment. The

Table I Characteristics of All Participants

Characteristics	All N=457	65–74 N=299	≥ 75 N=158	p
Age	73 ± 6	69 ± 3	80 ± 5	< 0.001
SBP (mmHg)	142 ± 15	142 ± 15	143 ± 16	0.508
DBP (mmHg)	92 ± 8	92 ± 7	93 ± 9	0.190
Female (%)	252 (55.1)	160 (53.5)	92 (58.2)	0.387
BMI (kg/m^2)	25.2 ± 3.8	25.6 ± 3.8	24.5 ± 3.9	0.007
Waist circumference cm	87.0 ± 10.2	87.6 ± 10.1	85.7 ± 10.3	0.052
Calf circumference cm	33.5 ± 3.5	34.0 ± 3.4	32.6 ± 3.4	< 0.001
Hypertension	303 (66.3)	217 (72.6)	86 (54.4)	< 0.001
Diabetes	296 (64.8)	209 (69.9)	87 (55.1)	0.002
Dyslipidemia	221 (48.4)	153 (51.2)	68 (43.0)	0.120
ICOPE score	0.2 ± 0.5	0.1 ± 0.4	0.4 ± 0.6	< 0.001
Geriatric functional impairment	78 (17.1)	37 (12.4)	41 (25.9)	< 0.001
Cognitive decline	25 (5.5)	10 (3.3)	15 (9.5)	0.011
Limited mobility	13 (2.8)	3 (1)	10 (6.3)	0.003
Malnutrition	10 (2.2)	1 (0.3)	9 (5.1)	0.001
Visual impairment	32 (7.0)	18 (6.0)	14 (8.9)	0.348
Hearing loss	8 (1.8%)	4 (1.3)	4 (2.5)	0.582
Depressive symptoms	9 (2.0)	6 (2.0)	3 (1.9)	1.000
HbA1c %	6.9 ± 1.1	6.9 ± 1.1	6.7 ±1.0	0.158
Glucose (mg/dl)	112 ± 38	114 ± 42	108 ± 31	0.084
Creatinine (mg/dl)	1.2 ± 4.6	1.3 ± 5.7	1.0 ± 0.4	0.563
eGFR (mL/min/1.73m^2)	75.8 ± 21.3	79.5 ± 21.7	68.8 ± 18.7	< 0.001
LDL (mg/dl)	95 ± 28	96 ± 29	93 ± 27	0.205

Abbreviations: SBP, systolic blood pressure; DBP, diastolic blood pressure; eGFR, estimated glomerular filtration rate by CKD-EPI formula; LDL, low-density lipoprotein cholesterol.

ICOPE score (0.4 ± 0.6) of participants aged ≥ 75 was higher than that (0.2 ± 0.5) of the participants aged 65–74 (p < 0.001, t-test). The percentage of participants with cognitive decline (9.5% vs 3.3%), limited mobility (6.3% vs 1%), and malnutrition (5.1% vs 0.3%) were higher in participants aged ≥ 75. The percentage of participants with hearing loss, visual impairment, and depressive symptoms was not different between participants aged 65–74 and at least 75. The eGFR was significantly higher in participants aged 65–74 (p < 0.001). The HbA1c, glucose, creatinine, and LDL were not different between the two groups.

Seventy-eight (17.1%) participants have at least one geriatric functional impairment (Table 2). Participants with geriatric functional impairment were older (p < 0.001) and were more likely to have dyslipidemia (64.9% vs 45.2%, p = 0.003). The percentage of the female gender, diabetes, hypertension was not different between participants with and without geriatric functional impairment. BMI, waist circumference, calf circumference, HbA1c, creatinine, eGFR, and LDL were not different between participants with and without geriatric functional impairment.

Individuals' age was positively associated with the ICOPE score (p < 0.001, Table 3). Dyslipidemia was associated with increased ICOPE score (p = 0.034) and BMI was negatively linked to ICOPE score (p = 0.04). Factors associated with geriatric functional impairment were age (p < 0.001) and dyslipidemia (p = 0.03) in stepwise logistic regression (Table 4). The OR of age was 1.09 (95% CI: 1.05–1.14) and

Table 2 Characteristics of Participants with and without Geriatric Functional Impairment

Characteristics	Geriatric Functional Impairment (-) N=379	Geriatric Functional Impairment (+) N=78	p
Age (year)	72 ± 6	76 ± 8	< 0.001
Female (%)	209 (55.1)	43 (55.1)	1.000
BMI (kg/m^2)	25.3 ± 3.7	24.7 ± 4.3	0.182
Waist circumference (cm)	87 ± 10	86 ± 10	0.405
Calf circumference (cm)	33.6 ± 3.5	33.1 ± 2.9	0.261
Diabetes	250 (66.0)	46 (59.0)	0.295
Hypertension	248 (65.4)	55 (70.53)	0.464
Dyslipidemia	173 (45.6)	48 (61.5)	0.015
Number of comorbidity	2.0 ± 0.9	2.0 ± 0.9	0.919
HbA1c %	6.9 ± 1.1	7.0 ± 1.2	0.311
Glucose (mg/dl)	112 ± 39	112 ± 38	0.970
Creatinine (mg/dl)	1.3 ± 5.1	1.0 ± 0.4	0.439
eGFR (mL/min/1.73m^2)	76 ± 21	77 ± 21	0.686
LDL (mg/dl)	96 ± 28	92 ± 30	0.300

Abbreviations: BMI, body mass index; eGFR, estimated glomerular filtration rate by CKD-EPI formula; LDL, low-density lipoprotein cholesterol.

Table 3 Factors Associated with ICOPE (Integrated Care for Older People) Scores in Stepwise Linear Regression

Characteristics	Beta	95% CI		p
Age	0.02	0.01	0.03	< 0.001
Dyslipidemia	0.15	0.05	0.24	0.002
Hypertension	0.06	−0.04	0.16	0.3
Diabetes	0.00	−0.10	0.10	> 0.9
Female	−0.03	−0.14	0.09	0.6
BMI	−0.02	−0.04	0.00	0.075
Waist circumference	0.00	0.00	0.01	0.3
Calf circumference	0.01	−0.01	0.03	0.5
eGFR	0.00	0.00	0.01	0.13

Abbreviations: CI, confidence interval; BMI, body mass index; eGFR, estimated glomerular filtration rate by CKD-EPI formula.

2.21 (95% CI: 1.32–3.74) for dyslipidemia. Age (OR: 1.13, p < 0.001) and dyslipidemia (OR: 3.81, p < 0.001) was associated with cognitive decline. Female (OR: 5.87, p = 0.04) and lower eGFR (OR: 0.77, p < 0.001) was associated with limited mobility. Lower BMI (OR: 0.81, p = 0.03) and eGFR (OR: 0.86, p = 0.02) was linked to malnutrition. Age (OR: 1.14, p =

0.03) was linked to hearing loss and female was less likely to have hearing loss (OR: 0.08, p = 0.01). No factor was significantly associated with visual impairment and depressive symptoms.

Discussions

The prevalence of geriatric functional impairment was 17.1% in a community-dwelling elderly aged at least 65 with chronic diseases or 75. The percentage of participants with geriatric functional impairment is lower than that reported in the previous study in China[3] but is similar to another study in community-dwelling elderly.[13] We anticipated that diabetes might be associated with geriatric functional impairment because diabetes is associated with more complications and poor outcomes than other diseases. To our surprise, dyslipidemia was associated with geriatric functional impairment. Cognitive decline may play a significant role in the association of dyslipidemia and geriatric functional impairment (Table 4). The percentage of patients on anti-hypertensives and oral anti-diabetic medications is usually higher than that of dyslipidemia.[14,15] The over-looked dyslipidemia treatment may be responsible for its association with geriatric functional impairment. More studies are needed to explore if treatment of dyslipidemia may decrease geriatric functional impairment.[16]

Table 4 Factors Associated with Geriatric Functional Impairment and Functional Impairments in Stepwise Logistic Regression

	OR	95% CI	p
Geriatric functional impairment			
Age (year)	1.10	1.05–1.14	< 0.001
Dyslipidemia	2.15	1.27–3.70	0.005
Hypertension	1.37	0.78–2.46	0.3
Diabetes	0.96	0.56–1.66	0.9
eGFR (mL/min/1.73m2)	1.01	1.00–1.03	0.059
Cognitive decline			
Age (year)	1.13	1.07–3.96	< 0.001
Dyslipidemia	3.81	7.60–69.75	< 0.001
Limited mobility			
Female	5.87	1.13–32.31	0.04
eGFR	0.77	0.66–0.89	< 0.001
Malnutrition			
BMI	0.81	0.66–0.97	0.03
eGFR	0.86	0.75–0.96	0.02
Visual impairment			
eGFR	1.02	0.99–1.03	0.08
Hearing loss			
Age (year)	1.14	1.01–1.28	0.03
Female	0.08	0.01–0.51	0.01
Depressive symptoms			
Dyslipidemia	3.81	0.91–25.87	0.09

Abbreviations: OR, odds ratio; CI, confidence interval; BMI, body mass index; eGFR, estimated glomerular filtration rate by CKD-EPI formula.

Visual impairment (7.0%) was the most common functional impairment, followed by a cognitive decline (5.5%), limited mobility (2.8%), malnutrition (2.2%), depressive symptoms (2.0%), and hearing loss (1.8%). The prevalence of functional impairment was low because this study was conducted in the community-dwelling elderly. Elderly with limited mobility and depressive symptoms are more likely to stay home and were less likely to be enrolled. The percentage of individuals with visual impairment is similar to previous studies.[17,18] However, we did not find any factors associated with visual impairment. Dyslipidemia was related to cognitive decline, and the association was also found in patients with multiple sclerosis.[19] Female was linked to limited mobility, and we may encourage female individuals to do more exercise to avoid the geriatric functional impairment. Renal function was associated with mobility and nutrition. Our previous research[20] supported that mobility is associated with better renal function in individuals with chronic kidney disease. The association of renal function and nutritional status was also supported by other studies.[21,22]

Limitations of the study include the cross-sectional study design. We did not identify geriatric functional impairment using other diagnostic tools and can not further validate ICOPE tools' accuracy in identifying geriatric functional impairment. ICOPE tools evaluate subject symptoms and may be under-estimated. A limited number of laboratory data and information on the status of hypertension, diabetes control. We can not explore if optimal management of hypertension and diabetes decreases the geriatric functional impairment. In addition, hypothyroidism may link to dyslipidemia, cognitive decline, limited mobility, and depressive symptoms.[23] We can not analyze the association of hypothyroidism and geriatric functional impairment because thyroid hormone measurements were not available.

Conclusion

The geriatric functional impairment is common in community-dwelling elderly in Taiwan, especially in those aged at least 75. Dyslipidemia and age are associated with geriatric functional impairment, and more studies are needed to support if treatment of dyslipidemia may decrease geriatric functional impairment in the elderly.

Data Sharing Statement

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Ethics Approval and Consent to Participate

The recruitment and follow-up protocols complied with the Declaration of Helsinki and were approved by the institutional review board of Ditmanson Medical Foundation Chia-Yi Christian Hospital (IRB NO 2020141). Informed consent was waived by the institutional review board of Ditmanson Medical Foundation Chia-Yi Christian Hospital because of de-identified data and the retrospective nature.

Consent for Publication

Not applicable

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or

critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare that they have no competing interests.

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