Burden of Post-COVID-19 Hair Loss among Older Adults in Vietnam

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Abstract

Background: Little is known about the burden of hair loss following coronavirus disease 2019 (COVID-19) infection in older adults. This study investigated the prevalence and associated factors of hair loss in older outpatients in Vietnam. **Materials and methods:** Between March 2022 and July 2022, this multicenter cross-sectional study included 547 older patients (aged ≥ 60 years; mean age 68.5 ± 6.9 years; men 27.1%) from three post-COVID-19 clinics. Factors associated with hair loss were assessed using logistic regression. **Results:** In total, 63 patients (11.5%) experienced hair loss. All of the patients with hair loss exhibited diffuse type. In the adjusted model, factors associated with hair loss were women (odds ratio [OR], 3.36; 95% confidence interval [CI], 1.43 - 7.89; P = 0.005), single or divorced in marital status (OR, 3.27; 95% CI, 1.33 - 8.02; P = 0.01), and history of COVID-19 related hospitalization (OR, 5.17; 95% CI, 2.44 - 10.95; P < 0.001). **Conclusion:** Our study found a substantial prevalence of post-COVID-19 hair loss in older outpatients.

Key words: *COVID-19, post-COVID-19 symptoms, hair loss, older adults, Vietnam.*

1. BACKGROUND

Since the cases of coronavirus disease 2019 (COVID-19) were first reported in December 2019, the COVID-19 pandemic has directly or indirectly affected most people around the world [1]. In Vietnam, the first COVID-19 cases were reported in January 2020 and then the number of people acquired the virus has been increasing throughout the four waves of the COVID-19 pandemic [2, 3]. In this country, until September 2022, according to the World Health Organization (WHO), there have been 11,414,359 confirmed COVID-19 cases with 43,117 deaths [4]. During the COVID-19 pandemic, older adults were considered as a vulnerable group at high risk of virus infection as a result of age-related physiological changes [5,6]. Notably, older individuals who have recovered from acute COVID-19 illness may experience post-COVID-19 symptoms [7]. In a systematic review and meta-analysis, the most five common post-COVID-19 symptoms were fatigue, headache, attention disorder, dyspnea, and hair loss [8]. While many post-COVID-19 symptoms have been studied in the general population, there is lack of published studied showing the burden of hair loss among the older population after COVID-19 infection.

Hair loss related to COVID-19 infection was reported as a medical condition characterized by acute non-scarring hair loss with more than 100 daily shed hairs lasting up to 6 months [9]. Although the mechanism of hair loss after COVID-19 infection remains unclear, it may be related to the pro-inflammatory cytokines released during the infection [10]. A recent study found that post-COVID-19 hair loss frequently occurred in COVID-19 infected patients, and it was associated with severity of COVID-19 illness, such as disease length and inflammatory symptoms [11]. However, among the older population, the prevalence of post-COVID-19 hair loss and the association of sociodemographic factors, geriatric issues, and comorbidities with this condition remains unclear. Therefore, the present study aimed to determine the prevalence and characteristics of post-COVID-19 hair loss among older outpatients in Vietnam. We also sought to identify the factors associated with hair loss in the older population.

2. MATERIALS AND METHODS

Sample size calculation

Sample size was calculated using a single population proportion formula: $n=Z^2_{1-\alpha/2}*[p*(1-p)/d^2]$, with n = the required sample size, $Z_{1-\alpha/2}$ = 1.96 (with α = 0.05 and 95% confidence interval), d = precision (assumed as 0.04). A systematic review showed that post-COVID-19 hair loss presented in

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Recieved: 18/7/2023; Accepted: 12/12/2023; Published: 31/12/2023
DOI: 10.34071/jmp.2023.6.6

ranged from 17% to 34% of general population [8]. Therefore, this study required a minimum of 539 post-COVID-19 infected patients.

Study design and data collection

Between March 2022 and July 2022, this cross-sectional study included patients aged ≥ 60 years at three post-COVID-19 clinics in Cho Ray hospital, Gia Dinh People's hospital, and University Medical Center, Ho Chi Minh City, Vietnam. Patients with active malignancy was excluded. The patients answered a questionnaire through face-to-face interviews with trained geriatricians. The sociodemographic characteristics and comorbidities were obtained from interviews and electronic medical records. All patients provided written informed consent. The study was carried out in accordance with the ethical principles and the Helsinki Declaration. The study protocol was approved by the local research ethics committees.

Educational levels were divided into pre-senior high school, senior high school, and tertiary education. Marital status included married, single, and widowed or divorced. Multimorbidity was defined as the presence of two or more chronic diseases. Polypharmacy was defined as five or more medications. Decreased outdoor activities were determined if the older adults have spent less time outdoors, compared with time before the COVID-19 pandemic. BMI was calculated as the quotient between body weight (kg) and body height (m^2). BMI was stratified per the World Health Organization's guidelines for the Asia-Pacific region and defined as underweight (< 18.5 kg/m^2), normal weight (18.5 - 22.9 kg/m^2), overweight (23.0 - 24.9 kg/m^2), and obese (≥ 25 kg/m^2).

Functional status was assessed using the Katz activities of daily living (ADLs) and the Lawton instrumental ADLs indices. The ADLs include six tasks: bathing, dressing, toileting, transfer, continence, and feeding. The instrumental ADLs include eight tasks: using the telephone, shopping, preparing food, housekeeping, doing laundry, using transportation, handling medications, and handling finances. Patients were coded as having limitations in functional status if they were unable to complete one or more tasks by themselves. Frailty was screened by Program of Research to Integrate Services for the Maintenance of Autonomy 7 (PRISMA-7) questionnaire with seven questions each scoring 0 or 1 point. A total score of ≥3 is considered indicative of frailty [12]. Depressive disorders were evaluated using a 15-item geriatric depression scale (GDS). A total score of ≥ 5 was considered to indicate depression [13]. Sleep quality was assessed by the Pittsburgh sleep quality index (PSQI). A total score ≥ of 5 indicates poor sleep quality [14].

In our study, post-COVID-19 symptoms were defined as medical conditions either persisting at least a two-week period after the end of acute COVID-19 illness or appearing during the recovery time for COVID-19. The patient self-reported five post-COVID-19 symptoms, including fatigue, headache, attention disorder, dyspnea, and hair loss. A dermatologist performed a hair pull test to diagnose hair loss and evaluated the characteristics of hair loss, including type of hair loss (diffusse or focal). Focal type was classified as bitemporal, occipital, and frontovertical.

Statistical analyses

All the collected data were analysed using the IBM SPSS Statistics, version 25 (IBM Corp., Armonk, N.Y., USA). Categorical variables are described as frequencies and percentages (%). The Kolmogorov–Smirnov test was conducted to assess the distribution of continuous variables. Continuous variables were described using means and standard deviations for normal distribution and median and interquartile range (IQR) (25 - 75th percentile) for non-normal distribution. Chi-square test or Fisher's exact test was used to compare categorical variables. Student's t-test was used to determine the statistical significance of the difference between two study group means. The Mann–Whitney test was used to compare two groups with non-normal distribution. Univariate logistic regression was performed on the potential factors associated with hair loss. Variables with p values < 0.2 in the univariate analysis were selected for multivariate logistic regression. All variables were examined for interaction and multicollinearity. The significance level was set at $p < 0.05$.

3. RESULTS

3.1. Prevalence of post-COVID-19 hair loss and baseline characteristics of participants

After excluding 5 patients due to acute illness (3 patients) and serious mental condition (2 patients), our study included 547 older outpatients with a mean age of 68.5 ± 6.9 years (range, 60 - 95) and predominance of women (72.9%). Overall, post-COVID-19 hair loss was reported in 63 patients (11.5%). All patients with hair loss exhibited diffuse type. Participants were assigned to hair-loss or non-hair-loss group. Table 1 shows the baseline characteristics of the participants and compares the two groups. There was no difference

in age, level of education, BMI, decreased outdoor activities, limitations in ADLs and instrumental ADLs, depression, frailty, and poor sleep quality between the groups. The rates of women, polypharmacy, multimorbidity were significantly higher in the hair-loss group, compared with the non-hair-loss group. There was a significant difference in marital status between the two groups with more single or divorced older adults in the hair-loss group. In the comorbidities, hypertension, osteoarthritis, and diabetes mellitus were the most three prevalent medical disorders.

Table 1. Baseline characteristics of participants according to post-COVID-19 hair loss

Characteristics	Total (n = 547)	Hair-loss group (n = 63)	Non-hair-loss group (n = 484)	*p* value[a]
Age, years	68.5 ± 6.9	69.4 ± 6.0	68.4 ± 7.0	0.312
Age ≥ 75 years, n (%)	98 (17.9)	10 (15.9)	88 (18.2)	0.7
Gender, n (%)				0.002
Men	148 (27.1)	7 (11.1)	141 (29.1)	
Women	399 (72.9)	56 (88.9)	343 (70.9)	
Marital status, n (%)				< 0.001
Married	428 (78.2)	40 (63.5)	388 (80.2)	
Widowed	90 (16.5)	12 (19.0)	78 (16.1)	
Single or divorced	29 (5.3)	11 (17.5)	18 (3.7)	
Level of education, n (%)				0.495
Pre-senior high school	362 (66.2)	45 (71.5)	317 (65.5)	
Senior high school	118 (21.6)	13 (20.6)	105 (21.7)	
Tertiary education	67 (12.2)	5 (7.9)	62 (12.8)	
BMI, kg/m^2	22.4 ± 2.9	22.8 ± 2.8	22.3 ± 2.9	0.175
BMI groups, n (%)				0.554
Underweight	51 (9.3)	5 (7.9)	46 (9.5)	
Normal	288 (52.7)	29 (46.0)	259 (53.5)	
Overweight	114 (20.8)	15 (23.8)	99 (20.5)	
Obese	94 (17.2)	14 (22.3)	80 (16.5)	
Polypharmacy, n (%)	112 (20.5)	26 (41.3)	86 (17.8)	< 0.001
Multimorbidity, n (%)	316 (57.8)	50 (79.4)	266 (55.0)	< 0.001
Decreased outdoor recreation, n (%)	163 (29.8)	25 (39.7)	138 (28.5)	0.079
Limitations in ADLs, n (%)	14 (2.6)	1 (1.6)	13 (2.7)	1.000
Limitations in instrumental ADLs, n (%)	112 (20.5)	13 (20.6)	99 (20.5)	1.000
Depression, n (%)	105 (19.2)	11 (17.5)	94 (19.4)	0.865
Frailty, n (%)	102 (18.6)	10 (15.9)	92 (19.0)	0.610
Poor sleep quality, n (%)	373 (68.2)	43 (68.3)	330 (68.2)	1.000
Medical history, n (%)				
Hypertension	393 (71.8)	54 (85.7)	339 (70.0)	0.011
Coronary artery disease	88 (16.1)	17 (27.0)	71 (14.7)	0.017
Stroke	33 (6.0)	2 (3.2)	31 (6.4)	0.409
Diabetes mellitus	129 (23.6)	17 (27.0)	112 (23.1)	0.528
Osteoarthritis	160 (29.3)	22 (34.9)	138 (28.5)	0.305
Chronic pulmonary diseases	38 (6.9)	3 (4.8)	35 (7.2)	0.468

Chronic venous insufficiency	83 (15.2)	8 (12.7)	75 (15.5)	0.709
Chronic kidney disease	84 (15.4)	14 (22.2)	70 (14.5)	0.135

Note: Comparisons were conducted using the chi-square test or Fisher's exact test for categorical variables and Student's t-test for continuous variables. ADLs: activities of daily living, BMI: body mass index. [a] Hair-loss group vs non-hair-loss group.

3.2. Characteristics of post-COVID-19 symptoms

Table 2 shows the characteristics of post-COVID-19 symptoms according to the hair loss. Overall, there were 60 patients (11.0%) having history of COVID-19 related admission, and 465 patients (85.0%) who had at least a post-COVID-19 symptom. Fatigue, headache, and dyspnea were the three most common post-COVID-19 symptoms in the study population. Compared with the non-hair-loss group, the hair-loss group had significantly higher rates of COVID-19 related admission, any post-COVID-19 symptom, attention disorder, and headache.

Table 2. Post-COVID-19 conditions in participants

Characteristics	Total (n = 547)	Hair-loss group (n = 63)	Non-hair-loss group (n = 484)	*p* value[a]
Time from infection to the enrolment, n (%)				< 0.001
< 3 months	317 (58.0)	13 (20.6)	304 (62.8)	
≥ 3 months	230 (42.0)	50 (79.4)	180 (37.2)	
COVID-19 related hospitalization, n (%)	60 (11.0)	18 (28.6)	42 (8.7)	< 0.001
Post-COVID-19 conditions, n (%)	465 (85.0)	63 (100)	402 (83.1)	< 0.001
Fatigue	347 (63.4)	38 (60.3)	309 (63.8)	0.581
Headache	149 (27.2)	9 (14.3)	140 (28.9)	0.015
Attention disorder	92 (16.8)	24 (38.1)	68 (14.0)	< 0.001
Dyspnea	86 (15.7)	7 (11.1)	79 (16.3)	0.359

Note: Comparisons were conducted using the chi-square test for categorical variables.
[a] Hair-loss group vs non-hair loss group.

3.3. Factors associated with post-COVID-19 hair loss

The univariate and multivariate logistic regression analyses results are shown in Table 3. In the adjusted model, women (odds ratio [OR], 3.36; 95% confidence interval [CI], 1.43 - 7.89; p = 0.005), single or divorced in the marital status (OR, 3.27; 95% CI, 1.33 - 8.02; p = 0.010), and COVID-19 related hospitalization (OR, 5.17; 95% CI, 2.44 - 10.95; p < 0.001) were the three factors increased the probability of post-COVID-19 hair loss.

Table 3. Factors associated with post-COVID-19 hair loss

Variables	Univariate		Multivariate	
	OR (95% CI)	P-value	Adjusted OR (95% CI)	*p* value[a]
Age ≥ 75 years	0.87 (0.42 - 1.77)	0.868		
Women	3.22 (1.43 - 7.24)	0.005	3.36 (1.43 - 7.89)	0.005
Marital status				
Married	Reference		Reference	
Widowed	1.54 (0.77 - 3.06)	0.225	1.00 (0.46 - 2.19)	0.998
Single or divorced	6.10 (2.69 - 13.83)	< 0.001	3.27 (1.33 - 8.02)	0.010
BMI groups				
Normal	Reference			

Underweight	0.97 (0.36 - 2.64)	0.954		
Overweight	1.25 (0.64 - 2.46)	0.519		
Obese	1.56 (0.79 - 3.10)	0.202		
Polypharmacy	3.10 (1.77 - 5.40)	< 0.001		
Multimorbidity	3.08 (1.63 - 5.82)	0.001		
Decreased outdoor recreation	1.57 (0.91 - 2.72)	0.105		
Limitations in ADLs	0.60 (0.08 - 4.63)	0.620		
Limitations in instrumental ADLs	1.03 (0.54 - 1.98)	0.919		
Depression	0.90 (0.45 - 1.79)	0.758		
Frailty	0.82 (0.40 - 1.68)	0.589		
Poor sleep quality	0.98 (0.56 - 1.72)	0.936		
COVID-19 related hospitalization	4.32 (2.29 - 8.13)	< 0.001	5.17 (2.44 - 10.95)	< 0.001
Hypertension	2.51 (1.21 - 5.23)	0.014		
Coronary artery disease	2.20 (1.19 - 4.06)	0.011		
Stroke	0.49 (0.11 - 2.09)	0.334		
Diabetes mellitus	1.15 (0.62 - 2.10)	0.662		
Osteoarthritis	1.38 (0.79–2.41)	0.253		
Chronic pulmonary diseases	0.65 (0.20–2.19)	0.491		
Chronic venous insufficiency	0.81 (0.37–1.77)	0.597		
Chronic kidney disease	1.73 (0.91–3.30)	0.097		

ADLs: activities of daily living, BMI: body mass index, CI: confidence interval, OR: odds ratio.

4. DISCUSSION

In this multicenter cross-sectional study, we found three key observations regarding the burden of post-COVID-19 hair loss among the older adults in Vietnam. First, there was 11.5% of geriatric outpatients at post-COVID-19 clinics experienced hair loss. Second, diffuse hair loss was the only type of hair shedding after COVID-19 infection. Third, gender, marital status, and COVID-19 related hospitalization were associated with post-COVID-19 hair loss. According to these findings, we propose three discussion points.

Although hair loss, a dermatological disorder, is neither life threatening nor painful, it can result in social and psychological consequences, and effect on patients' quality of life. Hair loss was one of the most common post-COVID-19 symptoms after COVID-19 infection [8]. While there have been many studies on the hair loss after COVID-19 in the general population [8 - 11, 15, 16], little clinical information is available to understand this medical condition among the older population. The reported global post-COVID-19 hair loss rates in the general population vary from 17% to 48% [8, 10], and the rate was lowest in the subgroup aged ≥ 60 years [11]. Our study found a lower rate of post-COVID-19 hair loss among geriatric outpatients. We suggest that at least two reasons explain to the inconsistent rates. First, these may be due to differences in sociodemographic and cultural characteristics across the study population and the different impact of the COVID-19 pandemic on the countries. For instance, depression was demonstrated as a factor positively associated with hair loss, and the psychological distress related to the strict lockdown restrictions during the pandemic was considered as factor in the mechanisms that precipitate in hair loss [17]. Before the pandemic, in 2018, the rate of depression in Vietnamese older adults was 66.9% [18]. However, there was only 19.2% of older adults in our study having depression during the pandemic and no significant difference in the rates between the hair-loss and non-hair-loss groups. This may be explained by the pattern of Vietnamese household in that many generations living together and the older people are cared for by their offspring and relatives. During social distancing, the family members stayed at home and likely gave more contact and care to

the older ones. In agreement with this notion, the lower rate of depression may explicate the lower rate of hair loss in our study. Second, although the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has been found in the sweat glands of COVID-19 patients, the virus was only found in one-third of sweat glands of COVID-19 older individuals [19]. Taken together, the impact of COVID-19 on hair shedding may be different between general and older population. Further research is needed to understand how COVID-19 triggers serial pathologic and psychological cascades leading to hair loss in the older individuals.

Until now, the evidence suggesting COVID-19 infection as a cause of hair loss was based on the findings that SARS-CoV-2 can enter human cells via the angiotensin-converting enzyme 2 (ACE2) receptors which were also located on the skin cells [20], and the SARS-CoV-2 has been identified in the sweat glands and the sweat ducts of COVID-19 patients [19]. The mechanisms of post-COVID-19 hair loss probably were due to immediate anagen release and pro-inflammatory reactions from viral infection or resultant stress response [21], [22]. We found that telogen effluvium, a form of diffuse nonscarring hair loss, was mainly responsible for the cause of hair shedding after COVID-19 infection among older adults. Our finding is consistent with the results of previous studies in general adult population [9], [10], [23]. Telogen effluvium is an heterogenous medical condition with many possible triggers such as metabolic or nutritional changes, medication, fever, or after severe infective episodes [24], [25]. The latter etiology can explain for post-COVID-19 acute telogen effluvium, which was defined as an onset hair loss occurring 2-3 months after COVID-19 infection [9], [26]. Based on the onset of post-COVID-19 telogen effluvium, in our study, most of cases with hair loss were recorded in patients with time from COVID-19 infection to the enrolment ≥3 months. A longer follow-up of the older patients with post-COVID-19 hair loss is required to address the clinical nature of this condition among the older population.

Recent study showed that post-COVID-19 hair loss was associated with disease length and inflammatory symptoms such as high fever, dyspnea, and myalgia [11]. Our study additionally demonstrated that older patients with COVID-19 related hospitalization were also at a higher probability of having hair loss after COVID-19. This association can be explained based on the two pathologic and psychological factors from previous evidence showing that hospitalized COVID-19 patients had higher plasma levels of pro-inflammatory cytokines, and the majority of COVID-19 survivors persist with depression and psychiatric symptoms lasting up to a half-year after hospital discharge [27]. In addition, our study found that sociodemographic factors, including women and single or divorced were associated with hair loss after COVID-19 infection among older adults. Previous evidence have shown that women are more susceptible to post-COVID-19 acute telogen effluvium than men [9], [11], [15], [16]. The gender disparity in hormones such as estrogens and progesterone was considered to play a pivotal role in female dominance in having hair loss. The two hormones contribute in the regulation of immunomodulation and anti-inflammatory effects inhibiting pro-inflammatory cytokines [28], [29]. Furthermore, estrogen and progesterone are known to protect the hair follicle [30]. Thus, a reduction in the two hormone levels due to postmenopause may be a factor related to the greater extent of hair loss in older women. Besides gender, this study revealed that single or divorced was a factor associated with hair loss after COVID-19. Unlike widowed older adults can live with their offspring and receive the care from other family members, single or divorced older adults may have more depression in marital disruption or feeling alone and receive less support from their relatives. Future studies are required to understand the impact of other factors on post-COVID-19 hair loss and in the older population.

Our study has several limitations. First, there was a lack of information on COVID-19 vaccination status and the symptom severity in the acute phase of the COVID-19 illness. Second, because only information of five post-COVID-19 symptoms was obtained, our study is unable to totally reflect the burden of post-COVID-19 symptoms in Vietnamese older outpatients. Third, the medical disorders of our study population may not be generalisable to the general older population since the sample only included patients attending post-COVID-19 clinics. Fourth, due to cultural issues, the results of our study may not reflect the total burden of hair loss in other countries. Finally, due to the cross-sectional nature of the study design, we could not evaluate the causal relationship between hair loss and the associated factors.

5. CONCLUSIONS

This is the first study to identify the substantial prevalence of post-COVID-19 hair loss in older outpatients in Vietnam. Besides providing different

baseline characteristics and post-COVID-19 symptoms between hair-loss and non-hair-loss groups, our study found women, single or divorced in marital status, and COVID-19 related hospitalization as three factors associated with post-COVID-19 hair loss.

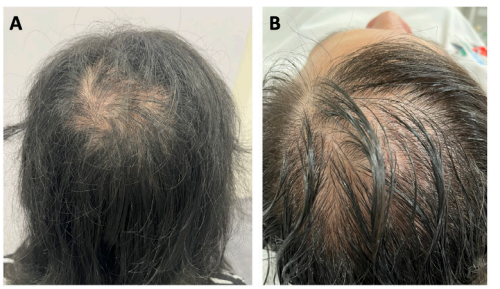

Figure 1. Diffuse type of hair loss in an older woman **(A)** and in an older man **(B)** after COVID-19 infection.

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