Original Article

COVID-19-induced hair shedding and related risk factors: A Saudi perspective

Abrar E. Bukhari[1], Dalal A. AlDosari[1], Manal A. AlDosari[1], Reema F. Muqrin[1], Othillah M. Moazin[1], Malak M. Almutlq[2], Saad M. Altalhab[1], Ruaa S. Alharithy[3], Abdullah I. Alkhalifah[4]

[1]Department of Dermatology, College of Medicine, Imam Mohammad Ibn Saud Islamic University (IMSIU), Riyadh, Saudi Arabia, [2]Department of Dermatology, King Fahad Medical City, Riyadh, Saudi Arabia, [3]Department of Dermatology, Princess Nourah Bint Abdul Rahman University, Security Forces Hospital, Riyadh, Saudi Arabia, [4]Department of Dermatology, Prince Sultan Military Medical City, Riyadh, Saudi Arabia

Abstract

Introduction: Many cases of telogen effluvium (TE), acute hair shedding, following coronavirus disease 2019 (COVID-19) were reported during the pandemic. **Methodology:** We conducted a cross-sectional study to assess the relationship between COVID-19 and TE in Saudi Arabia. Self-administered online questionnaires were distributed online between March and September 2022 in Saudi Arabia. A multivariate logistic regression model was used to determine risk factors associated with TE post-COVID-19 (significance at $P < 0.05$). **Results:** Of the 703 responders, 392 were included in the study. 59.70% ($n = 234$) recognized hair shedding during or after COVID-19. The time taken to realize hair shedding (3 or 6 months) and the duration varied (3, 6, >6 months). The risk factors significantly related to TE post-COVID-19 were: female sex ($P < 0.001$, odds ratio [OR] = 2.98), COVID-19 antiviral treatment ($P = 0.032$, OR = 3.02), and TE history ($P = 0.001$, OR = 3.78). **Conclusion:** Healthcare providers and physicians should be aware of the relationship between TE and COVID-19, to easily recognize, treat, and improve their patients' outcomes).

Keywords: COVID-19, hair loss, SARS-CoV-2, telogen effluvium

Introduction

In late 2019, coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), spread rapidly, causing a massive global crisis.[1] The most common COVID-19 symptoms are fever, dry cough, joint pain, muscle pain, and headache.[1] Cutaneous manifestations have been found in some patients who recovered from COVID-19, which are helpful disease markers and prognostic indicators.[2-4] Family physicians have a main role in providing a holistic approach of health services to all population, regardless of their age, gender, or medical condition. Also, they are the gatekeeper to the healthcare's network as they have the first contact with the patient.[5,6] Hair loss is a common complaint in primary care clinics, seen in females more than males and almost in all different age groups.[7] During the pandemic, many cases of acute hair shedding following COVID-19 have been reported.[8] In fact, it is assumed that SARS-CoV-2 infection provokes telogen effluvium (TE),[9,10] which is defined as diffuse hair shedding following stress triggers, such as systemic diseases, stressful events, drugs, nutritional deficiencies, febrile illnesses, major surgery, or any disturbance of the body's normal

Address for correspondence: Dr. Abrar E. Bukhari, Department of Dermatology, College of Medicine, Imam Mohammad Ibn Saud Islamic University (IMSIU), P O Box 7544, Riyadh 13317-4233, Saudi Arabia.
E-mail: aebukhari@imamu.edu.sa

Received: 17-02-2023 **Revised:** 13-07-2023
Accepted: 19-07-2023 **Published:** 21-12-2023

Access this article online
Quick Response Code:
Website: http://journals.lww.com/JFMPC
DOI: 10.4103/jfmpc.jfmpc_314_23

How to cite this article: Bukhari AE, AlDosari DA, AlDosari MA, Muqrin RF, Moazin OM, Almutlq MM, *et al*. COVID-19-induced hair shedding and related risk factors: A Saudi perspective. J Family Med Prim Care 2023;12:3304-11.

physiology.[8,11] Although TE is one of the most common forms of hair loss in humans,[12] it is a self-limiting disease characterized by a sudden shift of the hair follicles from the anagen to the telogen phase, leading to unusual shedding (more than 100 shed hair/day).[13] Physiologically, approximately 90% of the scalp hair should be in the anagen phase and 10% in the telogen phase.[7,14] In this study, we aimed to assess the relationship between COVID-19 and TE and raise awareness of this phenomenon in Saudi Arabia. To the best of our knowledge, this topic has not yet been addressed, and it could be a valuable contribution to the growing medical literature on COVID-19. Therefore, we conducted a cross-sectional study to assess the relationship between COVID-19 and TE in Saudi Arabia.

Materials and Methods

This cross-sectional study was conducted between March and September 2022 in Saudi Arabia after obtaining ethical approval from Imam Mohammad Ibn Saud Islamic University's (IMSIU) Institutional Review Board (number 226-2022).

The sample size was calculated using the following formulas: X = Z (c/100) 2r (100−r); n = N x/((N−1) E2+x); and E = Sqrt[(N-n) x/n (N−1)], where n is the sample size, E is the margin of error, N is the population size, r is the fraction of responses, and Z (c/100) is the critical value for the confidence level c. We used a confidence level of 95% and a confidence interval of 5%, with a standard deviation (SD) of 0.5.

The initial population size extracted from the Saudi Ministry of Health portal was 748,311.[15] The sample consisted of 384 randomly selected participants complying with the selection criteria. The inclusion criteria were as follows: (1) SARS-CoV-2 infection, and (2) age ≥18 years. Participants with one of the following criteria were excluded: (1) age <18 years, (2) no SARS-CoV-2 infection, (3) no completion of the questionnaire, or (4) no provision of informed consent.

Self-administered questionnaires distributed online through different social media platforms were used as data collection tools to assess the relationship between COVID-19 and TE in the general population of Saudi Arabia. The questionnaire considered participants' data such as demographics, age, and sex. The questionnaire was administered to 703 participants; however, only a total of 392 participants were included according to the selection criteria.

Data were kept confidential and used only for the purposes described in the study objectives. All the participants provided informed consent, and personal data were kept to a minimum from participants to ensure their privacy. Data analysis was performed using the Statistical Package for the Social Sciences software (SPSS, 23rd version, IBM). Categorical variables were displayed as frequencies and percentages. The Chi-square test was used to evaluate associations between categorical variables and a multivariate logistic regression was performed to determine risk factors for hair shedding post-COVID-19.

The logistic regression model included the following variables: sex, major stressful life events in the past 3 years, medical history (vitamin D deficiency, iron-deficiency anemia, hypothyroidism, and diabetes), hospitalization/intensive care unit admission due to COVID-19, COVID-19 treatment received (antiviral, steroids, immunomodulators, and symptomatic treatment), and related hair problems. The level of significance was set at $P < 0.05$.

Results

Almost 50% of participants were 18 to 29 years old, and almost 80% were female. Table 1 shows the participants' sociodemographic characteristics. Regarding their medical history, 192 (49%) participants had vitamin D deficiency, 120 (30.60%) had iron-deficiency anemia, 35 (8.90%) had hypothyroidism, and 19 (4.80%) had diabetes [Figure 1]. Additionally, 63 (16.10%) reported having major surgeries in the past 3 years, 5 (1.30%) reported having major trauma, 35 (8.90%) reported having a crash diet, and 289 (73.70%) reported not experiencing any previous stressful events [Figure 2].

Table 1: Socio-demographic and academic profile of the study participants (*n*=392)

Demographical characteristics	*n*	%
Age (years)		
18–29	193	49.20
30–39	104	26.50
40–49	51	13.00
0–59	35	8.90
60–69	8	2.00
>70	1	0.30
Sex		
Female	308	78.60
Male	84	21.40
Region of residency		
Central	301	76.80
Western	38	9.70
Eastern	30	7.70
Northern	7	1.80
Southern	16	4.10
Education level		
Elementary	4	1.00
Middle	7	1.80
High	62	15.80
Bachelor's degree	265	67.60
Postgraduate studies	54	13.80
Income		
Less than 2500 SR	122	31.10
2,500–5,000 SR	51	13.00
5,000–10,000 SR	66	16.80
10,000–15,000 SR	46	11.70
More than 15,000 SR	107	27.30

SR=Saudi Riyal

Table 2 displays the results obtained when considering previous hair disease profiles. A total of 168 (42.90%) participants reported having a history of previous hair diseases: 7 (4.20%) reported alopecia areata, 43 (25.60%) reported androgenic alopecia (AGA), 52 (31%) reported TE, 13 (7.70%) reported trichotillomania, and 53 (31.50%) reported other hair diseases. Among these 168 patients, only 66 (39.30%) received treatment. The most common treatments used prior to COVID-19 were topical treatments for hair thinning (minoxidil, commercially available as Avogain, Rogaine, Hairgrow, Regaine, and Neoxidil) used by 39 (23.21%) participants, vitamin D used by 32 (19.05%), and iron supplements used by 31 (18.45%).

Next, the participants' COVID-19 profiles were assessed considering the manifestations experienced and their severity. Only six (1.5%) participants in the sample were admitted to the hospital [Table 3]. As for the COVID-19 treatment received, 32 (8.20%) received antivirals, 12 (3.10%) received steroids, 13 (3.30%) received immunomodulators, 231 (81.90%) received symptomatic treatments, such as nasal decongestants, paracetamol, ibuprofen, and nebulizer, and 81 (20.66%) received other treatments.

Table 2: Participants' previous history of hair disease (*n*=392)

	n	%
Previous history of hair diseases		
Yes	168	42.9
No	224	57.1
Diagnosis (*n*=168)		
Alopecia areata	7	4.2
Androgenic alopecia	43	25.6
Telogen effluvium	52	31
Trichotillomania	13	7.7
Others	53	31.5
Treatment (*n*=168)		
Yes	66	39.3
No	102	60.7
Type of treatment (*n*=168)		
Topical treatment for hair thinning	39	23.21
Vitamin D supplements	32	19.05
Iron supplements	31	18.45
Multivitamins	25	14.88
Biotin	16	9.52
Platelet-rich plasma injections	16	9.52
Micrograft injections	9	5.36
Other treatments	5	2.98

From the original sample (*n* = 392), only 234 (59.70%) participants recognized hair shedding during or after COVID-19 [Figure 3]. When enquiring the participants about the time when hair shedding started, 38 (16.40%) reported it during the infection period, 30 (12.82%) realized it 1 week post-infection, 30 (12.82%) within 1 month post-infection, 67 (28.63%) within 3 months post-infection, 56 (23.93%) within 6 months post-infection, and 13 (5.56%) after >6 months post-infection [Table 4]. The duration of hair shedding was variable: 1 week in 8 (3.42%) participants, 1 month in 28 (11.97%), 3 months in 66 (28.21%), 6 months in 27 (11.54%), and >6 months in 105 (44.87%). Only 59 (25.2%) reported receiving treatment for hair shedding, whereas 175 (74.8%) did not. The most common treatments were iron supplements (*n* = 32, 13.68%), topical treatment for hair thinning (*n* = 30, 12.82%), and vitamin D (*n* = 25, 10.68%).

As evidenced in Table 5, sex was significantly associated with the incidence of hair shedding post-COVID-19 (P < 0.001); females had a significantly higher rate than males (67.20% vs. 32.10%). Vitamin D deficiency and iron-deficiency anemia were also both significantly associated with hair shedding post-COVID-19 (P = 0.011 and P = 0.001, respectively). In addition, having a history of hair disease was significantly associated with hair shedding post-COVID-19 (P = 0.008) (67.30% vs. 54%).

Moreover, different hair diseases differed in their level of association with hair shedding post-COVID-19 (P = 0.007), with TE being associated with the highest rate (82.7%) and trichotillomania with the lowest (46.2%). Participants who underwent previous hair loss treatment with vitamin D supplements showed a higher incidence of hair shedding post-COVID-19 than those who did not (81.30% vs. 50%), and the relationship was also significant (P = 0.008). Similar results were observed for participants using antiviral medication for

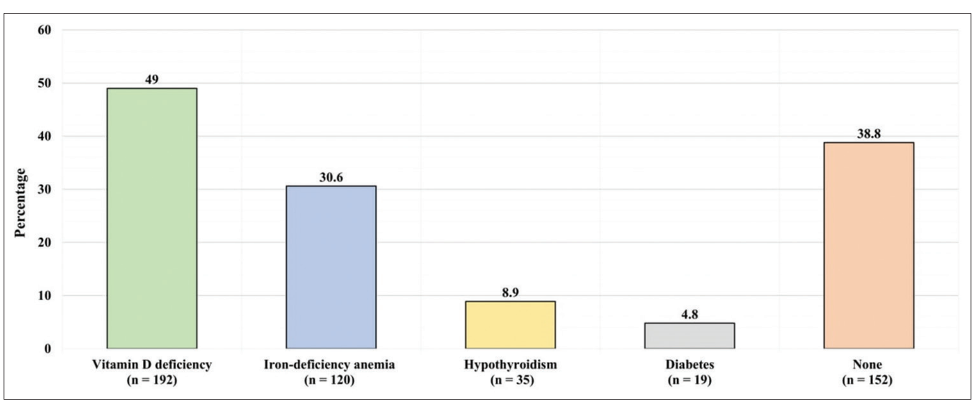

Figure 1: Participants' medical history

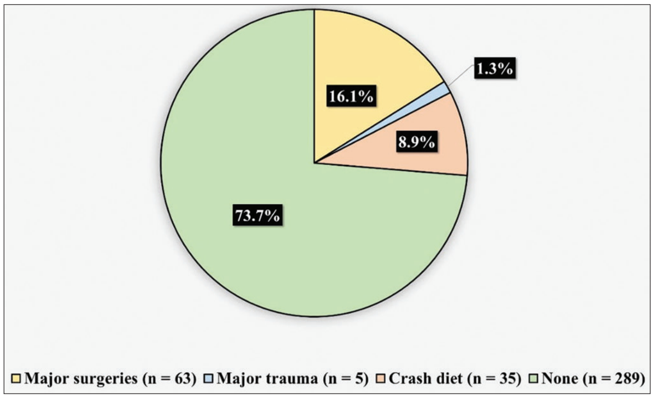

Figure 2: Major health events of participants in the past 3 years

COVID-19 ($P = 0.027$; incidence of 78.10% vs. 58.1% in those without antiviral medication).

The multivariate logistic regression analysis confirmed risk factors that significantly predicted the incidence of hair shedding post-COVID-19: female sex (increased risk of hair shedding by 198%) ($P < 0.001$, odds ratio [OR] =2.98), COVID-19 antiviral therapy (increased risk by 220%) ($P = 0.032$, OR = 3.02), and history of TE (increased risk by 278%) ($P = 0.001$, OR = 3.78) [Table 6].

Discussion

We performed a cross-sectional study using self-administered online questionnaires to investigate the association between TE and COVID-19 in Saudi Arabia. Further, we identified significant risk factors for this association.

Hair loss is not a disabling consequence of SARS-CoV-2 infection; however, it causes psychological stress that affects the patients' quality of life and may initiate a viscous cycle of hair shedding.[7,10,16] Therefore, it is important for primary care physicians and dermatologists to not underestimate patient complaints.[7,17] Although alopecia areata and AGA have been reported as related conditions to COVID-19, TE remains the most common trichologic disease in these patients,[18] in both acute (≤6 months) or chronic (>6 months) forms.

Headington suggested five clinical types of acute TE based on hair cycle alteration: immediate or delayed anagen release, short anagen syndrome, and immediate or delayed telogen release.[19] COVID-19-induced TE is mostly explained by the immediate anagen release. SARS-CoV-2 infection is associated with a consistent increase in proinflammatory cytokines (tumor necrosis factor α, interleukin 1b and 6, interferon types 1 and 2).[20] Cytokine storms induce damage to hair matrix cells, which triggers TE.[19] Moreover, high interferon levels are associated with TE.[21]

Hussain *et al.* reported in a systematic review that TE affects 25% of patients with COVID-19, while Starace *et al.* found

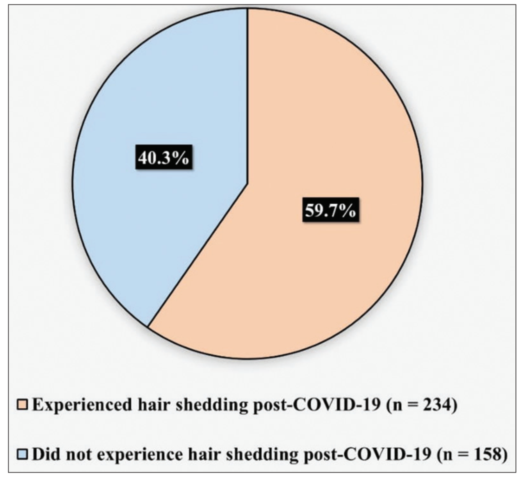

Figure 3: Hair shedding incidence post-COVID-19

that it affects 66.3%. However, it is worth mentioning that this latter study only evaluated patients visiting hair specialists' clinics expressing hair issues after SARS-CoV-2 infection.[18,22] In our study, we found that hair shedding affects 60% of the patients. The fact that almost 74% of participants did not have a clear risk factor for hair shedding, might strengthen the causal relationship between COVID-19 infection and hair shedding. A Turkish study conducted with a similar study design found that TE affects only 27.9% of patients, indicating a lower incidence than that in our study.[23]

Results on the first appearance of hair shedding displayed a wide range. We believe that the condition in these cases is most probably related to etiologies other than COVID-19. Previous research has shown that the mean duration between COVID-19 confirmed diagnosis and TE appearance is 74 days, which is shorter when compared to other triggers.[22] Nevertheless, other studies have reported different onsets, varying from 28 to 90 days.[4,8,12] Although acute TE is more common than chronic TE, almost 45% of the patients in our study showed persistent symptoms for >6 months, suggesting a possible relationship between COVID-19 and chronic TE.

Also, only 43 patients out of 168 reported a history of AGA, questioning the actual incidence rate of AGA, usually associated with chronic TE. Further controlled prospective studies are required to better define the possible association between SARS-CoV-2 infection and chronic TE.

We found that among 234 participants with TE post-COVID-19, only 25.2% sought treatment, which is slightly higher than the evidence provided by other research groups.[23,24] When considering the most common medications (iron, topical treatments for hair thinning, and vitamin D supplements), several factors can explain our findings: patients' fear of exposure during the pandemic, social distancing, and reduction of hospital visits when possible.

In line with current knowledge in the field, our analysis showed that females had a significantly higher risk of hair shedding

Table 3: Participants' COVID-19 profile (*n*=392)

Question	*n*	%
COVID-19 manifestations		
Fever		
None	90	23
Mild	97	24.7
Moderate	118	30.1
Severe	87	22.2
Loss of taste		
None	171	43.6
Mild	58	14.8
Moderate	61	15.6
Severe	102	26
Loss of smell		
None	181	46.2
Mild	106	27
Moderate	70	17.9
Severe	35	8.9
Dyspnea		
None	117	29.8
Mild	113	28.8
Moderate	111	28.3
Severe	51	13
Headache		
None	170	43.4
Mild	65	16.6
Moderate	74	18.9
Severe	83	21.2
Diarrhea		
None	71	18.1
Mild	86	21.9
Moderate	119	30.4
Severe	116	29.6
Muscle pain		
None	257	65.6
Mild	54	13.8
Moderate	58	14.8
Severe	23	5.9
Coryza		
None	78	19.9
Mild	88	22.4
Moderate	112	28.6
Severe	114	29.1
Hospitalization/intensive care unit admission		
Yes	6	1.5
No	386	98.5
Treatment received		
Antivirals	32	8.2
Steroids	12	3.1
Immunomodulators	13	3.3
Symptomatic treatments	321	81.9
Others	81	20.66

post-COVID-19 than males.[2,4,8,12,14,16,22,25] Several reasons sustain this observation: first, females usually have long hair, which makes shedding easily noticeable; second, females are more disturbed by hair shedding and tend to seek medical attention; third, females are more prone to risk factors associated with shedding (such as giving birth and lactation); and fourth, males tend to underreport these issues.

Table 4: Participants' hair shedding profile after COVID-19 (*n*=234)

	n	%
Onset (*n*=234)		
After 1 week	30	12.82
After 1 month	30	12.82
After 3 months	67	28.63
After 6 months	56	23.93
After>6 months	13	5.56
During COVID-19	38	16.24
Duration (*n*=234)		
1 week	8	3.42
1 month	28	11.97
3 months	66	28.21
6 months	27	11.54
>6 months	105	44.87
Treatment (*n*=234)		
Yes	59	25.2
No	175	74.8
Type of treatment (*n*=59)		
Iron supplements	32	13.68
Topical treatment for hair thinning	30	12.82
Vitamin D supplements	25	10.68
Multivitamins	22	9.40
Platelet-rich plasma injection	11	4.70
Biotin supplement	10	4.27
Micrograft injections	6	2.56
Other treatments	8	3.42

Interestingly, the current study showed a significant association between the use of antiviral medication and hair shedding post-COVID-19. Ribavirin, a common antiviral used for the treatment of severe COVID-19, is known to cause alopecia.[26] Even though drug-induced hair shedding in SARS-CoV-2 infection has been widely discussed in the literature, the causality of this relationship has not been confirmed yet due to rapid changes and differences in medications, doses, and variable protocols used globally. Watras *et al.* already discussed the role of anticoagulant agents, including enoxaparin, in inducing TE.[27]

Other medications used in SARS-CoV-2 treatment protocols, such as hydroxychloroquine and azithromycin, should be closely monitored in relation to this condition.

The multivariant logistic regression module in our study allowed us to successfully identify three risk factors for hair shedding post-COVID-19: female sex, antiviral treatment, and medical history of TE. The main limitation of our study is the lack of clinical evaluation of the participants by specialized dermatologists, which puts our numbers and findings at risk of subjective and variable understanding of patients. We attempted to overcome this limitation by designing an educational video attached to our electronic survey, helping individuals from a nonmedical background to understand TE and hair shedding.

Table 5: Risk factors associated with the incidence of hair shedding after COVID-19

Factor	Hair shedding after COVID-19		*P*
	Yes (*n*=234)	No (*n*=158)	
Socio-demographic			
Sex			<0.001*
Male	27 (32.1%)	57 (67.9%)	
Female	207 (67.2%)	101 (32.8%)	
Medical history			
Vitamin D deficiency			0.011*
Yes	127 (66.1%)	65 (33.9%)	
No	107 (53.5%)	93 (46.5%)	
Hypothyroidism			0.138
Yes	25 (71.4%)	10 (28.6%)	
No	209 (58.5%)	148 (41.5%)	
Iron-deficiency anemia			0.001*
Yes	86 (71.7%)	34 (28.3%)	
No	148 (54.4%)	124 (45.6%)	
Diabetes			0.427
Yes	13 (68.4%)	6 (31.6%)	
No	221 (59.2%)	152 (40.8%)	
Experience with major stressful events			
Major stressful events in the past 3 years			0.197
Yes	67 (65%)	36 (35%)	
No	187 (57.8%)	122 (42.2%)	
Type of event			0.176
Major surgeries	45 (71.4%)	18 (28.6%)	
Major trauma	2 (40%)	3 (60%)	
Crash diet	20 (57.1%)	15 (42.9%)	
None	167 (57.8%)	122 (42.2%)	
Previous hair problems			
History of hair diseases			0.008*
Yes	113 (67.3%)	55 (32.7%)	
No	121 (54%)	103 (46%)	
Type of hair disease			0.007*
Alopecia areata	4 (57.1%)	3 (42.9%)	
Androgenic alopecia	23 (53.5%)	20 (46.5%)	
Telogen effluvium	43 (82.7%)	9 (17.3%)	
Trichotillomania	6 (46.2%)	7 (53.8%)	
Treatment			0.639
Yes	43 (65.2%)	23 (34.8%)	
No	70 (68.6%)	32 (31.4%)	
Previous hair problems treatment			
Topical treatment for hair thinning			0.206
Yes	23 (59%)	16 (41%)	
No	20 (74.1%)	7 (25.9%)	
Vitamin D supplements			0.008*
Yes	26 (81.3%)	6 (18.8%)	
No	17 (50%)	17 (50%)	
Iron supplements			0.147
Yes	23 (74.2%)	8 (25.8%)	
No	20 (57.1%)	15 (42.9%)	
Multivitamins			0.149
Yes	19 (76%)	6 (24%)	
No	24 (58.5%)	17 (41.5%)	
Biotin			0.798
Yes	10 (62.5%)	6 (37.5%)	
No	33 (66%)	17 (34%))	
Platelet-rich plasma injection			0.391
Yes	9 (56.3%)	7 (43.8%)	
No	34 (68%)	16 (32%)	
Micrograft injection			0.516
Yes	5 (55.6%)	4 (44.4%)	
No	38 (66.7%)	19 (33.3%)	
COVID-19 severity			
Hospitalization/intensive care unit admission due to COVID-19			0.726
Yes	4 (66.7%)	2 (33.3%)	
No	230 (59.6%)	156 (40.4%)	
COVID-19 treatment			
Antivirals			0.027*
Yes	25 (78.1%)	7 (21.9%)	
No	209 (58.1%)	151 (41.9%)	
Steroids			0.922
Yes	7 (58.3%)	5 (41.7%)	
No	227 (59.7%)	153 (40.3%)	
Immunomodulators			0.890
Yes	8 (61.5%)	5 (38.5%)	
No	226 (59.6%)	153 (40.4%)	
Symptomatic treatments			0.712
Yes	193 (60.1%)	128 (39.9%)	
No	41 (57.7%)	30 (42.3%)	

*Significant at $P<0.05$

Even though SARS-CoV-2 infection can be an important trigger of TE, other associated factors should not be overlooked especially, but not limited to, a history of hair disease (e.g., AGA, TE), other concomitant diseases (e.g., iron-deficiency anemia, vitamin D deficiency), psychological stress, and drug intake. Primary care physicians and dermatologists should be aware of these aspects to reassure patients and manage their cases properly.

In conclusion, cutaneous manifestations following COVID-19 are reported as long-term sequelae of this viral disease. Our study provided subjective evidence of hair loss during or after COVID-19, differing between participants in terms of onset and duration. In addition, this study showed that the incidence of hair shedding is significantly associated with female sex, history of hair loss disease, and use of antivirals for COVID-19 treatment. Therefore, healthcare providers and physicians in general and family medicine practitioners in specific, the guardians of patients' care, must be aware of different presentations and

Table 6: Multivariate logistic regression (factors predicting the incidence of hair shedding after COVID-19)

Factor	*P*	Odds ratio	Confidence interval
Sex (female vs. male)	<0.001*	2.98	[1.62, 5.48]
Major stressful events in the past 3 years			
Major surgeries	0.074	1.89	[0.94, 3.82]
Major trauma	0.410	0.40	[0.04, 3.60]
Crash diet	0.687	0.84	[0.35,1.99]
Vitamin D deficiency (yes vs. no)	0.799	1.07	[0.64, 1.80]
Hypothyroidism (yes vs. no)	0.205	1.86	[0.71, 4.83]
Iron-deficiency anemia (yes vs. no)	0.068	1.76	[0.96, 3.23]
Diabetes (yes vs. no)	0.748	0.83	[0.26, 2.66]
Hospitalization/intensive care unit admission due to COVID-19? (yes vs. no)	0.978	1.03	[0.14, 7.73]
Receiving antiviral for COVID-19 (yes vs. no)	0.032*	3.02	[1.10, 8.29]
Receiving steroids for COVID-19 (yes vs. no)	0.963	1.04	[0.18, 5.90]
Receiving immunomodulators for COVID-19 (yes vs. no)	0.302	1.95	[0.55, 6.90]
Receiving symptomatic treatments like nasal decongestant, paracetamol, ibuprofen, and nebulizer for COVID-19 (yes vs. no)	0.413	1.30	[0.69, 2.43]
Related hair diseases			
Alopecia areata	0.836	0.84	[0.16, 4.35]
Androgenic alopecia	0.811	1.09	[0.53, 2.24]
Telogen effluvium	0.001*	3.78	[1.68, 8.52]
Trichotillomania	0.487	0.66	[0.20, 2.14]

*Significant level at $P<0.05$

common treatments available, to manage their patients properly and get to know when to refer them to a colleague dermatologist. Hopefully, this work will add value to this growing medical field and contribute to the literature on COVID-19.

We suggest further studies using objective assessment measures, such as physician global assessment of hair loss, to reach a more precise conclusion. Future clinically controlled studies should tackle the association between COVID-19 and chronic TE.

Data availability statement

The authors state that all data used in this study including raw data, clean data, and figures are stored safely after participants' deidentification and are available upon requests.

Acknowledgement

The authors would like to thank all participants who took a few minutes of their valuable time to fill out this questionnaire which helped them to contribute to medical literature and knowledge about COVID-19.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Lopez-Leon S, Wegman-Ostrosky T, Perelman C, Sepulveda R, Rebolledo PA, Cuapio A, *et al.* More than 50 long-term effects of COVID-19: A systematic review and meta-analysis. Sci Rep 2021;11:16144.
2. Babaei K, Kavoussi H, Rezaei M, Kavoussi R. Characteristics of telogen effluvium in COVID-19 in western Iran (2020). An Bras Dermatol 2021;96:688-92. doi: 10.1016/j.abd.2021.05.006.
3. Singh H, Kaur H, Singh K, Sen CK. Cutaneous manifestations of COVID-19: A systematic review. Adv Wound Care (New Rochelle) 2021;10:51-80. doi: 10.1089/wound.2020.1309.
4. Starace M, Iorizzo M, Sechi A, Alessandrini AM, Carpanese M, Bruni F, *et al.* Trichodynia and telogen effluvium in COVID-19 patients: Results of an international expert opinion survey on diagnosis and management. JAAD Int 2021;5:11-18. doi: 10.1016/j.jdin.2021.07.006.
5. Garg S, Engtipi K, Kumar R, Garg A. Role of family physicians in providing primary healthcare during COVID-19 pandemic. J Family Med Prim Care 2022;11:6687-9. doi: 10.4103/jfmpc.jfmpc_2209_20.
6. Li DKT. Challenges and responsibilities of family doctors in the new global coronavirus outbreak. Fam Med Community Health 2020;8:e000333. doi: 10.1136/fmch-2020-000333.
7. Alharbi M. Telogen effluvium after COVID-19 vaccination among public in Saudi Arabia. J Family Med Prim Care 2022;11:6056-60. doi: 10.4103/jfmpc.jfmpc_377_22.
8. Abrantes TF, Artounian KA, Falsey R, Simão JCL, Vañó-Galván S, Ferreira SB, *et al.* Time of onset and duration of post-COVID-19 acute telogen effluvium. J Am Acad Dermatol 2021;85:975-6. doi: 10.1016/j.jaad.2021.07.021.
9. Tufan A, Avanoğlu Güler A, Matucci-Cerinic M. COVID-19, immune system response, hyperinflammation and repurposing antirheumatic drugs. Turk J Med Sci 2020;50:620-32. doi: 10.3906/sag-2004-168.
10. Gentile P. Hair Loss and Telogen Effluvium Related to COVID-19: The potential implication of adipose-derived mesenchymal stem cells and platelet-rich plasma as regenerative strategies. Int J Mol Sci 2022;23:9116. doi: 10.3390/ijms23169116.

11. Rivetti N, Barruscotti S. Management of telogen effluvium during the COVID-19 emergency: Psychological implications. Dermatol Ther 2020;33:e13648. doi: 10.1111/dth.13648.
12. Sharquie KE, Jabbar RI. COVID-19 infection is a major cause of acute telogen effluvium. Ir J Med Sci 2022;191:1677-81. doi: 10.1007/s11845-021-02754-5.
13. Inamadar AC. Covid Induced Telogen Effluvium (CITE): An insight. Indian Dermatol Online J 2022;13:445-8. doi: 10.4103/idoj.idoj_139_22.
14. Asghar F, Shamim N, Farooque U, Sheikh H, Aqeel R. Telogen effluvium: A review of the literature. Cureus 2020;12:e8320. doi: 10.7759/cureus.8320.
15. Kingdom of Saudi Arabia-Ministry of Health Portal. Available from: https://www.moh.gov.sa/en/Pages/default.aspx. [Last accessed on 2022 Oct 31].
16. Aryanian Z, Balighi K, Hatami P, Afshar ZM, Mohandesi NA. The role of SARS-CoV-2 infection and its vaccines in various types of hair loss. Dermatol Ther 2022;35:e15433. doi: 10.1111/dth.15433.
17. Rebora A. Telogen effluvium: A comprehensive review. Clin Cosmet Investig Dermatol 2019;12:583-90. doi: 10.2147/CCID.S200471.
18. Starace M, Iorizzo M, Sechi A, Alessandrini AM, Carpanese M, Bruni F, *et al*. Trichodynia and telogen effluvium in COVID-19 patients: Results of an international expert opinion survey on diagnosis and management. JAAD Int 2021;5:11-18. doi: 10.1016/j.jdin.2021.07.006.
19. Headington JT. Telogen effluvium: New concepts and review. Arch Dermatol 1993;129:356-63. doi: 10.1001/ARCHDERM.1993.01680240096017.
20. Ye Q, Wang B, Mao J. The pathogenesis and treatment of the `Cytokine Storm' in COVID-19. J Infect 2020;80:607-13. doi: 10.1016/j.jinf.2020.03.037.
21. Olsen EA, Rosen ST, Vollmer RT, Variakojis D, Roenigk HH Jr, Diab N, *et al*. Interferon alfa-2a in the treatment of cutaneous T cell lymphoma. J Am Acad Dermatol 1989;20:395-407. doi: 10.1016/s0190-9622(89)70049-9.
22. Hussain N, Agarwala P, Iqbal K, Omar HMS, Jangid G, Patel V, *et al*. A systematic review of acute telogen effluvium, a harrowing post-COVID-19 manifestation. J Med Virol 2022;94:1391-1401. doi: 10.1002/jmv.27534.
23. Turkmen D, Altunisik N, Sener S, Colak C. Evaluation of the effects of COVID-19 pandemic on hair diseases through a web-based questionnaire. Dermatol Ther 2020;33:e13923. doi: 10.1111/dth.13923.
24. Kutlu Ö, Güneş R, Coerdt K, Metin A, Khachemoune A. The effect of the "stay-at-home" policy on requests for dermatology outpatient clinic visits after the COVID-19 outbreak. Dermatol Ther 2020;33:e13581. doi: 10.1111/dth.13581.
25. Malkud S. Telogen effluvium: A review. J Clin Diagn Res 2015;9:WE01-3. doi: 10.7860/JCDR/2015/15219.6492.
26. Seirafianpour F, Sodagar S, Pour Mohammad A, Panahi P, Mozafarpoor S, Almasi S, *et al*. Cutaneous manifestations and considerations in COVID-19 pandemic: A systematic review. Dermatol Ther 2020;33:e13986. doi: 10.1111/dth.13986.
27. Watras MM, Patel JP, Arya R. Traditional Anticoagulants and Hair Loss: A role for direct oral anticoagulants? A review of the literature. Drugs Real World Outcomes 2016;3:1-6. doi: 10.1007/s40801-015-0056-z.