Telogen effluvium and COVID-19: a cross-sectional study

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Abstract. – **OBJECTIVE:** COVID-19 is a febrile infectious disease caused by severe acute respiratory syndrome coronavirus type 2 (SARS-CoV-2). This virus affects several organs, including the skin. Acute telogen effluvium (TE) is a non-scarring hair loss characterized by diffuse hair shedding that begins three months after a stressful event and can last up to six months. COVID-19 infection is one of these potential stressors. Recently, there has been a reported link between increased scalp hair shedding and post-infection patients during the COVID-19 outbreak. The present work aimed to study the possible effects of COVID-19 on hair and the relationship between COVID-19 and TE and to assess the level of awareness about TE in the Asir region of Saudi Arabia.

SUBJECTS AND METHODS: A questionnaire-based cross-sectional study was conducted using a pre-validated questionnaire. The study involved 561 participants from the Asir region of Saudi Arabia. Eligible participants were individuals from the Asir region who were 20 years of age or older, had previously contracted COVID-19 and had no history of TE before infection. All statistical methods used were two-tailed with an alpha level of 0.05, considering significance if the *p*-value was lower than or equal to 0.05.

RESULTS: A total of 1,000 eligible participants completed the study questionnaire. The mean age was 32.5 ± 13.9 years, and 494 (88.1%) participants were females. In addition, 558 (99.5%) of the study participants had received the COVID-19 vaccine. A total of 411 (73.3%) participants experienced an increase in hair loss after COVID-19 infection, and 171 (30.5%) began suffering from pain when combing their hair. In addition, 182 participants (32.4%) had a family history of TE. Only 109 (10.9%) participants had a good awareness level about TE, while 452 (80.6%) had an overall poor awareness level. There was a significant relationship between the level of awareness and age, where 23.9% of the participants aged 20-29 years had a good level of awareness vs. 16.1% of others aged 40 years or older (*p* = 0.041). Moreover, 26.9% of participants with a family history of TE had a good awareness of TE, *vs.* 15.8% of those with no family history of TE (*p* = 0.002). In addition, significant correlations were found between increased hair loss post-COVID-19 infection and female gender (77.3% *vs.* 43.3%; *p* = 0.001) as well as suffering from pain when combing hair (86.5% *vs.* 65.5%; *p* = 0.001).

CONCLUSIONS: In our study, the incidence of TE was highly related to COVID-19 infections among both sexes. However, the incidence was greater among the female population. The awareness level toward post-COVID-19 TE was poor among most of the participants in our study.

Key Words:
 Telogen effluvium, Post-COVID-19 manifestation, Hair loss.

Introduction

In December 2019, the first case of coronavirus disease 2019 (COVID-19), a pandemic infection caused by severe acute respiratory syndrome coronavirus type 2 (SARS-CoV-2), was reported in Wuhan, central China. Apart from the respiratory system, this virus affects several other organs, including the skin. Skin is increasingly affected by the expanded use of personal protective equipment (PPE) and hygiene measures (hand sanitizer gels and repetitive hand washing)[1]. Acute telogen effluvium (TE) is a non-scarring hair loss that starts three months after a stressful event and can last up to six months[2]. Though women are more vulnerable to this disease, it affects both

males and females[3]. The presence of empty hair follicles, a predominance of follicular units with only one hair, perifollicular discoloration, upright regrowing hair, and progressive uniform hair thinning are the most prevalent but nonspecific observations of TE. A recent study[4] has reported a correlation between increased scalp hair shedding in post-infection patients during the COVID-19 outbreak and no scarring or permanent hair loss. This type of hair loss appeared soon after the patients were admitted to the intensive care unit.

SARS-CoV-2 infection increases proinflammatory cytokines, which can start the TE process by harming matrix cells. Intense and prolonged psychological stress – as seen with COVID-19 infection – promotes hair loss. However, in some cases, even the systemic inflammation, oxidative stress, and autoimmune reactions induced by SARS-CoV-2 in the body could affect hair follicles on the scalp surface. Pro-inflammatory cytokines and stress hormones released during pronounced forms of COVID-19 infection negatively affect the normal metabolism of proteoglycans, which are known regulators of the hair growth cycle. Additionally, the presence of large amounts of interferons has already been linked to TE. Finally, reduced oxygenation, fever, vaccination, and even some medications may accelerate massive hair loss in some people[5,6]. At the same time, a multi-drug COVID-19 treatment regimen was offered as a possible explanation for COVID-related TE. Other causes of hair loss after COVID-19 infection include insufficient oxygenation of the hair follicle, high fever, inflammation, and vitamin and mineral deficiencies[7-9].

The present work aims to study the possible effects of COVID-19 on hair and the relationship between COVID-19 and TE and to assess the level of awareness of telogen effluvium in the Asir region of Saudi Arabia.

Subjects and Methods

Research Design

A cross-sectional study was conducted in a tertiary hospital-based, and participants were among patients discharged with a diagnosis of COVID-19 from June 2022 to November 2022.

Data Collection

A prospective, web-based cross-sectional study was performed utilizing a survey questionnaire to acquire responses from patients discharged with a diagnosis of COVID-19.

A standardized, self-administered questionnaire was used to collect the data. The study site was the Asir region of Saudi Arabia, and the study duration was three months.

Inclusion criteria:
- Age $\geq$ 20 years.
- Previously diagnosed with COVID-19.
- No history of telogen effluvium before COVID-19 infection.
- Citizens of the Asir region.
  Exclusion criteria:
- Adults with mental illnesses or those unwilling to participate.
- Children.

Sample Size Calculation

The sample size calculation can be performed using the following formula (considering that the number of patients included is 561):

$$n = \frac{Z_{1-\frac{\alpha}{2}}^2\, p(1-p)}{d^2}$$

$\alpha = 0.05;\ Z_{1-\frac{\alpha}{2}} = 1.96; p = 0.005; d = 0.004;$

Statistical Analysis

The data were collected, reviewed, and then fed into the Statistical Package for Social Sciences Version 21.0 (IBM Corp., Armonk, NY, USA). All statistical methods used were two-tailed with an alpha level of 0.05, considered to be significant if the *p*-value was lower than or equal to 0.05. Regarding awareness, each correct answer was given a score of one point. The general awareness level of telogen effluvium was assessed by totaling discrete scores for the correct awareness-related items. The overall awareness score was classified as poor if the participants' score was less than 60% of the overall score. On the other hand, a score of 60% or more of the overall score was considered a good level of awareness. Descriptive analysis was performed by prescribing frequency distribution and percentage for study variables, including participant data, medical history, and awareness items. Additionally, awareness items were tabulated, and the overall awareness level was graphed. Cross-tabulation was carried out to show the distribution of the general awareness level using their data. Assessment of the factors associated with increased hair loss after COVID-19 infection was carried out with Pearson's Chi-square test for significance and, in the case of small frequency distributions, the exact probability test.

Table I. Personal data of study participants in the Asir region of Saudi Arabia.

Personal data	Frequency	%
Age (years)		
20-29	264	47.1%
30-39	111	19.8%
40+	186	33.2%
Gender		
Male	67	11.9%
Female	494	88.1%
Educational level		
Below secondary	59	10.5%
Secondary	99	17.6%
University or above	403	71.8%
Monthly income		
< 900 SR	360	64.2%
1,000-1,500 SR	138	24.6%
> 1,500 SR	63	11.2%

Results

Sociodemographic Characteristics

A total of 561 eligible participants completed the study questionnaire. The sociodemographic characteristics of the participants are shown in Table I. Participants' ages ranged from 20 to 55 years, with a mean age of 32.5 ± 13.9 years. Most of the participants – 494 (88.1%) in total – were women. A total of 403 (71.8%) participants had a university level of education or higher, while 99 (17.6%) participants had a secondary level of education. As for monthly income, 360 (64.2%) participants had monthly incomes of less than 900 saudi riyal (SR), while 138 (24.6%) had monthly incomes of 1,000-1,500 SR.

Medical and Family Histories

The medical and family histories of the study participants are described in Table II. Almost all the study participants – 558 (99.5%) in total – received the COVID-19 vaccine. In particular, 479 (85.4%) of the participants complained of hair loss, and 182 (32.4%) had a family history of telogen effluvium. Moreover, 411 (73.3%) participants experienced an increase in hair loss after being infected with COVID-19, and 171 (30.5%) began suffering from pain when combing their hair.

Awareness of Telogen Effluvium

Table III represents the awareness regarding telogen effluvium. A total of 319 (56.9%) participants heard about telogen effluvium, and around 371 (66.1%) believed that telogen effluvium was one of the symptoms that appeared after COVID-19 infection. Regarding awareness of the symptoms associated with telogen effluvium, participants reported the following. 83.6% of the study participants reported hair loss while showering or combing; 56.1% described their hair as dry, dull, frizzy, and easy to pluck; 43.5% found their hair to be thinner overall; 21.6% were aware of alopecia hair loss and lack of hair luster; and 16.9% mentioned temporary hair loss. In terms of the causes of telogen effluvium, the most reported causes were poor nutrition (82%), followed by severe stress (69.7%),

Table II. Medical and family history of study participants in the Asir region of Saudi Arabia.

	Frequency	%
Did you receive the COVID-19 vaccine?		
Yes	558	99.5%
No	3	0.5%
Did you have hair loss?		
Yes	479	85.4%
No	82	14.6%
Is there a family history of telogen effluvium?		
Yes	182	32.4%
No	379	67.6%
Have you experienced an increase in hair loss after COVID-19 infection?		
Yes	411	73.3%
No	150	26.7%
Do you suffer from pain when combing your hair?		
Yes	171	30.5%
No	278	49.6%
Don't know	112	20.0%

Table III. Participants' awareness of telogen effluvium in the Asir region of Saudi Arabia.

Awareness of telogen effluvium	Frequency	%
Have you ever heard of telogen effluvium?		
Yes	319	56.9%
No	242	43.1%
Do you think that telogen effluvium is one of the symptoms that appear after COVID-19 infection?		
Yes	371	66.1%
No	190	33.9%
What are some symptoms associated with telogen effluvium?		
Hair loss while showering or combing	469	83.6%
Dry, dull, and frizzy hair that is easy to pluck	315	56.1%
Hair is generally thinner	244	43.5%
Alopecia hair loss and lack of hair lustre	121	21.6%
Temporary hair loss	95	16.9%
Healthy scalp	31	5.5%
What are some causes of telogen effluvium?		
Severe stress	391	69.7%
Poor nutrition	460	82.0%
Sudden weight loss	256	45.6%
Menopause	132	23.5%
Certain drugs	225	40.1%
Certain diseases	221	39.4%
Surgery	81	14.4%
Chronic & immunologic diseases	148	26.4%
What are some risk factors of telogen effluvium?		
Female gender	359	64.0%
Vitamin D deficiency	379	67.6%
Type 2 DM	100	17.8%
Post-COVID infection	213	38.0%

sudden weight loss (45.6%), certain drugs (40.1%) and certain diseases (39.4%). On the other hand, the most known risk factors for telogen effluvium among participants were vitamin D deficiency (67.6%), female gender (64%), post-COVID infection (38%), and type 2 diabetes (17.8%).

The overall participants' awareness level regarding telogen effluvium is shown in Figure 1. A total of 109 (19.4%) had a good awareness level regarding telogen effluvium, while 452 (80.6%) had an overall poor awareness level.

Factors Affecting the Level of Awareness of Telogen Effluvium

Table IV represents the frequency of factors affecting the study participants' awareness level of telogen effluvium. Exact 23.9% of participants aged 20-29 years had a good level of awareness *vs.* 16.1% of the participants aged 40 years or older with recorded statistical significance ($p = 0.041$). Furthermore, 21.3% of the female participants had a good level of awareness compared to 6% of the males ($p = 0.003$). A total of 30.2% of the participants with a high income had a good awareness of telogen effluvium, compared to 11.6% of the participants with a monthly income of 1,000-1,500 SR ($p = 0.006$). Good awareness of telogen effluvium was reported among 26.9% of the participants with a family history of telogen effluvium *vs.* 15.8% of the participants ($p = 0.002$). Additionally, 25.7% of participants who suffered from pain when combing their hair had a good awareness level compared to 13.4% of the participants with a poor awareness level ($p = 0.026$).

Post-COVID-19 Infection and Hair Loss

As shown in Table V, there was a significant correlation between increased hair loss post-COVID-19 infection and female gender (77.3% *vs.* 43.3%; $p = 0.001$). However, there was no significant correlation between increased hair loss after COVID-19 infection and age, educational level, COVID-19 vaccine status or presence of a family history of TE.

Table IV. Factors that affect study participants' awareness level of telogen effluvium in the Asir region of Saudi Arabia.

Factors	Overall awareness level				p-value
	Poor		Good		
	Frequency	%	Frequency	%	
Age in years					
20-29	201	76.1%	63	23.9%	
30-39	95	85.6%	16	14.4%	0.041*$
40+	156	83.9%	30	16.1%	
Gender					
Male	63	94.0%	4	6.0%	
Female	389	78.7%	105	21.3%	.003*
Educational level					
Below secondary	46	78.0%	13	22.0%	
Secondary	83	83.8%	16	16.2%	.614
University or above	323	80.1%	80	19.9%	
Monthly income					
< 900 SR	286	79.4%	74	20.6%	
1,000-1,500 SR	122	88.4%	16	11.6%	.006*
> 1,500 SR	44	69.8%	19	30.2%	
Did you receive the COVID-19 vaccine?					
Yes	449	80.5%	109	19.5%	
No	3	100.0%	0	0.0%	394$
Is there a family history of telogen effluvium?					
Yes	133	73.1%	49	26.9%	
No	319	84.2%	60	15.8%	.002*
Have you experienced an increase in hair loss after being infected with COVID-19?					
Yes	324	78.8%	87	21.2%	
No	128	85.3%	22	14.7%	.085
Do you suffer from pain when combing your hair?					
Yes	127	74.3%	44	25.7%	
No	228	82.0%	50	18.0%	.026*
Don't know	97	86.6%	15	13.4%	

P: Pearson's χ^2 test; $: Exact probability test; *$p < 0.05$ (significant).

Discussion

Fever and lung symptoms are common symptoms of COVID-19. However, some studies[10-12] have reported that telogen effluvium may be yet another symptom of COVID-19. Telogen effluvium is a self-limiting condition that causes generalized hair loss a few weeks after a stressful event. Systemic infection, psychological trauma, surgery, starvation, and medications can cause hair to fall out prematurely, and scarring is rare[13].

To our knowledge, this is the first study to evaluate the awareness of TE and the factors that affect it. Additionally, this is the first study to report a correlation between previous COVID-19 infections and the incidence of telogen effluvium in the Asir region. Our study found that 73.3% of participants experienced an increase in hair loss after being infected with COVID-19, with the majority (92.9%) being female. This is consistent with a study by Olds et al[10] that reported 10 cases of telogen effluvium post-COVID-19 infection among patients, many of whom were women.

Similarly, Abdulwahab et al[17] reported an increased prevalence of hair loss after COVID-19 infection, especially in female patients (60.2% *vs.* 28.4% of males) from the Makkah region of Saudi Arabia. In contrast, Seyfi et al[14] reported no correlation between hair loss and age or sex, which could be due to the difference in male gender participation in both studies.

Table V. Factors associated with hair loss after being infected with COVID-19 in the Asir region of Saudi Arabia.

Factors	Have you experienced an increase in hair loss after being infected with COVID-19?				p-value
	Yes		No		
	Frequency	%	Frequency	%	
Age in years					
20-29	191	72.3%	73	27.7%	
30-39	87	78.4%	24	21.6%	.389
40+	133	71.5%	53	28.5%	
Gender					
Male	29	43.3%	38	56.7%	.001*
Female	382	77.3%	112	22.7%	
Educational level					
Below secondary	48	81.4%	11	18.6%	
Secondary	69	69.7%	30	30.3%	.268
University or above	294	73.0%	109	27.0%	
Have you received the COVID-19 vaccine?					
Yes	410	73.5%	148	26.5%	
No	1	33.3%	2	66.7%	
Yes	393	82.0%	86	18.0%	.117$
No	18	22.0%	64	78.0%	
Is there a family history of telogen effluvium?					
Yes	131	72.0%	51	28.0%	.634
No	280	73.9%	99	26.1%	
Do you suffer from pain when combing your hair?					
Yes	148	86.5%	23	13.5%	
No	182	65.5%	96	34.5%	.001*
Don't know	81	72.3%	31	27.7%	

P: Pearson's χ^2 test; \$: Exact probability test; *$p < 0.05$ (significant).

Sharquie and Jabbar[2] studied 29 patients aged 22 to 67, 36 (92.3%) of whom were women and 3 (7.69%) of whom were males. The study involved all telogen effluvium patients with a prior SARS-CoV-2 virus diagnosis that had been laboratory confirmed. The study declared that 24 (61.53%) patients had significant illnesses, 15 (38.46%) individuals had minor symptoms, and no one needed to be hospitalized. Within two to three months post-infection, all patients experienced significant hair loss.

Goldust et al[15] conducted a study involving only women with a mean age of 55 years and no history of hair loss. Participants experienced excessive hair loss several weeks to several months after infection. Similarly, 20 adult patients (all women) were enrolled in a study by Shome et al[16] beginning a few weeks after they had recovered

from their COVID-19 infection and had continuously presented with telogen effluvium for more than six months.

Telogen effluvium is a common cause of diffused hair shedding from the premature end of anagen and the entry of the hair follicle into the catagen. The telogen effluvium was one of the catastrophic impacts of the influenza pandemic in 1918[17].

The results of our study have shown that the majority (80.6%) of the study participants had a poor level of awareness regarding telogen effluvium. Given that this is the first study to assess the level of awareness of telogen effluvium post-COVID-19 infection, no published literature was available for us to compare our results. Additionally, we did not find any relevant studies on the level of awareness toward post-COVID-19 infection complications in general.

Limitations

There are several limitations to our study. First, the study is retrospective, and the gathered data are subjective due to the cross-sectional study design. The predominance of female participation limits the generalisability of the conclusion to include the male gender. Another limitation is found in the fact that we cannot be certain that COVID-19 itself is the only factor implicated in the increased incidence of hair loss. This is because telogen effluvium might also occur due to the use of hydroxychloroquine, azithromycin, or other drugs used in the treatment of COVID-19.

Conclusions

The COVID-19 pandemic has affected the world in a multitude of ways, and one of the lesser-known effects is hair loss. Telogen effluvium is a type of hair loss that is often temporary and caused by physical or emotional stress. This study found a significant correlation between previous COVID-19 infection and an increased incidence of telogen effluvium. This means that individuals who have had COVID-19 are more likely to experience hair loss due to telogen effluvium. Additionally, the study found that both genders were affected by telogen effluvium, but the incidence was greater among the female population. This is an important finding, as it indicates that women may be at increased risk of experiencing hair loss due to COVID-19.

Another important finding of the study was the poor awareness level regarding post-COVID-19 telogen effluvium among most participants. This means that many people are unaware that hair loss can be a consequence of COVID-19, which could lead to anxiety or distress if they experience it without understanding the cause. The authors emphasize the necessity of designing educational programs to increase awareness of the consequences of previous infections, including hair loss. The need for education is particularly important, given the psychological impact of hair loss. Additionally, hair loss can be a visible reminder of the trauma of COVID-19, which could exacerbate the already high levels of anxiety and stress that many people experience.

In addition to educational programs, there are other ways to address the issue of post-COVID-19 telogen effluvium. For example, healthcare providers could screen individuals who have had COVID-19 for hair loss and guide them on managing it. Additionally, mental health support could be offered to individuals who are experiencing hair loss as a result of COVID-19 infection.

In conclusion, this study provides important information on the potential consequences of COVID-19, particularly the correlation between the virus and telogen effluvium.

Ethics Approval
The study was carried out according to the guidelines of the Declaration of Helenski and was approved by the Research Committee at King Khalid University (Approval No. EC-M#2022-2118-HAPO-06-B-001).

Informed Consent
Informed consent was obtained from all subjects involved in the study.

Availability of Data and Materials
Data supporting this study's findings are available from the corresponding author upon reasonable request.

Conflict of interest
The authors declare that they have no conflicts of interest.

Authors' Contributions
The authors declare that all of the authors named in the article have carried out this work. Afaf Aldahish planned the project work. The data collection, research experimentation, statistical analysis and drafting of the manuscript were carried out by Rajalakshimi Vasudevan, Heba Hamed Salem, Ali Alqahtani, Shaima Yahya Al Qasim, Arwa Ali Alqhatani, Malath Saeed Al Shahrani, Lujain Khalid Al Mohsen, Manar Jauz Hajla, Daniela Calina and Javad Sharifi-Rad.

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