Changes in Hand Hygiene Behaviors and Its Related Factors Among Northern Iranian Population During the First Peak and Subsidence of COVID-19 Pandemic Period: Results From PERSIAN Guilan Cohort Study (PGCS)

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Research

Abstract

Background: Considering the importance of the hand hygiene behaviors for the prevention of COVID-19 transmission, the current study was conducted to investigate the changes in hand-washing behaviors and its related factors among the northern Iranian population during the first peak and subsidence of COVID-19 pandemic period.

Methods: This cross-sectional study was conducted during two periods in Guilan (Northern provinces of Iran). First period conducted at the first peak of COVID-19 pandemic in Iran (between 03/23/2020 and 03/30/2020), and second period conducted at the first subsidence of COVID-19 pandemic in Iran (between 05/3/20 and 05/10/2020). The questionnaire was completed by 571 adult participants. Data on frequency, procedure and circumstances of hand-washing and obsessive-like behaviors were collected. Potential correlates of reduction in frequency of hand washing were analyzed by multiple logistic regression.

Result: Compared to peak of COVID-19 pandemic, frequency and procedure of hand-washing and obsessive-like behaviors were significantly reduced at the subsidence of COVID-19 pandemic (all p<0.05). Females with negative family history of coronavirus disease had greater odds (Adjusted Odds Ratio = 2.19, P =0.03) of reduction in the frequency of daily hand-washing. Younger than 50 years old males and males who reduced the procedure of hand-washing had greater odds (AOR = 1.71, P =0.02 and AOR = 2.16, P =0.001, respectively) of reduction in the frequency of daily hand-washing.

Conclusion: Northern Iranian populations were found to decrease their frequency and quality of hand washing and obsessive-like behaviors over time from the first peak to first subsidence of COVID-19 pandemic. Here, the factors that independently predicted reduction in frequency of hand washing in male population were younger age and reduction in procedure of hand-washing and in female population was a negative family history of coronavirus disease. Thus, special attention should be paid to maintaining the general population's perceived susceptibility to illness, especially in younger men during the pandemic.

Background

On March 11, 2020, the World Health Organization (WHO) declared the global coronavirus-19 disease pandemic, caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) [1, 2]. By October 27, 2020, roughly 43,777,000 COVID-19 cases and 1,164,514 deaths had been confirmed in 216 countries[3].

In Iran, the first COVID-19 infectious case was confirmed on February 19, 2020[4] and by the beginning of March 2020, COVID-19 cases had dramatically increased, with 148,950 cases and 7,734 confirmed deaths by the end of March 2020[5]. The COVID-19 infection rate peaked for the first time in late March and early April 2020, at which time approximately 3,000 new cases of COVID-19 and 140 deaths were being confirmed each day[5]. Although, one month later, in late April and early May 2020, the COVID-19 infection rate subsided with approximately 800 new cases per day[5] but, the COVID-19 infection rate peaked for the second time in early June 2020, with approximately 3,000 new cases per day [5].

Concurrent with official declaration of the spread of COVID-19 infection in Iran, Iranian Ministry of Health and Medical Education made an effort to mitigate the disease transmission and attempted to educate the general population about preventive behaviors that decrease the risk of transmission, including stay at home, regular hand washing with water and soap or alcohol based hand rub, wearing a face mask in public[6]. Although these actions led to the epidemic subsided, but may increase the obsession and anxiety in society [7]. The Centers for Disease Control and Prevention (CDC) recommendation on hand-washing with proper procedure at the correct time were sufficient for COVID-19 infection prevention [8] but individuals who were susceptible to obsessive-compulsive disorder were more likely to using stronger disinfectants or washing for longer in response to, worries of potential or mental contamination and anxiety[9–11]. On the other, decreased perceived susceptibility to illness in the community and inappropriate hand hygiene can lead to epidemic eruption[12, 13].

Considering the importance of the hand hygiene behaviors for the prevention of COVID-19 transmission, the current study was conducted to investigate the changes in hand-washing behaviors and its related factors among the northern Iranian population during the first peak and subsidence of COVID-19 pandemic period through a cross-sectional population-Based study.

Methods

Study design

In this cross sectional study, subjects were recruited by simple random sampling from PERSIAN Guilan Cohort Study (PGCS) population. The full details of the PGCS have been described elsewhere [14].In short, The PGCS was a multistage probability sample of the northern Iranian population in which 10520 individuals from 35 to 70 years of age were enrolled since 2014,, as part of the Prospective Epidemiological Research Studies in Iran (PERSIAN)[15, 16].

The sample size was estimated by G*Power version 3.1.9.7 software. The sample size was estimated to be 571 participants, based on effect size (f ^{2}) of 0.05 and the number of related factors (25 independent variable), with a confidence level of 95% and test power of 80%.

The inclusion criteria were participation in PGCS and willingness to complete the questionnaires. The exclusion criteria were 20% missing data in the questionnaire.

Data were collected using a phone interview format by trained interviewers during two periods. First period conducted between 03/23/20 and 03/30/20, at the first peak of COVID-19 pandemic in Iran[17]. Second period conducted between 05/3/20 and 05/10/20, at the first subsidence of COVID-19 pandemic in Iran[17].

Ethical consideration

The ethical approval was obtained from the ethics committee of Guilan University of Medical Sciences, Rasht, Iran (IR.GUMS.REC.1399.004).

Measurements

In the first period of study, general characteristics of participants were collected, including age, education, gender, occupation, residency, marital status, underling disease (Includes cardiovascular disease, uncontrolled high blood pressure, uncontrolled diabetes, respiratory diseases and BMI > 40), immune deficiency condition (corticosteroid use, chemotherapy, malignancies, organ transplants and HIV), pregnancy and past history of COVID-19 infection in participants or their families.

Information about hand-washing behavior and believes were collected twice, in the first period of study (peak of COVID-19 pandemic) and second period of study (subsidence of COVID-19 pandemic).

A data gathering questionnaire was designed to assess the hand-washing behavior and believes, based on recommendations on appropriate hand-washing by WHO[18] and CDC [19] and Obsessive-Compulsive Disorder criteria in the DSM 5 [20]. Content validity of the questionnaire was confirmed by 20 experts with CVI = 0.8 and CVR = 0.71. A pilot study was conducted with 40 participants prior to the study in order to confirm the face validity and reliability of the questionnaire. The results of this pilot study confirmed the face validity and reliability of the questionnaire with Cronbach's alpha of 0.86.

Information about hand-washing behavior and believes was collected in following areas:

Section 1 collected data on frequency of hand-washing per day

Section 2 collected data on type of detergent used for hand-washing (categories as only soap, soap + alcohol or bleach)

Section 3 collected data on procedure of hand-washing by 5 yes or no questions to define if they include each step, as follows: 1) Wet hands with running, clean water, 2) rubbing hands together with the soap to lather them, including under the nails, between the fingers, and backs of the hands, 3) Scrub the hands for at least 20 seconds, 4) Rinse the hands well under running, clean water, 5) Dry hands by a clean towel. Each yes answer got one point and the total score was 5.

Section 4 collected data on circumstances of hand-washing by 14 yes or no questions to define if they include each condition, as follows: 1)Before, 2)during, 3)after preparing food, 4)before eating, 5)before, 6)after caring for someone who is sick at home, 7)before, 8)after treating a wound or cut, 9)after toilet using, 10)after or cleaning up a child who has used the toilet or changing diapers, 11)after sneezing, coughing or blowing nose, 12)after animal waste, animal feed, or touching an animal, 13)after pet treats or handling pet food, 14)after touching garbage. Each yes answer got one point and total score was 14.

Section 5 collected data on worries about hand-washing or obsessive-like behaviors by 8 yes or no questions to define if they experience each item, as follows: 1) worry about remaining a contamination on a properly washed hand, 2) afraid or anxious about hands are not clean enough, even after repeated rinsing, 3)wash in a special order, 4) starts washing again for fear of mistake, 5) avoid places or situations where may be exposed to germs or soil, 6)avoid touching surfaces in public places, 7) red, cracked and scaly hands due hand-washing, 8)effect of pollution concerns and efforts to reduce them in daily relationships and activities. Each yes answer got one point and total score was 8.

Statistical analysis

Change in type of detergents, procedure and circumstances of hand-washing and obsessive-like behaviors, over time (at the subsidence versus the peak of COVID-19 pandemic) were examined by McNamar tests. Change in hand washing frequency (the frequency was categorized to, 0–4 times, 5–8 times, 9–12 times, more than 13 times) over time was examined by Wilcoxon test. Change in score of obsessive-like behaviors and score of procedure and circumstances of hand-washing over time was examined by paired T test.

Independent T test and chi-square test were used to examine the differences of procedure and circumstances of hand-washing score, obsessive-like behaviors score and reduction in hand hygiene behaviors between male and female.

Additionally, to identify factors related to decrease in hand-washing frequency at least one time, simple and multiple logistic regression models stratified by gender were used. Factors with a p value < 0.05 on a univariate analysis were entered into a multivariate analysis. Unadjusted and adjusted odds ratios (ORs) with 95% confidence intervals (CIs) were calculated.

The SPSS version 17.0 software (SPSS Inc., Chicago, IL, USA) was used to for all data analysis.

Result

Demographic characteristics of 571 participants that were enrolled in this study are outlined in Table 1. The majority of the participants were male (55.3%), married (94.4%), employed (55.9%), resident in urban area (80.2%), and had diploma or less level of education (64.3%) (Table 1).

Table 1
Demographic characteristics of the study population.

	Number	%
Gender		
Male	316	55.3
Female	255	44.7
Educational level		
Diploma and less	367	64.3
More than diploma	204	35.7
Residency		
Rural	113	19.8
Urban	458	80.2
Occupation		
Unemployed	252	44.1
Employed	319	55.9
Marital status		
Not married /Widowed /Divorced	32	5.6
Married	539	94.4
Age		
≤ 50	248	43.4
> 50	323	56.6
Underlying disease*		
No	390	68.3
yes	181	31.7
Immune deficiency condition**		
No	561	98.2
yes	10	1.4
* cardiovascular disease, uncontrolled high blood pressure, uncontrolled diabetes, respiratory diseases and BMI > 40		
** corticosteroids use, chemotherapy, malignancies, organ transplants and HIV		

The comparison of frequency of hand-washing, type of detergents, procedure of hand-washing, circumstances of hand-washing and obsessive-like behaviors at the first peak of COVID-19 pandemic and at the first subsidence of COVID-19 pandemic are presented in Table 2. The daily frequency of hand-washing and procedure of hand-washing score at subsidence of COVID-19 pandemic was significantly lower than at the peak of COVID-19 pandemic (p = 0.0001). Additionally, 49.9% of participants reported decreasing frequency of hand-washing from peak to subsidence of COVID-19 pandemic. Use of alcohol or bleach in addition to soap at the peak of COVID-19 pandemic was significantly higher than at the subsidence period (p = 0.028). Total score of procedure of hand-washing at the peak of COVID-19 pandemic was

significantly higher than at the subsidence period (p = 0.001). Also, 48.2% of participants reported decreases in at least one step of procedure of hand-washing from peak to subsidence of COVID-19 pandemic. Although, 27.5% of participants reported decreases in at least one circumstance of hand-washing, but the total score of circumstances of hand-washing was significantly changed over time(p = 0.342). Total score obsessive-like behaviors at the peak of COVID-19 pandemic was significantly higher than at the subsidence period (p = 0.001) and 65.8% of participants reported decreases in at least one obsessive-like behavior.

Table 2
Comparison of frequency of hand-washing, type of detergents, procedure of hand-washing, circumstances of hand-washing and obsessive-like behaviors at the first peak of COVID-19 pandemic and at the first subsidence of COVID-19 pandemic in northern Iranian population

	at the first peak of COVID-19 pandemic		at the first subsidence of COVID-19 pandemic		P-value*
	number	%	number	%	
Detergent type					0.028
Only soap	130	22.8	162	28.4	
Soap + alcohol or bleach	441	77.2	409	71.6	
frequency of hand-washing					
≤ 4	20	3.5	30	5.3	0.001
5−8	74	13	125	21.9	
9−12	123	21.5	159	27.8	
,≥13	354	62	257	45	
circumstances of hand-washing (total score) mean/SD	10.8	3.4	10.9	3.9	0.342**
Before preparing food	486	85.1	463	81.1	0.051
During preparing food	481	84.2	459	80.4	0.062
After preparing food	488	85.5	459	80.4	0.015
Before eating food	569	99.6	568	99.5	0.912
Before caring for someone who is sick at home	353	61.8	359	62.9	0.820
After caring for someone who is sick at home	352	61.6	360	63	0.765
Before treating a wound or cut	350	61.3	365	63.9	0.621
After treating a wound or cut	351	61.5	365	63.9	0.701
After using the toilet	554	97	570	99.8	0.962
After cleaning up a child who has used the toilet or changing diapers	299	52.4	362	63.4	0.001
After sneezing, coughing or blowing nose	527	92.3	538	94.2	0.114
After animal waste, animal feed, or touching an animal	352	61.6	408	71.5	0.001
After pet treats or handling pet food	420	73.6	420	73.6	0.865
After touching garbage	570	99.8	568	99.5	0.321
procedure of hand-washing (total score) mean/SD	4.2	0.8	3.7	0.8	0.001**
Wet hands with running, clean water	509	89.1	518	90.7	0.487
Rubbing hands together with the soap to lather them including under the nails, between the fingers, and backs of the hands	565	98.9	567	99.3	0.745
Scrub the hands for at least 20 seconds	515	90.2	515	90.2	0.964

	at the first peak of COVID-19 pandemic		at the first subsidence of COVID-19 pandemic		P-value*
	number	%	number	%	
Rinse the hands well under running, clean water	359	62.9	371	65	0.321
Dry the hands by a clean towel	456	79.9	168	29.4	0.001
obsessive-like behaviors(total score) mean/SD	3.7	1.3	2.7	1.5	0.001**
Worry about Remaining a contamination on a properly washed hand	78	13.7	60	10.5	0.081
Afraid or anxious about hands are not clean enough even after repeated rinsing,	71	12.4	52	9.1	0.062
Wash in a special order	189	33.1	138	24.2	0.001
Start washing again for fear of mistake	76	13.3	86	15.1	0.421
Avoid places or situations where may be exposed to germs or soil	525	91.9	483	84.6	0.001
Avoid touching surfaces in public places	544	95.3	550	96.3	0.437
Red, cracked and scaly hands	132	23.1	94	16.4	0.001
Effect of pollution concerns and efforts to reduce them in daily activities	514	90	128	22.4	0.001

Data are expressed as number and percentages or mean and standard deviation.

* Statistical significance based on the McNamar test

** Statistical significance based on the paired T test

Correlations of obsessive-like behaviors with frequency, procedure and circumstances of hand-washing are shown in Table 3. There was a significant but weak positive correlation between obsessive-like behavior score and all frequencies, procedure and circumstances of hand-washing score (Table 3).

Table 3
Correlations of obsessive-like behaviors with frequency, procedure and circumstances of hand-washing

	obsessive-like behaviors score	
	Correlation coefficient(r)	p-value
frequency of daily hand-washing	0.265	0.001
procedure of hand-washing score	0.239	0.001
circumstances of hand-washing score	0.237	0.001

Comparison of the reduction in hand hygiene behaviors over time from peak to subsidence of COVID-19 pandemic according to demographic characteristics of participants are shown in Table 4. Although, males were significantly more likely to reduce obsessive-like behaviors, there was no significant difference between males and females in reduction of procedure, circumstances and frequency of daily hand-washing (Table 3). Also, under 50 years old participant were significantly more likely to reduce frequency of daily hand-washing. There was no further association between demographic factor and reduction in hand hygiene behaviors (Table 4).

Table 4
Reduction in hand hygiene behaviors over time from peak to subsidence of COVID-19 pandemic according to demographic characteristics of participants

	Reduction in obsessive-like behaviors*		Reduction in procedure of hand-washing*		Reduction in circumstances of hand-washing*		Reduction in frequency of daily hand-washing*	
	Number	%	Number	%	Number	%	Number	%
Total	**376**	**65.8%)**	**275**	**48.2%)**	**157**	**27.9%**	**285**	**49.9%**
Gender								
Male	**222**	**70.3%**	147	46.5%	93	29.%	165	52.2%
Female	**154**	**60.4%**	128	50.2%	64	25.5%	120	47.1%
P-value	**0.016**		0.400		0.258		0.239	
Educational level								
Diploma and less	246	67%	186	50.7%	112	30.8%	183	49.9%
More than diploma	130	63.7%	89	43.6%	48	23.5%	102	50%
P-value	0.462		0.116		0.06		0.998	
Residency								
Rural	70	61.9%	58	51.3%	36	31.9%	60	53.1%
Urban	306	66.8%	217	47.4%	121	26.9%	225	49.1%
P-value	0.376		0.464		0.294		0.464	
Occupation								
Unemployed	164	65.1%	124	49.2%	79	31.7%	126	50%
Employed	212	66.7%	151	47.5%	78	25%	159	50%
P-value	0.722		0.736		0.088		1	
Marital status								
Not married /Widowed /Divorced	18	56.2%	13	40.6%	6	18.8%	14	43.8%
Married	358	66.4%	262	48.6%	151	28.5%	271	50.3%
P-value	0.253		0.467		0.311		0.586	
Age								
≤ 50	162	65.3%	128	51.6%	63	25.7%	**136**	**54.2%**
> 50	214	66.3%	147	45.5%	94	29.7%	**149**	**46.1%**
P-value	0.859		0.152		0.343		**0.043**	
Underlying disease*								

	Reduction in obsessive-like behaviors*		Reduction in procedure of hand-washing*		Reduction in circumstances of hand-washing*		Reduction in frequency of daily hand-washing*	
No	256	65.6%	190	48.7%	98	25.7%	86	47.5%
yes	120	66.3%	85	47%	59	32.8%	199	51%
P-value	0.925		0.719		0.087		0.472	
Immune deficiency condition***								
No	369	65.8%	270	48.1%	150	27.2%	282	50.3%
yes	7	70%	5	50%	3	30%	3	30%
P-value	0.998		0.999		0.954		0.339	

* at least one point reduction

**cardiovascular disease, uncontrolled high blood pressure, uncontrolled diabetes, respiratory diseases and BMI > 40

** corticosteroids use, chemotherapy, malignancies, organ transplants and HIV

- Statistical significance based on the chi-square test

Change in frequency of daily hand-washing over time from peak to subsidence of COVID-19 pandemic stratify by gender are presented in Fig. 1. Both groups reported a significant decrease in frequency of hand washing over time. At both times frequency of daily hand-washing was higher in female, with statistical significance by Chi-square analysis ($p < 0.05$).

Comparison of procedure of hand-washing score, circumstances of hand-washing score and obsessive-like behaviors score over time from peak to subsidence of COVID-19 pandemic stratify by gender are shown in Table 5. The score of circumstances of hand-washing at both times and the score of obsessive-like behaviors at the first subsidence of COVID-19 pandemic were significantly higher in females (Table 5).

Table 5

Procedure of hand-washing score, circumstances of hand-washing score, obsessive-like behaviors score and reduction in hand hygiene behaviors over time from peak to subsidence of COVID-19 pandemic stratify by gender in northern Iranian population

| | | gender | | | total |
		male	female	p-value*	
at the first peak of COVID-19 pandemic	procedure of hand-washing score (mean ± SD)	4.20 ± 0.8	4.21 ± 0.8	0.432	4.21 ± 0.8
	obsessive-like behaviors score (mean ± SD)	3.67 ± 1.3	3.79 ± 1.4	0.322	3.72 ± 1.3
	circumstances of hand-washing score (mean ± SD)	10.32 ± 3.6	11.38 ± 3.1	0.001	10.80 ± 3.4
at the first subsidence of COVID-19 pandemic	procedure of hand-washing score (mean ± SD)	3.77 ± 0.8	3.71 ± 0.8	0.430	3.74 ± 0.8
	obsessive-like behaviors score (mean ± SD)	2.61 ± 1.5	2.99 ± 1.5	0.004	2.78 ± 1.5
	circumstances of hand-washing score (mean ± SD)	10.61 ± 4.3	11.40 ± 3.2	0.015	10.96 ± 3.9

Data are expressed as number (percentages) or mean ± standard deviation.

* Statistical significance based on the independent T test and chi-square test

Table 6 reveals the results univariate and multivariate logistic regression to explore factors associated to reduction in the frequency of daily hand-washing over time from peak to subsidence of COVID-19 pandemic stratify by gender. In females, only negative family history of coronavirus disease was identified as an independent factor associated with reduction in the frequency of daily hand-washing. Females with negative family history of coronavirus disease had greater odds (Adjusted OR = 2.19, P = 0.03) of reduction in the frequency of daily hand-washing. In male, younger age and reduction in procedure of hand-washing were identified as independent factors associated with reduction in the frequency of daily hand-washing. Younger than 50 years old males had greater odds (Adjusted OR = 1.71, P = 0.02) of reduction in the frequency of daily hand-washing. Also, males who reduced the procedure of hand-washing, had greater odds (Adjusted OR = 2.16, P = 0.001) of reduction in the frequency of daily hand-washing.

There was no independent association of demographic factors, underlying disease and other hand hygiene behaviors with reduction in the frequency of daily hand-washing over time from peak to subsidence of COVID-19 pandemic in both genders (Table 6).

Table 6
Simple and Multiple logistic regression analysis for factors related to reduction in frequency of daily hand-washing over time from peak to subsidence of COVID-19 pandemic stratify by gender in northern Iranian population

	Reduction in frequency of daily hand-washing**											
Variables	male						female					
	Unadjusted			Adjusted*			Unadjusted			Adjusted*		
	OR	(95% CI)	p-value	OR	(95% CI)	p-value	OR	(95% CI)	p-value	OR	(95% CI)	p-value
Age (year)												
≤ 50	**1.84**	**1.16–2.92**	**0.009**	**1.71**	**1.07–2.73**	**0.024**	0.87	0.48–1.60	0.672			
> 50(ref)	1	-	-	-	-	-						
Educational level												
Diploma and less	1.26	0.62–1.92	0.710				1.09	0.62–1.92	0.745			
More than diploma(ref)	1	-	-	-	-	-						
Residency												
Rural	0.87	0.49–1.56	0.655				1.51	0.81–2.85	0.191			
Urban (ref)	1	-	-	-	-	-	1					
Occupation												
Unemployed	0.99	0.51–1.92	0.981				1.62	0.81–3.24	0.163			
Employed (ref)	1	-	-	-	-	-	1					
Family history of coronavirus disease												
no	0.95	0.51–1.79	0.88				**2.33**	**1.14–4.79**	**0.020**	**2.19**	**1.06–4.53**	**0.034**
yes(ref)	1	-	-	-	-	-	1					
Underlying disease												
No	1.55	0.92–2.61	0.092				0.98	0.58–1.65	0.981			
yes(ref)	1	-	-	-	-	-	1	-	-			
Reduction in obsessive-like behaviors												
yes	1.05	0.61–1.64	0.981				1.6	0.95–2.69	0.077			
no(ref)							1					

	Reduction in frequency of daily hand-washing**											
Reduction in procedure of hand-washing												
yes	2.28	1.44–3.6	0.001	2.16	1.36–3.43	0.001	1.51	0.91–2.49	0.113			
no(ref)	1						1					
Reduction in circumstances of hand-washing												
yes	0.98	0.60–1.61	0.944				1.86	1.05–3.30	0.034	1.74	0.97–3.11	0.062
no(ref)	1						1					

CI = confidence interval, OR = Odds Ratio

*Adjusted for all variables that were significant in univariate analyses.

** at least one time reduction

Discussion

Our study demonstrates that, over time from the first peak to first subsidence of COVID-19 pandemic in Iran, frequency and procedure of hand-washing were regressed and obsessive-like behaviors were reduced. The effect of appropriate hand hygiene behaviors in preventing COVID-19 is reflected in a worldwide interest in this issue, and has been shown as an indicator for policies to population health literacy and reduce transmission [21]. It is claimed that a proper hand washing behavior could break the transmission cycle of respiratory infection disease and decrease the risk by 6 to 44%[22]. Therefore, the second peak of COVID-19 pandemic in Iran could be due to reduced hand hygiene in first subsidence of COVID-19 pandemic. The second peak of COVID-19 in Iran was occurred 1 months after the first subsidence [5]. Although hand-washing is recommended as a low-cost and affordable protective behavior for prevention of some viral respiratory infections epidemic [23] and studies reported increasing frequency of hand washing, during the peak pandemic periods of COVID-19 and H1N1 influenza[24, 25], it is very hard to maintain high hand-washing compliance[26].

We found a positive correlation between obsessive-like behaviors and hand hygiene behaviors. These findings are compatible with some previous studies that revealed a positive dose-response gradient between levels of anxiety and personal protective behaviors [27–30]. Thus, a reduction in obsessive-like behaviors may indicate a decrease in perceived susceptibility to illness in the community, which may lead to poor hand hygiene and an epidemic outbreak. Our findings have shown that males were more likely to reduce obsessive-like behaviors, therefore, special attention should be paid to maintaining the men's perceived susceptibility in epidemics.

Our findings revealed that during both peak and subsidence of COVID-19 pandemic, males reported less frequently hand-washing than females. Similar findings were also reported in previous studies[31, 32]. However, the reduction in frequency of hand-washing was not different between males and female.

The results of regression analyses in current study demonstrate, in male participants, the younger age and reduction in procedure of hand-washing were independent predictors for reduction in frequency of hand washing. Younger than 50 years old males and males with reduced procedure of hand-washing were more likely to reduce the frequency of daily hand-

washing. Some previous studies have also determined that, older adults, are more likely to follow recommended behaviors, including hand washing to prevent the infectious diseases transmission [31].

In female participants the negative family history of coronavirus disease was the only independent predictor for reduction in frequency of hand washing. Close experience of risk in family member can maintain perceived susceptibility to illness high[33].

According to obtained findings, the necessity of constant hand hygiene education and advice was recommended to policy makers, especially in terms of the COVID-19 worldwide pandemic. Also, in order to maintain perceived susceptibility to illness in population mass media and information channels should be engaged.

The strengths of this study were population-based data and the large sample size. However, social-desirability bias due to over-reporting to 'look good' and recall bias of past experiences are limitations of all self-reporting surveys. Also, a possibility of non-contact bias due to hard-to-reach people who are not at home most of the time is the limitation of household telephone surveys.

Conclusions

The results of this study indicated that northern Iranian population were found to decrease their frequency and quality of hand washing and obsessive-like behaviors over time from the first peak to first subsidence of COVID-19 pandemic. Here, the factors that independently predicted reduction in frequency of hand washing in male population were younger age and reduction in procedure of hand-washing and in female population was a negative family history of coronavirus disease. Thus, special attention should be paid to maintaining the general population's perceived susceptibility to illness, especially in younger men during the pandemic.

Abbreviations

AOR
Adjusted Odds Ratio; **CI**:Confidence interval; **COVID-19**:Corona virus disease 2019, **WHO**:World Health Organization; **PGCS**:PERSIAN Guilan Cohort Study.

Declarations

Acknowledgments

Authors' contributions

Study conception and design: F.J, F.MG and M.N

Acquisition of data: S.Y and M.A

Statistical analysis: S.H and S.M

Interpretation of results: F.J, F.MG and M.N

Drafting of manuscript: All authors

All authors approved the final version of the article, including the authorship list.

Availability of data and materials

The datasets generated and/or analyzed during the current study are not publicly available due to joint research and development with the company, but are available from the corresponding author.

Ethics approval and consent to participate

This article is a part of the research plan approved by the committee of Guilan University of Medical Sciences (Ethics Code: IR.GUMS.REC.1399.004). Before answering the questionnaires, each participant was provided with necessary information by the purpose of the study and their contribution to the study.

Consent for publication

Not applicable.

Competing interests

The authors of this article declare they have no conflict of interests.

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Figures
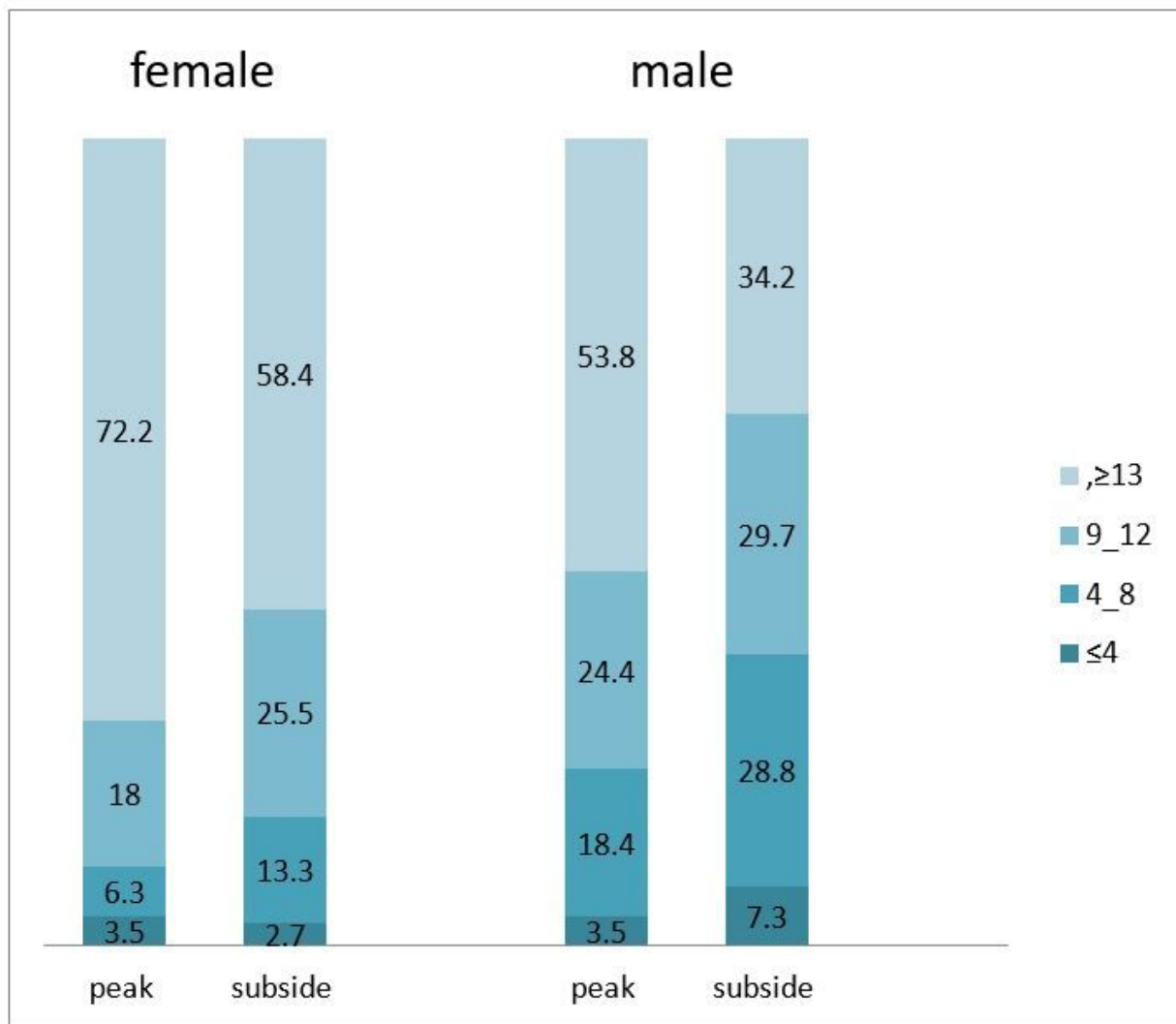
Figure 1

Change in frequency of daily hand-washing over time from peak to subsidence of COVID-19 pandemic stratify by gender in northern Iranian population (p=0.001 by Wilcoxon test in both gender)