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Analysis of Factors Associated with Melasma Among Female Gas Station Workers in Nanjing

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Abstract: *Objective* to investigate the prevalence and the related risk factors of Melasma in Nanjing female gas station workers. *Methods* The 677 women workers of general conditions, living habits and behaviors, menstruation and fertility situation, career, genetic conditions, Melasma prevalence data were collected in the form of questionnaires. After investigation, multivariate analysis was applied to the risk factors of Melasma. Using SPSS statistical software 22.0, inspection level is $p = 0.05$. $P < 0.05$ indicates that the difference was statistically significant. *Results* A total of 677 female workers in the Nanjing gas station participated in the survey: 479 were confirmed Melasma and the prevalence is 70.6%. Analysis of related factors of Melasma, older patients with Melasma increased risk of OR=1.624 (1.383-1.906); The risk of Melasma increased in mothers and/or sisters. The OR values of mother, sister, mother, and sister were 2.151 (1.082-4.277), 4.17 (1.403-12.398), 4.079 (1.386-12.007), respectively. The length of the menstrual cycle was negatively correlated with Melasma OR = 0.623 (0.414 – 0.938); the risk of Melasma in one abortion was lower than that in two abortions (OR = 0.564, 0.335-0.95). The risk of Melasma in the cesarean section was lower than that in spontaneous delivery (OR = 0.607, 0.404-0.913). *Conclusion* The prevalence of Melasma among female workers in Nanjing gas station is related to age, heredity, length of the menstrual cycle, the number of abortions, and mode of birth.

Keywords: Female Gas Station Workers, Melasma, Epidemiological Survey, Influence Factor

1. Introduction

Melasma is an acquired, symmetrical pigmentary disease that occurs on the face. The clinical manifestations were round, strip or butterfly-shaped yellow spots or dark coffee spots with varying facial depth. The prevalence and related factors of Melasma among female workers participating in the occupational health examination in our hospital in 2016 are reported as follows:

2. Objects and Methods

2.1. Subjects

Participants 677 female workers from gas stations who participated in our hospital's occupational health examination in 2016.

2.2. Research Methods

2.2.1. Data Collection

The questionnaire was completed by face-to-face interviews with all subjects under the guidance of professional dermatologists. A questionnaire survey was conducted on demographic data, living habits, menstruation, fertility history, occupational status, and genetics. The diagnostic criteria for Melasma were based on the diagnostic and therapeutic criteria for Melasma and vitiligo issued by the Pigment Diseases Group of the Dermatology and Venereal Diseases Committee of the Chinese Society of Integrated Traditional and Western Medicine (2010 edition).

2.2.2. Data Entry and Statistical Analysis

EpiData3.1 software was used for data entry and SPSS 22.0 software was used for data processing. Single-factor

analysis using X2 test, multivariate analysis using binary Logistic regression analysis. The test level was $p = 0.05$, and $p < 0.05$ indicated that the difference was statistically significant.

3. Results

3.1. General Information

This study investigated 700 female workers in Nanjing gas station and 700 questionnaires were collected. 19 questionnaires were missing more than 20%, 4 had obvious logical errors, and were regarded as invalid. The final 677 questionnaires were included in this study, and the qualified rate was 96.7%. In this study, the oldest was 49 years old and the youngest was 22 years old, with an average of 39.09 ± 5.77 years old. The middle-aged population was the main population. There were 515 people (76.07%) aged 31 – 45 years old, 130 people (19.20%) aged 31 – 35 years old, 198 people (29.25%) aged 36 – 40 years old, and 187 people (27.62%) aged 41 – 45 years old. Junior high school and high school accounted for 42.98% and 48.45% respectively. 95.71% of female workers are married. There were 479 confirmed cases of Melasma, with a prevalence rate of 70.6%.

3.2. Single-factor Analysis

3.2.1. Demographic Characteristics Analysis

Multiple factors were analyzed by single-factor analysis, the results showed that: age, educational level, menstruation (menstrual period and menstrual cycle length), contraceptive methods, gynecological diseases, abortion times, fertility and reproductive methods, workplace, night shift, genetics, and Melasma were correlated. (See Table 1)

Table 1. *Analysis of related factors of Melasma.*

		Melasma	Non-Melasma	prevalence rate	X2	p
age	22~25 years old	4	1	20%		
	26~30 years old	35	20	36.40%		
	31~35 years old	57	73	56.20%		
	36~40 years old	48	150	76%		
	41~45 years old	34	153	81.80%	69.1	0
	46~49 years old	20	82	80.40%		
Educational level	Primary school and below	1	4	80%		
	Junior high school	67	224	77%		
	high school	106	222	67.70%	13.7	0.03
	University and above	24	29	54.70%		
Menstruation period	Less 3 days	12	54	81.80%		
	4-6 days	112	253	69.30%		
	7 days and more	45	83	64.8	6.051	0.049
Menstrual cycle length	Less than 25 days	22	103	82.40%		
	26-28 days	135	270	66.70%		
	31 days and more	12	17	58.60%	13.012	0.001
No contraceptive method	No	44	83	65.40%		
	intrauterine ring	78	274	77.80%		
	tubal ligation	1	3	75%		
	condom	60	106	63.90%		
	oral contraceptive	4	3	42.90%		
	miscellaneous	11	10	47.60%	22.25	0
gynecological diseases	Yes	47	154	76.60%		
	No	151	325	68.30%	4.75	0.029
abortion	No	92	209	69.40%	4.26	0.119
	1 time	77	167	68.40%		
	2 times and more	29	103	78.00%	3.89	0.049
bearing children	0	18	19	51.40%		
	1	168	422	71.50%		
	2	12	38	76.00%	7.566	0.023
the way of procreation	eutocia	115	362	75.90%		
	caesarean section	65	98	60.10%	14.943	0
night-shift	Yes	127	348	73.30%		
	No	71	131	64.90%	4.846	0.028
inheritance	No	178	363	67.10%		
	mothers	12	50	80.60%		
	sisters	4	29	87.90%		
	Mothers and sisters	4	37	90.20%	18.629	0

3.2.2. Multiple Factors Analysis of Melasma

The dependent variable is set to whether the Melasma (0,1) 0 ~ indicates no Melasma, 1 ~ indicates Melasma. The above statistically significant factors as independent variables (Table 2), Logistic regression analysis.

Table 2. *Variable assignment of Melasma related factors analysis.*

variable	assignment				
Dependent variable	**non-Melasma =0**	**Melasma =1**			
Age	**22~25 years old =1**	**26~30 years old =2**	**31~35 years old =3**	**36~40 years old =4**	**41~45 years old =5**
Educational level					
	Primary school and below	X1=0	X2=0	X3=0	
	Junior high school	X1=1	X2=0	X3=0	
	high school	X1=0	X2=1	X3=0	
	University and above	X1=0	X2=0	X3=1	
Menstruation period	≤3 days=1	4~6 days=2	≥7 days=3		
menstrual cycle length	≤25 days=1	26-30 days=2	≥31 days=3		
No contraceptive method	no	X1=0	X2=0	X3=0	X4=0
	intrauterine ring	X1=1	X2=0	X3=0	X4=0
	tubal ligation	X1=0	X2=1	X3=0	X4=0
	condom	X1=0	X2=0	X3=1	X4=0
	oral contraceptive	X1=0	X2=0	X3=0	X4=1
	miscellaneous	X1=0	X2=0	X3=0	X4=0
gynecological diseases	Yes=1	no=2			
abortion					
	no	X1=1	X2=0		
	1 time	X1=0	X2=1		
	2 times or more	X1=0	X2=0		
generation					
	unbearing	X1=0	X2=0		
	1 birth	X1=1	X2=0		
	2 births	X1=0	X2=1		
the way of procreation					
	eutocia	X1=0	X2=0		
	caesarean section	X1=1	X2=0		
	unbearing	X1=0	X2=1		
job site	Non-fuelling area =1	Fuelling area=2			
night-shift	yes=1	no=2			
inheritance					
	no	X1=0	X2=0	X3=0	
	mothers	X1=1	X2=0	X3=0	
	sisters	X1=0	X2=1	X3=0	
	Mothers and sisters	X1=0	X2=0	X3=1	

The following factors entered the regression equation (Table 3). The older the age, the higher the risk of Melasma OR = 1.624 (1.383-1.906). The risk of Melasma in mothers and/or sisters was increased. The OR values of mother's disease, sister's disease, and mother's sister's disease were 2.151 (1.082-4.277), 4.17 (1.403-12.398), and 4.079 (1.386-12.007), respectively. Menstrual cycle was negatively correlated with Melasma OR = 0.623 (0.414-0.938); the risk of Melasma was reduced by one abortion compared with two abortions OR = 0.564 (0.335-0.952; the risk of Melasma in the cesarean section was lower than that in natural delivery OR = 0.607 (0.404-0.913).

Table 3. *Logistics regression analysis of influencing factors of Melasma.*

factor	**standardized regression coefficient**	**standard error**	**chi-square value**	**p**	**OR**	**95% confidence interval**	
						lower limit	**upper limit**
age	0.485	0.082	35.078	0	1.624	1.383	1.906
inheritance			16.504	0.001			
inheritance (1)	0.766	0.351	4.776	0.029	2.151	1.082	4.277
inheritance (2)	1.428	0.556	6.599	0.01	4.170	1.403	12.398
inheritance (3)	1.406	0.551	6.515	0.011	4.079	1.386	12.007
menstrual cycle length	-0.472	0.209	5.127	0.024	0.623	0.414	0.938
abortion			4.594	0.101			
abortion (1)	-0.389	0.262	2.213	0.137	0.678	0.406	1.132
abortion (2)	-0.572	0.267	4.593	0.032	0.564	0.335	0.952
the way of procreation			7.962	0.019			
the way of procreation (1)	-0.499	0.208	5.76	0.016	0.607	0.404	0.913
the way of procreation (2)	-0.736	0.385	3.647	0.056	0.479	0.225	1.02
constant	0.184	0.589	0.098	0.755	1.202		

4. Discussion

Melasma is common in young and middle-aged women, and the prevalence of Melasma reported in China varies. Zhou Nana and others investigated 3696 people in Lan fang, Hebei Province, including 1705 women, the prevalence of women was 7% [1]; Yang et al. reported that the prevalence rate of female workers aged 40 – 50 in a printing factory in Chengdu was as high as 65.9% [2]. The prevalence rate of Melasma among female workers in this survey was 70.6%, which was higher than the above reports. It may be related to the older age of female workers in this survey. Whether it is related to the work in gas stations such as outdoor work, long-term low concentration gasoline exposure, and night shift needs further study.

4.1. Age and Melasma

Melasma is considered to be a manifestation of skin aging, mainly in the age of 30 – 40. This study showed that the prevalence of Melasma increased with age before 45 years old. The prevalence rate is slightly lower in the 46-49 age group than in the 41-45 age group, with no statistical difference, which may be related to a decline in estrogen levels in the postmenopausal body.

4.2. Genetics and Melasma

Genetic factors are important factors in the occurrence and development of Melasma. The study found that all races have the risk of Melasma, but Asian, Indian, Latin American, and African Americans have a higher prevalence [3-4]. A recent genetic analysis of a cohort study found a significant correlation between the occurrence of Melasma and race, family history, and genetic factors, with more than 64% of patients having a positive family history [5]. The study of 56 patients with Melasma, and 39 healthy controls in the White Dynasty showed that the incidence of Melasma was related to the polymorphism of ERα gene Xba I genotype, ERβ gene Alu I, and Rsa I genotype. Mutation genes increased the risk of Melasma, among which Xx, Aa, and RR genotypes were susceptible [6]. A global multicenter study conducted by Ortonne et al. showed that 48% of the 324 patients had a family history of Melasma, and 97% of them were first-degree relatives [7]. This study showed that the prevalence of Melasma in female workers with a family history was significantly higher than that in those without a family history. Multivariate analysis showed that the risk of Melasma was increased in sisters and/or mothers, which was consistent with Ortonne's study.

4.3. Menstrual and Fertility History and Melasma

Menstruation and reproductive history and Melasma endocrine is the primary cause of Melasma, estrogen, and progesterone are the main factors affecting the disease [1].

Sunni L et al. found that the length of the menstrual cycle was related to female hormone levels. The short menstrual cycle length (35 days) of women with normal menstrual cycle delayed the increase of estradiol, the peak of FSH and LH, and the increase of LH and the decrease of progesterone throughout the menstrual cycle [8]. Landgren et al. found that the menstrual cycle length was inversely proportional to the average concentration, peak value, and baseline concentration of estradiol by investigating the changes of 68 female hormones in plasma samples [9]. By detecting the concentration of urinary steroid metabolites, Windham et al. found that compared with the normal follicular phase, the urinary estradiol metabolites of women in the short follicular phase increased by 10–13% at baseline and average concentration. Harlow et al [10] found that the highest concentration of estradiol was in the short follicular phase group (7-11 days) [11]. The same results were also confirmed in quasi-menopausal women's health studies [12]. Therefore, there is a certain correlation between female menstrual cycle length and female hormone level. In this study, it was found that the shorter the menstrual cycle was, the higher the prevalence of Melasma was. It may be that the estrogen level in short-term women was relatively higher, while long-term exposure to high estrogen levels increased the risk of Melasma [13].

This study found that the risk of Melasma increased in patients with two or more abortions compared with one abortion, and there was no difference in the prevalence of Melasma between non-abortion and one abortion. The reason may be that multiple abortions can cause damage to the balance of sex hormone levels in the body. Studies have shown that estrogen will change after pregnancy, and endocrine and ovarian dysfunction will be caused after drug intervention.

This study found a greater risk of Melasma in natural delivery than in cesarean section. It may be related to the abnormal hormone level caused by the stimulation of the birth canal in the process of spontaneous delivery: (1) The estrogen level after natural delivery is higher than that after cesarean section. Yang Jia detected the levels of blood neutral hormones in 372 parturients six weeks after delivery. The results showed that the levels of estradiol, progesterone, testosterone, and prolactin in the vaginal delivery group were higher than those in the cesarean section group, and the difference was statistically significant ($p < 0.01$) [14]. The blood sex hormone levels of 100 normal parturients and 100 cesarean section parturients were detected by Bu Zhiqiang. It was also found that the levels of cortisol and estradiol in the natural delivery group were significantly higher than those in the cesarean section group. The direction of 330 cases of the maternal study showed that normal delivery group progesterone and estradiol were higher than cesarean section group [15]. (2) Thyroid hormone after natural delivery is higher than that after cesarean section [16-17]. Thyroid hormone is a stimulant of the oxidation process, which can promote the oxidation of tyrosine and melanin, reduce the sulfhydryl (SH) in the epidermis, and increase the formation of melanin. (3) Adrenocorticotrophic hormone (ACTH) after natural childbirth was higher than that after cesarean section [17]. The formation of melanin is the result of a series of

tyrosine oxidation reactions, which occur in melanocytes and are regulated by multiple factors. Tyrosinase is the key enzyme in this reaction, and its activity is positively correlated with the formation of Melasma. ACTH can increase tyrosinase activity and promote melanin formation by increasing serum copper ion concentration.

5. Conclusion

The prevalence of Melasma among female workers in Nanjing gas station is related to age, heredity, length of the menstrual cycle, the number of abortions, and mode of birth.

Fund

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Data Availability Statement

All datasets generated for this study are included in the manuscript and/or the supplementary files.

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