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Association between gastrointestinal cancers and fingerprint patterns in the Iranian population

S. Abbasi[1] and M. Rasouli[1,2]

[1]Department of Laboratory Medicine, School of Allied Medical Sciences, Tehran University of Medical Sciences, Tehran, Iran
[2]Laboratory of Vaccines and Immunotherapeutics, Institute of Bioscience, University Putra Malaysia, Serdang, Selangor, Malaysia

Corresponding author: S. Abbasi
E-mail: sakineh4612004@yahoo.com / abbasisk@tums.ac.ir

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ABSTRACT. Gastrointestinal cancers are malignant diseases with high mortality rate. Early diagnosis of patients could improve the results of treatment. Many studies used dermatoglyphics as a biomarker to predict the incidence of genetic diseases and cancers. This study assessed the association between gastrointestinal cancers and particular fingerprint patterns, which could be useful in early diagnosis of these malignancies. The study was conducted on 153 histopathologically confirmed gastrointestinal cancer patients and 299 healthy individuals. The fingerprints were taken by a specific method of rolling the subject's fingers or thumbs in ink. The data were analyzed for the significance using the chi-square test and the *t*-test. Odds ratio with 95% confidence intervals were calculated. Dermatoglyphic analysis showed that whorl and loop patterns significantly changed in the case group as compared to control. However, the odds ratio suggested that whorl pattern in 6 or more fingers might be a risk factor for developing

gastrointestinal cancers. Our results showed that there is an association between fingerprint patterns and gastrointestinal cancers, and so, the dermatoglyphic analysis may aid in the early diagnosis of these cancers.

Key words: Dermatoglyphics; Gastrointestinal cancer; Loop pattern; Whorl pattern

INTRODUCTION

Cancer is a main public health problem and the second leading cause of death in the United States and many centuries in the word. Gastrointestinal cancers are the third most common malignancy in men and women in 2015 (Siegel et al., 2015). The incidence rates of gastrointestinal cancers in men are almost two times higher than women (Stock et al., 2010). About 300,000 patients were diagnosed with digestive system cancers only in the United States in 2015. The developing countries showed higher incidence and mortality rates than the United States (Stock et al., 2010). It has been shown that almost one-half of all cancer deaths were due to lung, bronchus, breast/prostate, and colorectum cancer in 2015 (Bresalier et al., 2015; Siegel et al., 2015). The etiology of gastrointestinal cancers remains unclear, but it seems that both genetic and environmental factors play critical roles in developing these malignancies (Siegel et al., 2012). The incidence of these cancers between relatives is higher than the family without any background (Huntsman et al., 2001). The early stage of gastrointestinal cancers with high survival rate does not have specific symptoms (Huntsman et al., 2001). It takes about 8 to 10 years for early-stage cancer to become advanced cancer. The advanced stage of gastrointestinal cancers is malignant with high mortality rate and is rather too late for any effective treatment (Zivanović-Posilović et al., 2003). This emphasizes the necessity of identifying the population risks using genetic markers especially in developing countries such as Iran (Abbasi et al., 2006).

Dermatoglyphics has proven to be a useful and cheap genetic marker in identifying genetic syndromes and disease (Jatti et al., 2014). Dermatoglyphics is a term applied to the study of fingers patterns, palms patterns and soles patterns along with their quantitative measures (Cummins and Midlo, 1961). The word "dermatoglyphics" comes from two ancient Greek words: "derma" means skin and "glyph" means carving (Bhat et al., 2014; Karthick et al., 2015). Fingerprint patterns are obtained on the upper layer of the epidermis that begins developing during the third to the fourth month of fetal life and once formed remain constant throughout postnatal life (Mulvihill and Smith, 1969; Lakshmi Prabha and Thenmozhi, 2014). Fingerprint patterns are developed under genetic control and inherited through a polygenic system, although the exact mechanism of its inheritance is still unknown (Mulvihill and Smith, 1969). These patterns are unique to every individual, and there are not two persons in the world with the same dermatoglyphics, even in monozygotic twins (Lakshmi Prabha and Thenmozhi, 2014). Therefore, fingerprint patterns may be useful for studying the genetic patterns of any individual in populations.

Fingerprint patterns have been shown to correlate with some genetic diseases like the Down's syndrome and the Klinefelter syndrome (Katznelson et al., 1999). The association of fingerprint patterns and several cancers, such as breast cancer (Abbasi et al., 2006; Chintamani et al., 2007; Sridevi et al., 2010; Sariri et al., 2012; Raizada et al., 2013), cervix cancer (Kashinathappa and Khanzode, 2013), and oral cavity cancer (Jatti et al., 2014), was studied by several research groups. These findings have suggested that dermatoglyphics may aid in the prediction and the diagnosis of such diseases (Katznelson et al., 1999; Chintamani et al.,

2007; Wijerathne et al., 2015). It has also been shown that gastrointestinal cancers might be associated with fingerprint patterns (Zivanovic-Posilovic et al., 2003). Iran as a developing country with high rates of cancer-related mortality, needs a strategy for early diagnosis of a variety of cancers. So, the aim of this study was to test the hypothesis of the association between fingerprint patterns and gastrointestinal cancers in Iranian people. We conducted this study to compare the fingerprint patterns of gastrointestinal cancer patients with a healthy control group to detect any difference in the frequency of these patterns. The fingerprint analysis could be used as a general marker of screening for genetic diseases of big populations to find any individuals who might be at an elevated risk of gastrointestinal cancer and may help in the early diagnosis of this disease.

PATIENTS AND METHODS

For this study, our patient group (N = 153) had the gastrointestinal cancers (gastric, intestine, or pancreatic cancers). The patients were selected at the Cancer Institute of the Imam Khomeini Hospital, Tehran, Iran. The clinical records and the results of the histopathological tests of the patients were properly scrutinized by a professional person to ensure that our patient group has gastrointestinal cancers. The control group was a group of 299 subjects who were phenotypically healthy individuals and were never diagnosed with any gastrointestinal cancers. After taking the informed consent and permission from both patient and control groups, they were asked to fill a demographic information form about their age, ethnicity, marital status, parents' marriage type, history of cancer in their family, and smoking. The study was approved by the Research Ethics Committee of the Tehran University of Medical Science (IR.TUMS.REC.1395.2499). Informed consent for testing and publication was obtained from all participants before entering into the present study (or their parents/legal guardians).

The fingerprints were taken on a white paper after rolling the subject's fingers or thumbs in purple ink (ink method). Before taking prints, hands were thoroughly washed with water and soap and dried to remove any dirt from the hands. Patterns in both hands in all 10 fingers were analyzed. Fingerprints were analyzed in Window's Picture and Fax Viewer and were categorized in three patterns, whorl (W), arch (A), and loop (L) (Figure 1) (Penrose, 1963; Bhat et al., 2014). After counting the number of each pattern in each person, the distribution of each pattern (whorl, arch. and loop) was divided into two groups: 1) the pattern that was repeated in 6 or more than 6 fingers of each person, 2) the pattern that was repeated in less than 6 fingers of each person.

Figure 1. Three main classifications of fingerprint patterns.

Statistical analysis

The data were statistically analyzed using SPSS-17 version. The quantitative data are reported as means. The relationship between the risk of gastrointestinal cancer and fingerprint patterns was determined using the chi- square test (χ^2). Odds ratio (OR) with 95% confidence intervals (95%CI) were also calculated. All the results less than 0.05 were considered significant.

RESULTS

In this study, fingerprint patterns of 153 patients diagnosed with gastrointestinal cancers were compared with 299 healthy individuals as a control group. The results analyzing the demographic information are presented in Table 1. From 452 individuals (case and control) who were studied in our experiment, 66.8% are older than 40 years and had gastrointestinal cancers, and 33.2% were healthy. In the group of people who were younger than 40 years, only 6.5% had gastrointestinal cancers (P < 0/001). Besides, the percentage of gastrointestinal cancers in men (39.7%) was higher than the women (26.6) (P = 0.003). The demographic information also showed that 89.7% of people who had a family history of gastrointestinal cancers were diagnosed with these cancers at the time of our experiment (P < 0/001). Our analysis showed that the type of parents' marriage and ethnicity were also significantly associated with the development of gastrointestinal cancers, while interestingly, smoking did not show a significant effect on the percentage of gastrointestinal cancers in the case group as compared to the control group (Table 1).

Table 1. Distribution of demographic features and risk factors for gastrointestinal cancer in control and patient groups.

Groups		Case (%)	Control (%)	Results
Age (years)	≤40	16 (6/5)	231 (93/5)	χ^2 = 182/2
	>40	137 (66/8)	68 (33/2)	P < 0/001
Marital status	Single	8 (5/1)	150 (94/9)	χ^2 = 94/878
	Married	133 (47/8)	145 (52/2)	P < 0/001
	Others	12 (75)	4 (25)	
Marital age (years)	≤25	78 (47/9)	85 (52/1)	χ^2 = 2/264
	>25	66 (38/8)	104 (6/2)	P < 0/096
Gender	Female	55 (26/6)	150 (73/4)	χ^2 = 8/65
	Male	98 (39/7)	149 (60/3)	P = 0/003
Family history of cancer	Yes	61 (89/7)	7 (10/3)	χ^2 = 112/27
	No	92 (23/8)	292 (76/2)	P < 0/001
Parents' marriage type	First degree	29 (33/7)	58 (66/3)	χ^2 = 13/038
	Second degree	2 (5/9)	32 (94/1)	P = 0/005
	Distant relative	24 (35/5)	41 (64/5)	
	Non-relative	98 (36/8)	168 (63/2)	
Smoking	Yes	8 (23/5)	30 (76/5)	χ^2 = 1/948
	No	145 (35/4)	269 (64/6)	P = 0/163
Ethnicity	Fars	46 (33/3)	92 (66/7)	χ^2 = 14/82
	Turkish	64 (27/9)	165 (72/1)	P = 0/002
	Kurdish and Lor	29 (47/5)	32 (52/5)	
	Gilaki and Mazani	14 (60)	10 (40)	

Next, the frequency of three main types of fingerprinting patterns (loop, arch, and whorl) was analyzed in the case group regarding gender, type of parents' marriage, ethnicity, and family history of cancer. The results are summarized in Table 2.

Table 2. Frequency of fingerprint patterns in the case group in terms of 4 demographic categories: gender, parents' marriage type, ethnicity, and family history of cancer.

Groups		Loop (%)		Arch (%)		Whorl (%)		Results		
		< 6	≥ 6	< 6	≥ 6	< 6	≥ 6	Loop	Arch	Whorl
Gender	Female	36 (65/5)	19 (34/5)	55(100)	-	31 (56/4)	24 (43/6)	χ^2 = 2/170 P = 0/141	-	χ^2 = 0/141 P = 0/048
	Male	75 (76/5)	23 (23/5)	98 (100)	-	39 (39/8)	59 (60/2)			
	Total	111 (72/5)	42 (27/5)	153 (100)	-	70 (45/8)	83 (54/2)			
Parents' marriage type	Familial	42 (75/5)	13 (24/5)	55 (100)	-	21 (39/6)	34 (60/4)	χ^2 = 0/439 P = 0/507	-	χ^2 = 1/490 P = 0/222
	Non related	69 (70/4)	29 (29/6)	98 (100)	-	49 (50)	49 (50)			
	Total	111 (72/5)	42 (27/5)	153 (100)	-	70 (45/8)	83 (54/2)			
Ethnicity	Fars	37 (80/4)	9 (19/6)	46 (100)	-	17 (37)	29 (63)	χ^2 = 3/308 P = 0/346	-	χ^2 = 3/968 P = 0/265
	Turkish	42 (65/6)	22 (34/4)	64 (100)	-	34 (53/1)	30 (46/9)			
	Kurdish and Lor	22 (75/9)	7 (24/1)	29 (100)	-	15 (51/7)	14 (48/3)			
	Gilaki and Mazani	10 (66/7)	4 (33/3)	14 (100)	-	4 (33/3)	10 (66/7)			
	Total	111 (72/5)	42 (27/5)	153 (100)	-	70 (45/8)	83 (54/2)			
Family history of cancer	Yes	45 (73/8)	16 (26/2)	61 (100)	-	22 (36/1)	39 (63/9)	χ^2 = 1/215 P = 0/783	-	χ^2 = 0/189 P = 0/05
	No	66 (71/7)	26 (28/3)	92 (100)	-	48 (52/2)	44 (47/8)			
	Total	111 (72/5)	42 (27/5)	153 (100)	-	70 (45/8)	83 (54/2)			

Whorl and loop patterns were the most common patterns in our patients. When the whorl pattern was compared, 54/2% of patients had whorl pattern in more than 6 fingers, and 45/8% of them had this pattern in less than 6 fingers of both hands. In loop pattern, only 27/5% of patients had loop pattern in more than 6 fingers, and 72/5% of them had this pattern in less than 6 fingers of both hands. All the 153 patients showed an arch pattern in less than 6 fingers of both hands. In the category of gender, 60/2% of men significantly showed whorl pattern in more than 6 fingers, while 43/6% of women had this pattern (P = 0/0048). When family history of cancer was considered, 63/9% of patients with family history of cancer significantly showed whorl pattern in more than 6 fingers of both hands (P = 0/05). In another category, our results did not show any significant changes in different groups of patients (Table 2).

The OR was used to determine whether there was a correlation between a particular fingerprint pattern and a risk of developing gastrointestinal cancer. The results are presented in Table 3. The significant correlation was observed in the patients with whorl fingerprint pattern in the category of gender and family history of cancer. The estimated risk in the category of gender was 1/954 (95%CI: 1/001-3/815) (P = 0/048) and in the category of the family history of cancer was 0/517 (95%CI: 0/266-1/004) (P = 0/05). The OR > 1 shows that the whorl fingerprint pattern is associated with developing gastrointestinal cancer (Table 3).

Next, the frequency of three main types of fingerprinting patterns (loop, arch, and whorl) was compared in case and control groups regarding gender, type of parents' marriage, ethnicity, and family history of cancer. The results are summarized in Table 4. Whorl and loop patterns were the most common patterns in both case and control groups. All individuals in this study (452: case and control) showed an arch pattern in less than 6 fingers of both hands.

In the category of gender, there was not any significant difference in the case group as compared to the control group for the frequency of whorl pattern, while the frequency of loop pattern in men and women showed significant differences in the case group as compared to the control group. The female patients (34/5%) had loop pattern in more than 6 fingers of both hands, while 53/9% of the healthy females had this pattern (P = 0/014). In contrast, only 23/5% of male patients showed loop pattern in more than 6 fingers of both hands, and this frequency in healthy males was 38/3% (P = 0/015). In the category of ethnicity and type of parents' marriage, the significant differences between case and control groups were mostly observed in the frequency of loop pattern, while the frequency of whorl pattern did show significant differences in the case group as compared to the control group (Table 4). When the

category of family history of cancer was studied, there was a significant difference in the case group as compared to the control group for the frequency of whorl pattern. In the case group with a family history of cancer, 63/9% showed whorl pattern in more than 6 fingers of both hands, while only 14/3% of the control group with a family history of cancer had whorl pattern in more than 6 fingers of both hands (P = 0/012). The frequency of loop pattern in this group also significantly changed. In 26/2% of the case group and 57/1% of the control group, a loop pattern was shown in more than 6 fingers of both hands (P = 0/027) (Table 4).

Table 3. Estimated risk of fingerprint patterns in 3 demographic categories: gender, family history of cancer, and parents' marriage type.

Fingerprint patterns	Numbers	Gender		P value	OR
		Female	Male		
Loop	< 6	36 (32/4)	75 (67/6)	0/141	0/581 (0/281-1/201)
	≥ 6	19 (45/2)	23 (54/8)		
Arch	< 6	55 (100)	98 (100)	-	-
	≥ 6	-	-		
Whorl	< 6	31 (44/3)	39 (55/7)	0/048	1/954 (1/001-3/815)
	≥ 6	24 (28/9)	59 (71/1)		
		Family history of cancer			
		Yes	No		
Loop	< 6	45 (40/5)	66 (59/5)	0/783	1/108 (0/534-2/297)
	≥ 6	16 (38/1)	26 (61/9)		
Arch	< 6	61 (39/9)	92 (60/1)	-	-
	≥ 6	-	-		
Whorl	< 6	22 (31/4)	48 (68/6)	0/05	0/517 (0/266-1/004)
	≥ 6	39 (47)	44 (53)		
		Parents' marriage type			
		Familial	Non-related		
Loop	< 6	42 (36/7)	69 (63/3)	0/507	1/293 (0/604-2/769)
	≥ 6	13 (31)	29 (69)		
Arch	< 6	55 (35/1)	98 (64/9)	-	-
	≥ 6	-	-		
Whorl	< 6	21 (30)	49 (70)	0/222	0/656 (0/333-1/293)
	≥ 6	34 (39/5)	49 (60/5)		

Table 4. Frequency of fingerprint patterns in case and control groups in terms of 4 demographic categories: gender, parents' marriage type, ethnicity, and family history of cancer.

Groups			Loop (%)		Arch (%)		Whorl (%)		Results		
			< 6	≥ 6	< 6	≥ 6	< 6	≥ 6	Loop	Arch	Whorl
Gender	Female	Case	36 (56/5)	19 (34/5)	55 (100)	-	31 (56/4)	24 (43/6)	χ^2 = 0/085 P = 0/014	-	χ^2 = 0/638 P = 0/424
		Control	70 (46/1)	80 (53/9)	150 (100)	-	95 (62/5)	55 (37/5)			
		Total	106 (51/2)	99 (48/8)	205 (100)	-	126 (60/9)	79 (39/1)			
	Male	Case	75 (76/5)	23 (23/5)	98 (100)	-	39 (39/8)	59 (60/2)	χ^2 = 5/902 P = 0/015	-	χ^2 = 1/737 P = 0/188
		Control	92 (61/7)	57 (38/3)	149 (100)	-	72 (48/3)	77 (51/7)			
		Total	167 (67/6)	80 (32/4)	247 (100)	-	111 (44/9)	136 (55/1)			
Parents' marriage type	Familial	Case	42 (75/5)	13 (24/5)	55 (100)	-	21 (39/6)	34 (60/4)	χ^2 = 9/127 P = 0/003	-	χ^2 = 3/941 P = 0/047
		Control	67 (51/2)	64 (48/8)	131 (100)	-	73 (55/8)	58 (44/2)			
		Total	109 (58/2)	77 (41/8)	186 (100)	-	94 (51/1)	92 (48/9)			
	Non related	Case	69 (70/4)	29 (29/6)	98 (100)	-	49 (50)	49 (50)	χ^2 = 4/624 P = 0/032	-	χ^2 = 0/431 P = 0/511
		Control	96 (57/1)	72 (42/9)	168 (100)	-	91 (54/2)	77 (45/8)			
		Total	165 (62)	101 (38)	266 (100)	-	140 (52/6)	126 (47/4)			
Ethnicity	Fars	Case	37 (80/4)	9 (19/6)	46 (100)	-	17 (37)	29 (63)	χ^2 = 8/957 P = 0/003	-	χ^2 = 3/713 P = 0/054
		Control	50 (54/3)	42 (45/7)	92 (100)	-	50 (54/3)	42 (45/7)			
		Total	87 (63)	51 (37)	138 (100)	-	67 (48/6)	71 (51/4)			
	Turkish	Case	42 (65/6)	22 (34/4)	64 (100)	-	34 (53/1)	30 (46/9)	χ^2 = 3/411 P = 0/065	-	χ^2 = 0/076 P = 0/782
		Control	86 (52/1)	79 (47/9)	165 (100)	-	91 (55/2)	74 (44/8)			
		Total	128 (55/9)	101 (44/1)	229 (100)	-	125 (54/6)	104 (45/4)			
	Kurdish and Lor	Case	22 (75/9)	7 (24/1)	29 (100)	-	15 (51/7)	14 (48/3)	χ^2 = 6/486 P = 0/011	-	χ^2 = 2/848 P = 0/091
		Control	14 (43/8)	18 (56/3)	32 (100)	-	21 (65/6)	11 (34/4)			
		Total	36 (59)	25 (41)	61 (100)	-	36 (59)	25 (41)			
	Gilaki and Mazani	Case	10 (66/7)	4 (33/3)	14 (100)	-	4 (33/3)	10 (66/7)	χ^2 = 3/167 P = 0/75	-	χ^2 = 1/567 P = 0/211
		Control	10 (100)	-	10 (100)	-	6 (62/5)	4 (37/5)			
		Total	20 (83/3)	4 (16/7)	24 (100)	-	10 (45)	14 (55)			
Family history of cancer	Yes	Case	45 (73/8)	16 (26/2)	61(100)	-	22 (36/1)	39 (63/9)	χ^2 = 1/215 P = 0/027	-	χ^2 = 6/297 P = 0/012
		Control	3 (42/9)	4 (57/1)	7 (100)	-	6 (85/7)	1 (14/3)			
		Total	48 (70/6)	20 (29/4)	68 (100)	-	28 (41/2)	40 (58/8)			
	No	Case	66 (71/7)	26 (28/3)	92(100)	-	48 (52/2)	44 (47/8)	χ^2 = 8/986 P = 0/003	-	χ^2 = 0/189 P = 0/664
		Control	158 (54/1)	134 (45/9)	292 (100)	-	160 (54/8)	132 (45/2)			
		Total	224 (58/3)	160 (41/7)	384 (100)	-	208 (54/1)	176 (45/9)			

Finally, the frequency of the three main fingerprint patterns, loop, arch, and whorl, were analyzed in the case group as compared to the control group and the results are presented in Table 5. When the whorl pattern was studied, 54/2% of patients had whorl pattern in more than 6 fingers, and 45/8% of patients had whorl pattern in less than of 6 fingers of both hands. The frequencies of whorl pattern in the control group were 44/5% in more than 6 fingers and 55/5% in less than 6 fingers ($P < 0/050$). When the loop pattern was analyzed, we interestingly observed only 27/5% patients showed loop pattern in more than 6 fingers, and 72/5% of them had loop pattern in less than 6 fingers of both hands. In the control group, 46/2% of healthy people showed loop pattern in more than 6 fingers, and 53/8% had loop pattern in less than 6 fingers of both hands. The frequency of arch pattern in both groups was less than 6 fingers of both hands (Table 5).

Table 5. Frequency distribution of loop, arch, and whorl patterns in case and control groups.

Groups	Loop (%)		Arch (%)		Whorl (%)	
	< 6	≥ 6	< 6	≥ 6	< 6	≥ 6
Case	111 (72/5)	42 (27/5)	153 (100)	-	70 (45/8)	83 (54/2)
Control	162 (53/8)	137 (46/2)	299 (100)	-	167 (55/5)	132 (44/5)
Sum	273 (60/1)	179 (39/9)	452 (100)	-	237 (52/2)	215 (47/8)
Results	$\chi^2 = 14/841$ $P < 0/001$		-		$\chi^2 = 3/849$ $P < 0/050$	

DISCUSSION

Nowadays, dermatoglyphics is an effective diagnostic tool for individual identification, predicting chromosomal disorders and genetically related diseases. It is also a useful method in the screening for genetic diseases in big populations. Dermatoglyphics has been studied in various research studies. It has been shown that dermatoglyphics was used to identify handedness (tendency to use either the right or the left hand) (Sinha et al., 2012), type I diabetes (Lakshmi Prabha and Thenmozhi, 2014), hypertension (Wijerathne et al., 2015), Alzheimer's disease (Berr et al., 1992), schizophrenia (Shakibaei et al., 2011; Pahuja and Agarwal, 2012), and epilepsy (Lal and Surekha, 2012). In dentistry, it is used to determine oral pathology and fibrosis (Lakshmi Prabha and Thenmozhi, 2014). Dermatoglyphics is commonly used to diagnose syndromes such as Down's syndrome (Rajangam et al., 1995), Turner's syndrome (Reed et al., 1977), Klinefelter's syndrome (Komatz and Yoshida, 1976), and Noonan syndrome (Rott et al., 1975). A search of the scientific articles identified many studies that also employed dermatoglyphics to predict malignant diseases, such as breast cancer (Abbasi et al., 2006; Chintamani et al., 2007; Sridevi et al., 2010; Sariri et al., 2012; Raizada et al., 2013), cervix (Kashinathappa and Khanzode, 2013), and oral cavity cancer (Jatti et al., 2014). In this study, the variations of fingerprint patterns in gastrointestinal cancer patients were studied to find the association between dermatoglyphics and gastrointestinal cancers in the Iranian population, which has not done before.

Analyzing demographic information showed that age, gender, family history of cancer, and ethnicity are the main risk factors for developing gastrointestinal cancers in our population (Table 1). About 89/5% of our patients (137 individuals) was 40 years old or more. It has been previously shown that the risk of developing gastrointestinal cancers rises with age (Karimi et al., 2014; Siegel et al., 2015). We also observed that the number of men with gastrointestinal

cancers is higher than women, which is consistent with previous studies showing that the prevalence of gastrointestinal cancers in men is more than in women (Freedman et al., 2010; Karimi et al., 2014). Our results also showed that family history of cancer was higher significantly in the case group than in the control group, which is indicating that the incidence of gastrointestinal cancers is controlled by genes (Kaurah et al., 2007; Oliveira et al., 2009; Karimi et al., 2014). Our results revealed that the incidence rate of gastrointestinal cancers in Gilaki and Mazani people (60%) was higher than in other ethnicities in our experiments. The association of race with the incidence of gastrointestinal cancers has been previously proven (Brown and Devesa, 2002; Kamangar et al., 2006).

Three basic fingerprint patterns were analyzed in this study. We found that whorl and loop patterns were the most common patterns in our population (Tables 5). In this study, 47/8% of total individuals showed whorl pattern in more than 6 fingers, and 39/9% of them had loop pattern in more than 6 fingers. The arch pattern was observed with less frequency. All the people in this experiment showed the arch pattern in less than 6 fingers of both hands (Table 5). Previous studies also reported that the whorl and the loop patterns are found in 60-70 and 25-35% of fingerprint patterns, respectively, while the arch pattern is seen in only 5% of fingerprint patterns (Jalali and Hajian-Tilaki, 2002; Bhat et al., 2014).

When the frequencies of fingerprint patterns in case and control groups in different categories were compared, we found that the frequencies of loop pattern in 6 and more fingers (≥6) were significantly reduced in patients in 8 categories (Table 4). The maximal change was observed in the category of ethnicity, in the Fars group. About 45/7% of healthy Fars showed loop pattern in more than 6 fingers, while in of Fars patients only 19/6% had loop pattern in more than 6 fingers of both hands. It was also observed that the frequency of whorl pattern in 6 and more fingers (≥6) was significantly increased in patients in 2 categories (Table 4). The maximal change was observed in the category of family history of cancer. About 14/3% healthy people who had a family history of cancer showed whorl pattern in more than 6 fingers, while in a patient with family history of cancer 63/9% had whorl pattern in more than 6 fingers of both hands.

A review of the literature showed that there are few studies regarding fingerprint patterns and gastrointestinal cancers. In 2003, the correlation between 18 different digital-palmar dermatoglyphic features (but not fingerprint patterns) and gastric cancer was investigated (Zivanovic-Posilovic et al., 2003). They showed that palmar ridge counts in patients with gastric cancer were significantly lower than the control group of phenotypically healthy individuals. However, they did not study the fingerprint patterns in their research. Therefore, our report could be a useful resource for other researchers who are interested in analyzing the correlation between fingerprint patterns and gastrointestinal cancers.

When the frequency distribution of fingerprint patterns was analyzed in case and control groups (Table 5), it was observed that the frequency of loop pattern in 6 and more fingers (≥6) was significantly reduced in patients (27/5% in the case group in compared to 46/2% in the control group), while the frequency of whorl pattern in 6 and more fingers (≥6) slightly increased in patients (54/2% in the case group compared to 44/5% in the control group) (Table 5). This finding might suggest that decreasing loop pattern and increasing whorl pattern are well correlated with gastrointestinal cancers. To test this hypothesis, we calculated the OR to determine whether frequencies of loop and whorl patterns are a risk factor for incidence of gastrointestinal cancers (Table 3). Our results showed that only the OR of whorl pattern was statistically significant. So, we suggest that the frequency of whorl pattern could

be considered to be associated with having gastrointestinal cancers. In some studies, the association between whorl pattern and some cancers was also reported. It has been shown that the whorl pattern was statistically significant among the breast cancer patients (Seltzer et al., 1990; Abbasi et al., 2006; Chintamani et al., 2007; Sridevi et al., 2010) and carcinoma cervix patients (Kashinathappa and Khanzode, 2013) as compared to the control group.

Although many studies proved the association between the dermatoglyphic analysis and some genetic diseases and cancers, we all know that fingerprint patterns cannot play a role as a specific marker for developing cancer. There are a lot of clinical and genetic tests that can be more accurate and specific than dermatoglyphic analysis. Furthermore, fingerprint patterns can be used as a general marker only to predict the incidence of genetic diseases and cancers. It is a cheapest and faster method of screening for genetic diseases in big populations and follows up suspicious individuals with more accurate tests.

CONCLUSION

To conclude, we showed that the whorl and loop patterns significantly changed in gastrointestinal cancer patients as compared to control healthy people. However, our results showed that only whorl pattern might be a risk factor for developing gastrointestinal cancer. These finding could prove the association between dermatoglyphic patterns and gastrointestinal cancers. Shortly, the dermatoglyphic analysis can be used as a biological marker in the early diagnosis of the malignancies such as gastrointestinal cancers. However, very few studies have been done on dermatoglyphic and gastrointestinal cancers. Further studies with more number of patients from different ethnicities are required to be able to conclude accurately.

Conflicts of interest

The authors declare no conflict of interest.

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