Alq J Sci. 2026;2(4):433-439
https://doi.org/10.69667/ajs.26406
Alqalam Journal of Science
مجلـــة القلم للعلـوم
https://alqalam.utripoli.edu.ly/index.php/AR

Original article

Gender-Based Variation in Morphogenetic Traits in Sirte, Libya: Arm-Folding Differences

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Abstract
This study investigates gender-based variations in human morphogenetic traits within the Sirte area of Libya, using data from 373 females and 255 males. The studied variables include attached earlobe, free earlobe, square earlobe, tapering earlobe, tongue rolling, tongue folding, widow's peak, straight hairline, right cheek, left cheek, right clasping, left clasping, right writing, and left writing. The study found no significant sex differences for most variables. However, it highlights statistically significant differences in arm-folding patterns: left arm folding was 45% in males and 55% in females (P = 0.012), while right arm folding was 56% in males and 44% in females (P = 0.012). These findings contribute to the understanding of population-specific morphogenetic trait distributions and highlight potential sex-linked expressions in certain physical characteristics.
Keywords. Gender differences, Morphogenetic Traits, Arm-folding.

Introduction

Morphogenetic traits, though often broadly distributed, can vary significantly within a population because of factors such as geographic isolation, localized genetic drift, and sex-specific genetic or environmental influences [1]. These traits add variety and distinguish members of the same species. Genetic and observable variations within one species, in particular humans, have been taken into account [2]. These variations appear as morphogenetic traits, leading to biodiversity among individuals [3]. Understanding these intra-population differences is crucial for a nuanced appreciation of human biological diversity and for identifying potential areas of genetic distinctiveness. The expression of these traits is often modulated by sexual dimorphism and environmental plasticity. Research has indicated that sex-linked genetic factors may influence the prevalence of certain morphogenetic characteristics, with some studies observing higher rates of recessive traits in females compared to males within the same ethnic context [4].

Traits like tongue rolling, widow's peak hairline, and cleft chin have often been cited as examples of simple dominant–recessive inheritance patterns [5]. Earlobe attachment is also frequently presented as a "one gene–two alleles" Mendelian trait in humans. Furthermore, it was concluded that the ability to roll the tongue is strongly influenced by heredity [6]. On the other hand, several studies have suggested that these traits are not strictly genetically controlled. For example, the acts of arm folding and hand clasping are not inherited and show no correlation with sex; they are usually lifelong behaviors established early in life [7]. This study investigates gender--related differences in a range of frequently observed morphogenetic (physical form and structure) traits among the human population of the Sirte region in Libya. Using existing Phenotypic data collected from the Sirte region.

Several studies have investigated gender differences in earlobe type. While some research indicates variations, findings are inconsistent. For instance, a study in southern Korea found attached earlobes significantly more common in females [8]. Conversely, other studies, including one with 1,000 students [1], another with 750 individuals in Lagos [9], and a statistical analysis correlating earlobe types with age, sex, and origin [10], reported no statistically significant correlation or difference between gender and earlobe types. Although free earlobes were generally observed more frequently in females than in males across several studies, including one in Nigeria (192 males and 192 females) [11] and another with 1,130 individuals [12], these differences were not consistently statistically significant.

Many studies on gender differences in tongue rolling and folding consistently report no significant associations. For instance, research found no significant gender differences in the frequencies of rollers and folders across various combination groups [13]. A Southern Nigerian study (n=400) observed that 71.0% of males and 66.1% of females were "folders," while 69.9% of males and 75.0% of females could roll their tongues; however, no significant gender

Received*: 11-02-2026 -* ***Accepted****: 08-04-2026 -* ***Published****: 15-04-2026*

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association was established [14]. Similarly, a study at the University College of Swansea (n=1,066) indicated no gender difference in tongue-rolling, although differences existed between faculties [15]. Other studies also corroborate these findings, reporting no significant gender differences in these traits [1, 16, 17].

Research on gender differences in dimple types presents mixed findings, with several studies indicating no significant associations. One study found the absence of dimpled cheeks to be significantly more prevalent in males [1]. Another study of 250 men and 250 women reported that over 20% had cheek dimples, with females exhibiting them more frequently (4.4% women vs. 2.8% men) and also showing a higher frequency of chin dimples [18]. However, other studies, including one with 176 men and 224 women where 12.5% of men and 21.3% of women had cheek dimples [19], and a large Greek study (n=28,282) where dimples were observed in 13.08% of females and 12.7% of males [20], concluded that these observed female predominances were not statistically significant. Further research also supports the lack of meaningful gender differences in these traits [21, 12].

Many studies have investigated the prevalence of widow's peaks, consistently finding no significant gender differences. For example, a study of 176 males and 224 females reported widow's peaks in 14.7% of males and 16.5% of females, with no statistical difference between genders [19]. Another study found approximately 30% of people exhibit a widow's peak, with 27.7% of females and 32.2% of males, again showing no significant variation by gender [12]. Correlation analysis in a separate study also confirmed that gender was not significantly correlated with the presence of a widow's peak [1].

Studies examining gender differences in hand-clasping and arm-folding present varied results, with many indicating a lack of significant association. While some research in India suggested a slightly higher frequency of right-hand clasping in males [16] and right arm-folding in males [22], gender differences in hand-clasping and arm-folding were often found to be statistically insignificant [23, 24, 25, 26]. A Chi-square test involving 234 women and 189 men also indicated no association between hand-clasping and gender [26]. Another study with 1,165 individuals reported no significant differences in hand-clasping between males and females [12]. However, one study noted significant sex differences only in a single group for arm-folding [24], and another in 2,100 Bulgarians found significance exclusively in arm-folding, not hand-clasping [27]. One specific finding highlighted a difference of 23.6% in males versus 10.0% in females for one group, though overall differences were statistically insignificant [22].

Studies on handedness consistently indicate no significant gender differences. For instance, one study found no statistically significant difference between sexes [23]. In a study of 1,130 participants, 97.1% of males and 98.2% of females were right-handed, with no significant difference observed [12]. Another research project reported no significant gender variation in handedness, except for one tribe, and no significant variation across populations [16]. Although some sexual differences were noted for handedness, these were statistically insignificant [22].

Materials and Methods

The data for this study were derived from a sample of 628 individuals (373 Females and 255 Males) from the Sirte area of Libya. The participants were randomly drawn from six distinct residential areas: Sirte city, Abohadi, Agbeiba, Ahroa, Alarbain, and Jarif. The morphogenetic traits under investigation included: earlobe morphology (attached, free, square, tapering), oral motor skills (tongue rolling, tongue folding), hairline patterns (widow's peak, straight hairline), facial dimorphism (right cheek, left cheek), and handedness/arm-folding preferences (right clasping, left clasping, right writing, left writing, left arm folding, right arm folding) (Fig 1- Fig 5). Data collection involved visual observation and physical examinations. Statistical analysis, including Two-Proportion Tests, was conducted using Minitab Version 20.3 to identify significant differences across geographical groups and between genders. A p-value of less than 0.05 was considered statistically significant.

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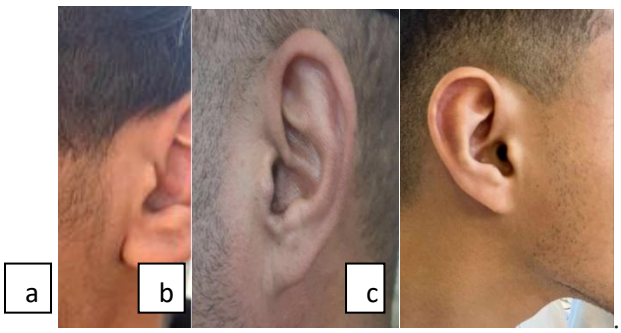

Fig. 1: (a) free earlobe, (b) square earlobe, (c) tapering earlobe.

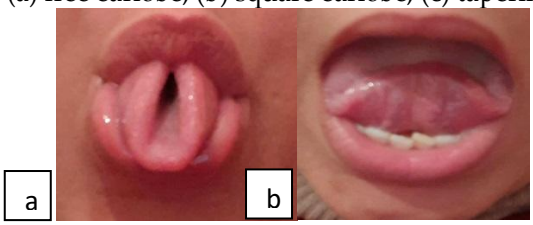

Fig 2: (a) Tongue folding, (b) Tongue rolling

Fig 3: (a) widow's peak, (b). straight hairline

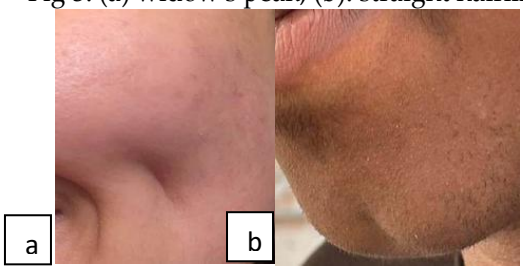

Fig 4: (a) Facial dimple, (b). Chin dimple

Fig 5: (a) Arm-folders, (b) Hands clasping.

Results

Analysis of gender differences revealed that for the majority of the studied traits, there were no statistically significant differences between males and females. However, a notable exception was observed in arm folding patterns. Specifically, a significant difference was found in Right arm folding between males (56%) and females (44%) (p-value = 0.012). Similarly, a significant difference was also present in Left arm folding, with males accounting for 45% and females for 55% (p-value = 0.012) (Fig 6). These findings are summarized in Table 1.

Received: *11-02-2026* - ***Accepted***: *08-04-2026* - ***Published***: *15-04-2026*

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Table 1: Two Proportions Test for Gender Differences of the studied traits

Variable	Gender	Count	95% CI for Difference	Z-Value	P-Value
Attached earlobe	Females	42	(-0.111016, 0.024402)	-1.25	0.210
	males	53			
Free earlobe	Females	212	(-0.024402, 0.111016)	1.25	0.210
	Males	201			
Square earlobe	Females	25	(-0.099714, 0.013100)	-1.50	0.132
	males	36			
Tapering earlobe	Females	17	(-0.043462, 0.043462)	0.00	1.000
	males	17			
Tongue rolling	Females	175	(-0.122084, 0.035470)	-1.08	0.281
	males	186			
Tongue folding	Females	20	(-0.028859, 0.060355)	0.69	0.489
	males	16			
Widow's peak	Females	54	(-0.066979, 0.074853)	0.11	0.913
	males	53			
Straight hairline	Females	200	(-0.074853, 0.066979)	-0.11	0.913
	males	201			
Double cheek dimple	Females	26	(-0.026245, 0.073489)	0.93	0.353
	males	20			
Right cheek dimple	Females	47	(-0.033667, 0.096660)	0.95	0.343
	males	39			
left cheek dimple	Females	36	(-0.026151, 0.089143)	1.07	0.284
	males	28			
Right Arm Folding	Females	104	(-0.196446, -0.024027)	-2.51	0.012*
	males	132			
Left Arm Folding	Females	150	(0.024027, 0.196446)	2.51	0.012*
	males	122			
Right clasping	Females	115	(-0.058717, 0.113835)	0.63	0.531
	males	108			
Left clasping	Females	139	(-0.113835, 0.058717)	-0.63	0.531
	males	146			
Chin dimple	Females	30	(-0.056130, 0.056130)	0.00	1.000
	males	30			
Right writing	Females	228	(-0.066602, 0.035106)	-0.61	0.544
	males	232			
left writing	Females	26	(-0.048329, 0.056203)	0.15	0.883
	males	25			

**P ≤ 0.05 indicates statistical significance.*

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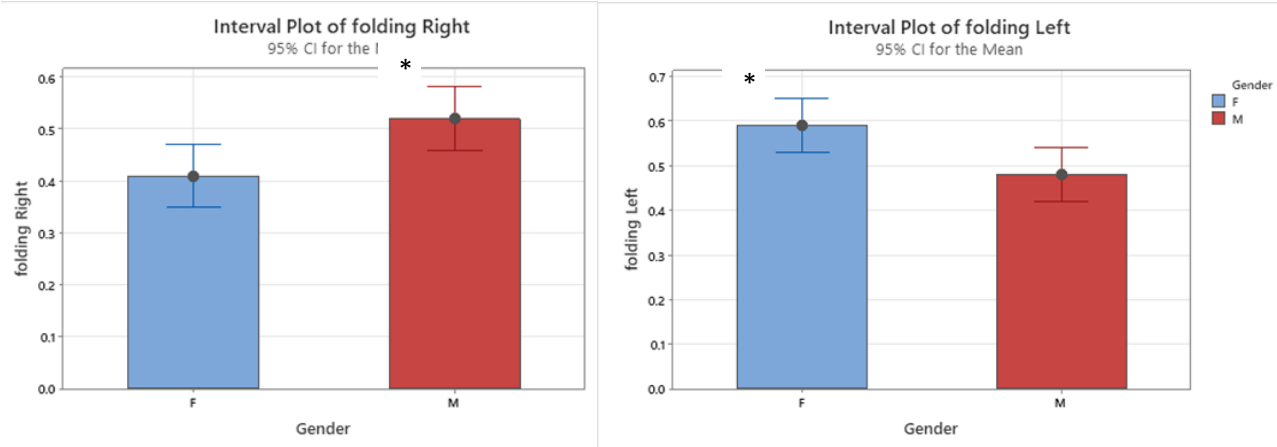

Fig. 6: (a)Interval plots of gender to (a) Left folding and (b)Right folding. (F) means Females (M) means Males, (*) means that it is statistically significant...

Discussion

An analysis of gender differences across the measured traits indicated that, for the majority of variables examined, no statistically significant differences were detected between male and female participants. This suggests that most of the studied characteristics are similarly distributed across sexes within our sample, pointing toward broad phenotypic overlap for these traits in the population studied. However, an exception to this overall pattern emerged for arm folding patterns, where clear sex-related differences were observed. For Right arm folding, a significantly higher proportion of males exhibited the right-folding pattern compared with females, and this difference reached statistical significance. The distribution for Left arm folding showed the opposite directional skew: females were more likely to display the left-folding pattern; this difference was also statistically significant. In fact, arm folding has been previously reported to show gender disparities in some populations [4]. Similarly, a study involving 2100 Bulgarians found that left-handedness was more prevalent among females, especially in the context of arm folding. Also, research in India suggested a slightly higher frequency of right arm-folding in males [22]. This gender disparity was notably significant only in arm folding [27]. Conversely, other studies found that gender differences in hand-clasping and arm-folding were often statistically insignificant [23, 24, 25, 26].

The study's finding that males exhibit a higher percentage of right arm folding and females a higher percentage of left arm folding, both with statistical significance, aligns with some existing literature [24]. This could be attributed to a complex interplay of genetic factors; hormonal influences, neurobiological factors that affect lateralized motor preferences, and potentially even cultural or behavioral patterns that differ between sexes from an early age. The absence of significant gender differences in most other traits, such as earlobe type, tongue abilities, and hairline, suggests that these traits are largely independent of sex-specific biological or behavioral influences in the Sirte population.

Conclusions

This article has explored the gender-based variations of morphogenetic traits in the Sirte area of Libya. It was found that while most traits are uniformly distributed, arm folding patterns exhibit significant gender differences. By demonstrating gender-specific morphogenetic differences within an ostensibly uniform population, these findings contribute valuable insight into the complexity of human variation. Such insights are valuable for population genetics, forensic science, and for informing public health initiatives that may require an understanding of population substructure. Further investigations are warranted to unravel the underlying genetic determinants of these observed variations.

Acknowledgements

We sincerely thank the people of the Sirte community for their generous cooperation, patience, and continued support.

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Conflict of interest:
The authors report no conflicts of interest.

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Received*: 11-02-2026 -* ***Accepted****: 08-04-2026 -* ***Published****: 15-04-2026*