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The relation between the anthropometric characteristics of fingers and cancer

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ABSTRACT

Anthropometry is a science of human body measurement that could be used for manufacturing artificial limbs or prosthesis, investigating body differences between populations, utilizing in forensics and criminology, or even in the diagnosis of some diseases. Two of the most important anthropometric characteristics are dermatoglyphic patterns and finger length. Many studies have evaluated the relation between these two characteristics in different diseases such as cancers. It assumed that dermatoglyphic patterns and finger length could be used as predictors of some cancers such as gastric, ovarian, prostate, testicular, and breast cancers. In this review, we evaluated the relation between dermatoglyphic variability and finger length in different cancers more precisely.

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Introduction

Anthropometry is a Greek name which defines as a measurement of human body, which mostly deals with the measurement of human physical properties (1). These physical variations including the dimensional description of body size and shape could be used for manufacturing artificial limbs or prosthesis, investigating body differences between populations, utilizing in forensics and criminology, or even in the diagnosis of some diseases. Biometry is a measurement method of body characteristics, which has been developed to evaluate behavioral and physical features of living organisms. Thus, it could be able to distinguish one person from another or easily recognize a person(2). Biometry of hand digits is one of the major branches of anthropometry that determines the descriptive dimensions of fingers. Biometric traits are classified into behavioral and physiological biometrics. Iris, retina, hand geometry, face, fingerprints, and palm prints are physiological biometrics. Voice pattern, signature, keystroke, and gait are examples of behavioral biometrics (3).

Finger length of fetus is under the influence of sex hormones and their effects on HOX genes during pregnancy. Genetic diseases could affect the concentration of hormones which might alter the fingers length and 2D:4D ratio, the second to fourth digit ratio (4).

Hand Anthropometry and Sexual Dimorphism

A) Finger length

Sexual dimorphism is related to variation in characteristics of two sexes of same species. Sexual dimorphism is due to the developmental differences of internal and external systems in addition to sexual traits including body size, appendage, and cellular content. Different types of sexual dimorphism of hand are as follow:

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1)Hand and palm dimensions: sexual dimorphism in hands and palms of general population could be used for sexual determination. These dimensions are different among populations.
2)Finger length: sexually morphologic differences are approved in many studies. In a homogenous population, men fingers are literally longer. The length of the middle finger is more dimorphic compared with other fingers. The thumb is shorter in men compared to women and the length of little finger is shorter in men.
3)Finger ratio: it is determined by the ratio of the length of second (index) finger (2D) to fourth (ring) finger (4D). There are various types of 2D:4D ratio, including:
- Radial: index finger is longer than ring finger
- Ulnar: ring finger is longer than index finger
- Intermediate: the index finger is the same size as ring finger

Individuals with radial type are mostly women, ulnar type is mostly observed in men, and intermediate type consists of equal proportion of men and women. The difference between index and ring finger length is higher compared with middle finger length in men, while this difference is lower in women. In other word, these three fingers (2D, 3D, and 4D) are similar in length in women. Sexual difference based on finger proportions is independent of body size, height, and age. Sexual dimorphism is more significant in proportion to 2D:4D than that of 2D:5D ratio, and eventually in proportion to 3D:4D ratio. The proportions of hand digits are constant since prenatal period. Thus, it is possible to determine the sexuality based on digit proportion even during the prenatal period (5).

B) Dermatoglyphic patterns

The scientific study of fingerprints is one of the oldest methods of identification. Fingers have a set of skin lines that extend from one side to the other side. These lines have specific points (clefts near the edges) and patterns including arch, spirals, rings, bottom edges, branches, islands (two close clefts), intersections (between two or more edges), and pores.

The palms and soles have lines that form specific figures. These lines are formed at third and fourth months of embryonic period when fetus height (head to appendage) is almost 70 mm, with no change over the course of lifetime. The study of dermatoglyphic patterns has been one of the most interesting issues in recent years, which have been studied in different populations In the 18th century, Mayer mentioned that dermatoglyphic patterns were not similar between any two individuals and Purkinje divided dermatoglyphic patterns into nine different groups for the first time in 1823. Newman mentioned that permanent lines in the digits and palms were controlled by various genes; in this regard, it seems that dermatoglyphic patterns is more accurate to study human populations compared to blood types (6). In 1892, Galthon divided fingerprints to three categories including arch, loop, and whorl (7).

Arch is the simplest type with the lowest frequency (almost 5% of all finger lines). Loop lines accounts for 65% of all finger lines while whorl lines comprise almost 30% of all lines (8).

Atd angle, connection of three triradii points named “a” (at the base of 2nd finger), “t” (on the proximal of palm), and “d” (at the base of 5th finger) and dat angle, which is made by connecting “d”, “a”, and “t” triradii points on the palm are observed in hand palm (9).

The number of detected lines between point A in forefinger and point B in middle finger are called a-b line (Figure 1).

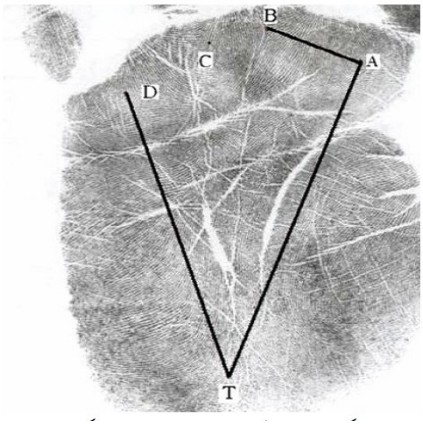

Figure 1. Left hand palm print with triradii a, b, c, d, t, a-b line, and dat angle are shown in right hand.

Literature review

Relation between cancer and dermatoglyphic patterns in digits

Technological developments and new treatment methods are effective on increasing the life span of cancerous patients. The incidence of gastric, ovarian, prostate, testicular, and other cancers have been declined worldwide. In spite of surgical approaches, chemotherapy, and radiotherapy, no significant improvement has been obtained since previous decades (10).

The association between hand dermatoglyphic patterns and cancers have been studied previously, which will be briefly reviewed here.

A) Prostate cancer

Different methods have been used to study the relation between hand anthropometry and prostate cancer including fingerprint, palm print,

2D:4D ratio, and relation with Δr−l, which is the difference between 2D:4D ratio in both hands.

In 2009, Oladipo et al. studied the relation between prostate cancer and dermatoglyphic patterns in Nigerian men over 50 years of age. They revealed significant difference between atd angle in cancerous patients and normal individuals (11). In another study, Lophatananon et al. proposed an adverse relation between the 2D:4D ratio and prostate cancer. They also concluded that the prevalence of prostate cancer was higher in patients with lower 2D:4D ratio (12). In 2011, Jung and colleagues observed similar results in Korea. They demonstrated a negative relation between 2D:4D ratio of right hand and prostate cancer. They also revealed that prostate cancer was more prevalent in individuals with proportion higher than 0.95 (13). In another study in United States, negative relation was observed between 2D:4D ratio and prostate cancer. It was suggested that this negative relation was due to the prenatal testosterone hormone. However the accuracy of measuring method to calculate the line proportion should be considered (14). In Australia, the relation between prostate cancer and 2D:4D ratio was studied in both hands. It was proposed that individuals under 60 years old showed a significantly negative relation with cancer, which was not significant in individuals over 60 years old. This finding could be useful as a screening indicator (15). One Spanish group investigated the efficacy of this relation as a prognosis indicator in patients with prostate cancer. They found a positive association between 2D:4D ration of left hand with prostate cancer (16).

In large sample size study including two different ethnicities of African-American and Caucasians, it was suggested that 2D:4D ratio of right hand was lower in African-Americans with prostate cancer compared with Caucasians (17).

Due to the possible influence of criteria such as genetic factors, ethnicity, nutritional diet, and smoking on the incidence of prostate cancer, wide investigations are needed to study digit anthropometry as a prognosis indicator of different diseases.

B) Cervical cancer

Cervical cancer is known as the second prevalent cancer worldwide and in developing countries. In 2006, Vaishali et al. studied the relation between palm print and cervical cancer in women at age range of 25-65 years in England. They demonstrated that atd angle in women with cervical cancer was lower compared to healthy women (18). In Britain study (2008), 2D:4D ratios of both hand was lower in patients with cervical cancer compared with control group (19).

C) Oral cancer

In 2011, Renato et al. studied the relation between 2D:4D ratio and oral cancer patients (similar in age and smoking history). They revealed higher 2D:4D ratio in patients compared to control group (20). In another study in India, Gupta et al. found an increased frequency of arch and ulnar loop patterns on fingertips, decrease number of whorl patterns on fingertips in addition to a decrease in the frequency of palmar accessory triradii on both hands. They concluded that dermatoglyphic patterns look promising diagnostic method in the determination of the genetic susceptibility of high risk individuals to develop oral squamous cell carcinoma (21).

D) Gastric cancer

In 2012, Renato et al. obtained a significant relation between 2D:4D ratio and gastric cancer in English men. 2D:4D ratio was lower in left hand of men with gastric cancer compared with controls (22). Moreover, changes of this ratio in right hand, and Δr−l were significantly lower in healthy men. The relation between 2D:4D ratio and different stages of the disease was not significant (4) Based on the study of Živanović-Posilović at al., dermatoglyphic patterns confirmed the role of genetic predisposition in the development of gastric patients (23).

E) Laryngeal cancer

In 2005, Rudic et al. studied the relation between laryngeal cancer and dermatoglyphic patterns and did not reveal any significant difference between case and control groups (24).

F) Testicular cancer

In 2011, Auger et al. proposed no significant relation between testicular cancer and 2D:4D ratio, but they showed a negative relation between birth weight and volume of testis (25).

G) Breast cancer

In 2010, Sridevi et al. investigated the relation between dermatoglyphic patterns and breast cancer based on total a-b palmar ridge count (TABRC), and a-b line. They found that their patients had significant increase in their TABRC and a-b line of right and left hands (P= 0.003) (26). Sariri et al. studied the relation between dermatoglyphic characteristics and breast cancer in Iran. They concluded that despite the higher prevalence of the loop pattern in both groups (2.3% in patients and 45.7% in controls), there was not a significant difference between groups (P=0.337). Dermatoglyphic patterns in breast cancer patients with or without family his-

tory was also studied, which showed no significant difference. They proposed that dermatoglyphic patterns could not be used as efficient screening method in breast cancer patients (27).

In Australia, Muller et al. studied the differences between 2D:4D ratio of right and left hands in patients with breast cancer for the first time and did not find any significant difference (28).

According to the study performed in India, the presence of six or more whorls in the finger print pattern were statistically significant in patients with breast cancer. They found an increased number of whorls in the right ring finger and right little finger in patients suffering from breast cancer in addition to the significant differences between mean pattern intensity index of patients and control group (29). These findings were in concordance with the results of Abbasi`s study in Iran, which also showed more frequent whorls in in women known to have risk factors for breast cancer (30). while Raizada found a highest frequency of arch pattern in patients with breast cancer. They also indicated that lower values of absolute finger ridge count (below 100) were related to breast cancer (31).

Conclusion

Different anthropometric characteristics such as digit length, fingerprints, palm print, which are constant during lifetime, could be representatives of unique individual features. Based on various studies, they could be used as prognostic indicators in some cancers, especially breast and gastric cancers. Further investigations are required to characterize the relation between dermatoglyphic patterns and cancers more precisely.

Conflict of Interest

The authors have no conflict of interest.

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