COLLEGE OF NATURAL AND COMPUTATIONAL SCIENCEs,

DEPARTMENT OF ZOOLOGICAL SCIENCE

FREQUENCY OF HUMAN MONOGENIC TRAIT AT SODO SECONDARY COMPREHENSIVE HIGH SCHOOL IN WOLAITA ZONE SOUTH REGION, ETHIOPIA

A Thesis submitted to the Graduate Studies of Addis Ababa University in Partial Fulfillment of the Requirements for the Degree of Masters of Science in Biology

By

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Addis Ababa University, Ethiopia

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SCHOOL OF GRADUATE STUDIES

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DECLARATION

This thesis is entitled **"Frequency of Human Monogenic Trait At Sodo Comprehensive High School In Wolaita Zone South Region, Ethiopia"**. I declare that this is my original work and yet,it has not been presented in any other university or organization.

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Abstract

Traits are structural characteristics of an organism that is determined genetically and transmitted from parents to offspring. There are many morphogenetic traits exist in human could be sued for personal identification and investigations. Morphogenetic characters are physical characters of an individual and due to the way we inherit these traits varied the same part of our body which function similarly may looks different. The current study was focused to identify the variation of some of the morphogenetic characters such as earlobe attachment, widow peak, tongue rolling, bent little finger, and hitchhiker's thumb among the student's of wolaita sodo comprehensive high school. The general objective of this study was to investigate the distribution and frequencies of observable morphological traits among the students. Morphological traits of grade 9,10,11, and 12 students of both sexes who volunteered between the ages of 15-20 years old after agreement or consent was obtained from each student and their respective parents, indicating their readiness to participate. A cross-sectional study were conducted on 381 volunteer students (183 males, 198 females) to decide the variation in morphogenetic traits. Data collection for external morphological traits was done by using an observation and recording technique. Then, the data were categorized based on the traits observed and finally the data was analyzed to develop standards for the unique morphology of different parts of the body. Tables and Figures were used to present the findings. Among the morphogenetic traits that investigated in the selected population, the Chi-squared analysis of variance showed that there is significant association were observed in widow peak and bent hitchhiker thumb with gender ($p>0.05$). The rest morphogenetic traits, did not show association with sex. There was also the higher dominant frequency distribution observed in tongue rolling were found to be female 151(40%) and the lower dominant frequency distribution in male 137(36%). The frequency distribution of bent little finger was 33(9)% and the straight little finger was 348(91%). The frequency distribution of straight hitchhiker thumb was lower 157(41)% than bent hitchhiker thumb 224(59)%. Analysis of the frequency and distribution of the 5 traits in 381 male and female students showed that the dominant phenotype more expressed in the facial morphological traits of earlobe, widow's peak and tongue rolling. The recessive phenotype more expressed in hands morphological traits of bent little finger and hitchhiker thumb.

Key words: ***Bent little finger, Dominant and Recessive gene, Morphogenetic traits, Widow peak***

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1. INTRODUCTION

1.1. Background of the study

Morphological variations exist among organisms of the same population, humans inclusive. The morphometric difference observed as a result of environmental factors and genetic aspects are morphological variation. There are morphological traits which are genetically controlled less or no effect from the environment. Morphogenetic traits helps to distinguish among organisms of the same species and are a source of variation (Ebeye *et al.,* 2014). Morphogenetic taits are controlled single geneand are recognizedby their Mendilian patterns of inheritance within families. In humans there are morphogenetic traits that can be easly scored by physical observation. Morphogenetic traits are also konown as hereditary taits; these taits may be dominant or recessive trait. Most of the genes are transmitted in the Mendelian pattern and a few multiple genes are grouped together and transmitted through the non-Mendilian pattern that includes: co-dominance, sex linked and polygenes (Onyij *et al*.,2012).

Morphogenetic traits are mostly inherited in Mendelian fashion as a result of single gene as either autosomal recessive or autosomal dominant whereas some traits are polygenic such as height, skin and hair colour, being affected by more than one gene. There are traits which are under control of single gene inheritance such as Tongue rolling, Earlobe attachment, Widow peak, Bent little finger, and Hitch-hiker's thumb (Adekoya *et al*., 2020).

The Hairline is the line demarcating the hair of scalp from the forehead and the shape of the hairline may be straight or curved. The curved hairline has presentation of a V-shape, descending from middle of the head just above widow's peak. Among various regions and ethnic groups, several studies have been conducted on widow's peak inherited as Mendelian single gene inheritance pattern and not affected by sex (Nwaopara *et al*., 2008).

The tongue is a movable organ made up of muscular tissues and surrounded by mucosa membrane it can assume various shapes and forms (Keith and Arthur, 2006). The tongue could be a profoundly muscular organ of deglutition, taste and discourse. The motor innervation to the tongue is by means of the hypoglossal nerve. The exemption is the palatoglossus which gets its innervation from the pharyngeal plexus. Although, relatively small is known around the motor neurons innervating the intrinsic muscles of the tongue (Odokuma *et al.,* 2008). Tongue rolling is the fitness to roll the horizontal edge of the tongue

in an upward way into a tube and controlled by a single gene. The muscles of the tongue permit a few people to overlay their tongues into a particular shapes and roll their tongue into a tube. The rolling and collapsing of the tongue is frequently depicted as a dominant trait with simple Mendelian inheritance. The dominant gene is accepted to be dependable for tongue rolling and folding whereas the failure to roll and overlap the tongue is related with recessive gene (Abimbola, 2019).

The anatomy of the human external ear, also known as the pinna or auricle, is complex(Hunter and Yotsuyanagi, 2005) and it possesses certain individual characteristics like fingerprints and other characteristics of the human body (Krishan *et al*., 2019). Ear lobe can be classified into two categories specifically attached and free. The allele for free ear lobe being dominant and the allele for attached earlobe is recessive. Free ear lobes are those that hang underneath the point of attachment to the head. Attached ear lobes are connected specifically to the side of the head (Nwaopara *et al*., 2008). However, many of the research reports on earlobe hereditary qualities have identified that there are numerous individuals with partially attached earlobes and El Kollali classified ear lobes into three parts, based on whether the connection point was right, obtuse, or acute (Ahmed and Yaas, 2013).

The little finger is the smallest finger of the human hand, inverse of the thumb, another to the ring finger. It is composed of three phalanges joined by two interphalangeal joints; proximal and distal. The distal joint can cause internal sloping surface of the distal phalange towards the ring finger in a few people whereas in other individuals it is straight at 180 with the intermediate phalange at the joint (Harbour, 2007). Clinodactyly is the technical name for a little finger that bends in towards the ring finger. It is usually associated with other abnormalities in many genetic syndromes like plantaris and keratosis Palmaris and in approximately 80% of individuals with Down's syndrome (Ordu and Nwosu, 2015). Streblomicrodactyly is the proximal phalange joint of little finger bends in towards the palm in the form of inverted v-shape and can't be straightened out (Dutta, 1965).

Hitchhiker's thumb is a flexible or hypermobile thumb, that can be able to bend backward beyond the normal range of motion. Distal hyperextensibility is a condition that isn't painful and doesn't inhibit the thumb's function in any way. Our thumb's bendability is controlled by its distal interphalangeal joint, the bending point at which the bones of our thumb are connected. People with hitchhiker's thumb have distal joints that can bend back as far as 90°. This looks similar to the classic roadside hitchhiker's pose, thumb out in hopes of hitching a ride. The Hitchhiker's thumb can occur in one or both thumbs (https://www.healthline.

Com/health/hitchhikers-thumb). All of the monogenic traits such as earlobe attachment, widow peak, tongue rolling, bent little finger and hitchhiker thumb are easily observable and studied in different population of Nigeria (Adekoya *et al.*, 2020). The sexual distribution of straight hitchhikers thumb in Ethiopian school children of Dagmawi Berhan primary school Addis Ketema sub city of Addis Ababa was female 49(17%) and male 40(14%) while the bent hitchhikers thumb was female 117(40%) and male 85(29%) (Alemshet, 2022) but their distribution have not been documented at Southern region of Ethiopia.

1.2. Statement of the problems

Genetic variation is a differences occurs among the population of the same species, these variations are under the control of genes and some of them coupled with environment. These variations could results in morphological visible differences within the populations based on the type of genotype an individual carries. Generally, these traits are referred as anthropogenic or morphogenic traits. The study of the distributions of the monogenic traits conducted in one of the most populous nation of Africa, Nigeria shown: widow's peak present in 36.8%; the curved widow's peak in males was 221 (22.1%) and 147 (14.7%) in females with X^2 =0.914. The double jointed hitchhiker's thumb, 46.5%; tongue rollers, 63.9%; free earlobe attachment, 22.0% and bent little finger, 36.7% (Adekoya et al., 2020). Similarly, a study conducted in Ethiopian school children of Dagmawi Berhan primary school Addis Ababa among the studied groups, the frequency distribution of curved widow peak's was found to be female 11(4%) and male 28(10%) while the straight hairline was female 155(53%) and male 97(33%). The tongue roller were higher (69%) than non-roller (31%). It was observed that the free earlobe were lower than 139(48%) attached earlobe 152(52%) in the study population. The result also displayed that the frequency of straight hitchhikers thumb 31% was lower than the bent hitchhikers thumb 69%. Among the studied groups the bent little finger were 0.4% and straight little finger were 99.6%. However, the study conducted in Ethiopian population is very local and it doesn't represent the whole population of the country. Hence, the population of Dagmawi Berhan primary school children doesn't studied from my best of knowledge. Moreover, a diversified sampling population have different ecological and geographical backgrounds would not only provide a unique method to better understanding of the distribution of these morphogenetic traits but also provide a better representation of the population. In response, the study was designed to fill aforementioned gap and then contribute for the compilation the anthropogenic traits in the country. The general objectives of the study were to observe and identify the frequency

distribution of earlobes, widow peak, tongue rolling, bent little finger, and hitchhiker thumb among school children's.

1.3. Significance of the study

The study establishes the frequencies of Mendelian passion heritable and observable traits such ear attachment, widow's peak, tongue rolling, hitchhiker thumb and bent little finger. These trait are easily observable but there is minimal/no awareness in school community regarding their significance for student project work in high school genetic lesson and their uses for forensic investigation. Therefore, the documentation of these traits enables us to establish their frequencies in Ethiopian population for future and also to initiate student project for genetics lessons in high school lesson. This gives an opportunity for high school students to establish a fact that genotypic and/or phenotypic frequencies are established on population level. Moreover, they can figure out unique personal identification phenotypes that could be used for forensic investigation. Regarding to some morphological characteristics of human being, the finding of this study may be important for other studies.

1.4. Objective of the study

1.4.1. The general objective of the study

- The main objective of the study was to investigate the frequency of earlobes, tongue rolling, widow's peak, bent little finger, and hitchhiker thumb among school children's.

1.4.2. The specific objective of the study

The specific objectives of the study were:

- To observe and identify the phenotypic frequency of free and attached earlobes.
- To observe and determine the phenotypic frequency of tongue rolling and widows' peak bent little finger and hitchhiker thumb morphogenetic traits.
- To determine which morphogenetic traits variation common among the school children.

2. Literature Review

2.1. Some Morphogenetic Traits Inheritance in Human

2.1.1. Ear Lobe Attachment

The ear lobe which is the lowest point on the ear lobe was the attachment point ”attached” and they classified all other ear lobes as “free”(*Figure* 1) Laiand Walsh (1966). Ear lobe is also explained either directly attached to the lateral side of the head or detached hanging freely and therefore,the attached ear lobe is slightly smaller than the detached type (Ordu *et al.*, 2014).

The oval shaped ear was among 40% of male and 44.8% of the females in the study sample. The outer type of the ear such as oblique, rectangular, round and triangular were also found in both sexes. Bilateral asymmetry was observed in the shape of the ear. The earlobe showed different characteristics in different individuals. In nearly half of the cases, in both males and females, the earlobe was found to be attached . the size and shape of the earlobe also showed variation with respect to sides as well as sexes (Krishan *et al*., 2019)

A study were conducted at one family and concluded that the attached earlobes were recessive trait Powell and Whitney (1937). Wiener, (1937) observed the ear lobes and isolated them into four similar groups, starting from totally free to totally connected. From totally free to totally connected ear lobe, all possible mating were produced a few intermediate earlobes and concluded that earlobes were determined by one gene with more than two alleles, or by over one gene (Dutta, 1965).

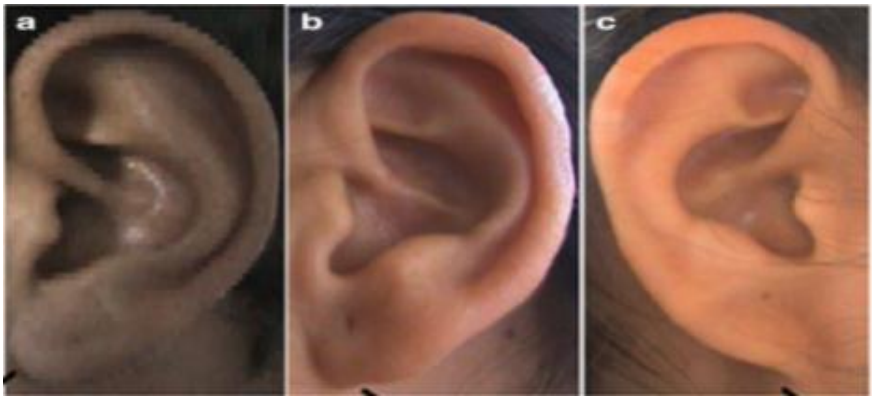


Figure 1: **Different forms of the earlobe attachment.**

a/ Free **b/** Partially attached **c/** Attached (Krishan *et al.*,2019).

Qualitative evaluation of the body features of the ear such as shape, form, ear lobe attachment to the soft skin on each side the face can act as soft biometric traits. These traits are those characteristics that provide some information about an individual, but luck the distinctiveness and permanent to differentiate sufficiently between individuals (Jain *et al*., 2000). Biometric traits help to identity information provided by primary biometric system that includes iris, retina scanning and fingerprints. Thus, the performance of the primary biometric system improved by soft biometric trait. The external morphological feature of the ear have been long used as a means of establishing forensic personal identification, Bertillon (1893) and Iannarelli (1989).

2.1.2. Widow's peak

Genetically, a straight hairline is a recessive trait and individuals who have a widow peaks are dominant genes for the trait(McDonald, 2011). One of the distinctive trait with human variations is hair morphology. The shape of the hairline may be straight or curved. A widow peak is the curved hairline has presentation of a V shape descending from middle of the head just above the forehead (Ese A. *et al*., 2021).

The percentage of frontal hairline type were found to be linear(women 36.1% men 45.9%), triangular (7.2%, 0.82%), round (38.5%, 10.7%) and M-shaped (18.2%, 42.6%), and straight (24.8%, 10.6%). The incidence of a widow's peak was 29.6% in women and 32.8% in men. The mean length of the mid- frontal line was 6.2 cm in women and 6.65cm in men (Kashiyama *et al.*,2021)

The expression of the gene for hairline is a widow's peak. This single gene has two alleles, one recessive allele for the straight hairline and one dominant allele for widow's peak. Widow's peak is a dominant inherited trait that doesn't skip generations to generation and during pedigree study, there are varying degrees of the peaks in a population. People who do not have widows peak have a straight hairline phenotype (Ese *et al*., 2007). The two alleles are focusing for controlling the shape of hairline. This characteristic takes after basic dominant-recessive inheritance pattern. The design of transmission takes after the Mendel's law of inheritance, which expect that (w) allele is for straight hairline which is recessive whereas (W) allele is for dominant widow peak.In case an individual expresses strait hairline has the genotype (ww) where as one that expresses the widow's peak hairline shape, the possible genotype is (WW) homozygous or (Ww) heterozygous genotype (Naz, 2014).

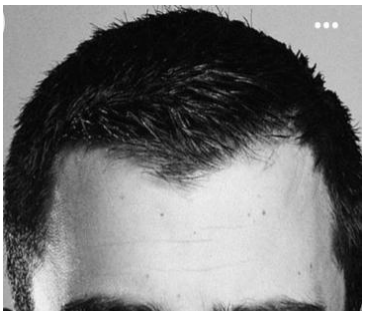
a.  b. 

Figure 2. The hairline phenotypes in human: a/ widow peak hairline and b/ Straight hairline

2.1.3 Tongue rolling

The tongue rolling ability is controlled by pair of alleles at single locus and greatly influenced by hereditary factors. (Garakani, 1989), Figure 3. The two alleles character, the tongue rolling and non rolling trait described with the allele for rolling (usually given the symbol R or T) being dominant over the allele for non-rolling (r or t) (Sturtevant, 1940 and Singh, 2012). The dominant gene is responsible for rolling and folding of the tongue lateral edges while unability to roll and fold the tongue is associated with the recessive gene. Some other researchers have shown that these traits are not genetically controlled but learned. The proportion of the people tongue rolling ability ranges from 65 to 81 percent, with slightly greater proportion of tongue-rollers in females than in males (Sturtevant 1940, Urbanowski and Wilson 1947, Liu and Hsu 1949, Komai 1951, Lee 1955). These traits are of huge value from physical anthropological window especially in studying human diversity and population variation (Odokuma *et al*,. 2008). Many studies have described that the myth is correct, but in genetic classes the tongue rolling remains a popular subject. When people first asked, immediately they can easily roll their tongue ("R"), or can not roll it at all ("NR").

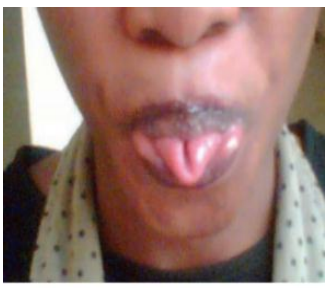
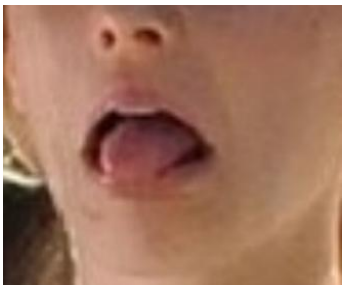
a.  **b.** 

***Figure 3*: The tongue rolling and non-rolling traits in human: a/ rolling b/ Non-rolling**

2.1.4. Bent little finger

The shape of little fingers ranges from perfectly straight to bending inwards at a sharp angle. It is not clear whether fingers fall into two discrete categories or there is a continuous ranges of pinky angle (Hersh *et al*,. 1953).

Clinodactyly can be broadly defined as curvature of the finger(s) occuring distal to the metacarpophalangeal joint. While the curvature can involve any finger and the deviation can be toward the ulnar or radial side of the forelimb, the most common form of cinodactyly involves a radialcurvature of the fifth finger (Rayan G. et al 2014). The average curvature was small at just 2.98 degrees (median:2.70)for the right finger and4.38 degrees (median 4.29) for the left. Only 10 individuals exceeded the nominal clinical thresh hold of 10 degree. These 10 individuals did not exhibit any other notable characteristics in interms of their demographic profile. No individuals had a curvature greater than 10 degree on both the left and right finger (Lee *et al*., 2022).

Variations in little finger bendability represent two phonotypical distinct alternate expressions called alleles (Marden, 2006). This different variation in the curvature of the little finger is inherited from the parents and found to follow a pattern. Two other extended families with bent little fingers shown different results. Six children of the two straight finger parents were all straight finger whereas 22 out of 34 children of bent and straight families were bent little finger. This result shows the bent little finger being caused by a single dominant allele, but the number of families is exceptionally little (Duta, 1965).

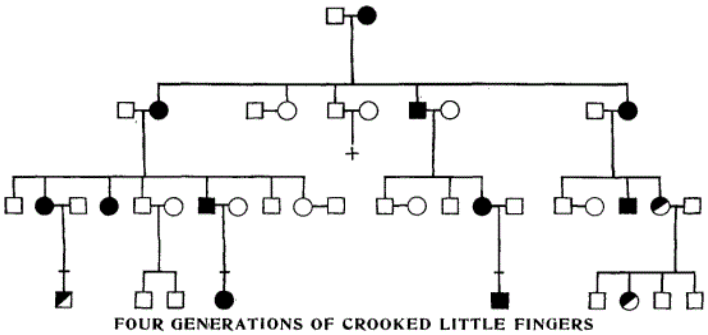
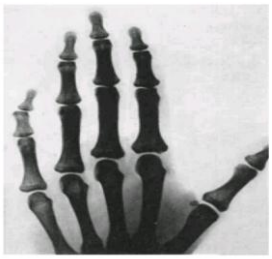


***Figure 4*: Four generation of little finger**

Solid black symbols indicate individuals with both little fingers affected half black symbol indicate only one finger affected (Dutta, 1965).

In 47 of families, one parent had bent little fingers and the other had straight. Another studies identified 51 families in which one or more children had bent little fingers and concluded that bent little finger was caused by a single dominant allele, but the four families in which both parents of a bent child were straight are inconsistent with this trait (Hersh *et al.*, (1953).



X-ray of hand with bent little finger (from Hersh et al. 1953).

Figure: 5

Figure 6: **a) Bent little finger** **b) Straight little finger**

2.1.5. Hitchhiker's thumb

Hitchhiker thumb is also known as "Distal Hyperextensibility of the Thumb", that distinguished by the ability to bend back the distal joint of the thumb as far as possible. Some people able to bend their thumb back as far as a 90 degree angle. It is believed that trait is caused by recessive gene (h), meaning two copies of recessive alleles are required to display this characteristics (Samia and Mona, 2008).

The characteristic of the thumb expansion is supposedly due to a single gene. In United state, 75% of the people is straight thumb dominant. This characteristics shown in Caucasian population. The rest 25% of the population were the recessive hitchhiker's thumb (http://gslc.genetics.utah.edu).

In some people, the hitchhiker's thumb bend backwards with a large angle between the two phalanges. There are just two kinds of thumbs, the dominant Straight thumbs(S) and the recessive Hitchhiker's thumbs(h). The trait is controlled by a single gene with two alleles, with the allele for S being dominant. It was proposed by Glass and Kister (1953). Some alleles become stronger than the others when they combine together. The stronger allele is

responsible for the dominant trait. Dominant alleles can be found in all organisms. A person with dominant traits will have a straight thumb which can not be folded to the back of the hand. The recessive allele will be expressed when the dominant allele fails to express itself. These are known as recessive traits. A person will have a hitchhiker thumb with recessive traits that can be folded to backward. When a person receives two recessive alleles from the parents, he will have a hitchhiker thumb. Brennan (2021).

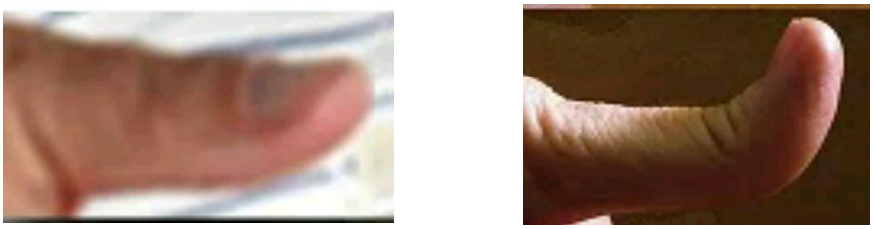


Figure 7- **a/ Straight Hitchhiker thumb b/ Bent Hitchhiker thumb**

Thumbs ranging from straight to hitchhiker (Glass and Kister 1953)

2.2. Inheritance patterns of some morphogenetic traits in different population

Simple dominant, recessive pattern with the detached dominant over the attached earlobe and do not differ among the tribes with no greater difference in gender distribution of the trait in the population as a research conducted in Nigeria on inheritance pattern of ear lobe attachment among 760 persons from 200 families with 400 parents and 360 offspring within the ages of 5 months- 60 years. The research results on observation of pattern of earlobe attachment trait might leads for genetic analysis and can help in settling paternal dispute (Ordu *et al.,* 2014).

As a research conducted in Nigeria among Esan ethenic group on morphogenetic traits in 400 volunteered adult subjects (176 males, 224 females) between the ages of 18-60 and their parents and grandparents were from Esan backgrounds, results reveals that 29.0% and 40.0% had unattached earlobe while 15.0% and 16.0% had their earlobes attached for males and females respectively.Further more, results for widow's peak showed 14.7% and 16.5% had widow's peak while 29.3% and 39.5% didn't have a peak for males and females respectively (Ebeye *et al.,* 2014).

According to a research held in India Thrissure district among 1130 individuals, 65.5% had a free ear lobe, and 53% were able to roll there tongue and these traits were sense and there

association and they have found that 63.9% of the sampled subjects were able to roll there tongue while 36.1% were unable to roll there tongue. On the other hand, straight little finger was found to be more expressed (63.3%) among sampled individuals than bent little finger (36.7%). The study also indicates that a greater percentage of the participants had free earlobes (74.6%) than those who had attached earlobes (25.4%). Furthermore, the frequency distribution of hitchhiker's thumb showed a higher percentage of single jointed thumb (53.5%) compared to double jointed hitchhiker's thumb (46.5%), although the difference between the two phenotypes was marginal (Usha *et al.*, 2016).

Based on a few studies conducted in our country Ethiopia, Amhara region among 270 individuals on the assessment of morphogenetic traits and blood groups, the condition of free ear lobe attachment and the ability of tongue rolling were high in males than females while the condition of straight thumb, straight hair line shape and absence of mid digital hair were high in females than males (Zenebe Awoke, 2018).

2.3. Non-Mendelian traits of inheritance

Mendelian inheritance refers to the inheritance of trait controlled by single gene with two alleles, one of which may be dominant to the other. While the non-Mendelian inheritance are extension of the Mendelian inheritance with deviation from his assumptions as the result there is modification of phenotypic ratio. Non-Mendelian traits of inheritance is any pattern in which trait do not segregate in accordance with Mendel's laws. These laws explains the inheritance of traits linked to single gene on a chromosomes in the nucleus.

The many human traits,which have more complex modes of inheritance than Mendelian traits is known as non-Mendelian inheritance, and they contain inheritance of multiple allele traits, traits with codominance or incomplete dominance, and polygenic traits, among others (Suzanne and Mandeep, 2021).

2.3.1. Incomplete dominance

Having Mendel's work under consideration, Carl Correns conducted an experiment on four o'clock flowers. He took two true-breeding flower traits (red color as dominant allele and white color as recessive allele) of four o'clock flowers and crossed them. The results show an intermediate heterozygote with pink color flowers (non of the alleles get dominant). This condition inheritance is known as incomplete dominance. Generally, incomplete dominance means a partial dominance, meaning the phenotype is in between the genotype dominant and

recessive alleles. Incomplete dominance occurs in heterozygote, in which the dominant allele does not dominate the recessive allele entirely; rather, an intermediate trait appears in the offspring (Rheinberger, H J, 2000).

Incomplete dominance happens when the dominant allele is not completely dominant, so an intermediate phenotype results in heterozygote who inherit both alleles. This occurs when the two alleles for a given gene both produce proteins but one protein is not functional. As a result, the heterozygote individual produce only half the amount of normal protein as is produced by an individual who is homozygous for the normal allele (Suzanne and Mandeep, 2021).

2.3.2. Codominance

According to the context of genetics, Codominance is a type of inheritance in which two versions (alleles) of the same gene are expressed separately to yield different trait in an individual. That means instead of one trait being dominant over the other, both trait appear, such as in a plant or animal that has more than one pigment color.

Examples of codominance in humans is MN blood group system,which is governed by two alleles, M and N. Individuals who are homozygous for the M allele have a surface molecule (called for the M antigen) on their red blood cells and Heterozygote those with both alleles carry both antigens. Codominance example for a gene with multiple alleles is seen in the human ABO blood group system , in which person with type AB blood have one allele for A and one for B and the O allele is recessive (its expression is masked by the other allele). Speckled chickens, which have alleles for both black and white feathers and roan cattle which express alleles for both red hair and white hair are examples of codominance for animals. Codominance is also seen in plants like rhododendrons with simultaneous expression of red and white genes for flower colour display flowers with both red and white petals (Rogers, 2020).

2.3.3. Polygenic traits

Several human traits are controlled by more than one gene. These traits are called polygenic traits. On the human phenotype, these alleles of each gene have a minor additive effect. There are many possible combination of alleles. Therefore, a whole continuum of phenotypes is possible. Adult height is an example of a human polygenic trait. Many genes, each with more than one allele, contribute to this trait, so there are several possible adult heights. One adult’s

height might be 1.656 m (5.433feet), and another adult's height might be 1.655 m(5.430 feet) Suzanne and Mandeep (2021).

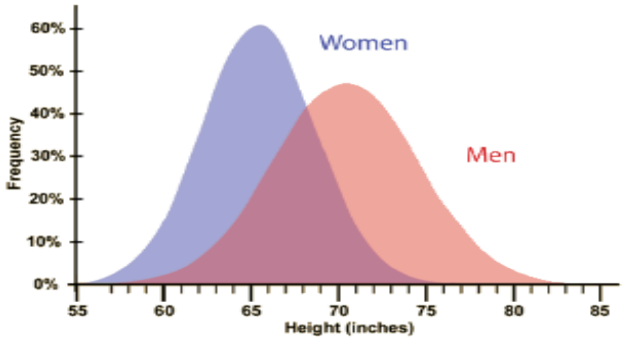


Figure 8: **Human Adult Height. Like many other polygenic traits, adult height has a bell shaped distribution.**

2.3.4. Epistasis

Condition in which one gene affect the expression of other genesis called Epistasis. Albinism ,for example, is the case for epistasis in which the albinism mutation negate the expression of skin color genes. If an person has the albinism mutation, he or she will not have any skin pigment, regardless of skin color genes that were inherited . The condition occurs due to an entirely different than the genes that encode skin color. Tyrosinase is a protein which is a causes for albinism which is required for the production normal skin pigment and is not produced due to a gene mutation (CK-12/Adapted by Christine Miller).

Classical ratio(9:3:3:1 ratio):It is classic Mendelian ratio for a dihybrid cross in which the alleles of two different genes assort independently in to gametes. Among all laws ,the given ratio 9:3:3:1 is due to the law of independent assortment. A cross is made between two parents with two different contrasting characters.

Dominant Epistasis (12:3:1 ratio):It occurs when the dominant allele of one gene hide the expression of both alleles of another genes, which means one dominant gene masks the the expression of another dominant or recessive allele. Albinism gene is the dominant gene and hide the expression of the pigment in the eyes, skin and hair.

Recessive epistasis (9:3:4 ratio): when the recessive allele of one gene hide the expression of an alleles of another gene. The hair color in mice displays the recessive epistasis is a good example of such interaction.

Duplicate gene with cumulative effect (9:6:1 ratio):occurs when two genes produce the same phenotype when both genes have a phenotype with dominant allele either in heterogeneous or homogenous dominant condition.

Duplicate dominant gene(15:1 ratio):occurs when the dominant allele at one of the two location masks the expression of the recessive alleles. When a dihybrid cross produces progeny in two phenotypic classes in a 15:1 ratio, this can be the two locis gene products have the same function with the same biological path way.

Duplicate recessive gene (9:7 ratio):It happens if the recessive alleles at either or the two location hide the expression of dominant alleles at both location. The best example of duplicate recessive epistasis is flower color in sweet pea.

Dominant and recessive interaction (13:3:0 ratio):describes how alleles ,or variations of gene, interact with each other. Dominant alleles are always expressed whether the organism has one or two of the dominant allele. Recessive alleles require two copies to be expressed.

Table 2. Briefly describe the epistasis interactions at least mention in the following table.

Interaction Type	Diploid Genotype			
	A – B–	*A – bb*	*aaB–*	*aabb*
Classical ratio	9	3	3	1
Dominant epistasis	12		3	1
Recessive epistasis	9	3	4	
Duplicate genes with cumulative effect	9	6		1
Duplicate dominant genes	15			1
Duplicate recessive genes	9	7		
Dominant and recessive interaction	13		3	0

2.3.5. Pleiotropy

Pleiotropy is a condition in which some gene affect more than one phenotypic trait. There are numerous example of pleiotropy in humans. It happens when there are engagement of proteins that are needed for the normal development or functioning of more than one organ system.When pleiotropy in human occurs with the gene that codes for the main protein in collagen, a substance that helps form bones is one example. This protein is also important in the ear and eyes. Problem in bones is not is not the only cause for mutations but also in these

sensory organs, which is how the gene's phototropic effects were recognized. Sickle cell anemia is another example of pleiotropy. Hemoglobin, which encodes the red blood cell protein, mutation is the cause for this recessive genetic disorder. The disorded persons have two alleles for sickle cell hemoglobin, so named for the sickle shaped red blood cells take on under certain conditions as physical extension (Suzanne and Mandeep, 2021).

3. Methods of the study

3.1. Description of the Study Area

The study was conducted in wolaita sodo comprehensive high school which is found at sodo city. Woolaita sodo is the administrative capital of wolaita zone and serves as administrative, commercial and transport center of zone (*Figure 9*). The city is located at 369 kilometer distance from Addis Ababa via Hosanna and 390 kilometer via Shashemene. The total geographical location of the city is between 06046'-06059 North latitude and 360 between 37042' - 37048' East longitudes the air condition of the city in average 20^{o}c. According to the 4^{th} structural design of the city, the total area of the city is 9,100 hectare and the city is structured in to seven (07) kebele, 19 district, 59 sub-district, and 379 stations and the total population of the city is estimated 254,295.

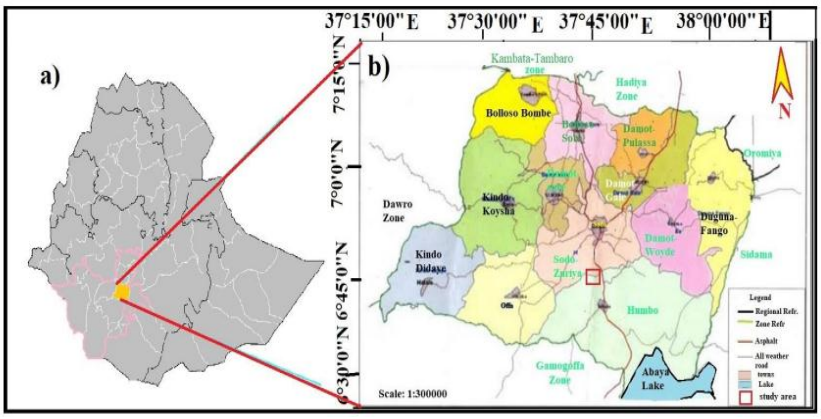


Figure 9: Map shows the study site, Wolaita Sodo, Panel a) Regions of Ethiopia and Panel b) Administrative map of Wolaita Zone.

Wolaita sodo comprehensive high school is found at the centre of sodo city in wolaita zone south region of Ethiopia (*Figure 9*). This school is founded in 1972 E.C. with 9-10^{th} grade level. Now the school organized from 9-12^{th} grade level.

3.2. Study population Sampling procedure

The study population was students from sodo comprehensive high school which is located in Wolaita zone at sodo town had a total students of 1876. This study does not consider ethnicity and using random sampling technique the study was conducted in general among unrelated 381 volunteer students of Sodo comprehensive high school. Their age were ranges between 15- 20 and students who were willing to participate in the study was selected. The study was conducted on total 381 students where 198 of them females and in 183 of them males'. Those who were participated the study under age of 18, their parents filled as signed assent form and then the participants filled consent form. Those 18 or above had filled and signed the consent form. Students who have any abnormality or having difficulty to perform the tasks included in the investigation were excluded in this study.

3.3. Data collection Procedures

A place were organized by accepting authorization from the school principal for morphogenetic characteristics observation. Earlier to examination a brief clarification were given to the students how the study interested. A consent was dispersed to those who are willing to take an interest in the study and the composed informed consent has been gotten on the following day at long last the subjects are taken from the study population for additional investigation.

A schedule were prepared for identification of morphogenetic traits based on grade and the data were collected and organized at sodo comprehensive high school. The parameters that were investigated include, ear lobe attachment, tongue rolling widow's peak, hitchhikers thumb, and bent little finger in order to develop standards for the unique morphology of different parts of the body.

The examiner recorded the data for Ear lobe attachment, Widow peak, Tongue rolling, Bent little finger and Hitch-hikers thumb by observation. For examination of tongue rolling, and hitch-hiker thumb, the researcher did both and was demonstrated the subject. Each individual was asked to perform the activity of tongue rolling and a person was classified tongue roller or non-roller depending up on their ability Sturtevant (1940). Bent little Finger were determined by physical examination of individuals. The subject was asked to place there hands on the table and stretch all there fingers to check there is a bent little finger.

Information for ear lobe attachment was collected by physical examination of individuals where the ear lobe of each subject was checked to know in case it is attached or free. Widows peak was decided by physical examination. The researcher were looked at the subject forehead to know whether the hair runs straight over or descends downwards.

3.4. Method of data collection

A simple structured questioner were administered to participant, to collect of social demographic variables (grade, age and gender) and other relevant information. In recording and observing of some morphogenic traits, various standard techniques were used. For tongue rolling each individuals was asked to perform the activity, however each person was classified as roller and non-roller. Meanwhile, in the case of ear lobe, widow's peak, tongue rolling, bent little finger and hitchhiker thumb, physical observation were carried out and result recorded accordingly. Observed variations in participants were assigned dominant or recessive according to the standard protocol.

Table:2 The morphogenetic characters traits with dominant and recessive

No.	**Morphogenic characters**	**Dominant trait**	**Recessive trait**
1	**Earlobe**	**Free earlobe** the fleshy flap of skin on the lowest part of the outer ear hang down below the point of connection.	**Attached earlobe** is the fleshy flap of skin connected directly to the head.
2	**Hairline distribution**	**Widow's peak** a V-shaped point in the hairline in the center of the forehead.	**Straight hairline** the hairline goes straight across the head without much or any receding vsble.
3	**Tongue rolling**	**Tongue rolling** the ability to roll the lateral edges of the tongue upwards in to a tube.	**Non rolling** in the case that a person is born with two recessive allles, they can not roll their tongue.
4	**Bent little finger**	**Bent little finger** a condition where the little finger curves at the joint closest and bent to other finger.	**Straight little finger** the shape of the little finger being straight.
5	**Hitchhiker thumb**	**Straight hitchhiker** a thumb that extends from the base without bending and it contolled by dominnt trait.	**Bent hitchhiker** is a thumb where the distal joint can bend as far backwards as 90 degree.

3.5. Data analysis

The collected morphogenetic trait of the student's data were entered in to a computer using excel sheet and then analyzed with IBM SPSS v29 (statistical package for social science) to calculate the frequencies and percentage of distribution. It's primary source of observation was calculated, organized, tabulated, and classified the frequency and distribution of morphogenetic trait on the students in age, sex and percentage. Values were considered significant at $p<0.05$.

3.6. Ethical consideration

Research and Ethical Review Committee IRB of College of Natural and Computational Science, Addis Ababa University were approved the ethical condition of the study. The participant were told about the benefit of being tested. Besides a written and oral informed consent will be taken from each study participant. Permission were also obtained from study site and data will be collected and analyzed using codes for confidentiality purpose throughout the study period.

3.7. Inclusion and Exclusion criteria

3.7.1. Inclusion criteria

The study participant were included according to the following criteria. For recording of data that were collected by direct observation or that do not require additional procedures such as tongue rolling, ear lobe attachment and hair line shape the participant should have normal ear which is not swollen by any means or that do not have any defect, for tongue rolling able to roll without pain and hair line shape free from any kind of scalp infection. For bent little finger and hitch-hiker thumb evaluation, the study subject was so healthy to perform all activities that going to be performed like bending and stretching easily.

3.7.2. Exclusion criteria

The participants had the following characteristics in the study: Any medical history of hand surgery, participant who had a dislocated joints due to injury and a scalp infection (*tinea capitis*), age below 15 years and above 20 years were excluded from the study.

4. RESULTS

4.1. Morphogenic traits variation among study population

4.1.1. The socio demographic characteristics of study population

The socio demographic characteristics of the students were involved in the study from sodo comprehensive high school summarized in Table 3. A total of 381 students were consented and participated in the study from grade 9-12. Males 48 and females 54 from grade 9, males 47 and females 51 from grade 10, males 46 and females 48 from grade 11, males 42 and females 45 from grade 12. It also identified that a total of 183 males and 198 females.

Table 3: Demographic characteristics of the study population grades, gender and ages

		Gender					
Grade	**Age**	**Male**		**Female**		**Total**	
		N	%	N	%	N	%
9	15-17	46	46	53	54	99	100
	18-20	2	67	1	33	3	100
	Total	**48**	**47**	**54**	**53**	**102**	**100**
10	15-17	43	49	45	51	88	100
	18-20	4	40	6	60	10	100
	Total	**47**	**48**	**51**	**52**	**98**	**100**
11	15-17	8	53	7	47	15	100
	18-20	38	48	41	52	79	100
	Total	**46**	**49**	**48**	**51**	**94**	**100**
12	15-17	__	__	__	__	__	000
	18-20	42	48	45	52	87	100
	Total	**42**	**48**	**45**	**52**	**87**	**100**
	15-17	97	49	102	51	199	100
	18-20	86	47	96	53	182	100
	Total	**183**	**48**	**198**	**52**	**381**	**100**

4.1.2. The distribution Mendelian morphogenic traits among study population

The frequency distribution of Mendelian monogenic traits was studied in both males and females at sodo comprehensive high school. This study was showed that the frequency distribution of free earlobe were greater than attached earlobe. In this studied groups, the

frequency distribution of free earlobe was found to be male 117(31)% and female 124(33)% while the attached earlobe was male 66(17)% and female 74(19)%.

It was observed that the frequency distribution of curved widow peak was higher(36)% than straight hairline(12)% in males while the curved widow peak was lower(22)% than straight hairline(30)% in females.

The frequency distribution of tongue roller(76)% were greater than non- roller(24)%. The result showed that the frequency distribution of tongue roller was male137(36)% and female151(40)% while the non-roller were male46(12)% and female47(12)%.

The frequency distribution of bent little finger was 33(9)% and the straight little finger was 348(91)%. This result showed that the frequency of bent little finger was lower than straight little finger.

From the groups of the study the frequency distribution of straight hitchhiker thumb was lower 157(41)% than bent hitchhiker thumb 224(59)%. The distribution of straight hitchhiker thumb was male66(17)% and female 91(24)% while the bent hitchhiker thumb was male 117(31)% and female 107(28)%.

Table 4. The frequency distribution Mendelian morphogenetic traits

Gender							
Morphogenic traits		**Male**		**Female**		**Total**	
		N	%	**N**	%	**N**	%
Earlobe	Free	117	31	124	33	241	63
	Attached	66	17	74	19	140	37
Total		**183**	**48**	**198**	**52**	**381**	**100**
Hairline	Widow peak	138	36	85	22	223	59
	Straight	45	12	113	30	158	41
Total		**183**	48	**198**	**52**	381	**100**
Tongue	Roller	137	36	151	40	288	76
	Non-roller	46	12	47	12	93	24
Total		**183**	**48**	**198**	**52**	**381**	**100**
Little finger	Bent	17	4	16	4	33	9
	Straight	166	44	182	48	348	91
Total		**183**	**48**	**198**	**52**	**381**	**100**
Hitchhiker	Straight	66	17	91	24	157	41
	Bent	117	31	107	28	224	59
Total		**183**	48	**198**	**52**	**381**	**100**

4.2. The association of Mendelian morphogenetic traits with gender

4.2.1. The association of Mendelian morphogenetic traits among gender

The distribution of the traits between gender showed that Widow's peak and Hitchhiker thumb were significant difference to gender ($p<0.05$). The V-shaped widow's peak observed significantly more frequency distribution to the males than females ($X^2=41.23$, df=1, $p<0.05$). In Hitchhiker thumb, the straight hitchhiker thumb were significantly more frequency distributed and associated to females than males ($X^2=3.874$, df=1, $p<0.05$). And also indicated that there was no association between gender and morphogenic traits of Ear lobe, Tongue rolling, and bent little finger ($p>0.05$) as showed below in table 5.

Table 5. Association of morphogenetic Mendelian traits among gender

Gender									
Morphogenic traits	**Males**		**Females**		**Total**		**df**	**X^2**	**P-value**
	N	**%**	**N**	%	**N**	**%**			
Earlobe									
Free Dominant	117	31	124	33	241	63	1	0.382	0.536
Attached Recessive	66	17	74	19	140	37			
Total	**183**	**48**	**198**	**52**	**381**	**100**			
Hairline									
Widow's peak Dominant	138	36	85	22	223	59	1	41.23	0.000
Straight Recessive	45	12	113	30	158	41			
Total	**183**	**48**	**198**	**52**	**381**	**100**			
Tongue rolling									
Roller Dominant	137	36	151	40	288	76	1	0.102	0.749
Non-roller Recessive	46	12	47	12	93	24			
Total	**183**	**48**	**198**	**52**	**381**	**100**			
Bent little finger									
Bent Dominant	17	4	16	4	33	9	1	0.175	0.675
Straight Recessive	166	44	182	48	348	91			
Total	**183**	**48**	**198**	**52**	**381**	**100**			
Hitchhiker thumb									
Straight Dominant	66	17	91	24	157	41	1	3.874	0.049
Bent Recessive	117	31	107	28	224	59			
Total	**183**	**48**	**198**	**52**	**381**	**100**			

4.2.2. The distribution of Mendelian morphogenic traits with age group

The frequency distribution of morphogenic traits with age group was observed in the study of the free Earlobe was greater 123(32)% between the age of 15-17 than attached ear lobe which were 79(21)%. Based on this result, the frequency distribution of the free earlobe in the studied groups were found between age 15-17 were 123(32)% and the attached earlobe were

79(21)% . The frequency distribution of earlobe between the age of 18-20 were free earlobe 118(31%) and attached earlobe 61(16)%.

The result of this study showed that the frequency distribution of the curved widow peak hairline was greater 118(31)% between the age of 15-17 than straight hairline 84(22)%. In the the case of the age between 18-20 the widow peak hairline were 105(28)% and the straight hairline were 74(19)%.

The frequency distribution also observed that tongue rolling ability among the studied groups age between 15-17 were tongue roller 150(39)% higher than non-roller 52(14)%. In the age of 18-20 the frequency distribution of roller were 139(36)% and non-roller were 40(10)%. There was very few frequency distribution of bent little finger between the age 15-17 were found 15(4)% and there were also observed few frequency distribution bent little finger between age of 18-20(5)%.

It was found that the frequency distribution presence of hitchhiker thumb between the age of 15-17 were greater 121(32)% than the absence of hitchhiker thumb were 81(21)%. In the age of between 18-20 there was observed that the frequency distribution of hitchhiker thumb found 103(27)% and the straight thumb were 76(20)%.

Table 6. The distribution of Mendelian morphogenetic traits with age group

	Age					
Morphogenic traits	**15-17**		**18-20**		**Total**	
	N	**%**	**N**	**%**	**N**	**%**
Earlobe						
Free	123	32	118	31	241	63
Attached	79	21	61	16	140	37
Total	**202**	**53**	**179**	**47**	**381**	**100**
Hairline						
Widow peak	118	31	105	28	223	59
Straight	84	22	74	19	158	41
Total	**202**	**53**	**179**	**47**	**381**	**100**
Tongue						
Roller	150	39	139	36	289	76
Non-roller	52	14	40	11	92	24
Total	**202**	**53**	**179**	**47**	**381**	**100**
Little finger						
Bent	15	4	18	5	33	9
Straight	187	49	161	42	348	91
Total	**202**	**53**	**179**	**47**	**381**	**100**
Hitchhiker Straight						
Bent	81	21	76	20	157	41
Total	121	32	103	27	224	59
	202	**53**	**179**	**47**	**381**	**100**

4.3. The distribution of dominant and recessive morphogenetic traits

The frequency distribution of dominant recessive morphogenic traits of patterns of inheritance were identified among the studied group. The number of observed dominant phenotype for morphogenetic traits that assessed was greater in males than female but the number of repressively observed phenotype for morphogenic traits assessed was more in females than male. The chart that showed below in (*figure*-10) tongue rolling was the more dominant(76%) observed phenotype than recessive phenotypes and the bent little finger were the least(9%) expressed dominant phenotype in the studied population.

Table 7. The distribution of dominant and recessive morphogenetic traits

Morphogenic traits	**Dominant**	%	**Recessive**	%
Earlobe	241	63	140	37
Hair line	223	59	158	41
Tongue rolling	288	76	93	24
Bent little finger	33	9	348	91
Hitchhiker thumb	157	41	224	59

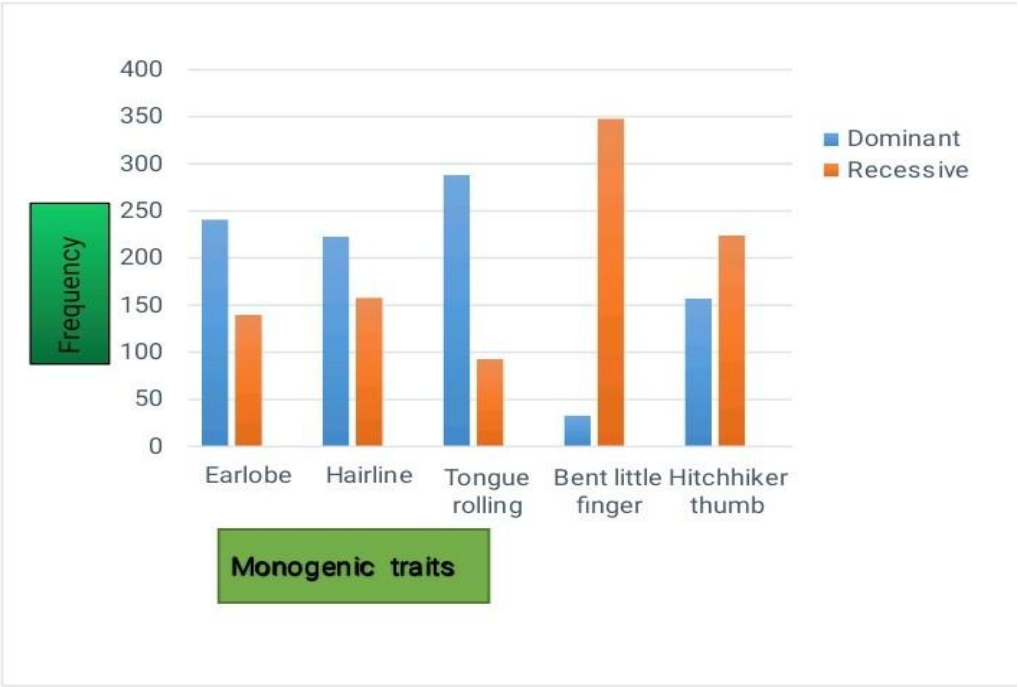


Figure 10 **The distribution of dominant and recessive monogenic traits in the sampled individuals.**

5. DISCUSSION

5.1. The frequency distribution of morphogenic traits

The frequency distribution of morphogenic traits in their hands and their faces were studied. The frequency distribution of the free earlobes were higher (63%) than attached earlobes(37%). Among the studied groups the frequency distribution of the free earlobe was found to be male 117(31)% and female 124(33)% while the attached earlobe was male 66(17)% and female 74(19%). This result showed similarities with the study of Ebeye et al.(2014) who reported the frequency of unattached earlobe was found to be more in the Nigeria studied population (69%) copmped to the attached earlobe (31%).

Among the studied group the curved widow's peak were found to be male 138(36%) and female 85(22%) while straight hairline was male 45(12%) and female 113(30%). The frequency distribution of the curved widow's peak was higher (59%) than the (41%) straight hairline (no widow's peak). The current result was in agreement with the report of Adekoya et al.(2020) who reported that the frequency distribution of the curved widow's peak in the studied population showed higher frequency distribution curved widow's peak than straight hairline (no widow's peak). This result disagree with Adekoya et al.(2020). The distribution of the widow's peak in the sampled population showed less distribution of widow's peak (curved hair line) than no widow's peak (straight hairline) in Nigeria (Adekoya et al.(2020).

The frequency of tongue rolling ability showed that higher frequency distribution of tongue rollers(76%) than non-rollers(24%). This findings were similarities with the study of Onyije et al. (2012). It was observed that the frequency of tongue rollers was higher in females(40%) than males(36%) in the studied population. This result agree with Odukuma et al.(2008) it was observed that the incidence of tongue roller was higher in females than males.

The frequency distribution of bent little finger lower than straight little finger in both male and female and the total percentage of straight little finger(91%) were higher than bent little finger(9%). The frequency distribution of this study agree with the study of Adekoya et al.(2020) who reported that the straight little finger was found to be more expressed (63.3%) among sampled individuals than bent little finger 367(36.7%). The distribution of bent little finger of this study were almost the same(4%) in both male and female. But, Ordu and Nwosu (2015), who reported a higher prevalence of straight little fingers in females than males in their studies.

The frequency distribution of straight hitchhiker thumb were lower in males 66(17%) than females 91(24%) while the bent hitchhiker's thumb was male 117(31%) and females was

107(28%). Based on this study, the frequency distribution of straight hitchhiker thumb of male was lower (48%) than straight hitchhiker thumb of female (52%). This result showed an agreement with the study conducted with Adekoya et al. (2020). This result also showed similarities with the studies of Onyije et al. (2012) who reported similar lower prevalence of hitchhiker's thumb in south south, Nigeria. However, Usha et al. (2016), observed a higher prevalence of curved thumb (53.5%) in Thrissur district in India.

5.2. The association of morphogenic Mendelian traits with gender

Among the studied that observed the morphogenetic traits with selected population, a significant association were observed in morphogenic traits of widow peak and bent hitchhiker thumb with gender(males). This result contradict with the study conducted by Adekoya et al. (2020) that was no significant association between widow peak with gender in selected population The curved widow's peak in male was 221(22.1%) and 147(14.7%) in females with X^2 =0.914. But the result agree with the study observed by Adekoya et al. (2020) that was significant association between straight hitchhiker thumb with gender in selected population. The other morphogenetic traits were free earlobes, tongue rolling and bent little finger did not show significant association with gender. Different result was observed by Adekoya et al. (2020) that was association between free earlobe and tongue rolling with gender but similar result was reported between bent little finger and gender.

5.3. The distribution of dominant and recessive morphogenic traits

This study found difference in the 5 selected morphogenetic traits in both the distribution of their dominant and recessive phenotype and the occurrence of these phenotypes in males and females in the selected population of 381 students in Table-6 and Figure-11. Most of the dominant phenotype studied in morphogenetic traits were in earlobe attachment, hairline distribution and tongue rolling expressed as a dominant character. These dominant phenotype morphogenetic traits were more distributed in the population of the study. This could be contributed by both homozygous and heterozygous genotypes account for the dominance trait. The earlobe attachment, widow's peak and tongue rolling were higher distribution in males than the females. The little finger and hitchhiker thumb was expressed as recessive phenotype. The bent little finger and straight hitchhiker thumb (dominant character) were expressed less in both males and females of the population. But, the study of Adekoya et al.(2020) the number of recessively expressed phenotype for morphogenic traits evaluated was more in the male individual than female which may be attributed to higher male number than the in the sampled population.

6. CONCLUSION AND RECOMMENDATION

6.1. Conclusion

The frequency distribution of the five morphogenic traits include the earlobe attachment, widow's peak, tongue rolling, bent little finger and hitchhiker thumb were studied. Analysis of the frequency and distribution of the 5 traits in 381 male and female students showed that the dominant phenotype more expressed in the facial morphogenetic traits of earlobe, widow's peak and tongue rolling. The recessive phenotype more expressed in hands morphogenetic traits of bent little finger and hitchhiker thumb. Findings from this study showed that tongue rolling was the more dominant observed phenotype than recessive phenotype and the frequency distribution of bent little finger were lower than the straight little finger. In curved widow peak's the male was higher frequency distribution than the female but in the rest three traits were higher in females than males. Among the studied morphogenetic traits, with a selected population a significant association were observed in morphogenic traits of widow peak and bent hitchhiker thumb with gender. The other morphogenetic traits were earlobe attachment, tongue rolling and bent little finger did not show association with either of male or female.

6.2. Recommendation

Based on the findings from this study showed that morphogenetic trait is important in forensic and antropological studies. In the future, further studies with greater sample size is needed to identify the distribution of these traits in south region of Ethiopia.

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Appendices

Appendix 1

Addis Ababa University Department of Zoological Science

Research Title: Frequency of Human Monogenic trait at Sodo comprehensive high school
Place of collection:_____ Collector's name_____ Date of collection_____
Principal investigator_____ mobile phone _____ Email_____
School principal_____ mobile phone_____ Email_____
Advisor_____ mobile phone_____ Email_____

No.	participant					Morphological traits scoring form									
	Age		Sex		Grade	Earlobe attachment		Widow peak		Tongue rolling		Hitchhiker thumb		Bent-little finger	
	15-20	>20	M	F	9-12	Attached	Free	V-Shape	Straight	Rolling	No-rolling	Present	Absent	Bent	Straight
1															
2															
Total															

Remember: Every data collection form should attach with letter of informed consent forms field and signed by each participant guardian. Morphological trait guiding chart that used during scoring it should be color print.

Appendix 2

የአዲስ አበባ ዩኒቨርስቲ የዞሎጂካል ሳይንስ ትምህርት ክፍል
የጥናት ርዕስ : በወላይታ ሶዶ ከተማ የሶዶ ከፍተኛ 2ኛ ደረጃ ት/ቤት ተማሪዎችን ጥቂት ውጫዊ አካል ማጥናት
የሚሰበሰቡበት ቦታ _____ የሰብሳቢ ስም _____
የተሰበሰቡበት ቀን _____
ዋና ተመራማሪ _____ ስልክ_____
አድራሻ_____
ር/መ/ር_____ ስልክ_____
አድራሻ_____
አማካሪ _____ስልክ _____ አድራሻ _____

ተራ ቁጥር	የተሳታፊዎች መረጃ					የውጫዊ አካል ክፍል ባህሪያት መመዝገቢያ ቅፅ									
	እድሜ		ፆታ		ክፍል	የታችኛው የጆሮ ክፍል ሁኔታ		የፊት ለፊት ፀጉር ቅርፅ ሁኔታ		የምላስ መጠቅለል ሁኔታ		የአውራ ጣት ወደኋላ መታጠፍ ሁኔታ		የትንሿ ጣት መጉበጥ ሁኔታ	
	15 - 20	>20	ወ	ሴ	9-12	የተያያዘ	ነፃ	V-ቅርፅ	ቀጥ ያለ	የሚጠቀለል	የማይጠቀለል	አለ	የለም	የጎበጠ	ቀጥ ያለ
1															
2															
ጠቅላላ															

ማሳሰቢያ:- እያንዳንዱ የውጫዊ አካል ክፍል ባህሪያት መመዝገቢያ ቅፅ ከወላጅ ፈቃድ መጠየቂያ መመዝገቢያ ቅፅ ጋር መያያዝ አለበት

Appendix 3

LETTER OF INFORMED CONSENT

Adult-in-Life Study Addis Ababa University Department of Zoological Sciences.

Title of Research: Frequency of Human Monogenic trait at Sodo comprehensive high school

Name of principal investigator: Fantahun Ayele

Phone Number of principal investigator: 0911020818

Dear Parent/Guardian/:

We are very excited to inform you that your youth will have the opportunity to participate in the questioner entitled.

CONFIDENTIALITY: The records from this study will be kept as confidential as possible. No individual identities will be used in any report or publications resulting from the study.

If you have any questions about the study, please contact Mr. Fantahun Ayele by calling 0911020818. You can also contact school principal: Mr, Lewutu office phone no. +251465512065 with any questions about the rights of research participants or research related concerns.

CONSENT YOU ARE MAKING A DECISION WHETHER OR NOT TO PARTICIPATE YOUR YOUTH IN RESEARCH STUDY. YOUR SIGNATURE BELOW INDICATES THAT YOU HAVE DECIDED TO YOUR YOUTH TO PARTICIPATE IN THE STUDY AFTER READING ALL OF THE INFORMATION ABOVE AND YOU UNDERSTAND THE INFORMATION IN THIS FORM, HAVE HAD ANY QUESTIONS ANSWERED AND HAVE RECEIVED A COPY OF THIS FOR YOU TO KEEP.

We are asking permission for your youth to participate in this program. Please complete the attached consent form and indicate whether you do or do not want your youth to participate in the survey.

Yes ☐ ☐ **No**

(Mark X for your choice)

Name of Parent /Guardian/: ---------- Signature ---------- Date ----------

Name of the students:---------- Signature ---------- Date ----------

Appendix 4

ፈቃደኝነት ማረጋገጫቅጽ

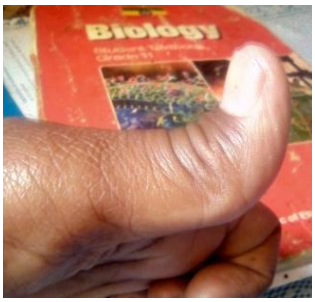
አዲስ አበባ ዩኒቨርስቲ፡-የስነ-እንስሳት ሳይንስ ጥናት ትምህርት ክፍል
የምርምር ፕሮጀክት ርዕስ፡- በወላይታ ሶዶ ከተማ የሶዶ ከፍተኛ 2ኛ ደረጃ ት/ቤት ተማሪዎች መካከል የሰውነት ቅርፅ ባህሪይ ድግግሞሽ ትኩረት ያደረገ ጥናትና ምርምር
የዋና ተመራማሪ ስም ፡- ፋንታሁን አየለ
የዋና ተመራማሪ የስልክ ቁጥር፡- 0911020818
ውድ ወላጅ / አሳዳጊ /
ለእርስዎ ለማሳወቅ የምንፈልግው ልጆ/የሚያሳድጉት ልጅ/በሚከተለው የጥናት መረጃ /phenotypic traits/**በመስጠት እንዲሳተፍ መልካም ፍቃዶን እንዲያደርጉልን ነው፡፡**
ሚስጥራዊነት፡- ከዚህ ጥናት የተገኙ መረጃዎች ሚስጥር ሙሉ በሙሉ ከፍተኛ ደረጃ የተጠበቀ ነው፡፡ከጥናቱ በተገኙ ማናቸውም ዘገባዎች ወይም ህትመቶች ላይ ማንነቶች ጥቅም ላይ አይውሉም፡፡ስለጥናቱ ማንኛውም ጥያቄ ካለዎት በሚከተሉት ስልክ ቁጥሮች ደውልው ማረጋገጥ ይችላላሉ፡፡፡-
አቶ _____ስልክ_____ወይም የት/ቤቱ ርዕሰ መምህር አቶ_____ በስልክ_____
ውድ ወላጅ / አሳዳጊ /
የእሮሶን መልካም ፍቃድ ልጆ/የሚያሳድጉት ልጅ/ በጥናቱ እንዲሳተፍ ከላይ የተጠቀሰውን መልእክት በአግባቡ ተረድተው በተለመደው ፊርማዎ እያረጋገጥሉን ነው፡፡
ለመልካም ፍቃዶ በቅድሚያ እናመሰግናለን፡፡
እንዲሳተፍ ፍቅጃለሁ **አልፈቀድኩም**
(X **ምልክት ያመልክቱ)** ☐ ☐
የወላጅ /የአሳዳጊ /
ስም ፡ _____ፊርማ_____ ቀን _____
የልጅ ስም ፡_____ክፍል _____ ፊርማ _____ቀን _____
ማስታወሻ፡- ጥናቱ እንደተጠናቀቀ መረጃዎቹ እንዲወድሙ ይሆናል፡፡
እናመሰግናለን !!

Appendix 5

Photos are showing morphogenic traits Ear lobe attachment, Hairline distribution, Tongue rolling, Hitch-hikers thumb, and Bent little finger (Photos are taken from wolaita sodo comprehensive high school among studied population, 2023).

Free Earlobe

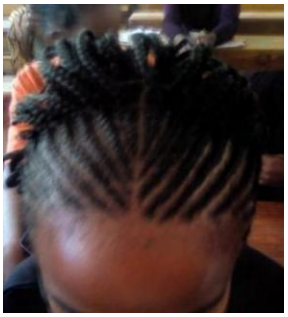
Attached Earlobe



Bent hitchhiker thumb

Straight hitchhiker thumb

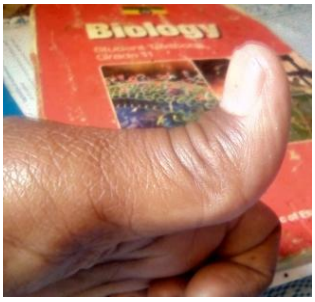
Widow's peak



Straight hairline

Tongue rolling

Non-Rolling tongue



Bent hitchhiker thumb

Straight Hitchhiker thumb

Bent Little finger

Straight Little finger

Appendix 6

COLLEGE OF NATURAL & COMPUTATIONAL SCIENCES

Addis Ababa University

OFFICE OF THE DEAN

የተፈጥሮና ኮምፒዩቴሽናል ሣይንስ ኮሌጅ

አዲስ አበባ ዩኒቨርሲቲ

የዲን ጽ/ቤት

Ref.No. CNCSDO/507/15/2023

ቁጥር፡

Date February 20, 2023

ቀን፡

To Whom It May Concern

The College of Natural & Computational Sciences Institutional Review Board (**CNS-IRB**) Committee in its meeting held on **08/02/23, Minute No. IRB/03/2015/2023** has examined the project proposal entitled **"**Frequency of human monogenic trait at Sodo Secondary Comprehensive high school in Wolaita zone south region, Ethiopia**"** **by Fantahun Ayele** from the Addis Ababa University.

The proposal is approved for implementation for one year, effective February 20, 2023.

With regards,

Tileye Feyissa, (Prof)
Dean, College of Natural & Computational Sciences
Addis Ababa University

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Please Quote our reference number in you correspondence

"Examine all things; hold fast that which is good" "ሁሉን መርምሩ መልካሙን ያዙ"