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SOME MONOGENIC MORPHOGENETICS TRAITS FREQUENCY AMONG STUDENTS OF DAGMAWI BERHAN PRIMARY SCHOOL ADDIS KETEMA SUB CITY ADDIS ABABA, ETHIOPIA

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A Thesis Submitted to Department of Zoological Sciences in Partial Fulfillment of the Requirements for the Degree of Master of Science Degree in Biology

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A Thesis Presented to the School of Graduate Studies of the Addis Ababa University in Partial Fulfillment of the Requirements for the MSc in Biology (Summer-In-Service)

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DECLARATION

This thesis is entitled "**Some Monogenic Morphogenetics Traits Frequency Among Students Of Dagmawi Berhan Primary School Addis Ketema Sub City Addis Ababa, Ethiopia".** I declare that this is my original work and has not been presented in any other university and organization yet.

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Abstract

Morphological traits are a structural characteristic of an organism that is determined genetically and transmitted from parent to offspring. Some of these characteristics, such as tongue rolling, widow's peak hairline, bent little finger, and ear lobe attachment, are thought to be exact epitome of simple dominant and recessive patterns of transmission; as a demonstration of how Mendelian genetics works, they are clear, and easy to follow epitomes. Thus, these traits were little to No study conducted and documented in Ethiopian population. So, this study has its own contribution to asses and documents the data for next studies as reference. The general objective of this study was to investigate the distribution and frequencies of the morphological traits of tongue rolling, earlobe attachment, widow’s peak, Hitch-hiker’s thumb, Bent little finger and long palmar muscles pattern among Students of Dagmawi Berhan primary school in 2020/2021 academic year. Morphological traits of grade 7 and 8 students of both sexes who volunteered were taken from each participant after agreement or consent was obtained from the students and their respective parents, indicating their readiness to participate. Data collection for morphological traits was done utilizing an observation and recording technique. Figures, tables, and words were used to present the findings. In this study the frequency distribution of the curved widow’s peak was lower than straight hairlines among the population. There were also the more frequency distribution present long Palmaris muscle was found to be male 106 (36%) and lower distribution in female 83 (29%). The study showed that among the morphogenetic traits assessed with the selected population, a significant association was observed in morphogenetic traits of Widow’s peak; tongue rolling, Earlobe attachment and Palmaris longues muscle with sex in the selected population. Other morphogenetic traits which were bent little finger and hitchhiker thumbs did not show association with either of the sex in the study.

Key Words: bent little fingers, longus Palmaris muscle, Morphological traits, Widow’s peak

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1. Introduction

1.1 Background of the Study

Morphological traits are structural characteristics of an organism that are determined genetically and transmitted from parent to offspring. Most human genetic traits can be classified as either monogenic or complex. Monogenic traits are controlled by a single gene and are recognized by their Mendelian patterns of inheritance within families. In human there are monogenic traits that can be easily scored by physical observation. These traits include such as tongue rolling, widow's peak hairline, cleft chins, ear lobe attachment and are thought to be exact epitome of simple dominant and recessive patterns of transmission. Morphogenetic traits are also known as hereditary traits; these traits may be dominant or recessive traits. Most of the genes are transmitted in the Mendelian pattern and a few multiple genes are grouped together and transmitted through the non-Mendelian pattern that includes: co-dominance, sex-linked genes and polygenes Onyije *et al*. (2012).

The fleshy, soft lower region of the external ear, or pinna, is known as the earlobe. It is the part of the human ear that extends below the antitragus and is the lowest part of the ear. The typical earlobe length is around two centimeters, and it gradually lengthens with age. Phenotypically the ear lobe in humans can be free hanging (unattached) or attached; the attached variety is sometimes referred to as 'lobe less' Ebeye *et al*. (2014). These traits are governed by two alleles: dominant and recessive.

The hairline is the point on the head where the hair begins. The hairline could be V shaped as in widow's peak or straight. A widow's peak is a V shaped hairline across the top of the forehead behind which the hairs grows in widow's peak hair growth on the forehead is suppressed in a bilateral pair of per orbital field. Normally this field joins in the middle of the forehead so as to give a hairline that runs straight across. When the point of meeting on the forehead of the top border of these fields is lower than normal, Widow's Peak occur Ebeye *et al.* (2014). The two alleles are responsible for regulating the shape of hairline. Widow's peak is dominant trait while the straight one is recessive. This character follows simple dominant-recessive transmission pattern. The pattern of inheritance follows the Mendel's law of transmission, which assumes that (W) allele is for widow's peak which is dominant while (w) allele is for recessive straight hairline. If an individual expresses the widow's peak hairline shape, the possible genotype is (WW) homozygous or (Ww) heterozygous while one that expresses straight hairline possesses the genotype (ww) Naz *et al*. (2014).

Deglutition, taste, and speech are all performed by the tongue, which is a highly muscular organ. The hypoglossal nerve provides motor innervation to the tongue. The palatoglossus is the exception, as it is innervated via the pharyngeal plexus. Sokoloff and Deacon (1992).There has been earlier research on tongue rolling characteristics Sturtevant (1940).The dominant gene is responsible for the folding and rolling of the tongue's lateral margins, whereas the recessive gene is responsible for the inability to roll and fold the tongue. The capacity to move the tongue was divided into rollers and non-rollers by Sturtevant, with the roller being the most dominant. The author also noted that about70% of people of Europeans are able to roll up the lateral edges of the tongue, while the remaining 30% could not Sturtevant (1940).It is controlled by a single gene with a pair of alleles. The appropriate to roll the lateral edge of the tongue in an upward manner into a tube is tongue rolling. The muscles of the tongue allow some individuals to fold their tongues into specific shapes and roll their tongue into a tube. The rolling and folding of the tongue are often described as a dominant trait with simple Mendelian inheritance Hsu *et al*. (1948). These traits are of enormous value from physical anthropological window especially in studying population variation and human diversity Odokuma *et al*. (2008).

Hitchhiker's thumbs, also known as "distal hyper extensibility" or "bent thumb," are characterized by the ability to bend the thumb backwards to a 90°-degree angle. All thumbs that could bend at or greater than a 50° degree angle were Hitchhiker's thumbs proposed by Glass and Kistler. This trait is thought to be governed by the recessive gene (h); therefore the trait emerges in a homozygous state. "Hitchhiker's thumbs" are thumbs that bend backwards with a wide angle between the two segments in certain persons (phalanges). Straight thumbs (S) and hitchhiker's thumbs (H) are the only two types of thumbs based on bending ability, and the characteristic is regulated by a single gene with two alleles, with the S allele being dominant. This was proposed by Glass and Kistler in 1953, and it has received relatively little attention since then. Kirner was the first to describe the phenomena of the bent little finger.

The dominant gene (Bb/BB) causes bent small fingers, while the recessive gene causes straight little fingers (bb). Clinodactyly, Camptodactyly, and Kiner's deformity are the three distinct forms of bent little finger. Clinodactyly is a physical trait that occurs when the little finger diverges from the axial point of the finger. It is unrelate and to any deformity. Camptodactyly is defined as a persistent constriction of one or both little fingers at the distal proximal inter a phalangeal (PIP) joint, which was first described by Landouzy and is derived from the Greek words camptos, which means bend, and dactulos, which means finger Munir *et al*. (2015).

The Palmaris longus muscle originates from the epicondyleus medialis of the humerus and inserts into the Apo neurosis Palmaris and the distal section of the retinaculum muscular umflexorum in the anterior area of the forearm. It functions as an auxiliary flexor as well as tensioning the Apo neurosis Palmaris. Some writers claim that, aside from its secondary role, the loss of this muscle would not cause any significant loss of strength.

The Palmaris longus muscle, according to Alves *et al* (2011), had a significant genetic retreat with loss of function over human evolution and eventually extinction. Furthermore, they suggest that its removal will not result in a loss of wrist and hand function. On the other hand, this muscle presents a great clinical relevance when used as a donator tendon in surgery techniques as the reconstruction of the hand and the plastic surgery to repair neck and head, cases in which we can obtain a satisfactory functional and aesthetic reconstruction Ueda *et al*.(2007); Ozeri *et al*.(2009). These traits were may not well studied and documented in Ethiopian population. So, it attempts to document these traits in the population. The documentation of these traits could have a significance to develop high school genetics student project to understand inheritance in human population. Moreover, the knowing of these traits as personal identifier could create awareness to use them for forensic investigation. Thus, the research was designed to determine the frequency and distribution of the observable monogenic Mendelian traits such as tongue rolling, earlobe attachment, widow's peak, Hitch-hiker's thumb, Bent little finger and long palmar muscles pattern.

1.2. Statement of the problem

Genetic and morphological variation exists among organisms of the same the species, including human. Morphological characteristics are genetically transmitted unique physical features from one's parents; thus, they are generally referred to as morphogenetic or anthropogenic traits. Morphogenetic characteristics help to differentiate among organisms of the same species and are a source of variation Ebeye *et al.* (2014). Even though the system underlining genetic control of inheritance of these traits still remain difficult as they have been shown to be expressed differently in different populations of the world, their essentiality in understanding human evolution and diversity. Although there have been several studies on the distribution of some morphogenetic traits in Nigeria by several authors Adekoya *et al*.(2020).They have mainly been on the distribution of these traits and localized. These traits were widow's peak, hitchhiker's thumb, cleft chin, tongue rolling, earlobe attachment, dimpled cheeks, bent little finger, ability to taste phenylthiocarbamide (PTC), mid-phalangeal hair and polydactyly were assessed by observations. However, sampling a diversified population having different geographical and ecological backgrounds would not only provide a unique main street to better study these morphogenetic traits but also provide a better representation of the population Adekoya *et al*.(2020). Thus, these traits were little to No study conducted and documented in Ethiopia population. So, this study has its own contribution to asses and documents the data for next studies as reference. The generated information is creates an opportunity for fugitive identification for forensics investigation, teaching these traits in high school biology and school student project.

1.3. Significance of the Study

The findings of this study may be important for other studies on some Morphological characteristics of human being. Like Tongue rolling, widow's peak hairline, ear lobe attachment, Hitch-hiker's thumb, Bent little finger and long palmar muscles pattern and helps to develop strategies related to Morphological characteristics in primary school children. This may also contribute for further research efforts on focusing the frequency of Morphological traits among students between the ages of 13-15 and 16-17 years and create awareness about the traits. It can also give additional information regarding the morphogenetic variation. The aspect of relating morphogenetic traits has of great important used as a baseline for further anthropological researches and it will be useful to determine the frequency distribution of these traits among the population.

1.4 Objectives of the Study

1.4.1. The general objective of the study

The main objective of this study was to investigate the distribution and frequencies of the scorable morphological traits of human tongue rolling, earlobe attachment, widow's peak, Hitch-hiker's thumb, Bent little finger and long palmar muscles pattern among school children.

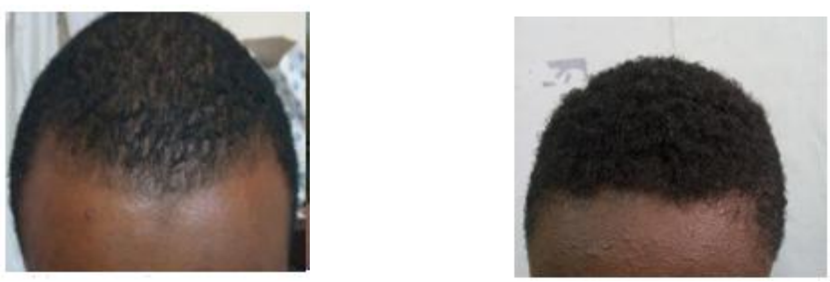
1.4.2 The specific objectives of the study were :-

- To determine phenotypic frequency of attached and free earlobes.
- To determine phenotypic frequency of tongue rolling, and widow's peak.
- To determine the phenotypic frequency of monogenic hand traits such as Hitchhiker Thumb, Bent Little Finger and the Palmaris Longus muscle.

2. Literature review

2.1 Widow's peak

The Widow's Peak is a major inherited trait that does not normally transmitted between generations. These are signs that the genes that control how characteristics are transmitted are present on autosomal chromosomes. The peaks come in a variety of sizes and shapes. People that don't have a widow's peak have a straight hairline Dougherty (2007). The hairline can be curved or straight, with the curved hairline displaying a V-shaped point descending from the middle of the head slightly above the forehead (also known as Widow's peak) (Figure 1). The two alleles are responsible for determining the form of the hairline. Curved Widow's peak is dominant character while the straight one is recessive. This trait follows simple dominant-recessive inheritance pattern. The pattern of transmission follows the Mendel's law of inheritance, which assumes that (W) alleles is for curved widow's peak, which is dominant whereas the allele (w) is for recessive straight hairline. If an individual expresses the curved widow's peak hairline shape, the possible genotype is (WW) Homozygous or (Ww) heterozygous while one that expresses straight hairline possesses the genotype (ww) Ebeye *et al.* (2014).



(a) (b)

Fig.1: The human hairlines on foreheads (a): curved widow peaks and (b): straight hairlines.

2.2 Pattern of Earlobe Attachment

The fleshy soft lower region of the external ear, also known as lobules auricular, is called earlobe. It's the only portion of the auricle that doesn't have cartilage to support it. It's made up of the rough areola and adipose (fatty) connective tissues, which lack the pinna's rigidity and elasticity. Earlobe is roughly 2 cm long on average and elongates gradually with age. It is either linked directly to the lateral side of the head or hangs freely away from the lateral side of the head (Figure 2). The earlobes are further classified into three different types on the base of attachment or angle such as obtuse, acute and right the single gene regulates this trait for which free earlobe is dominant and attached earlobe is recessive, however other factors such as sex and age also influence the length of earlobes Munir *et al*. (2015). This is observable trait in human being. The detached type is slightly bigger than the attached earlobe Ebeye *et al*. (2014).This variation in attachment of earlobe is a trait that is inherited from parents and its inheritance follows a pattern of Mendelian Inheritance. The pattern of transmission expresses how allele work together to produce characteristics. Understanding transmission patterns enables geneticists to predict the probability of an offspring inheriting certain traits from parents.

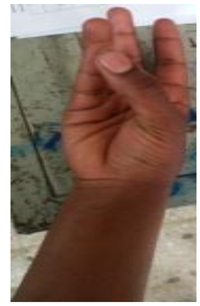
(a) (b)

Fig.2: The human earlobes attachment traits variation: panel (a) free earlobes and panel (b) attached earlobes.

2.3 Long palmar muscle

The Palmaris longus muscle originates from the epicondylus medialis of the humerus and inserts into the Apo neurosis Palmaris and the distal section of the retinaculum muscular umflexorum in the anterior forearm (Figure 3). Its function is to tension the Apo neurosis Palmaris and it also works as an auxiliary flexor. According to some writers, besides having a secondary purpose, there would be no cause loss of strength due to loss of this muscle. During human evolution, the Palmaris longus muscle experienced a filo genetic withdrawal with loss of function, eventually leading to extinction. Furthermore, they claim that losing it will not result in a functional absence of the wrist and hand. On the other hand, this muscle found a great clinical relevance when used as a donator tendon in surgery techniques as the reconstruction of the hand and the plastic surgery to repair neck and head, cases in which we can take a satisfactory functional and aesthetic reconstruction Ueda *et al*. (2007; Ozeri *et al*. (2009) The trait is controlled by a pair of alleles of the same gene.one of the allele is dominant over the other. In 1975, it was shown that there was an increased incidence of loss of the Palmaris longus muscle in patients suffering from manic-depressive psychosis and endogenous depression, it was revealed that the defect was genetically determined, inherited in a mono factorial way, and determined by an autosomal gene of a dominant character with incomplete penetrance. The loss of the Palmaris longus muscle was a dominant trait, its presence a recessive trait Mobin (2016).

One of the most variable muscles in the human body is the Palmaris longus muscle its agenesis is thought to be the most common anatomical variant. Some authors suggest that there is a relation between the distribution of the Palmaris longus muscle agenesis and different ethnic groups Alves *et al.* (2011). In a study with the Turk population, Ceyhan &Mavt (1997) reported that 63.91% of the individuals presented Palmaris longus muscle agenesis. However, Sebastin et al. (2006) found 4.6% of agenesis in Chinese, and Gangata (2009), when evaluating black individuals from African origin, observed that only 1.5% of the sample presented absence of the Palmaris longus muscle.



(a) **(b)**

Fig.3: The human the long Palmaris muscle variations: panel (a): long palmar muscle present and panel (b): long palmar muscle absent photo taken from Dagmawi Berhan School among study population (2021).

2.4. Bent little finger

Clinodactyly is the technical name for a little finger that bends inwards towards the ring finger. Streblomicrodactyly, streblodactyly, or camptodactyly is a condition in which the little finger bends inwards towards the palm and cannot be straightened out. Little fingers might curve inwards at a severe angle or be absolutely straight. (Figure 4) It's unclear if fingers are divided into two groups or if there is a continuous range of pinkly angled fingers. According to Hersh *et al*. (1953), bent little fingers bend inward at a 15 to 30 degree angle. They found that only 4 out of a sample of 4,304 people had what they considered to be bent little fingers. Marden *et al*. (1964) identified about 1% of Healthy new-borns as having bent little fingers and also Hersh *et al*. (1953) identified 51 families in which one or more children had bent little fingers. In 47 of the families, one parent had bent little Fingers and the other had straight. Hersh *et al*. (1953) concluded that bent little finger was caused by a single dominant allele, but the four families in which both parents of a B child were S are inconsistent with this Dutta (1965) found two extended families with bent little fingers. Six children of S x S parents were all S, while 22 out of 34 children of B x S parents were B. This fits the model of bent little finger being caused by a single dominant allele, but the number of families is very small. Leung and Kao (2003) found one more extended family in which bent little fingers were common; they concluded that it fit the model of B caused by a dominant allele, but the data also fit a model in which it is recessive.

(a) **(b)**

Fig.4: The human bent little fingers variations: (a) bent little fingers and (b) straight little finger.

2.5 Hitchhiker's Thumb

Hitchhiker's thumb is a hypermobile (very flexible) thumb that can bend backwards beyond its normal range of motion (Figure 5). This disorder, properly known as distal hyper extensibility, is painless and has no effect on the thumb's ability to operate. The bendability of our thumb is governed by the distal inter phalangeal joint, the bendy place where the bones of our thumb are connected. People with hitchhiker's thumb have distal joints that may bend back as much as 90 degree. This resembles classic roadside hitchhiker's position, with the thumb extended in the hopes of hatching a ride. Hitchhiker's thumb is a condition that affects one or both thumbs. It hasn't been well researched, and there is little to no information on its dissemination in the United States or elsewhere in the world. Some people with hitchhiker's thumb may have acquired two recessive copies, or alleles, of the gene that determines thumb straightness. This means that the trait for hitchhiker's thumb was present in both parents of the person born with it. If instead one parent had the dominant gene for thumb straightness and the other had the recessive gene for hitchhiker's thumb; their offspring wouldn't have the condition. People with the recessive gene for this condition are called carriers. A person who carries a recessive gene would have to have a child with another carrier of the gene in order for that child to inherit the trait Afsaneh (2019).

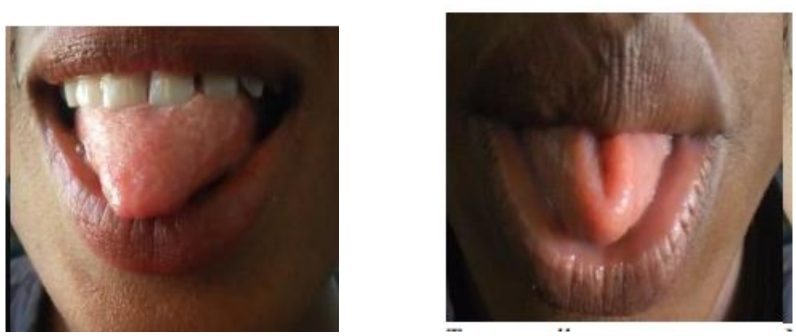
A genotype is a group of genes that are responsible for a trait, and a phenotype is the characteristics of that particular trait. Hitchhiker's thumb is a phenotypic rather than a hereditary illness or disorder. . Phenotype consists of traits that influence the appearance and behaviour of a person. Traits are alleles that help in the formation of chromosomes and fall into two categories: dominant traits and recessive traits. When alleles combine together, some become stronger than the others. This stronger allele is responsible for the dominant trait. A person with dominant traits will have a straight thumb, which can only be folded toward the palm. Dominant alleles can be found in all organisms. In case the dominant allele fails to show its presence, the recessive allele will be expressed. These are known as recessive traits. A person with recessive traits will have a hitchhiker thumb that can be folded to the back of the hand. Meanwhile, a person has a hitchhiker thumb only when he receives two recessive alleles from the parents Brennan (2021).

(a) **(b)**

Fig.5: The human Hitchhiker's Thumb variations: (a) straight (present) Hitchhiker’s Thumb and (b) bent (absent) Hitchhiker’s Thumb.

2.6 Tongue rolling

Some people are able to roll their tongue into a tube, whereas others are unable to do so. This is one of the most common characteristics used by biology teachers in high school genetics lessons to show basic genetic concepts (figure 6). Alfred Sturtevant (one of the pioneers of Drosophila genetics) described tongue rolling as a simple bi-allele character, with the allele for rolling (usually given the symbol T or R) being dominant over the allele for no rolling (t or r) Sturtevant (1940). The dominant gene is responsible for the tongue's lateral edges folding and rolling, whereas the recessive gene is responsible for the tongue's incapacity to roll and fold. Other researchers have claimed that these characteristics are learned rather than genetically regulated. These traits are of enormous value from physical anthropological window especially in studying population variation and human diversity Odokuma *et al.* (2008). Many studies have shown that the myth is incorrect, but tongue rolling remains a popular subject in genetics classes. People, when first asked, either can easily roll their tongue (here called "R"), or cannot roll it at all ("NR"). The proportion of people who can roll their tongue ranges from 65 to 81 percent, with a slightly higher proportion of tongue-rollers in females than in males Sturtevant (1940), Urbanowski and Wilson (1947), Liu and Hsu (1949), Komai (1951), Lee (1955). However, some people, especially children, cannot roll their tongue when first asked but later learn to do so (Sturtevant 1940). Komai (1951) found that the proportion of tongue-rollers among Japanese school children increased from 54 percent at ages 6-7 to 76 percent at age 12, suggesting that over 20 percent of the population learns to tongue-roll during that age range. That some people learn to roll their tongues after first being unable to is the first evidence that this is not a simple genetic character. There are also some people who can only slightly roll the edges of their tongue and cannot easily be classified as rollers or non-rollers.



(a) (b)

Fig.6: The Human variation in tongue rolling ability (a): tongue roller and (b): non-tongue roller.

2.7 Non Mendelian traits of inheritance

The Mendelian inheritance trait obeys the rules stated by Mendel. The non-Medelian inheritances are extension of the Mendelian inheritance with deviations from his assumptions as the result there is modification of phenotypic ratio. The factors accountable for these modifications are number of alleles (multiple alleles), linkage, epistasis, polygenic inheritance and lethal genotypes

There are a number of human traits, which have more complex mechanism of inheritance than Mendelian traits. Such mechanisms of inheritance are called non-Mendelian inheritance**,** and they contain inheritance of multiple allele traits, traits with codominance or incomplete dominance, and polygenic traits, among others, all of which are described below Suzanne and mandeep (2021).

2.7.1 Codominance

Codominance is the one of the intra-allelic interactions where neither of the allele dominant nor recessive. In genetics, codominance is a phenomenon in which two alleles (different versions of the same gene) are expressed in an organism to the same degree. As a result, traits linked to each allele are shown at the same time.

The MN blood group system in humans is an example of codominance. The M and N alleles control the MN blood type. Individuals who are homozygous for the M allele have a surface molecule (called the M antigen) on their red blood cells. Similarly, those homozygous for the N allele have the N antigen on their red blood cells. Heterozygotes those with both alleles carry both antigens. An example of codominance for a gene with multiple alleles is seen in the human ABO blood group system. Persons with type AB blood have one allele for A and one for B; the O allele is recessive (its expression is masked by the other alleles). Speckled hens, which contain alleles for both black and white feathers, and roan cattle, which have genes for both red and white hair, are examples of codominance in animals. Plants exhibit codominance as well. Rhododendrons that express both red and white genes for flower colour, for example, produce blooms with both red and white petals Rogers (2020).

2.7.2 Incomplete Dominance

Incomplete dominance occurs when the dominant allele is not totally dominant, thus that intermediate of two alleles for a particular gene both create proteins, but one protein is not functional. As a result, the heterozygotes produce half the amount of normal protein that a person who is homozygous for the normal allele produces. Tay Sachs illness, for example, is incomplete dominance in humans Suzanne and mandeep (2021). In this situation, the normal allele produce an enzyme that aids in the breakdown of lipids .The generation of a non-functional enzyme is caused by a defective allele for the gene. Heterozygotes with one typical and one insufficient allele produce half as much usable enzyme as a normal homozygote, which is generally enough for appropriate development. Homozygotes with only defective alleles, on the other hand, produce only the non-functional enzyme. This causes lipid accumulation in the brain to begin in the *in vtero* (womb), causing serious brain damage. The majority of people with Tay Sachs illness die at an early age, usually before the age of five.

2.7.3 Polygenic Traits

A number of human traits are controlled by more than one gene. These traits are called polygenic traits. The alleles of each gene have a very small additive effect on the phenotype. There are several possible combinations of alleles, especially if each gene has multiple alleles. Thus, a whole continuum of phenotypes is possible (Fig.7). 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 as continuum shown in figure 7. For case, one adult's stature might be 1.655 m (5.430 feet), and another adult's height might be 1.656 m (5.433 feet).

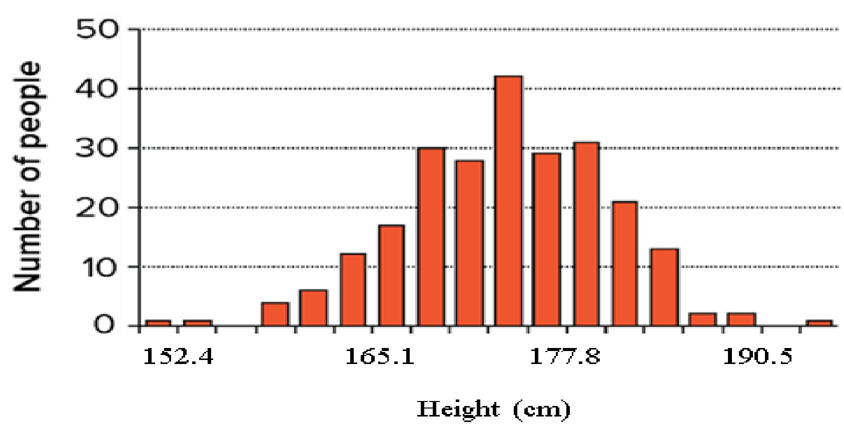


Fig. 7 Continuous variation of human height depicts the two extremes

2.7.4 Pleiotropy

Some genes affect more than one phenotypic trait. This is known as pleiotropy. There are many examples of pleiotropy in humans. They in general involve important proteins that are needed for the normal development or functioning of more than one organ system. An example of pleiotropy in humans found with the gene that codes for the main protein in collagen, a substance that helps form bones. This protein is also important in the ears and eyes. Gene mutations cause difficulties not just in the bones, but also in these sensory organs, which is how the gene's pleiotropic effects were discovered. Sickle cell anaemia is a good example of pleiotropy. When a mutation in the gene that ordinarily codes for the red blood cell protein haemoglobin occurs, it causes this recessive genetic condition. People with the disorder have two alleles for sickle-cell haemoglobin, so named for the sickle the sickle-shaped red blood cells block tiny blood arteries, resulting in stunted physical growth, certain bone abnormalities, renal failure, and strokes, among other phenotypic impacts. Under particular situations, such as physical exertion, their red blood cells take on a certain shape.

Pleiotropic effects can occur for a variety of causes, including: 1) the gene's distinct enzymatic products catalyse diverse processes. 2) The degree to which an enzymatic product responds with various substrates. 3) Separate product allocations to two different functions or organelles 4) various features of a single gene product Expenses associated with other activities counterbalance each of these activities. As a result, this system has developed in such a way that trade-offs are visible, and the degree of pleiotropy in genes is determined as a result. When obtaining a secondary trait, weak trade-offs indicate small losses in primary trait functioning. Selection favors scenarios when pleiotropic genes boost gene function at little cost to other functions, according to studies. The fitness and phenotypic strength of an organism are determined by this idea. Pleiotropy is more prevalent in highly expressed genes, implying that pleiotropy and gene expression evolved together Guillaume and Otto (2012).

Colorless seed coats on pea plants generated white flowered plants with no pigmentation on their avils, whereas colorful seed coats produced plants with colored flowers and colored axils, according to Gregor Mendel. The gene that controlled seed coat color was also in charge of blossom and axil colors in this example.

In fruit flies (Drosophila), a gene controls wing developments as well as the number of egg strings in the female's ovaries, the position of scutellum bristles, and life span.

The frizzle gene (Figure 8), which causes hens' feathers to curl outward rather than lay flat, was also shown to be responsible for abnormal body temperatures, higher metabolic and blood rates, greater digestive capacity, and few egg laying counts.

Figure 8: Poncho, a chicken with the frizzle gene Courtesy of Jennifer Key Lobo (2008).

Pleiotropy may be seen in people in a variety of forms, some of which are linked to disease. Gauntness, limb elongation, greater susceptibility to heart disease, and other abnormal traits are all symptoms of Marfan syndrome, which is caused by a single gene. Another illness produced by a pleiotropic gene is phenylketonuria. Mental retardation, eczema, and pigment disorders are all caused by this gene. While they can be detrimental to an organism's fitness, pleitropic genes' phenotypic impacts help us to better understand and map the roles of individual genes Lobo (2008).

2.7.5 Epistasis

Epistasis is one of the traits of inheritance where there is an inter-allelic interaction occurs between genes controlling the same metabolic pathways. Hence, one of the loci hides the phenotypic effect of the other is named as epistatic locus and the other one hypostatic locus. The phenotypic ratio of the Mendelian dihybrid cross-modified according to the types of epistatic interactions but the genotypic ratio remains the same. Epistasis can occur in a variety of different ways and result in a variety of different phenotypic ratios, as illustrated in Table 1 and types of epistasis which are described below Ilona Miko (2008).

Basic interaction inheritance [9:3:3:1 Ratio:] Complete dominance at both gene pairs; interaction between dominant alleles, as well as interaction between both homozygous recessives, results in new phenotypes.

Recessive Epistasis [9:3:4 Ratio]: Recessive epistasis occurs when recessive alleles at one locus hide the expression of both (dominant and recessive) alleles at another locus. Supplementary epistasis is the term for this sort of gene interaction. Grain color in maize is a good example of such gene interaction.

Dominant Epistasis [12: 3: 1 Ratio]: Dominant epistasis occurs when a dominant allele at one location may hide the expression of both alleles (dominant and recessive) at another locus. In other words, another dominant gene masks the expression of one dominant or recessive allele. This is also referred to as simple epistasis. An example of dominant epistasis is found for fruit colour in summer squash. There are three types of fruit colours in this cucumber, viz., white, yellow and green. White colour is controlled by dominant gene W and yellow colour by dominant gene G. White is dominant over both yellow and green.

Duplicate Recessive Epistasis [9: 7 Ratios]: Duplicate recessive epistasis occurs when recessive alleles at one of the two loci can hide the expression of dominant alleles at the other locus. Complementary epistasis is another term for this. Flower color in sweet peas is the greatest example of double recessive epistasis.

Duplicate Dominant Epistasis [15: 1 Ratio]: Duplicate dominant epistasis occurs when a dominant allele at one of two loci can mask the expression of recessive alleles at the other locus. This is referred to as duplicate gene action. The awn character in rice is good example of duplicate dominant epistasis. Rice awn development is governed by two dominant duplicate genes (A and B).

Table 1: Modified dihybrid phenotypic ratio due to gene interaction

Ratio	Genotypes				Interaction types
AaBb*AaBb	A-B-	A-bb	aaB-	Aabb	
9:3:3:1	9	3	3	1	Basic interaction inheritance
9:3:4	9	3	4		Recessive epistasis
12:3:1	12		3	1	Dominant epistasis
9:7	9	7			Duplicate recessive epistasis
15:1	15			1	Duplicate dominant epistasis

3. Materials and Methods

3.1. Description of the Study Area

The study was conducted in Dagmawi Berhan Primary School which is found in Addis Ketema sub city, Addis Ababa, Ethiopia (Fig. 9). The city was divided in to 11sub cities and have a total population of 3, 773,999 as reported by Central Statistics Agency (2021).   Addis Ketema is one of the 11sub cities which has a population size of 351, 723 (Central statistics agency, 2021) It borders with the districts of Gullele in the North, Arada in the East, Lideta in the South and Kolfe Keranio in the West. It is an epicenter of commerce of the country because one of the biggest market places called Merkato is located here. It is called Africa's largest open-air market place.

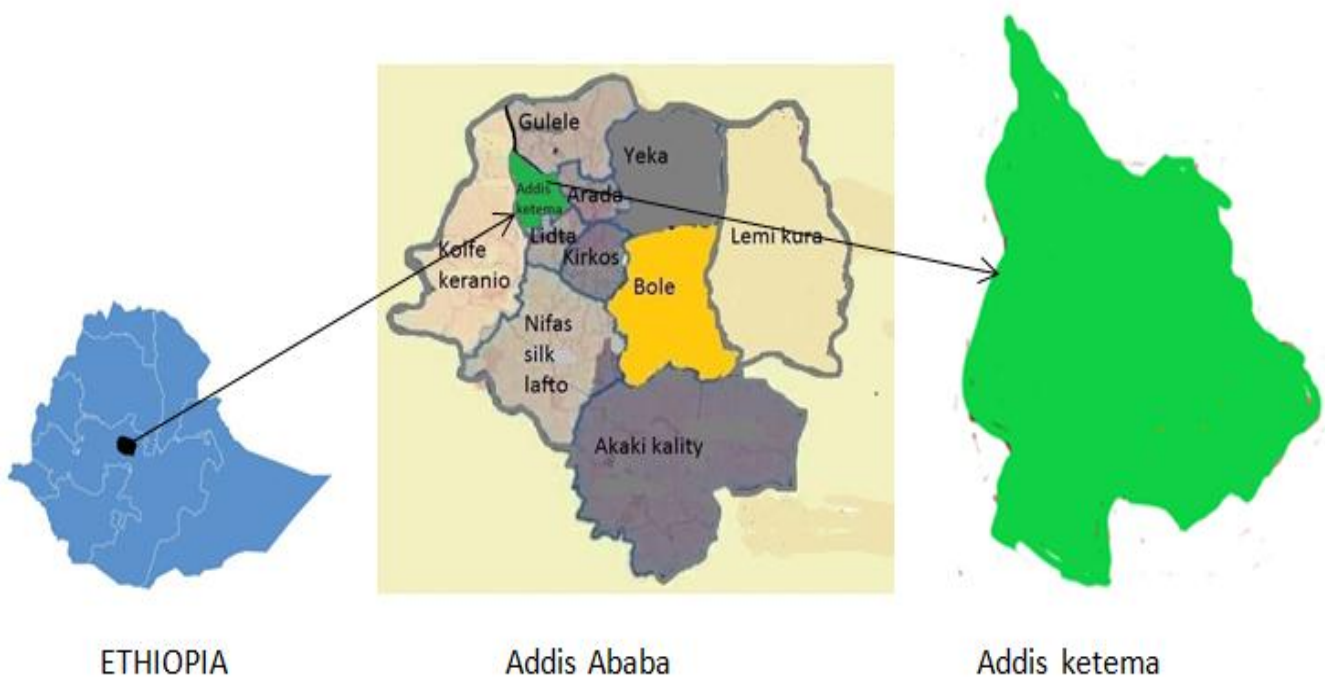


Fig.9: Map of the 11 districts (sub cities) of Addis Ababa

3.2. Study Populations

Based on the 2020/2021 Dagmawi Berhan's primary school students' statistics, from grade 7-8,the school has total students of 398, of whom 175 are males and 223 are females. The study was conducted in 125 males and 166 female volunteer students.

3.3. The socio demographic characteristics of the study population

The socio demographic characteristics of subjects were involved in the study from school (Table -2). A total of 291 students were consented and participated in the study from grade seven and eight. Males 62 and 86 females were from grade seven and males 63 and females 80 were from grade 8 .It is also indicated that 137(58 males and 79 females) and 11(4 males and 7 females) were from grade seven between the age of 13-15 and 16-17 years respectively. 117(males 52 and females 65) were from grade 8 between the age of 13-15 years and 26(males 11 and 15 females 15) were the age of 16-17 years.

Table 2: Demographic characteristics of the subject based on age, gender and grade

			Sex					
Grade			Male		Female		Total	
			N	%	N	%	N	%
7	Age	13-15	58	42	79	58	137	100
		16-17	4	36	7	64	11	100
	Total		**62**	**42**	**86**	**58**	**148**	**100**
8	Age	13-15	52	44	65	56	117	100
		16-17	11	42	15	58	26	100
	Total		**63**	**44**	**80**	**56**	**143**	**100**
	Age	13-15	110	43	144	57	254	100
		16-17	15	40	22	60	37	100
	Total		**125**	**43**	**166**	**57**	**291**	**100**

3.4 Method of data collection

3.4.1 Material used for data collection

Morphogenetic traits such as, Widow's peak, Tongue Rolling, Ear Lobes, Hitchhikers thumb, Bent little finger and the Palmaris longus muscle were scored based on direct observation and varies from student to student using a standard chart for proper characteristic identification.

3.4.2 Procedure of observing morphogenetic traits

Prior to the examination, the students were given a brief explanation of the study's contents. Participants who were unable to give informed permission were offered the option of having their parents or legal guardians give consent on their behalf, which was gained the next day (Appendix 4).

3.4.3 Methods for observing morphogenetic traits

A timetable depending on grade was prepared for the observation of morphogenetic traits, and the data was gathered at the student's class during their break time. The phenotypic data were collected include, widows peak, ear lobes attachment, tongue rolling, hitch-hikers thumb, bent little finger and Palmaris longus muscle with reference to standard photograph.

3.4.4 Protocol for collecting the essential information

To record and analyse morphogenetic traits, a variety of standard techniques were applied. For tongue rolling, each individual was asked to perform the activity and a person was classified tongue roller or non-tongue roller depending upon their ability Sturtevant (1940).In the cases of earlobe attachment, widow's peak, hitchhiker thumbs and bent little finger were recorded by physical observation and by taking photographs to check for the presence or absence of those phenotype and then the result was recorded accordingly. The presence of Palmaris longus is readily demonstrated by Schaeffer's test1 (Fig -10) where the wrist is slightly flexed with the thumb and little finger opposed Roohi *et al*. (2007).

(a)

(b)

Fig.10: Schaeffer's test1demonstrating the presence and absence of palmaris longus muscle, photo taken from Dagmawi Berhan School among study population (2021).

3.5 Data analysis

The raw data from the research was transferred to a computer using Excel and then, analysed using SPSS (Statistical Package for the Social Sciences), (IBM, SPSS Statistics for windows, version 28).

3.6 Ethical consideration

On April 7th, 2021, the Addis Ababa University Ethical Review Board granted ethical approval (Appendix 6).The selected study participants, aged 13 to 17, were requested to consult with their parents/guardians to get a permission whether they were willing to allow their children to participate in the study and bring written consent from their parents, following which the student completed the consent form (Appendix 4).

3.7 Inclusion and Exclusion criteria

3.7.1 Inclusion criteria

Participants in the research were chosen based on the following criteria. Participants should have a normal ear that is not swollen in any way nor has any defect, tongue rolling ability to roll without pain, and hair line shape free of any kind of scalp infection for data collected by direct observation or that do not require additional procedures such as tongue rolling, ear lobe attachment, and hair line shape. The person should be healthy enough to accomplish all exercises that will be conducted, such as bending, stretching, and fist their arms and palms easily, for the bent little finger, Hitchhiker thumb, and palmaris longus muscle examination.

3.7.2 Exclusion criteria

The Participants in the study had the following characteristics: Participants with a dislocated joint owing to accident or a scalp infection (tineacapitis) were excluded from the research due to their age, medical history of hand surgery, and a head infection (tineacapitis).

4 RESULTS

4.1 The frequency distribution of Mendelian monogenic traits

The frequency distributions of traits were studied in males and females (Table-3). It was observed that the frequency distribution of the curved widow's peak was lower than straight hairlines. Among studied groups, the frequency distribution of curved widow's peak was found to be male 28 (10%) and female11 (4%) while the straight hairline was male 97 (33%) and female 155(53%) The frequency distribution of tongue rollers were higher (69%) than non-tongue roller 31%. It showed that the frequency distribution of tongue roller were male 95 (33%) and female 105 (36%) while the non-roller were male 30(10%) and female 61 (21%).The females were higher tongue rollers (36%) than the males tongue roller 33%.It was observed that the frequency of free earlobes were lower than139 (48) attached earlobes152 (52) in the study population. The result also showed that the frequency of straight hitchhikers thumb was lower 31% than that of bent hitchhikers thumb 69%) (Table -3).The sexual distribution of straight hitchhikers thumb was male 40(14%) and female 49 (17%) while the bent hitchhikers thumb was male 85(29%) and female 117(40%). So the distribution of bent little finger was lower than the straight little finger. Among studied groups the frequency of straight little finger was 99.6% and the bent little finger was 0.4%. The frequency distribution of present long Palmaris muscle was higher 65% than the absent of long Palmaris muscle which was 35%. In this study, the more frequency distribution present long Palmaris muscle was found to be male 106 (36%) and lower distribution in female 83 (29%).

Table-3 The distribution pattern of Mendelian morphogenetic traits

Morphogenetic traits		Sex M N	%	F N	%	Total N	%
Hair line	Widows peak	28	10	11	4	39	14
	Straight	97	33	155	53	252	86
Total		125	43	166	57	291	100
Tongue rolling	Roller	95	33	105	36	200	69
	Non-roller	30	10	61	21	91	31
Total		125	43	166	57	291	100
Ear lobe	Free	69	24	70	24	139	48
	Attached	56	19	96	33	152	52
Total		125	43	166	57	291	100
Hitchhiker	Straight	40	14	49	17	89	31
	Bent	85	29	117	40	202	69
Total		125	43	166	57	291	100
Bent-little finger	Bent	0	0	1	0.34	1	0.34
	Straight	125	43	165	56.7	290	99.6
Total		125	43	166	57	291	100
Palmaris longus muscle	Present	106	36	83	29	189	65
	Absent	19	7	83	29	102	35
Total		125	43	166	57	291	100

4.2 The distribution of Mendelian monogenic trait with age group

The frequency distributions of traits were studied among age group (Table-4). It was observed that the frequency distribution of the widow's peak hairlines was lower 33(11) % between the ages of 13-15 than straight hairlines which were 221(76%). Among studied groups the frequency distribution of widow's peaks was found ages 13-15 were 33(11%) and the straight hairlines were 221(76%). in the case of age between 16-17 years widow's peak hairlines were 6(2%) and straight hairlines were 31(11%). The result also showed that the frequency distribution of tongue roller were higher 172(60%) between the age of 13-15 years than non-roller 82(28%).

It was observed that the frequency distribution of free earlobes between the age of 13-15 years were lower 126 (43%) than attached earlobes128 (44%) in the study population. The result also showed that the frequency of presences of hitchhikers thumb was higher176 (60%) than that of its absence 78(27%) (Table 4).In the age of 16-17 years frequency distribution of presences of hitchhikers thumb were 26(10%) and absence hitchhikers thumb11 (4%) There were no distribution of bent little finger between the ages of 13-15 years and there were found only one bent little finger between the ages of 16-17 years. The frequency distribution of present long Palmaris muscle were higher in the ages of 13-16years 167(57%) than the absent of long Palmaris muscle which were 87(30%).

Table-4 The distribution pattern of Mendelian morphogenetic traits with in age

Morphogenetic traits		Age					
		13-15		16-17		Total	
		N	%	N	%	N	%
Hair line	Widows peak	33	11	6	2	39	13
	Straight	221	76	31	11	252	87
Total		254	87	37	13	291	100
Tongue rolling	Roller	172	60	28	9	200	69
	Non-roller	82	28	9	3	91	31
Total		254	87	37	13	291	100
Ear lobe	Free	126	43	13	5	139	47
	Attached	128	44	24	8	152	52
Total		254	87	37	13	291	100
Hitchhiker	Straight	78	27	11	4	89	31
	Bent	176	60	26	10	202	70
Total		254	87.28	37	12.7	291	100
Bent-little finger	Bent			1	0.34	1	0.34
	Straight	253	86.9	37	13.1	290	99.6
Total		253	86	38	14	291	100
Palmaris longus muscle	Present	167	57	22	7	189	64
	Absent	87	30	15	5	102	35
Total		254	87	37	13	291	100

4.3 Association of monogenic morphogenetic Mendelian traits with gender

Association between gender and monogenic morphogenetic mendelian traits showed that Widow's peak, tongue rolling, Earlobe attachment and Palmaris longues muscle were significantly related to gender ($p<0.05$).The curved widow's peak showed significantly more frequency distributions and associated to the males than females (X^2 = 15.286,df=1,P<0.05).in the case of tongue rolling tongue rollers were significantly more frequency distributions and associated to females than males(X^2 =5.391, df=1, P<0.05).The pattern of Earlobe attachment in this study was evaluated. The free earlobes were more distributed and associated to females than males (X^2 =4.853, df=1, P<0.05) and presence of Palmaris longues muscle were significantly more distributed and associated to the males than females(X^2 =37.932, df=1, P<0.05).The study also indicated that there was no Association between gender and the monogenic morphogenetic mendelian traits of bent little finger and hitchhiker thumbs (Table -5).

Table -5 Association of monogenic morphogenetic Mendelian traits with gender

Morphogenetic Traits	Inheritance pattern in individuals		sex M N	M %	F N	F %	Total N	Total %	df	X^2	P-value
Hair line	Widows peak	Dominant	28	10	11	4	39	14	1	15.286	0.000
	Straight	Recessive	97	33	155	53	252	86			
Total			125	43	166	57	291	100			
Tongue rolling	Roller	Dominant	95	33	105	36	200	69	1	5.391	0.020
	Non-roller	Recessive	30	10	61	21	91	31			
Total			125	43	166	57	291	100			
Ear lobe	Free	Dominant	69	24	70	24	139	48	1	4.853	0.028
	Attached	Recessive	56	19	96	33	152	52			
Total			125	43	166	57	291	100			
Hitchhiker	Straight	Dominant	40	14	49	17	89	31	1	0.207	0.649
	Bent	Recessive	85	29	117	40	202	69			
Total			125	43	166	57	291	100			
Bent-little	Bent	Dominant	0	0	1	0.34	1	0.34	1	0.756	0.385
finger	Straight	Recessive	125	43	165	56.7	290	99.6			
Total			125	43	166	57	291	100			
Palmaris	Present	Recessive	106	36	83	29	189	65	1	37.932	0.00
longus muscle	Absent	Dominant	19	7	83	29	102	35			
Total			125	43	166	57	291	100			

4. 4 The distribution of dominant and recessive morphogenetic traits

The frequency distributions of dominant and recessive morphogenetic traits of inheritance pattern in individuals were assessed among studied population (Figure -11) indicated that the population harboured more recessive type of selected morphogenetic traits than the dominant phenotypes. Dominant Bent little finger was the least observed (0.34) in the population study. But, only tongue rolling showed more dominant expressed phenotypes than the recessive phenotypes. Moreover, the number of recessively expressed phenotypes for morphogenetic traits assessed was more in the female individuals than the male, which may be taken to higher number of females in the study population.

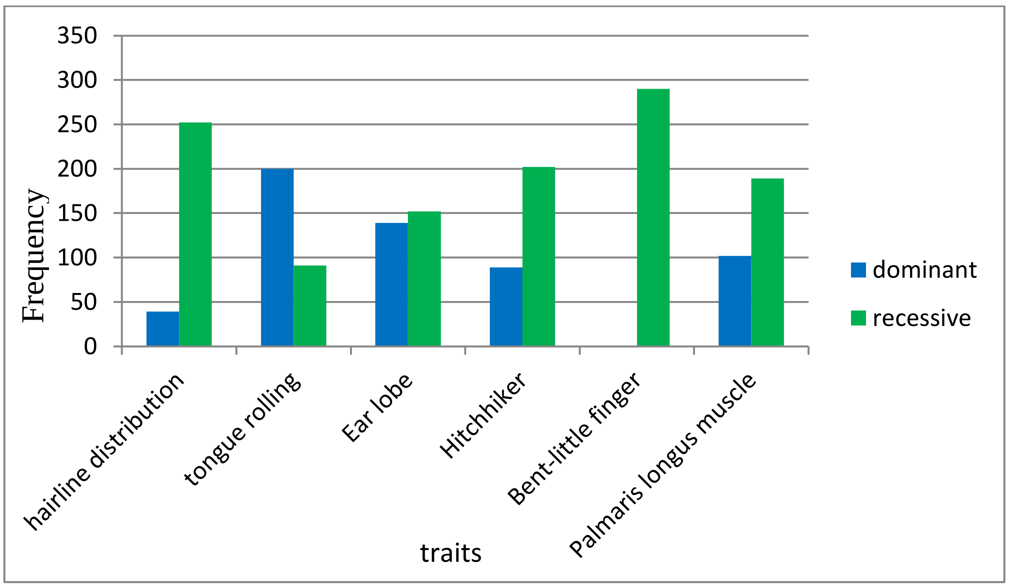


Fig.11: Distribution of dominant and recessive morphogenetic traits of inheritance pattern in individuals.

5 DISCUSSION

5.1 The frequency distribution of morphogenetic trait

The frequency distribution of facial and hand monogenic traits were studied. Among studied groups the curved widow's peak was found to be male 28 (10%) and female 11 (4%) while the straight hairlines was male 97 (33%) and female 155 (53%). The frequency distribution of the curved widow's peak in the study population showed lower frequency distribution of widow's peak (curved hairline) than no widow's peak (straight hairline).This result is in agreement with Adekoya *et al*. (2020), The distribution of the widow's peak in the sampled population showed less distribution of widow's peak (curved hairline) than no widow's peak (straight hairline) in Nigeria Adekoya *et al*. (2020). The current studies showed higher frequency of straight hair line shape than widow's peak hair line shape individuals Zeneb Awoke (2018).

The frequency distribution of free earlobes was lower (48%) than attached earlobes (52%). Among studied groups frequency distribution of free earlobes was found to be male 69 male (24%) and female 70(24%).This study showed similarity with different studies among these the attached earlobes were found more frequent than the free earlobes. In another study, mongoloid –Japanese (67.1%) and Chinese (64.3%) reported the attached earlobes frequencies Munir *et al*. (2015). This implies that the frequency of the attached earlobes is higher than in most populations.

The frequency distribution of straight hitchhikers' thumb was lower in male 40(14%) than females 49(17%) while the bent of hitchhiker's thumb was 85 male (29%) and 117 female (40%).So, in this study the frequency distribution of the straight hitchhikers thumb of male was lower (14%) than females (17%) The results showed similarities with the study conducted in Nigeria Adekoya *et al*. (2020), among female the phenotypic frequency of Hitchhiker's thumb was higher (16.8%) than male (15.5%) and in total population the frequency of Hitchhiker's thumb was higher. The study of Hitchhiker's thumb has not been given attention in past and further research is needed regarding this trait Munir *et al*. (2015). The frequency distribution of bent little finger in male was lower than female and in total population the percentage of straight little finger was higher than bent little finger. The results showed similarity with different studies, as the frequency of bent little finger in female was higher than male and in total population percentage of straight little finger was higher Onyije *et al*. (2012).

The distribution of tongue rolling ability in the study indicates that higher frequency distribution of tongue rollers (69%) than non-tongue rollers (31%) which are similar to the studies of Onyije *et al*. (2012). Other studies done by Kooffreh et al. (2015) which is in contrast to this result, the frequency distribution of tongue rolling showed a lower percentage of tongue rollers in the population and a higher percentage of non-rollers of tongue. It was observed that the tongue rollers of males were 95(33%) and females were 105(36%).So, in this study males were lower tongue roller than females.

The frequency distribution of present long Palmaris muscle was higher (65%) than the absent of long Palmaris muscle which was (35%). In this study, the more frequency distribution present long Palmaris muscle was found to be male 106 (36%) and lower distribution in female 83 (29%). Similar studies showed that Palmaris longus muscle was present in 432(85.7%) of the male subjects and in 171 females (82.2%). This indicated that the overall distribution of absence of Palmaris longus in females (17.8%) was higher than in males (14.3%) Tesfamichael Berhe and Assegedech Bekele (2014).

5.2 Distribution of dominant and recessive morphogenetic trait

Most of the studied monogenic morphogenetic traits which include hairline distribution, earlobe attachment, hitchhiker-thumb, Palmaris longues muscle and bent little finger were expressed in a recessive manner. These recessive phenotypes of the studied monogenic morphogenetic traits were distributed in the population of the study. Some of their dominant alternatively were not so expressed by the participants in the population of the study. Some of the traits like earlobe attachment, hitchhiker thumb, bent little finger and Palmaris longues muscles are rather expressed less in the population. Only tongue rolling was expressed as dominant in both male and female individuals. Similar result was observed in the study by Adekoya *et al*. (2020). Therefore, it should be stated that the general perception that dominant alleles or characters are mostly expressed more than the recessive is not always the case, so the expression of the traits varies in different population.

5.3 Association of monogenic morphogenetic Mendelian traits with gender

The study indicated that among the morphogenetic traits assessed with the selected population, a significant association was observed in morphogenetic traits of Widow's peak; tongue rolling, Earlobe attachment and Palmaris longues muscle with gender in the selected students. But, contrasting results have been reported by Adekoya *et al*. (2020) which means there were no significant associations between Widow's peak, tongue rolling and Earlobe attachment with gender in the selected population. Moreover, according to Ebeye *et al.* (2014) reported that there were no significant association between Widow's peak and Earlobe attachment with gender in the selected population. Other morphogenetic traits which were bent little finger and hitchhiker thumbs did not show association with either of the gender in the study. Similar results have been reported by Adekoya *et al*. (2020). but, contrasting results have been reported by Munir *et al*. (2015).

6 Conclusion and Recommendations

6.1 Conclusion

The frequency distribution of the six parameters- curved widow peaks, tongue rolling, attached earlobes, present hitchhikers thumb, bent little finger and present long Palmaris muscle traits have been studied. It was observed that the frequency of the curved widow peaks was lower than straight hairlines. The frequency distributions of bent little finger was lower than the Straight little finger. In curved widow peaks and present long Palmaris muscle the male has higher frequency distribution than the female but, in the rest four traits relatively higher in female than their male counterparts. Most of the studied monogenic morphogenetic traits which include hairline distribution, earlobe attachment, hitchhiker-thumb, Palmaris longues muscle and bent little finger were expressed in a recessive manner. Only tongue rolling was expressed as dominant in both male and female individuals. The study indicated that among the monogenic morphogenetic traits assessed with the selected population, a significant association was observed in morphogenetic traits of Widow's peak; tongue rolling, Earlobe attachment and Palmaris longues muscle with sex in the selected population. Other morphogenetic traits which were bent little finger and hitchhiker thumbs did not show association with either of the sex in the study.

6.2 Recommendations

The study of morphogenetic trait is particularly important in forensic and anthropological research. For future investigations, data with a larger sample size is recommended to establish the distribution of these traits in Ethiopian population.

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8 Appendices

Appendix 1

Addis Ababa University, Department of Zoological Science

Research Title: A STUDY OF SOME MORPHOGENETICS TRAITS AMONG STUDENTS OF DAGMAWI BERHAN PRIMARY SCHOOL ADDIS KETEMA SUB CITY ADDIS ABABA, ETHIOPIA

Place of Collection ______________________ **Collector's Name** ________________________ **Date of Collection** ____________________

Principal Investigator: Mob: ______________________ **email** _________________

School Principal: ________________________ **Mob:** ______________________ **email:** ____________________

Advisor: ______________________ **Mob:** ________________________ **email:** _______________

	Participant Information					Morphological traits scoring Form												
	Age		Sex		Grade	Widows peak		Tongue Rolling		Ear lobs		Hitachi-Hikers		Bent little Finger		Long palmer Muscle	
	10-15	>15	M	F		Curved Hairline	Straight Hairline	Roller	Non-Roller	Attached	Free	Present	Absent	Straight	Bent	Present	Absent
1																	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
total																	

N: B Each morphological scoring sheet should have the attachment of consent forms filled and signed by each participant parents/guardians.

Morphological traits guiding chart should be used during scoring (It should be color

Appendix 2

የአዲስ አበባ ዩኒቨርሲቲ, የዞሎጂካል ትምህርት ክፍል

የጥናት ርዕስ: በአዲስ አበባ አዲስ ከተማ ክፍለ ከተማ ወረዳ 8 በዳግማዊ ብርሃን የመ/ደ/ት/ቤት የሚገኙ ተማሪዎችን ጥቂት ውጫዊ አካል ባህርይ ማጥናት

የሚሰበሰብበት ቦታ ____________________ የሰብሳቢ ስም ______________________ የተሰበሰበበት ቀን____________________

ዋና ተመራማሪ : ስልክ: ______________________ አድራሻ ________________

ር/መ/ር: ______________________ ስልክ: ______________________ አድራሻ: ____________________

አማካሪ: ____________________ ስልክ: ________________________ አድራሻ: ______________

	የተሳታፊዎች መረጃ					የውጫዊ አካል ባህርያት መመዝገቢያ ቅፅ											
	ዕድሜ		ፆታ		ክፍል	የፊት ለፊት የፀጉር ቅርፅ ሁኔታ		የምላስ መጠቅለል ችሎታ		የታችኛው የጆሮ ክፍል		የአውራ ጣት ወደ ኋላ መንበጥ		የትንሿ ጣት መንበጥ		ረጅም የእጅ ጡንቻ	
	10-15	>15	ወ	ሴ		V-ቅርፅ	ቀጥ ያለ	የሚጠቀለል	የማይጠቀለል	የተያያዘ	ነፃ	አለ	የለም	ቀጥ ያለ	የጎበጠ	አለ	የለም
1																	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
total																	

ማሳሰቢያ-እያንዳንዱ የውጫዊ አካል ባህርያት መመዝገቢያ ቅፅ ከወላጅ ፍቃድ መጠየቂያ ቅፅ ጋር መያያዝ አለበት

የውጫዊ አካል ባህርያት መመዝገቢያ ቅፅ መጠቀምና ቀለም መሆን አለበት

Appendix 3

LETTER OF INFORMED CONSENT

Addis Ababa University: Department of Zoological Sciences.

Title of Research Project: **A STUDY OF SOME OBSERVABLE MORPHOGENETICS TRAITS AMONG STUDENTS OF DAGMAWI BERHAN PRIMARY SCHOOL, ADDIS ABABA**

Name of principal investigator: Alemshet Demsew Beyene

Phone Number of principal investigator: 0920743872

Dear Parent/Guardian/- We are very excited to inform you that your youth will have the opportunity to participate in the observer 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. Alemshet Demsew by calling (0920743872). You can also contact school principal: Mr Muluneh Anbesie, Mobile (0960284200) with any questions about the rights of research participants or research related concerns.

Dear parent/guardian/- 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/Adult-in-Life: ------------------------ Signature--------------------Date----Name of the students: --------------Signature--------------------------Date---------------------

Appendix 4

ፈቃደኝነት ማርጋግጫ ቅጽ

አዲስ አበባ ዩኒቨርስቲ፦የስነ-እንስሳት ሳይንስ ጥናትትምህርት ክፍል

የምርምር ፕሮጀክት ርዕስ፦ በአዲስ አበባ በዳግማዊ ብርሃን አፀደ ህፃናትና የመጀመርያ ደረጃ ት/ቤት ተማሪዎችን ጥቂት በሚታዩ ውጫዊ ስነ-ቅረፅ ባህርይ ጥናት
የዋና ተመራማሪ ስም ፦አለምሸት ደምሰው በየነ

የዋና ተመራማሪ የስልክ ቁጥር፦(0920743872)

ውድ ወላጅ / አሳዳጊ /

ለእርስዎ ለማሳወቅ የምንፈልገው 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፡፡ስለ ጥናቱ ማንኛውም ጥያቄ ካለዎት በሚከተሉት ስልክ ቁጥሮች ደውለው ማረጋገጥ ይችላሉ፡፡፦

አቶ አለምሸት ደምሰው ስልክ (0920743872) ወይም የት/ቤቱ ርዕሰ መምህር አቶ ሙሉነህ አንበሴ ስልክ (0960284200)
ውድወላጅ / አሳዳጊ /

የእሮሶን መልካም ፍቃድ ልጆ/የሚያሳድጉትልጅ/ 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 morphogenetic traits, A, B: hair line shape, C, D: tongue rolling; E, F: Ear lobe pattern; G, H: hitch-hiker thumb; I, Bent-little finger; J, K: Palmaris longus muscle. (Photos are taken from Dagmawi berhan school among studied population,2021).

(A)

(B)

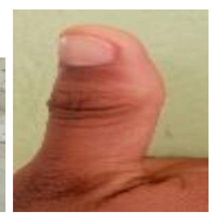
(C)

(D)

(E)

(F)

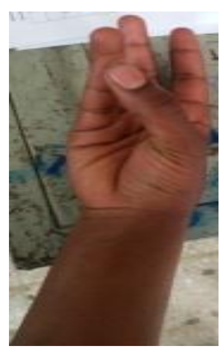
(G)



(H)

(I)

(J)



(K)

Appendix 6

COLLEGE OF NATURAL & COMPUTATIONAL SCIENCES

Addis Ababa University

የተፈጥሮና ኮምፒዩቴሽናል ሳይንስ ኮሌጅ

አዲስ አበባ ዩኒቨርሲቲ

OFFICE OF THE DEAN

Ref. No. ቁጥር: CNCSDO/619/13/2021

Date ቀን: June 01, 2021

To Whom It May Concern

The College of Natural & Computational Sciences Institutional Review Board (CNS-IRB) Committee in its meeting held on **May 28, 2021 Minutes No. IRB/03/13/2021** has examined the project proposal entitled **"A study of some morphogenetics traits among students of Dagmawi Berhan Primary School Addis Ketema Sub-City Woreda 08 Addis Ababa, Ethiopia" by Alemshet Demsew** from the Addis Ababa University.

The proposal is **conditionally approved** for implementation.

With regards,

Addisalem Abathun (PhD)
Dean, College of Natural & Computational Sciences
Addis Ababa University

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Please Quote our reference number in you correspondence