

Unit–2

PHYSICAL DEVELOPMENT

2.1 OBJECTIVES

At the end of the unit, students will be able to:

1. Understand the genetic Foundations which affect child development.
2. Aware of prenatal development and relevant issues
3. Describe the developmental course of physical growth
4. Familiar with the physical characteristics of learners
5. Develop appropriate physical activities for pre and elementary school children

2.2 OVERVIEW

Physical development is one of the major topical areas in the study of child development. It focuses on the ways in which the overall body's structure including the brain, nervous system, muscles, organs, senses and the bodily needs (e.g., hunger, thirst) determine an individual's behavior and development. For example, a developmental psychologist might be interested to see how malnutrition affects the physical growth of a child.

However, physical development is not only specified to the biological and maturational changes that occur over time with little or no influence from the context. Rather, it is believed to occur within an environmental context, where factors such as nutrition, opportunities for play, cultural practices etc play a significant role.

2.3 THE ABCS OF GENETICS

A human body is composed of trillions of micro units, called *cells*. Each cell has a core control, named as the *nucleus*. The nucleus contains rod like structures which are known as *chromosomes*. The chromosomes come in 23 pairs (one from the father and one from the mother) and carry information about the size, shape and other genetic features inherited from the parents. Overall, they are responsible for the storage and transmission of genetic information from one generation to another.

2.3.1 Genetic inheritance

Chromosomes comprise of a series of proteins called *deoxyribonucleic acid* or DNA. DNA has a tendency to duplicate itself through a process, called *mitosis*. This feature enables chromosomes to copy themselves and produce new cells which have exactly the same pattern of genetic information. Each DNA carries thousands of *genes* across the length of the chromosomes (Berk, 2013). Genes are the basic units of hereditary transmission.

They trigger the production of proteins in response to environmental cues or other genes. These proteins lay the biological foundation for our physical characteristics.

Since chromosomes come in pairs (one from each parent), the gene on one chromosome has an alternate or a partner on the corresponding chromosome. This alternate gene on the corresponding chromosome is referred to as an *allele*. The relationship between these alleles could be described as dominant or recessive depending on which of them is powerful than the other. The alleles of genes from both the parents and their interrelationship (i.e., when one allele gets dominant or recessive) determine the traits of the child. For example, the genes which regulate the color of the eyes may have dissimilar alleles specifying blue and brown eye color. However, if both the parents carry the blue-eyed allele, the dominant gene will express itself, resulting in the blue eyes of the child.

This implies that a combination of genes results in certain traits of the child. Luckily, many harmful traits are coded as recessive by the genes, which reduce the possibility of their genetic transmission (Berk, 2013). However, in cases, where both the parents carry the recessive allele for a certain harmful trait, it is likely that the child will carry that disorder. Yet, inheriting certain disorders from parents does not always lead to untreatable conditions. Rather, a supporting environment can play a significant role in helping the child to live a normal life.

2.3.2 Genes and environments

Contemporary researchers believe that genes (nature) and environment (nurture) interact to manipulate a child's development. This is because they often influence and get influenced from each other to form patterns of development (Keenan & Evans, 2009). For example, children's immediate environment is created by their parents. Since parents and children share rather similar genetic structure, it is likely that the environments which parents create for their children would support their genetic traits such as painting, playing soccer etc. Similarly, genes may have an evocative relationship with the environment which helps to reinforce certain inherited traits. For example, a socially active baby would draw positive attention from other people. As a result of these social exchanges, it is likely that the baby's genetic tendency is strengthened. Moreover, a child's genetic disposition urges him/her to find a compatible environment for himself/herself. For example, a child with a musical talent would be inclined to join the music/singing club at school etc. This tendency gets stronger as the child moves into adulthood and takes the charge of his/her own environment.

On the other hand, environment may also have a critical impact on genetic factors. For example, certain behavioral traits such as cognitive abilities etc change dramatically under supportive/unsupportive conditions. Similarly, different children react differently to their environmental circumstances (e.g., out of the two children coming from the

same deprived context, one child performs slightly better under supportive conditions, whereas the other one performs way better).

Overall, genes and environment continue to act upon each other to form behaviors and patterns of development. These influences are unique to each individual, caused by multiple factors and lead to multiple directions. This is why; even the identical twins living in the same context may develop some dissimilar traits.

Check your knowledge/understanding

1. Which one of the following is the smallest unit?
 - a. chromosomes
 - b. DNA
 - c. genes
 - d. cells

2. Both of Ali's parents have black hair. His hair is brown. How would you rationalize this difference?
 - a. mitosis
 - b. dominant-recessive genes
 - c. environmental factors
 - d. alleles

3. Contemporary researchers believe that the developmental behaviors are determined by:
 - a. biological factors
 - b. environmental factors
 - c. biological factors at birth and environmental factors throughout the life-span
 - d. a continuous interplay of biological and environmental factors

Answers: 1. (c) 2. (b) 3. (d)

2.4 LIFE BEFORE BIRTH - PRENATAL DEVELOPMENT

Life before birth encompasses the time period between conception and birth. The development that takes place during this period is referred to as *prenatal development*. This time period has considerable influences on the well being of the child in later life. Generally, prenatal development comprises nine months which are further characterized by three periods including the zygote, embryo and fetus (Keenan & Evans, 2009).

The period of the zygote lasts for about the first two weeks of life before birth. It involves rapid multiplication of cells to form a complex being. The embryo marks the beginning of the third week and lasts until the end of the second month of pregnancy. It is characterized by the most rapid changes during prenatal period which set the stage for the development of body parts, structures and systems. The fetus is the longest prenatal period which starts from the ninth week and lasts till birth. It is characterized by immense physical growth and finishing. In particular, the brain's growth is at its peak.

Although the unborn baby has minimal contact with the outer world, a number of environmental factors may interfere with the prenatal development. These are discussed in the section below.

2.4.1 Environmental Risks - Teratogens

Any environmental agent which may affect and cause damage to the development of embryo or fetus during the prenatal period is referred to as *teratogen* (Berk, 2013). Teratogens involve a range of factors and vary in their severity. The possible damage caused by teratogens depends on different factors such as the amount and length of the exposure to a harmful agent, genetic structure and age of both the mother and the fetus, and other negative influences from the environment (Keenan & Evans, 2009). The possible effects of teratogens do not only include physical damages, but may also involve psychological consequences, developmental delays, and even death.

The most influential teratogens include a number of prescribed, non-prescribed and illegal drugs used during the prenatal period (Berk, 2013). An exposure to a prescribed or non-prescribed medication (e.g., aspirin) or illegal drugs (e.g., cocaine and heroin) during the prenatal period is a major threat to the embryo or fetus. It may result in physical deformities, system abnormalities, low birth weight, infant's death around the time of birth, poor motor development and low intelligence levels.

Other critical teratogens include tobacco, alcohol or caffeine consumption by the expecting mothers. Their babies are at the risk of pre-mature birth, low birth weight and other physical defects. Besides, maternal health, diseases, age, exercise, nutrition, and emotional stress present prenatal complications which may have long-term negative consequences for the unborn child (Berk, 2013). Similarly, environmental pollution, and exposure to radiations and toxins etc can cause considerable harm to the developing fetus including physical deformities, brain damage, and cognitive deficits.

Overall, it is important for the expecting parents to evaluate and minimize the possible exposure to teratogens in order to ensure the safety of their unborn child.

Check your knowledge/understanding

4. Which of the following is NOT a stage in prenatal development?
 - a. zygote
 - b. embryo
 - c. fetus
 - d. teratogen

5. How would you *best* describe a teratogen?
 - a. a life-support system to protect the fetus
 - b. an abnormal defect caused by the use of drugs
 - c. an environmental agent that causes birth defects
 - d. a deformation of body organs

Answers: 4. (d) 5. (c)

2.5 PHYSICAL DEVELOPMENT IN CHILDHOOD

Physical development in children is crucial since it provides them with the needed skills to explore and interact with the world around them. This section presents the course of physical growth and development in childhood. It also discusses the environmental factors which influence the physical development of children.

2.5.1 The course of physical growth

The course of physical growth includes changes in body size, proportions, muscle-fat makeup, and skeleton. It also includes gains in gross- and fine-motor skills (Berk, 2013).

i Changes in body size.

The most rapid changes in body size are observed during infancy. These changes are marked by an immense increase in the height and weight of the child. However, the growth rate slows down in early and middle childhood. While the first two years of life characterize rapid but decelerating annual growth trends, early and middle childhood follow slow but steady growth. A sharp increase in growth is again observed in early adolescence followed by a sudden decline when the adult growth is achieved.

ii Changes in body proportions.

As the body increases in size, different parts of the body grow at different rates and follow different patterns. Understanding these trends would help us to develop appropriate expectations of a child's physical abilities at different age levels.

The first trend in the growth of the child highlights the 'head to toe' pattern. For example, a baby would learn to hold up his head way before he could walk. The next

pattern follows the 'inside to outside' or 'centre to outside' path. For example, the muscles around the trunk of the body grow stronger before the muscles in the hands, feet etc. Besides, growth also follows 'general to specific' and 'large to small' patterns of development during childhood.

iii Changes in muscle-fat makeup.

Muscle to fat ratio also changes during the course of physical development. While the body fat increases at a faster rate in infancy to help the baby keep a consistent body temperature, it is considerably reduced during early and middle childhood. Whereas, muscles build up at a much slower rate during infancy and childhood, when compared to the adolescence period, as they start to develop rapidly.

iv Skeletal growth.

Since children of the same age may grow and mature differently at different speeds, it becomes difficult to account for the causes and consequences of individual differences in physical development. Physical maturity is estimated by skeletal growth or age which specifies a measure of the development of body bones. It is based on the number of *epiphyses* (special growth centers which are present at each end of all long bones in the body) and the extent to which they are merged. This measure of an individual's physical development helps to understand the causes and consequences of individual differences in physical development of children.

v Changes in gross and fine motor skills.

Gross motor involves all the *big* muscles in a human body. Gross-motor activities involve activities which require the use of big muscles and include crawling, walking, running, skipping and jumping. Children's gross motor skills experience considerable gains with the increase in body size, proportion, and muscle strength. The acquisition of motor skills is guided by the patterns similar to growth as described in *section ii*. For example, children will learn to move in a random fashion before they can make precise movements to achieve desired results (i.e., general to specific movement).

On the other hand, fine motor skills require a precise control of muscles and coordination of body movements to perform different activities such as drawing, writing, and cutting with scissors. With time and experience, children acquire a complex system of fine motor skills featuring a dynamic interplay of brain, body movement, motivational and contextual factors.

2.5.2 Environmental factors in physical development

Physical growth and development is dependent on both biological and environmental factors. While biological structure and hormonal influences play a central role in manipulating physical development; environmental influences such as nutritional intake, emotional well-being and cultural practices are also critical (Berk, 2013). Physical growth is highly dependent on nutritional intake, and opportunities for play and physical

Check your knowledge/understanding

6. An infant's ability to hold up his head before he could walk represents which of the following growth patterns?
- inside to outside
 - general to specific
 - large to small
 - top to bottom
7. A dynamic system of motor skills indicates:
- an interplay of nature, nurture and motivational factors
 - an interaction of genes and environment
 - primarily genetic factors
 - primarily environmental factors

Answers: 6. (d) 7. (a)

activities. It is important that children do not only eat sufficient food, but also eat the right kind of food to maintain healthy physical growth and development. Besides, anxiety, fear and emotional deprivation may hinder physical development of children.

2.6 PHYSICAL CHARACTERISTICS OF LEARNERS

It is important to consider the physical characteristics of learners, since their physical needs influence the nature of instruction and learning environment. Although children who form an educational group at a school usually share similar physical attributes due to same age and rather similar socio-economic backgrounds, yet growth patterns and physical characteristics may vary with regards to gender and prior experiences. This section highlights the physical characteristics of the pre and elementary school children.

2.6.1 Children need to move

Children at the pre and elementary school level have an inherent need to move their bodies. It is, thus, difficult for them to remain static with little or no body movement while working on sedentary activities.

2.6.2 Improved eye-hand coordination

Eye-hand coordination, also referred to as visual motor integration skills, begin to develop during infancy. It controls the hand movement of a child guided by his/her vision. Although this coordination is not sophisticated during infancy, it reaches to the point of near independence during the pre-school years, and continues to improve through middle childhood.

2.6.3 Improved body coordination

Balance and coordination are critical physical attributes which help the child to maintain a controlled body position while performing a task. While the pre and elementary school children show increased body coordination in high energy activities such as running, climbing etc, they can still fall easily. It is, thus, important to remain vigilant and ensure safety and injury prevention measures.

2.6.4 Improved perceptual abilities

Although the five basic senses are well-developed at birth, the child continues to develop perceptual abilities during pre and elementary school years. These improved abilities help the child to interact with the physical and social world in an effective way.

2.6.5 Improved gross and fine motor skills

The motor skill development follows the 'general to specific' growth pattern among children. Children tend to develop gross motors well in advance before they start to develop fine motor skills. Pre and elementary school children develop better upper body mobility and coordination. They continue to develop improved gross motor skills through age 7 and beyond. This results in refined fine motor skills for children which help them to manipulate sharp objects etc with greater precision. The development of fine motor skills is crucial for other activities which require increased physical controls and skills such as writing, painting, etc.

2.7 ACTIVITIES IN SCHOOLS

Physical activities play a critical role in developing the basic movement skills of children. Since it is difficult for children to work on sedentary activities for longer duration of time, this section presents some ideas about developing physical activities for children in the pre and elementary school years. These ideas can be modified and expanded in certain other ways to support the physical development of children.

2.7.1 Preschool and Kindergarten

Preschool children are generally aged between three to five years. At this age, children tend to develop sufficient control over their fine motor skills which help them to draw, write, copy shapes and engage in activities that require precise control of hand and body movement. Children at this age learn best through intrinsic interests and physical involvement.

Some traditional physical activities for this age level involve running, jumping, hopping, skipping, drawing, coloring, painting, cutting, pasting, gluing, using play dough, rollers, and shape cutters etc. However, teachers, caregivers or parents can certainly extend this network in some non-traditional ways. This may involve using outside play as a reward for children, free play days, dramatic play, role play, sand, wet mud or clay play, collage, cooking, building and relaxation (e.g., stretching, breathing in and breathing out, closing eyes) activities etc. Besides, manipulative activities (e.g., lego, science

experiment with magnets) and musical, group and movement activities (e.g., locomotor movements which involve children rapidly moving from place to place, non-locomotor movements which involve children performing while keeping stationary, and manipulative movements which involve children using their body parts to manipulate an object) may provide excellent opportunities for a healthy physical development.

Overall, physical activities that are meaningful and enjoyable are more likely to produce positive learning outcomes among young children. Such activities lay the foundation for many other skills such as literacy, numeracy, creativity, and emotional stability which are needed in later years.

2.7.2 Elementary Level

The school age children continue to develop their gross and fine motor skills. With this refinement, they become adept at activities which require precise hand and body control, for example, writing. Daily physical activities should be incorporated into the school routine of elementary school children to maintain active physical development. This can be done in different ways, for example, introducing health and physical education classes and integrating physical activities into other areas of curriculum.

Besides physical education classes, there are many other ways in which teachers can engage students in physical activities. These include, for example, allocating some time for physical activity on daily basis, incorporating concepts from other areas of curriculum into physical activity time and vice versa, and providing children with hands-on experiences as much as possible (e.g., rather than teaching them the concepts of living and non-living things within the four walls of classroom, taking them out on a school round and helping them understand the concept from their surroundings). Moreover, physical activities described in section 2.5.1 can also be effectively used for elementary school children by adding consistent yet realistic challenges. For example, the sequential patterns for locomotor movements can be made more complex as the child learns to coordinate and control his body movements.

The overall goal of such activities should be to make children move their bodies at a moderate or rigorous level of intensity for at least 20 minutes during the school time. Some educationists also argue that engaging students in effective physical activities at elementary school is likely to have a positive impact on their overall health and well-being during adulthood by incorporating a life-style change.

2.8 SELF-ASSESSMENT QUESTIONS

1. How do genes and environment act upon each other to form patterns of physical growth and development? Illustrate with examples.
2. Create your own family medical or health tree to help you understand your genetic tendency toward certain diseases and traits. Consult internet to find out how to create a family medical or health tree (e.g., you may create an online 'My family health portrait' by accessing <https://familyhistory.hhs.gov/FHH/html/index.html>)
3. Make an exhaustive list of teratogens which may interfere with the prenatal development?
4. Discuss the course of physical growth in early childhood.
5. Design a physical education lesson plan for Grade 1 children. Your plan should include the following components: objectives (both general and specific), time allocated, materials/equipment needed, introduction/warm up, description of the physical activity, closure/cool down, and safety considerations.

2.9 BIBLIOGRAPHY

Berk, L. E. (2013). *Child development* (9th ed.). Upper Saddle River, U.S.A: Pearson Education Inc.

Keenan, T., & Evans, S. (2009). *An introduction to child development* (2nd ed.). Los Angeles: SAGE.