THE PUBLISHING HOUSE
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MEDICINE
Life sciences

THE DYNAMICS OF THE HUMAN LIFE CYCLE – A SYNTHESIS OF THE MAIN STAGES

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Accepted January 11, 2021

The study of human life cycle had always been an area of study of great interest given it's implications in order to better understand the humankind as well as in order to take the right decisions in order to improve living conditions throughout history. This article presents a synthesis of the seven stages of human life cycle, emphasizing the main characteristics of each stage as well as some of the factors affecting it.

Key-words: stages of growth and development, life cycle, life-span.

INTRODUCTION

The human life cycle includes all the stages of growth, development and maturation from conception to death. The pattern of growth is under the continuous influence of biological, socio-economic and cultural factors that had been shaping it throughout the history of our species. Thus, the study of human growth and development is a complex and multidimensional endeavor employing information from various fields of knowledge in order to acquire an image as complete as possible.

The study of human growth and development through the life span, had been an area of interest since ancient times, the huge body of knowledge accumulated until present contributing greatly to the understanding of the human being, in all of its biological, psychological, social and cultural complexity.

The first known document to divide the human life span into specific stages is the poem composed by Solon, who was known to be a lawmaker in ancient Athens. In his poem, Solon divides the human life into seven, so-called hebdomats that represent successive periods with an average span of seven years each. The author gives a description of the main biological changes occurring at each specific stage, from birth to senescence[1].

Later, Isidor of Seville will modify the tradition according to which human life is divided into seven stages, considering that there are actually six. According to Isidor's classification the six stages are known as: *infantia* (from birth to 7 years); *pueritia* (between 7 and 14 years); *adolescentia* (between 14 and 28 years); *juventus* (between 28 and 50 years); *gravitas* (between 50 and 70 years) and *senectus* (over 70 years). Most of the scientific literature at the present still divides the human life cycle into seven main stages, that could be further subdivided into smaller parts according to some authors.

INFANCY (0–1 years)

The newborn baby weighs, on average, 3–5 kg, it's length being about 50 cm. Boys are on average about 100 g heavier than girls[2]. The total infancy stage, comprising the first three years of life, is characterized by the most rapid velocity of growth of any of the post-natal stages[3]. Until the age of one a baby would have tripled its weight. The body proportions of a newborn differ significantly from the ones of an adult. The head is the biggest part in relation to the body and the limbs are shorter. By the age of one the differences in body proportions of a baby compared to those of an adult are becoming less pronounced. Fine motor skills are difficult for infants, but babies gradually develop

the hand and finger control to grab, aim and manipulate different objects within reach. Objects that move are particularly interesting for infants.

Infants are born with a number of instinctual responses to stimuli, known as primitive reflexes. For example when anything is placed in their mouth the baby will attempt to suck and swallow; touching the side of the cheek causes them to turn to that side in search of breast, when held upright on a firm surface will attempt to make stepping movements etc.

Among the senses, hearing seems to be the most developed at birth. A baby can distinguish their mother's voice from that of another female[4]. At the same time babies can distinguish their mother's face from another female at five days old[5,6] and can differentiate odours and recognize mother's odour at two days old[7].

During the first months of development newborns will make a lot of use of their senses in order to explore the new environment, thus their abilities regarding sensation and perception will develop as they are being stimulated.

INFANCY (1–2 years)

During this period of time the physical development takes place at a high pace. This includes changes in weight and height, muscle growth, length of bones, laying down of fat, and the growth of internal organs such as the heart, lungs and brain and nervous system[8].

By the age of two, baby's brain would have increased to 75% of it's adult weight. This rapid growth shows the important changes and high level of development of the central nervous system during this period of life. Regarding the motor and language development, a baby at this this stage will be able to run safely, walk up and downstairs, use a spoon to feed and drink from a cup, use small sentences and further expand their vocabulary. As the baby is being exposed to a stimulating environment, the senses continue to develop fast. In addition to vision, hearing and smell, taste (babies start to show a preference for sweet and an adversity to bitter and sour flavours) and touch (improved responses to changes in body temperature) will prevail.

At this stage of development babies go through what is known as Piaget's sensori-motor stage, that includes features like object permanence, causality, representational ability and imitation. For example, babies could imitate or reproduce a facial expression made by an adult[9]. Furthermore, at two years old, children begin to express their emotional states and make the distinction between self and others. Carefully observing the child's behaviour can give hints about it's personality and temperament traits in the future.

Vocabulary builds very slowly until about 18 months, after which babies start to put a name very fast to almost every object they come in contact with. After that, toddlers begin putting two words together, showing by their word order an understanding of the rudiments of grammar.

EARLY CHILDHOOD (2–5 years)

Starting with early childhood until the age of around 11 years old the child experiences a slow, steady pattern of development, as opposed to the asynchronous and fast development seen until this stage. During this period there will be a height gain of 6.5 cm on average, per year as well as a weight gain of 2.25–3.2 kg on average, per year. There are also slight gender differences: girls are generally lighter and smaller than boys. They have more fatty tissue while in boys more muscle tissue develops.

Other important changes involve the further development of the central nervous system, such as the rapid growth in the frontal lobes and the fast process of myelinization of neurons. The latter will result in an improved dexterity concerning a better control of hands and arms as the body continues to develop. Children develop a theory of mind- an understanding of what others might think, at around age four. At that point individuals become less egocentric and develop a better ability to understand the differences among perception, emotion and fact.

According to Vigotsky[10], playing is a very important activity at this stage of development, allowing the child to interact with other children and thus, increasing the potential for learning. At the same time, through play children explore the social, material and imaginary worlds and their relationships with them, learning to elaborate suitable responses in specific contexts. By playing children learn and develop as individuals and as members of the community[11]. Another effect of playing with peers is that children at this stage learn to control their emotions.

The socialization as well as immediate environment of the child represented mostly by the parents will also lead to the development of gender

identity. This can be understood in relation to children's preference of toys at this stage of development. According to Smith et al.[12], at approximately four years old most children understand that the gender of a person remains the same throughout life. As gender identity develops children also acquire sex-role stereotypes.

MIDDLE CHILDHOOD (6 to 11 years)

During this stage of development children experience a slow and steady pattern of growth. Fat deposits drop down as more muscle tissue builds up. Body fat continues to be greater in girls than in boys. On average, children gain about 2.25–3 kg in weight and approximatively 5–7.5 cm in height. Physical development at this stage is seen as the calm before the storm of puberty with the dramatical physical changes that it brings[13]. As the central nervous system continues to develop, an increased ability to perform complex tasks requiring a higher degree of motor skill is observed in both boys and girls.

With regards the psychological development, during middle childhood children become less egocentric. An important influence in this respect comes from the experience in school. Attending school brings more interaction with peers and the formation of friendships, a process that gets more complex as the child grows[14]. One other aspect pertaining to this stage is the moral development that can be described as the understanding of what is right and wrong.

This understanding stems from the parents as primary agents, and further develops from school, church and the social and cultural norms of the society in which the individual in immersed. According to Piaget children make the transition from moral reasoning and development-based rules imposed by adults to a situation based on mutual respect where rules are negotiated from within[15].

Due to their increasing independence and ability to care for themselves starting with this age, children can join and explore the wider social world, comparing themselves with others of the same age.

ADOLESCENCE (11 to 19 years)

From the perspective of biology, adolescence is defined as the totality of biological, morphological and physiological changes caused by puberty, which lead to the transformation of the child's body into that of a mature adult from a sexual and physical point of view. Puberty is an extremely important period in the life of the individual that involves major transformations, with pronounced dynamics at the anatomical, physiological and behavioral level. After birth, it is probably the most abrupt and comprehensive change a person experiences in their lifetime.

Even though it brings dramatic changes, at its base, puberty is a neuroendocrine transformation of the processes that regulate the physiology of reproduction. This transformation arose from the physiological mechanisms that already exist in latent form in the prepubertal child. The most significant aspect at the end of this process is the achievement of reproductive capacity.

During the prepubertal period, the secretion of androgen hormones of the adrenal glands increases, starting with the age of 7 years in girls, respectively 9 years in boys. With this age, the level of androgen hormones continues to increase during adolescence in both boys and girls[16].

These hormones are involved in a number of pubertal changes, such as: skeletal growth, subaxial and pubic hair growth, sebaceous and sweat gland development, and genital gland development[17,18]. Studies have also shown that this hormonal change also influences the daily mood especially in preadolescent girls[19].

One of the main characteristics of the pubertal period is the existence of the growth spurt - the visible acceleration of the increase in height and weight during puberty. Most organs and body sizes are characterized by growth spurt[20,21]. The growth spurt in adolescence is present in both boys and girls, in all human populations examined so far. This spurt occurs as a result of hormonal changes that occur during the period of sexual maturation.

Puberty is initiated and controlled by a very complex neuro-endocrine mechanism involving the hypothalamic-pituitary-gonadal axis. The hypothalamus secretes a small peptide hormone called GnRH(gonadotrophin-releasing hormone), which reaches the anterior pituitary gland.

In response to GnRH, the anterior pituitary secretes two hormones in the systemic circulation: follicle-stimulating hormone (FSH) and luteinizing hormone (LH). These two gonadotropins reach the gonads through the circulation where they will stimulate the activity of gamete secretion of the gonads as well as their specific hormones.

The period of puberty induces major changes in body proportions, so that, at the end of it, most

individuals reach the final values, specific to maturity, for most skeletal dimensions and height. After reaching the peak, the growth rate decreases rapidly, around the age of 16–17 years for girls, and almost 18–19 years for boys, in western populations. Growth can continue after this age until about 20 years, especially in boys, but the subsequent acquisition in height will be small.

The pattern of weight gain is different from that of height due to the fact that the onset of weight gain does not correspond to the age of the minimum rate of weight gain before puberty. Most children have the lowest annual weight gain during the early stages of childhood, around the age of 2–3[22].

Considering that through puberty the transition from childhood to the adult individual capable of reproduction is achieved, the hormones secreted during this period will determine the growth of the sexual organs and the achievement of their physiological functions. The so-called primary and secondary sexual characters are installed during puberty, representing another set of events typical of this period of development.

The maturation of primary sexual characteristics means that, during puberty, the first menstruation- menarche and spermarche occurs. Currently, the age of menarche is around 12 and a half years in the United States and European countries, although there are significant variations from one individual to another[23]. The ovulations that occur during the first months may not produce viable ovules, but this major change means that the young person is soon able to reproduce.

Along with the biological changes generated by the neuroendocrine mechanisms, during adolescence, psychological and emotional transformations take place, as well as a development of cognitive and intellectual capacity. At the same time, the personality and sense of identity develop. During adolescence there are three important processes that play a central role in shaping the brain: cell proliferation, selective elimination of neurons and synapses and myelination processes.

Therefore, the abstract rational forms of thinking develop, the possibility of logical determination of the relations between phenomena is developed, within a deductive and inductive system, the features of similarity and difference between classes of phenomena are logically followed, the logical criteria of classification are determined.

Consequently, a process of continuous development takes place, at the end of which well-determined psychic structures with a higher degree of mobility will emerge[24]. Adolescents are now developing many other tools of intellectual activity, such as: the ability to construct arguments, counter-arguments, demonstrate, develop hypotheses etc.

The group of friends is one of the most important socializing mechanisms during adolescence, due to the fact that young people gain a lot of autonomy and independence at this age, and most of the emotional and social support comes from friends. Adolescents also gain a lot of experience in social relationships, which would not be possible in relationships with parents or teachers. There are also many opportunities for reward within the group, such as group acceptance, popularity, status, etc.[25]

Group affiliation is very important for adolescents in the early and middle stages of this age group, and has a smaller impact in the case of preadolescents and those in the last stage, when this is no more absolutely necessary. Those who are in their late teens feel comfortable in the presence of those of the opposite sex, and the group disintegrates into cliques and /or couples.

A characteristic of socialization at this age, is the fact that once affiliated with the group, the so-called group pressure is exerted on the individual. The necessary condition for joining the group, and especially maintaining it, is to comply with the rules of the group (dress code, vocabulary rules, smoking habits etc.). Group pressure is felt most strongly in the early stages of adolescence, when young people are most in need of support.

Subsequently, as abstract thinking and the level of independence develop, adolescents begin to make their own decisions and take on responsibilities.[26]

EARLY TO LATE ADULTHOOD (20 to 60 years)

Given that by this time individuals reach the final point of growth and development, this period of life is characterized by a higher degree of uniformity and stability. Once the period of growth and development is complete, catabolic reactions start to prevail and their rate of occurrence increases as aging progresses. Adopting a generally healthy life-style will reduce the negative effect of the body while failing to do so will accelerate the process. Obviously one important factor in this respect is the socio-economic context and general well-being.

Among the changes in physical functioning starting to be visible and measurable after the age of 40 are: lens of eye thickens and loses accommodative power resulting in poorer vision, gradual loss of ability to hear very high and very low tones, decline in the ability to discriminate between different smells, loss of muscle tissue, particularly in fast fibers, increased reproductive risk and lowered fertility, gradual reduction in density of dendrites in the central nervous system, gradual loss of elasticity in most cells, hair may become thinner and grey etc.[27]

One obvious critical change occurring during middle age in women is menopause. As a woman's menstrual cycle stops, ovulation ceases while level of estrogen are significantly reduced. This critical change may bring various symptoms and problems, even though most women adapt relatively fast and well to this modification.

From a cognitive perspective middle age differs from earlier and later stages of life in the fact that in younger years, our cognitive development is mostly influenced by formal training while in old age cognition is more likely to be impacted by factors such as sensory and sensory motor functioning. In middle adulthood cognitive performance is mostly influenced by individual environments such as the specific jobs. Therefore in adulthood, cognitive potential is typically used to develop job specific skills.[28]

OLDER AGE (over 65)

Most theories of age make a distinction between primary and secondary ageing, primary ageing being the gradual age-related changes over which we have no control and that affect everybody, while secondary ageing being more individual in that it is influenced by lifestyle and environmental factors such as lack o exercise, smoking alcohol consumption, obesity and disease. Some of the signs of senescence include: an overall decrease in energy, wrinkles and brown spots on the skin, loss of skin elasticity, slower reaction times, change of sleep patterns, an overall decline of muscle strength, loss of height due to the compression of vertebral discs etc.

Although some of these signs and the time they appear may differ from individual to individual, eventually morbidity, disability and risk of mortality increase.

During this stage of life a natural degeneration of the brain and the nervous system occurs, that should not be confused with any specific type of nervous disease[29]. Even though there may be an increased loss in the number of synapses, most of the neurons actually remain healthy until death, but brain volume and size decrease in a proportion between 5% to 10% from the moment growth and development stops until up to 90 years of age.

One of the aspects of ageing is also a reduction in the abilities regarding mental function- memory, concentration, learning, problem-solving, alertness etc.

Studies show that the more the brain is stimulated the more this kind of functions are maintained at an optimal capability during the late stages of life. Pragmatic aspects of intelligence such as practical thinking, application of accumulated knowledge and skills, specialized expertise and wisdom, may continue to develop until very late phases of life.[30]

From a social point of view, friendship continues to be important in late adulthood as a source of happiness and as a buffer against problems of any sort. The spouse is the most important person in this respect. As a result, married elders tend to live longer, happier and healthier lives than unmarried elders, the death of a spouse becoming a serious stressor.

CONCLUSIONS

The brief description of the human life cycle presented above is a reflection of the fascinating journey each and every human takes during his or her lifetime. It is a truly dynamic process involving a diverse range of factors that can influence and shape it. Thus the life cycle perspective shows us that this development is multidirectional, multicontextual, multicultural and plastic.

It is the aim of the study of human development as a science, to understand how people change over time and space and in a given cultural setting as well as the effect of different environmental factors influencing it.

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