

CHAPTER 2

LITERATURE REVIEW

2.1 Physical Activity Theory

2.1.1 Definition of Physical Activity

Physical activity includes activities at school, at work, at home, on the go, and other activities carried out every day. According to the World Health Organization (2019), body movements produced by skeletal muscles that require energy expenditure are called physical activity.

Physical activity is the movement of muscles and skeletons that produces energy. When done regularly, physical activity has many health benefits, and the more physical activity the greater the benefits. Since physical activity affects children's health, growth, and development, it is clear that physical activity is beneficial for children. (Anderson & Durstine, 2019).

Some experts consider physical activity as part of a complex process that includes the development, learning, and adoption of skills, principles, norms, self-perceptions, identities, and roles. Factors in the family environment and social interactions, such as profession, socio-demographic group, school, and place of residence, can influence physical activity. Where physical activity is part of a complex process that includes development, learning, and

assimilation of skills, principles, norms, self-perception, and identity (Batista et al., 2016)

A physical activity is a process that requires energy expenditure involving body movements produced by muscles. Chronic diseases are one of the most common causes of death worldwide according to the World Health Organization (WHO). Physical activity is defined as an increase in body energy expenditure and calorie burning in every body movement (Ministry of Health, 2015).

2.1.2 Types of Physical Activity

Age determines the amount of physical activity that children do, divided based on their age, namely:

a. Age 3-5 years

Children aged 3 to 5 years old should be active every day to promote their growth and development. The types of activities are varied and encourage people to play actively.

b. Age 6-17 years

Children and adolescents aged 6-17 years should engage in 60 minutes or more of physical activity every day. This should include moderate- and vigorous-intensity aerobic activity at least three times a week, and physical activity aimed at developing muscle strength should also be done. Because children's natural movement patterns are different from

those of adults, children's physical activity should be tailored to their age.

Children participate in unorganized active play where they use basic aerobic techniques to improve their bone strength and learn movement patterns and skills such as running, skipping, jumping, and hopping. No weight-bearing exercises are performed by children to improve muscle strength. Instead, they increase muscle strength through unstructured physical activities, such as lifting, moving their own body weight, or playing against weights. Physical activity for school-age children focuses on three categories: aerobic exercise, muscle strengthening, and bone exercises that are beneficial to health (Jayadilaga et al., 2023)

2.1.3 Benefits of Physical Activity

The type of physical activity varies according to individual goals, but is essential to reducing the risk of non-communicable diseases and cardiovascular disease. Regular exercise is a physical activity that can make the body healthy. There are several benefits of physical activity according to the Indonesian Ministry of Health in 2020, including:

1. Maintain normal body weight
2. Control blood pressure to keep it normal
3. Prevent diabetes mellitus
4. Controlling cholesterol levels
5. Increase body resistance

6. Improve joint flexibility and muscle strength
7. Correcting body posture remains normal
8. Controlling stress

2.1.4 Factors Affecting Physical Activity

Previous studies have shown that dependence on technology has become part of the daily routine of early childhood, resulting in decreased physical activity. This has attracted the attention of researchers from various disciplines, such as technology, health, and sports (Ramadhan et al., 2024). Now it is increasingly rare for children to play traditional games in the yard, field, or environment around the house. Even in the general public, children prefer to use cellphones rather than gather and play games that require physical activity. Children spend more time outdoors, gathering, and playing together before the era of globalization and the popularity of devices like today (Kuswanto et al., 2022).

To overcome the problem of lack of physical activity in children, activities involving body movement are very important. Playing is one of the fun and common things for children (Tangse & Dimiyati, 2021). Children can play in the yard, park, or field around the house. Children can play with their friends.

2.2 Diabetes Mellitus Theory

2.2.1 Definition of Diabetes Mellitus

In a condition where the pancreas cannot produce insulin optimally, diabetes is a very serious non-communicable disease (Safitri & Nurhayati, 2019). The insulin hormone regulates glucose. If it does not work properly, blood glucose levels will increase. According to Fatanah (2015), normal blood glucose levels are 70–110 mg/dL when fasting. People around the world are now prioritizing solving health problems because this disease is widely experienced by the community and is a global public health problem (Global, 2016).

According to the International Diabetes Federation, there were 415 million people with diabetes mellitus (DM) in 2015, and 98% of them were type 2 DM sufferers. This shows that the population is more susceptible to type 2 DM. Hyperglycemia, or high levels of glucose in the blood, together with insulin deficiency causes abnormalities in the metabolic process is a disease known as diabetes mellitus.

2.2.2 Classification

Diabetes Mellitus is classified into two types (World Health Organization, 2019):

1. Diabetes Mellitus type 1

Some people have a rapid rate of cell destruction, while others have a slower rate of cell destruction. Rapidly progressive type 1 DM is

usually seen in children, but it can also be seen in adults. Some patients, especially children and adolescents, may develop ketoacidosis as the first symptom of the disease. Other patients may have mild hyperglycemia, which may rapidly progress to severe hyperglycemia and/or ketoacidosis when there is infection or other stress. Still others, especially adults, may retain sufficient β -cell function to avoid ketoacidosis for years. In the typical clinical presentation of type 1 DM, low or absent C-peptide levels in the blood or urine indicate little or no insulin secretion.

2. Diabetes Mellitus type 2

Type 2 diabetes accounts for between 90% and 95% of all diabetes cases, with the highest prevalence in low- and middle-income countries. Type 2 DM is a common and serious health problem worldwide. It has developed as a result of rapid economic, social, and cultural changes, population decline, unplanned urbanization, increased consumption of processed foods and sugar-sweetened beverages, obesity, decreased physical activity, unhealthy lifestyles and behaviors, and fetal malnutrition. Type 2 DM is most common in adults, but is also increasing in children and adolescents.

Table 2.1 Differences between Type 1 and Type 2 Diabetes Mellitus

Diabetes Mellitus type 1	Diabetes Mellitus type 2
Damage occurs in insulin-producing cells.	Familial/hereditary
Pancreatic B cells are damaged so that insulin cannot be formed.	Insulin resistance often occurs
Insulin requirements to control glucose are poor	There is sufficient insulin in the blood, but the body's cells cannot react properly.
Common in children or adolescents	Generally over 40 years old

2.2.3 Etiology

According to Lestari and St. Aisyah Sijad (2021) Diabetes is caused by a combination of genetic and environmental factors. Insulin secretion or action, metabolic abnormalities that interfere with insulin secretion, mitochondrial abnormalities, and other conditions that interfere with glucose tolerance are additional causes of diabetes. Exocrine pancreatic disease, which causes damage to the majority of pancreatic islets, can cause diabetes mellitus.

Exocrine pancreatic disease, which causes damage to the majority of pancreatic islets, can cause diabetes mellitus. Diabetes can also be caused by hormones that function as insulin antagonists (Putra, 2015). Type 1 diabetes was first identified as insulin resistance in muscle (Taylor, 2013). Insulin resistance can be caused by many things, such as obesity or overweight, excess glucocorticoids (such as Cushing's syndrome or steroid

therapy), excess growth hormone (such as acromegaly), pregnancy, gestational diabetes, polycystic ovary disease, lipodystrophy (caused by lipid accumulation in the liver) or insulin receptor mutations, peroxisome proliferator activator receptor mutations (PPAR γ), or mutations that cause obesity.

In type I diabetes, an autoimmune process destroys the beta cells of the pancreas, stopping insulin production. Although glucose from food remains in the blood, causing postprandial (after-meal) hyperglycemia, the liver cannot store all the filtered glucose. Therefore, the liver cannot store all the filtered glucose if the blood glucose concentration is high enough. As a result, it appears in the urine, known as diabetes. Excessive excreta and electrolytes accompany the excess glucose waste that is excreted in the urine. This condition is known as osmotic diuresis. Excess fluid can cause increased urination (polyuria) and thirst (polydipsia).

Insulin deficiency can also interfere with protein and fat metabolism, leading to weight loss. If insulin deficiency occurs, excess protein circulating in the blood will not be stored in the tissues. All parts of fat metabolism will increase rapidly in the absence of insulin. This usually occurs during meals, when insulin secretion is low; however, when insulin secretion is close, fat metabolism in DM will increase. Increased amounts of insulin secreted by the pancreatic beta cells are necessary to overcome insulin resistance and prevent the formation of glucose in the blood. In people with impaired glucose tolerance, excessive insulin secretion occurs,

so that glucose levels remain at normal or slightly elevated levels. However, if the beta cells cannot meet the increased demand for insulin, glucose levels will increase and type II diabetes will develop.

2.2.4 Signs and symptoms

Symptoms of DM include (Lestari & St. Aisyah Sijid, 2021):

1. Polyuria (frequent urination)

Sugar is excreted through urine because blood sugar levels exceed the renal threshold (more than 180 mg/dl). I urinate more often at night than usual. When using marijuana, the body absorbs as much water as possible into the urine to reduce the amount of urine excreted. As a result, the body can excrete a lot of urine and urinate frequently. Under normal circumstances, the average daily urine output is 1.5 liters, but in uncontrolled DM patients, urine output is greater. Often thirsty and want a lot of water (polyphagia). When urine is excreted, the body becomes dehydrated. The body will feel thirsty, which will make sufferers always want to drink water, especially cold, sweet, fresh water, and in large quantities.

2. Polyphagia (feeling hungry quickly)

Polyphagia, increased appetite, and fatigue. Insulin problems experienced by DM sufferers cause a decrease in sugar intake into body cells and a decrease in the energy produced. As a result, sufferers feel less energetic. In addition, cells lack sugar, so the brain perceives a lack

of food as a lack of energy. As a result, the body sends out hunger signals to encourage people to eat more.

3. Weight loss

When the body lacks insulin and cannot get enough energy from sugar, the body will immediately convert fat and protein into energy. Uncontrolled DM sufferers can lose 500 grams of glucose in the urine in one day through the urinary system. This is equivalent to losing 2000 calories every day.

2.2.5 Pathophysiology

In type I diabetes, an autoimmune process destroys pancreatic beta cells, stopping insulin production, which is the pathophysiological basis of all types of diabetes. Although glucose from food remains in the blood, causing postprandial (after eating) hyperglycemia, the liver cannot store glucose and causes fasting hyperglycemia, because the liver cannot store all the filtered glucose. As a result, the kidneys cannot fully reabsorb the filtered glucose. Glucose will appear in the urine, known as diabetes. Excessive excreta and electrolytes will accompany the excess glucose waste excreted in the urine. This condition is known as osmotic diuresis. Excess fluid can cause increased urination (polyuria) and thirst (polydipsia) (Lestari & st. Aisyah sijd, 2021).

Insulin deficiency can also cause protein and fat metabolism to be disturbed, which in turn can cause weight loss. If insulin is lacking, excess protein in the circulating blood will not be stored in the tissues. All parts of

fat metabolism will increase rapidly if insulin is absent. This usually occurs during meals, when insulin secretion is low; however, when insulin secretion is close, fat metabolism in DM will increase. An increase in the amount of insulin secreted by pancreatic beta cells is needed to overcome insulin resistance and prevent the formation of glucose in the blood.

Insulin deficiency can also cause impaired protein and fat metabolism, which in turn can lead to weight loss. If insulin is lacking, excess protein in the circulating blood will not be stored in the tissues. All parts of fat metabolism will increase rapidly if insulin is absent. This usually occurs during meals, when insulin secretion is low; however, when insulin secretion is close, fat metabolism in DM will increase. An increase in the amount of insulin secreted by pancreatic beta cells is needed to overcome insulin resistance and prevent the formation of glucose in the blood. In people with impaired glucose tolerance, excessive insulin secretion causes glucose levels to remain at normal or slightly elevated levels. However, if beta cells cannot meet the greater demand for insulin, glucose levels will increase and type II diabetes will appear (Lestari & st.aisyah sijd, 2021)

2.2.6 Risk factors for diabetes mellitus

These risk factors are divided into two categories: those that cannot be changed and those that can be changed by adopting a healthy lifestyle (Utomo, 2020)

a. Unmodifiable Risk Factors

1. Family history with DM

The genetic determinants of diabetes are associated with certain HLA histocompatibility types, suggesting that if a family member has diabetes, they are at greater risk of developing diabetes.

2. Age

The risk of developing diabetes increases with age. Tjekyan (2014) stated that the age at risk in developing countries is over 45 years, and in developed countries is over 65 years.

b. Modifiable risk factors

3. Obesity

Obesity is when there is a lot of fat in your body. The criteria for obesity are a BMI of at least 25 kilograms per square meter or a waist circumference of at least 80 centimeters for women and 90 centimeters for men. As a result, the body produces more calories than physical activity, which increases the risk of type 2 diabetes.

4. Lack of physical activity

The risk of developing Type 2 DM increases in high-income populations because they rarely engage in physical activity that can

burn calories. Controlling your weight and participating in physical activity for at least thirty minutes every day is the best way to avoid T2DM.

5. Hypertension

History of hypertension has a close relationship with cases of Type II DM. The risk is 2.629 times higher than non-hypertension sufferers.

6. Dyslipidemia

Increased blood fat levels are known as dyslipidemia, which has the potential to cause type 2 diabetes mellitus. Because dyslipidemia has no symptoms, blood tests or checkups are needed to detect this disease early. Dyslipidemia, both primary dyslipidemia (due to genetic disorders) and secondary dyslipidemia (due to DM due to insulin resistance or deficiency) often occur together with DM. Atherogenesis increases as a result of lipid toxicity. Metabolic changes that occur in DM, such as glycation and oxidation processes, will change lipoproteins. This can lead to type 2 DM and greater insulin resistance.

7. Smoking Habit

Smoking is the most common risk factor for diabetes mellitus (DM). Nicotine and other harmful chemicals contained in cigarettes can reduce insulin sensitivity, according to research. Several catecholamine hormones, including adrenaline and noradrenaline,

can be increased by nicotine. The release of adrenaline causes an increase in blood pressure, heart rate, blood glucose, and respiration.

2.3 Concept of growth and development

2.3.1 Definition of Growth and Development

Physical increase in some amount over time is called growth. This includes changes in height, weight, body proportions, and overall physical appearance; growth is a change measured in quantity. However, growth is an increase in the number and size of cells as they divide and synthesize new proteins, causing the body to become larger or smaller (Belagavi, 2019).

The continuous changes that a child experiences that occur tremendously during the neonatal, newborn, and early infancy periods are known as development. Today, children, parents, and families face many challenges, and children unknowingly enter adolescence and adulthood. Physical, emotional, and intellectual changes occur during the ongoing process called growth. In childhood development, growth is defined as a constant, irreversible increase in size, and development is defined as the growth in psychomotor abilities. Genes, nutrition, and environment greatly influence both processes. An important aspect of a patient's physical examination is the evaluation of their growth and development.

2.3.2 Stages of Child Development

Children must go through stages of development. Moral development, cognitive development, language development, physical motor development, and social emotional development are components of this development.

1. Cognitive development

Cognitive processes are one of the many components that affect the human thinking process. Cognitive processes relate to intelligence abilities that mark a person with various interests, especially aimed at ideas and learning. In the process, cognitive processes include a person's ability to connect, assess, and consider an event or incident.

Perception, attention, language, reasoning, and memory are some of the mental processes that aid cognitive development. All of these processes process information to produce responses, which in turn produce interactions. These interactions help the child understand the brain space around him.

According to Piaget (, there are four distinct stages of cognitive development.

- a. The first stage is Sensory Motor Intelligence, which occurs between the ages of 0-2 years, where babies create physical action schemes such as sucking, grasping, and hitting.
- b. The second stage is Preoperational Mind, which occurs between the ages of 2-7, where children learn to think using symbols.

- c. The third stage is Concrete thinking operations—children aged 7 to 11 years develop systematic thinking skills.
- d. The fourth stage is Formal Operations—children aged 11 and above develop systematic thinking skills through purely abstract designs and hypotheses.

2. Speech and language development

Language is a system of symbols that people use to communicate about concepts. Language is a communication tool that has many aspects. Sowers said that the aspects of language consist of two categories: receptive aspects and expressive aspects. According to him, these two categories are needed for language activities so that the communication process can occur.

The receptive aspect includes a person's ability to receive language information, which includes listening and reading activities. The expressive aspect includes a person's ability to convey language information, which includes speaking and writing activities. Therefore, children's language skills are naturally learned and acquired through their environment and used in interactions with their environment. Children use language to express their ideas, feelings, and goals of thought.

According to Chomsky, the stages of early childhood language development consist of:

- a) early language begins with very fine body movements from birth, and at six months, babies begin to make sounds like "ba" or "da", and so on;
- b) single word pronunciation, usually at the age of one year babies start to say single words like "cake", and so on.
- c) At 18 months, children begin to express two words together to indicate certain structures;
- d) At the age of 3 to 6 years, children experience grammatical changes and development, starting to make negative sentences and questions after being able to use 3 words; and
- e) By the age of 5-6, children will have mastered many aspects of grammar.

Language is a mental structure expressed by children through their speech, gestures, and mimics. In addition to starting to make many interrogative sentences, children also start to make negative sentences because they give many rules and interventions to adult speech. In the end, children always oppose adult words and correct their own words or say the opposite of what they hear. This is often heard by our ears, and it is a natural thing related to egocentric childhood.

3. Physical and motor development

Changes that occur in humans, such as becoming taller or bigger, are related to the development of physical motor skills and movement patterns. The development of children's gross and fine motor skills

shows their physical motor development. Motor development specifically is the process by which a person develops skills and develops their own body movement patterns.

All daily body activities are done by gross motor skills, which use large muscles, while fine motor skills use small muscles. Fine motor skills include activities such as drawing simple pictures and coloring, sewing, weaving paper, and using a pencil sharpener to sharpen pencils. However, some children are not mature enough to master these skills well. The maturity of children's motor development requires proper training.

4. Social-emotional development

Each individual must develop a self-understanding of how they see the world, especially how they interact with others. In the social group where a person lives and grows, this is very important, so it takes a process to form it. The ability to learn and behave as a person to join his group is known as social development.

Psychosocial development is a change in a person's ability to adapt to the wider social environment. In this development process, a person is expected to gain an understanding of others, meaning they can describe their characteristics, understand the thoughts, feelings, and desires of others, and consider the opinions of others without losing themselves. This development includes changes in the way a person behaves. Things related to feelings are very related.

Social emotional development is a term that refers to a child's ability to understand others through the way they interact with others, including adults. It includes the behaviors and responses children display during play and activities with their friends, family members, teachers, and caregivers.

2.3.3 Overview of growth and development phases based on age group

Humans will always experience changes from generation to generation. These changes are inseparable from growth and development. Human growth is marked by changes in weight and height. Development is marked by changes in aspects of skills, emotions, thoughts and physical maturity. Every child goes through phases of growth and development based on their age level. The following are the phases of growth and development in children, namely:

Table 2.2 Child Growth and Development Phases Based on Age

No	Age	Growth and development phase
1	Time before birth (9 months 10 days/ 280 days)	Since conception until the gestational age of 280 days. This period is divided into 3, namely: <ol style="list-style-type: none"> a. The egg or zygote period starts from conception until the second week. b. The embryonic period lasts from the end of the second week to the end of the second month. c. The fetal period lasts from the second month until the baby is born.
2	Newborn period (baby from birth to 10 days)	The shortest development period in all development periods that occur is at this time. The fetus needs adjustment to survive

		after being in the womb. If the fetus can pass this phase then it will enter the next period.
3	Infant period (0-12 months)	This phase occurs between the ages of 0 and 12 months and is the stage of language development, sensory motor coordination, and social skills through the family or family.
4	Toddler time (12-36 months)	This phase of increasing growth and development involves increasing the child's language, social and intelligence skills.
5	Pre-school or early childhood (5-6 years)	This phase is called preschool age because children need to learn the basics of social behavior to prepare them for their social life later on because they have to learn to adapt.
6	Late childhood (6-11 years)	Late age, also known as school time, is the time when children are ready to get an education at school and meet social demands.
7	Puberty	<p>This period overlaps with early to late adolescence. 4 (four) changes that occur in the body during puberty are:</p> <ol style="list-style-type: none"> a. Changes in body size b. Changes in body proportions c. The growth of primary sexual characteristics related to the child's sex organs, such as menstruation and wet dreams. d. Changes in secondary sex characteristics are marked if men will experience changes in voice, growth of Adam's apple, changes in the size of the penis and testicles, erection and ejaculation, increasingly dense muscles, growth of mustache or sideburns and hair in the armpits and around the genitals. Women experience changes such as hips widening, growth of hair in the armpits and around the genitals and breasts enlargement.

2.3.4 Parenting Patterns (Patterns, Love, and Nurture)

1) Sharpening pattern

Asah means sharpening or stimulating the potential possessed by the child, asah is a learning process for children to become talented children according to their abilities but still have noble morals. This is the same as asuh and asih, asah can also be done since in the womb, asah can be done by stimulating the child's motoric and cognitive abilities by stroking while inviting the child to talk since still in the womb. The pattern of parental sharpening will make parents know the child's potential and continue to explore these abilities so that this talent can be useful in the future

2) Pattern of love

Love is an inner need, or emotional need, or psychological need in the form of affection given by parents to their children in order to create a sense of security and peace for the child. Love is a need that will continue until the end of life, everyone needs love from the womb. Love or affection given by parents to their children will help the child's growth and development both physically and in terms of their thinking patterns.

3) Parenting

Parenting is an activity of caring for and fulfilling the physical needs of a child. Parenting since the child is still in the womb, namely by the mother must eat foods rich in nutrients with the right nutrition,

not only the nutrition needed by the mother, but also needed by her child so as to help the child's development. Parenting is also a primary need for children and greatly affects the growth and development of the child.

2.4 Questionnaire *Physical Activity Questionnaire for Children* (PAQ-C)

The PAQ-C questionnaire is suitable for elementary school-aged children (grades 4–8; approximately ages 8–14) who are attending school and have a weekly recess. In the absence of a gold standard, it is difficult to determine the most appropriate tool to assess physical activity. Several instruments have been used including various physiological indicators, laboratory methods, direct observation, motion sensors, and self-report measures. Self-report measures are most often used to assess physical activity levels in children and adolescents because they are generally inexpensive and accessible to large populations (Sallis & Saelens, 2000; Tremblay, Shephard, McKenzie, & Gledhill, 2001; Welk & Wood, 2000). However, only a few recall tools are reliable and feasible for use in large-scale studies (Crocker, Bailey, Faulkner, Kowalski, & McGrath, 1997).

The Physical Activity Questionnaire for Older Children (PAQ-C; Crocker, Bailey, Faulkner, Kowalski, & McGrath, 1997; Kowalski, Crocker, & Faulkner, 1997; & Kowalski, Crocker, & Faulkner, 1997), and the Physical Activity Questionnaire for Adolescents (PAQ-A; Kowalski, Crocker, & Kowalski, 1997), were developed and validated to meet the need for a self-report measure. The PAQ-C and PAQ-A are 7-day self-report

questionnaires that measure average physical activity levels during the school year. In most cases, the PAQ has been fairly strongly correlated with other measures of physical activity. This is in contrast to other measures of recall (Kowalski, Crocker, & Kowalski, 1997; Kowalski, Crocker, & Kowalski, 1997).

The PAQ-A and PAQ-C may be useful for use in longitudinal studies. The PAQ is feasible for large-scale studies because of its low cost, reliable and valid assessment of physical activity from childhood through adolescence, and ease of administration. The University of Saskatchewan longitudinal bone mineral accumulation study used a questionnaire developed using a common scoring scheme (Bailey, McKay, Mirwald, Crocker, & Faulkner, 1999). The PAQ-C is a self-administered, seven-day recall test. It was designed to evaluate children in grades 4 through 8 and those between the ages of 8 and 14 years on their overall physical activity levels during the elementary school years. The PAQ-C can be administered in the classroom. The PAQ-C is considered a reliable and valid measure of children's general physical activity levels during the school year. Three studies by Crocker, Bailey, Faulkner, Kowalski, and McGrath (1997) administered the PAQ-C to elementary school students (N = 215, N = 84, and N = 200) during the school year. The children attended public schools and were between the ages of 8 and 16.

Based on nine items, each rated on a 5-point scale, and provides a summary score of physical activity.

2.5 Questionnaire *Finnish Diabetes Risk Score (FINDRISC)*

Lindström and Tuomilehto developed the Finnish Diabetes Risk Score (FINDRISC) for the Finnish Diabetes Association. This measurement tool is considered simple, inexpensive and non-invasive. They are also considered a reliable and rapid tool that has been validated. To find people at high risk of developing type 2 diabetes based on prospective population data over a 10-year period (Lindström & Tuomilehto, 2003). To identify people at risk of developing diabetes mellitus, this diagnosis is necessary. This will allow them to start the necessary lifestyle changes in a short time to prevent the development of diabetes mellitus.

A group of metabolic disorders is called diabetes mellitus, which is characterized by chronic hyperglycemia caused by impaired insulin secretion, insulin action, or both (Ozougwu et al., 2013). The endocrine system suffers from a non-communicable disease called diabetes, which is caused by various factors that affect insulin secretion by the islet cells of Langerhans (Todkar 2016; Omondanisi et al. 2017).

Type 1 diabetes, formerly known as non-insulin-dependent diabetes, is a juvenile or childhood-onset diabetes caused by autoreactive T lymphocytes eliminating insulin-producing cells in the pancreatic islets, leading to elevated plasma glucose levels and insulin deficiency (Yu 2012; Ali 2013). Gestational diabetes, detected through prenatal screening, increases the likelihood of developing type 2 diabetes later in pregnancy (World Health Organization, 2016). The most common type, type 2 diabetes, typically

occurs when insulin secretion from the islets fails to compensate for the increasing insensitivity to circulating insulin in target tissues, characterized by elevated plasma glucose levels (Ali 2013). Although previously considered a disease of the elderly, it is beginning to occur in children.

The validated FINDRISC tool assesses eight factors to predict type 2 diabetes. These include age, body mass index (BMI), waist circumference, physical activity, fruit and vegetable consumption, use of antihypertensives, previous diagnosis of diabetes in the family, and family history of diabetes.

2.6 Research Gap

Table 2.3 Research Gap on the Relationship between Physical Activity and the Risk of Diabetes Mellitus in Elementary School Children (8-12 Years)

No	Title	Variables	Research methods	Source	Results
1	The relationship between physical activity and obesity in school children at Mardi Rahayu Elementary School, Ungaran, Semarang Regency	Obesity, physical activity, elementary school children, BMI, diet, gender, weight, height	Quantitative	Rr. Maghfira Nadia P, Sri Wahyuni, Sigit Ambar Widiyawati, 2019	The results of the study showed that there was a relationship between physical activity and the incidence of obesity in school children at Mardi Rahayu Elementary

					School, Ungaran.
2	The relationship between consumption behavior and physical activity with diabetes mellitus in Indonesia	Diabetes mellitus, consumption behavior, physical activity, risk factors for diabetes mellitus	Quantitative	By Ni Nyoman Veridiana and Made Agus Nurjana, 2019	Physical activity is a dominant risk factor for the incidence of DM in Indonesia.
3	The effect of physical activity of walking in type 2 diabetes mellitus sufferers on blood sugar stability	Diabetes mellitus, physical activity, blood sugar levels, insulin	Quantitative	Sri Sakinah, Jumiarsih Purnama, Nuraeni, 2022	The results of the study showed that there was a change in blood sugar levels in all diabetics who were used as subjects after treatment.
4	Physical activity education for elementary school children	Physical activity, children	Quantitative	English: 2023	Physical activity in children is directed to follow daily play patterns so that children do not become bored.
5	The role of parents in encouraging outdoor physical activity in early childhood	Parents, early childhood, physical activity, outdoor play	Qualitative	Elisa Pitria Ningsih, 2024	The study results highlighted a variety of strategies used

					by parents, including modeling behavior, creating a supportive environment, and direct involvement in play with children.
6	Analysis of physical activity of elementary school children in Mojoroto sub-district, Kediri city (survey using physical activity questionnaire for older children (PAQ-C))	Analysis, physical activity, elementary school children	Quantitative	Dionesius Bagas Ristanto, Irwan Setiawan, Dhedhy Yuliawan, 2024	The results of the study show that the analysis of the physical activity of elementary school children in Mojoroto District in 2023 was included in the category of sometimes doing physical activity.
7	Risk factors for diabetes mellitus	Age, family history, physical activity, diabetes mellitus	Quantitative	Fitriani Nasution, Andilala, Ambali Azwar Siregar, 2021	The results of the study showed that the risk factors for type 2 diabetes mellitus were age, family

					history and physical activity, while gender, history of hypertension and obesity were not related to the incidence of diabetes mellitus.
8	A review article : the combination of physical activity and healthy diet in adolescents to prevent diabetes mellitus	Physical activity, healthy diet, diabetes mellitus, adolescents	Literature review	Flowers Janviera Firnanda, Dziyaau Qoulin Nuzil, Amalia Firda Salsabila, Romyun Alvy Khoiriyah, 2022	The article show that in the age group of adolescents, prevention of diabetes mellitus can be conducted with combining physical activity with dietary pattern. This thing is related to insulin secretion, so glucose homeostasis can be more awake.

2.7 Conceptual Framework

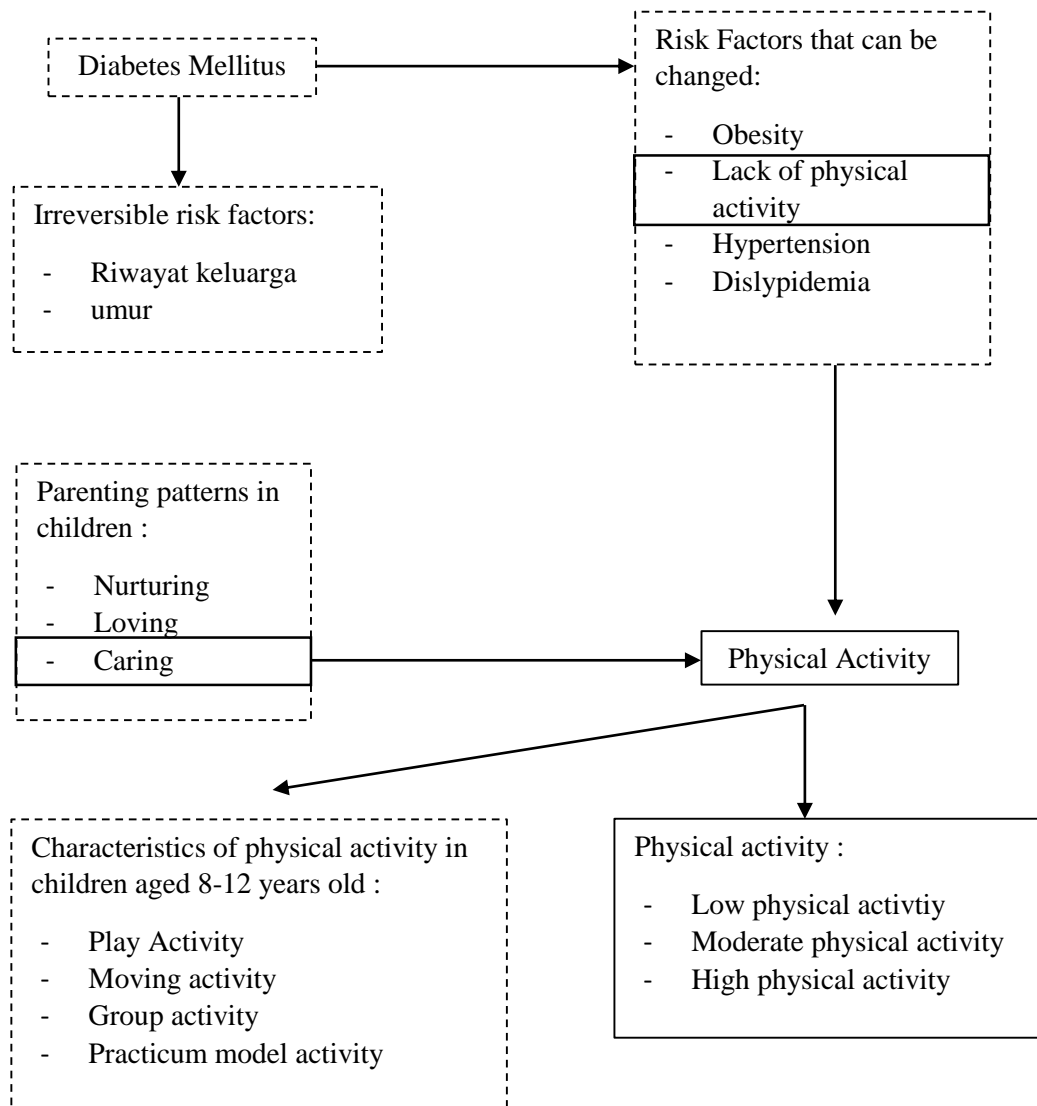


Figure 2.1 Conceptual Framework of the Relationship between Physical Activity and the Risk of Diabetes Mellitus in Elementary School Children Aged 8-12 Years

Information :

————— : researched

----- : not researched

2.8 Hypothesis

The research hypothesis was conducted to examine whether or not there is a relationship between physical activity patterns and the risk of diabetes mellitus in elementary school children.

H₁: there is a relationship between physical activity patterns and the risk of diabetes mellitus in elementary school children

H₀: there is no relationship between physical activity patterns and the risk of diabetes mellitus in elementary school children