

# DESCRIPTION OF HEMOGLOBIN LEVELS IN PATIENTS WITH DIABETES MELLITUS RENAL COMPLICATIONS IN TOTO KABILA HOSPITAL 2020

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## ABSTRACT

In 2018 the number of sufferers Diabetes mellitus in Bone Bolango district ranks sixth in Gorontalo Province. Data from Toto Kabila Hospital in 2020, as many as 24 patients. In some cases the disease that can cause complications in patients with diabetes mellitus is kidney failure. The decrease in hemoglobin levels in patients with kidney disorders is caused by decreased levels of erythropoietin which stimulates the bone marrow to produce red blood cells.

The aim of the study was to describe the hemoglobin levels in patients with diabetes mellitus with kidney complications.

This research design using quantitative descriptive. Conducted at Toto Kabila Hospital with a total sample of 24 patients with diabetes mellitus with kidney complications. The sampling technique was total sampling. Using the Univariate data analysis technique then the results are presented in tabular form.

Based on the results of the study of 24 samples, it was found that the results of normal hemoglobin levels were 9 samples with a percentage (37.5%) while patients who had abnormal hemoglobin levels were 15 samples with a percentage (62.5%).

**Keywords:** hemoglobin, diabetes mellitus, kidney complications

## INTRODUCTION

Non-Communicable Diseases (PTM) is one of the major public health problems in Indonesia which until now has become a concern in the world of health because it is one of the causes of death. This is indicated by non-communicable diseases that are increasing globally in the world and nationally have occupied the top ten diseases that cause death and most cases, including Diabetes mellitus (DM). Although Diabetes Mellitus is a chronic disease that does not cause immediate death, it can be fatal if handled inappropriately. The management of Diabetes Mellitus is known by four main pillars, namely counseling or education,

medical nutrition therapy, physical exercise or physical activity and pharmacological intervention [22].

The number of people with diabetes mellitus has increased every year, especially in developing countries. Judging from various studies that show a tendency to increase the incidence of diabetes mellitus in various parts of the world. In (2013) there were 1.5 million deaths caused by Diabetes Mellitus. In (2018) there were 422 million people worldwide who suffered from Diabetes Mellitus, the majority of whom lived in low and middle income countries [25].

In 2018 the prevalence of diabetes mellitus based on doctor's diagnosis in

*Overview of Hemoglobin Levels in Patients with Diabetes Mellitus, Kidney Complications at Toto Kabila Hospital, 2020*

people aged  $\geq 15$  years shows that Gorontalo province is included in the category of regions that are included in the top 10 with the highest number of people suffering from Diabetes Mellitus in Indonesia with a percentage of 2.4% in 2018 [16].

There were 4,415 people with Diabetes Mellitus found in Gorontalo Province in 2018. Among them are Pohuwato Regency with 563 inhabitants, Boalemo Regency with 186 inhabitants, North Gorontalo Regency with 211 people, Gorontalo Regency with 1,781 inhabitants, Gorontalo City with 302 people, Regency of Bonebolango with 1,372 people. The highest number of patients was in the Gorontalo Regency area with 1,781 patients and the least was in the North Gorontalo Regency area, as many as 211 people (Gorontalo Provincial Health Office, 2018) [4].

The number of diabetes mellitus sufferers with kidney complications at SOLOK Hospital in February-April 2017 showed that 15 male patients (50%) and 15 female patients (50%) [22]. and from the results of research conducted on 30 male and female patients as many as 10 patients with diabetes mellitus with renal complications who had hemoglobin levels in the range of 10.1-11.0 gr / dl and most of the hemoglobin levels were below normal. This is because when the kidneys are diseased or damaged they don't make enough erythropoetin. As a result, the bone marrow makes fewer red blood cells, leading to anemia or decreased hemoglobin levels [22].

Diabetes mellitus is a group of diseases metabolism which is characterized by hyperglycemia caused by disorders of insulin secretion, insulin action or both. Diabetes mellitus can also cause chronic complications in parts of human organs such as kidneys, eyes, nerves and blood vessels. One of the chronic microvascular complications is

diabetic nephropathy. Diabetic nephropathy is a condition in which the kidneys have decreased function and there is damage to the blood-filtering membrane caused by high blood sugar levels. which explains where diabetic nephropathy is found in diabetes mellitus patients in about 34-54% [7].

Damage to the structure and function of the kidneys can be accompanied by a decrease in GFR / Glomerular Filtration Rate. This decrease in GFR is related to the clinical picture that will be found in patients, one of which is a decrease in hemoglobin levels in the blood which can be said to be anemia. Hemoglobin is a parameter of anemia, the decrease in Hb levels in patients with kidney disorders is caused by decreased levels of erythropoietin, a hormone produced by healthy kidneys to produce red blood cells and if the body lacks oxygen levels, healthy kidneys will release erythropoetin hormone which will stimulate the marrow. the spine to produce more red blood cells [22].

Diabetics can experience various long-term complications if their diabetes is not managed properly. High blood sugar for a long time will cause damage to various organs, namely damage to the blood vessels of the eye can cause visual disturbances due to damage to the retina of the eye (diabetic retinopathy), kidney dysfunction can lead to kidney failure so that patients must undergo dialysis, attacks heart disease and stroke which can lead to paralysis resulting in death and amputation of the leg resulting in disability [11].

Diabetes mellitus incidence begins with insulin deficiency as the main cause. On the other hand the emergence of Diabetes mellitus can come from a relative lack of insulin caused by insulin resistance (Insuline Resistance). This situation is characterized by the inability of the organs to use insulin, so that insulin

cannot function optimally in regulating glucose metabolism. As a result, blood glucose levels increase (hyperglycemia) [3].

The greatness of Diabetes Mellitus will appear more powerful when Diabetes Mellitus enters the stage of complications. Diabetes mellitus can attack almost all systems of the human body, from the skin to the heart. The forms of complications can be, respectively in the system:

1. Cardiovascular system: hypertension, myocardial infarction, coronary insufficiency.
2. Eyes: Diabetic retinopathy
3. Nerves: Diabetic Nephropathy
4. Kidney: pyelonephritis, Glomerulosclerosis
5. Lungs: tuberculosis
6. Liver: Cirrhosis of the liver
7. Skin: Gangrene, ulcers, furuncles

Complications can be acute, and some are chronic, acute complications are characterized by: infection (Karbunke, Angren, pyelonephritis). Ketoacidosis occurs, followed by coma. Chronic complications associated with damage to the walls of blood vessels that cause atherosclerosis typical of the small blood vessels at the end of the organ called microangiopathy, manifested in the form of retinopathy, glomerulosclerosis and neuropathy [3].

Hemoglobin is a widely used parameter to determine the prevalence of anemia. Determination of anemia status using only hemoglobin levels is incomplete, so it is necessary to add another examination. Hemoglobin is an oxygen-carrying compound in red blood cells. Hemoglobin can be measured chemically and the amount of Hb / 100 ml blood can be used as an index of the oxygen-carrying capacity of the blood [1].

The decrease in hemoglobin levels is due to a chronic hyperglycemia condition that can cause a hypoxic environment in the renal interstitium, this kidney disorder

affects GFR and also indicates that there are fewer functioning nephrons resulting in impaired production of erythropoietin produced by peritubular fibroblasts. Erythropoietin stimulates the bone marrow to make red blood cells, so that if there is a disturbance in its formation, hemoglobin is not maximally formed and anemia results [15].

Anemia is a condition where the hemoglobin level in the blood is below normal which can be caused by a lack of nutrients for blood formation. complications occur most often in diabetes mellitus patients, especially when accompanied by nephropathy or renal disorders. Chronic anemia causes tissue hypoxia which is the key to diabetes causing organ damage. Recent reports have shown that anemia is a risk factor for progression of End Stage Renal Disease (ESRD) in patients with chronic kidney disease, with or without diabetes. The incidence of anemia increases with increasing stage of ND and chronic kidney disease [9].

The main function of the kidneys is to filter and cleanse toxins in the body. In one day the kidneys filter 200 liters of blood, remove toxins and two liters of water. The kidneys are also useful for regulating blood pressure, regulating the formation of red blood cells through the hormone erythropoietin, and playing a role in maintaining the density of the dulan. If the kidneys are damaged, people become pale due to lack of blood, high blood pressure, swelling and other possibilities due to toxins that have accumulated in the body, including bone loss. Kidney disorders are termed Nephropathy (Nephropathy). Kidney damage due to diabetes is called diabetic nephropathy [19].

The kidneys are the excretory organs in vertebrates that are pea-like, located behind the abdominal cavity, each kidney consisting of the renal artery and renal

vein. The macroscopic and microscopic structure of the kidney consists of the kidney, nephrons, blood vessels and renal nerves. Macroscopic consists of an excretory channel that leads to the bladder, renal parenchyma that surrounds the excretory tract, namely the medulla and the renal cortex [19].

When the diagnosis of diabetes mellitus is confirmed, the possibility of decreased kidney function should be checked, as well as when the patient has undergone routine treatment. Monitoring recommended by the American Diabetes Association (ADA) is checking for the presence of microalbuminuria and determining serum creatinine and creatinine clearance. Diabetic nephropathy is a microvascular complication of diabetes mellitus that occurs in small blood vessels. Diabetic nephropathy is one of the leading causes of renal failure and the highest mortality among all complications of diabetes mellitus [6]. Impaired diabetic renal function or diabetic nephropathy is assessed by a decrease in glomerular filtration rate which can result in fibrosis and cause anemia [3].

Chronic hyperglycemia can lead to nonenzymatic glycation of amino acids and proteins. Initially, glucose will bind to the amino residues non-enzymatically, then rearrange them to achieve a more stable but still reversible form called Amadori products. If this process continues, it will form irreversible Advanced Glycation End-Products (AGEs). AGEs are thought to be intermediaries for several cellular activities such as expression of adhesion molecules that play a role in the withdrawal of mononuclear cells, as well as in the occurrence of cell hypertrophy. This process will continue until the mesangium expansion occurs and the formation of nodules and fibrosis. In the condition of kidney fibrosis the number of

fibroblasts decreases so that erythropoietin production decreases which is the main cause of anemia.

Nephron consists of glomerulus and tubule. As part of the urinary system, the kidneys have the main function of maintaining the composition and volume of body fluids in order to remain constant through their excretory function. The kidneys also have a specific function, namely removing the waste products of the body's metabolism, removing toxins (drugs, food additives, etc.), filtering impurities (especially urea) from the blood and removing them together with water in the form of urine [19].

The decrease in the working period of the kidneys is influenced by chronic kidney factors. 60% of LPG has experienced an increase in plasma urea and creatinine levels but patients still do not feel some complaints until LPG below 30% of patients begin to show some symptoms such as anemia, increased blood pressure, disorders of phosphorus and potassium metabolism accompanied by nausea and vomiting, patients can also get infections of the gastrointestinal tract, water balance disorders such as hypo and hypervolemia and electrolyte balance disorders between sodium and potassium. Then until LPG below 15% of patients begin to experience more serious signs and symptoms requiring renal replacement therapy such as dialysis or kidney transplantation in this condition the patient is said to have reached the end stage of renal failure [24].

Decreasing tissue oxygen concentration can result in the kidneys increasing the production and release of erythropoietin into blood plasma, which stimulates stem cells to differentiate into proerythroblasts, further increasing the rate of mitosis, increasing the release of reticulocytes from the spinal cord, and inducing the formation of hemoglobin. In kidney failure there is a deficiency of

erythropoietin. the process of forming hemoglobin is reduced. There are other factors in chronic kidney disorders that also contribute to anemia, namely chronic and acute inflammatory conditions that have a strong influence on anemia of chronic kidney disorders, by inflammatory cytokines that decrease erythropoietin production and induce apoptosis in Colony Forming Units-Erythroid Cells (CFU- E). At the initial induction of apoptosis CFU-E cells stop the development process into red blood cells. Cytokine inflammatory agents have also been found to induce the production of hepcidin, a peptide produced in the liver, which interferes with red blood cell production, by decreasing the availability of iron for erythroblasts. This can reduce the production of red blood cells [24].

*Chronic Kidney Disease*(CKD) is an irreversible condition in which kidney function decreases over time. CKD (chronic kidney disease) usually develops slowly and progressively, sometimes over years, with patients often not realizing that their condition is severe. The condition of adequate function is impaired, resulting in a decrease in the production of new red blood cells and eventually anemia [23].

Decrease in hemoglobin levels due to chronic hyperglycemia can cause a hypoxic environment in the renal interstitium, this kidney disorder affects GFR and also indicates that there are fewer functioning nephrons resulting in impaired production of erythropoietin produced by peritubular fibroblast cells. Erythropoietin stimulates the bone marrow to make red blood cells, so that if there is a disturbance in its formation, hemoglobin is not maximally formed and anemia results [12].

Impaired kidney function in diabetes mellitus is assessed by a decrease in the glomerular filtration rate which can result in fibrosis and cause anemia, prolonged hyperglycemia, which increases the risk of

damage to cells in the kidney as seen from a decrease in the glomerular filtration rate, the cells involved. one of which functions as the formation of erythropoietin which is useful in the production of red blood cells. Therefore, the lower the glomerular filtration rate or the lower the kidney function, the lower the hemoglobin level is due to the inhibited erythropoietin production activity [12].

Anemia is a condition where the hemoglobin level in the blood is below normal which can be caused by a lack of nutrients for blood formation. complications occur most often in patients with diabetes mellitus, especially when accompanied by nephropathy or renal disorders. Chronic anemia causes tissue hypoxia which is a key cause of diabetes causing organ damage [18].

Anemia is functionally defined as a decrease in the mass of erythrocytes (redcell mass) so that it is unable to fulfill its function to carry sufficient oxygen to peripheral tissues. Practically anemia is indicated by a decrease in hemoglobin, hematocrit or erythrocyte count. But the most commonly used levels are hemoglobin, then hematocrit. It should be noted that there are certain circumstances in which these three parameters are inconsistent with the erythrocyte mass, such as dehydration, acute bleeding and pregnancy [12].

## RESEARCH METHODS

This research is a descriptive research with a quantitative approach. Where descriptive research with a quantitative approach is this research aims to explain the existing phenomena by using numbers to rely on individual or group characteristics to determine the value of the independent variable, either one or more (independent) variables without making comparisons, or connecting with variables other. This type of research is a descriptive approach to see an overview of



the results of hemoglobin examination in patients with diabetes mellitus with kidney complications at Toto Kabila Hospital [17].

Design This study used a cross sectional design (cross section). Cross sectional is a study by studying the correlation between risk factors and effects, carried out in situations where the researcher intends to collect data from a sample or population (Notoatmodjo, 2012). Cross sectional research is used to see the picture the results of hemoglobin examination in patients with renal-complicating diabetes mellitus[13].

Variable is something that becomes the object of research observation, often referred to as a factor that plays a role in the research or symptoms to be studied. The variable in this study is the hemoglobin level in patients with diabetes mellitus with kidney complications [17].

The population in this study were 24 patients with diabetes mellitus with kidney complications at Toto Kabila Hospital, Bonebolango Regency, Gorontalo Province. The sample used in this study was the entire population of people with diabetes mellitus with kidney complications at Toto Kabila Hospital, Bonebolango Regency, Gorontalo Province.

The sampling technique used in this study was total sampling. Total sampling is a sampling technique where the number of samples is the same as the population.

The research instrument is a tool that researchers use in collecting data so that jobs are younger and the results are better [20]. The instrument used is the Hematology Analyzer tool which is used as a measuring tool to determine the results of hemoglobin levels in people with diabetes mellitus with kidney complications. In addition, the questionnaire is used to determine the characteristics and factors that can interfere with research[20].

This study uses univariate data analysis techniques where the researcher will describe or describe each research variable then the results of the data analysis are presented in the form of a table along with a narrative [6].

## RESEARCH RESULT

Based on research that has been conducted on the image of hemoglobin levels in patients with diabetes mellitus with kidney complications at Toto Kabila Hospital on October 8 - 19 October 2020 with a sample size of 24 patients, the following results were obtained:

**Table 1.** Results of Examination of Hemoglobin Levels in Patients with Complicated Diabetes Mellitus Kidney.

Hemoglobin Test Results	Frequency	%
Normal	9	37.5
Abnormal	15	62.5
total	24	100

Source: Data processed (2020)

Based on Table 1. it can be seen that, patients with diabetes mellitus with kidney complications who have normal hemoglobin levels are 9 samples (37.5%) while patients who have abnormal hemoglobin levels are 15 samples with a percentage (62.5%) at Toto Hospital. Kabila Bonebolango district in 2020.

## DISCUSSION

Impaired kidney function in diabetes mellitus is assessed by a decrease in GFR which can result in fibrosis which causes anemia, long-lasting hyperglycemia, which increases the risk of damage to cells in the kidney as seen from a decrease in the glomerular filtration rate, one of which is involved. which functions as the formation of erythropoetin which is useful in the production of red blood cells. If the

body lacks oxygen levels, healthy kidneys will release the hormone erythropoietin which will stimulate the bone marrow to produce more red blood cells. Therefore the lower the glomerular filtration rate or the lower the kidney function, the lower the hemoglobin level because of the inhibited erythropoietin production activity. [12].

This study was conducted to examine hemoglobin in patients with diabetes mellitus with kidney complications. The aim was to determine the hemoglobin value and what factors could affect hemoglobin levels in people with diabetes mellitus with kidney complications at Toto Kabila Hospital using an automatic method with a total sample size of 24 diabetes mellitus patients. kidney complications. Why this research is considered important because it is an effort to prevent or overcome anemia in diabetes mellitus patients with kidney complications, so hemoglobin checks are necessary. Hemoglobin is used as an initial screening test for anemia.

This study used a sample of 24 patients with diabetes mellitus with kidney complications in Toto Kabila Hospital, Bonebolango Regency, Gorontalo province in October 2020. a percentage of 62.5% experienced a decrease in hemoglobin levels. While 9 samples with a percentage of 37.5% were in normal circumstances. These results indicate that most respondents have hemoglobin levels below normal.

These results are in accordance with previous research, it was found that the number of diabetes mellitus sufferers with kidney complications in SOLOK Hospital in February-April 2017 showed that 15 male patients (50%) and 15 female patients (50%) [22]. And from the results of research conducted on 30 male and female patients as many as 10 patients with diabetes mellitus with kidney complications who had hemoglobin levels

in the range of 10.1-11.0 gr / dl and most of the hemoglobin levels were below normal. This is because when the kidneys are diseased or damaged they don't make enough erythropoietin. As a result, the bone marrow makes fewer red blood cells, causing anemia or decreased hemoglobin levels. This decrease in GFR is related to the clinical picture that will be found in patients, one of which is a decrease in hemoglobin levels in the blood. Decreased hemoglobin levels in patients with kidney disorders are caused by decreased levels of erythropoietin, a hormone produced by healthy kidneys to produce red blood cells and if the body lacks oxygen levels, healthy kidneys will release the hormone erythropoietin which will stimulate the bone marrow to produce more cells. red blood [22].

In this study, 9 patients with diabetes mellitus with kidney complications had normal hemoglobin levels. One of the influencing factors is the possibility that the patient has previously received blood transfusions but whose history is not included in full in the medical record or the other possibility that the patient has previously received recombinant erythropoietin, and factors that affect patients with low hemoglobin levels are usually caused because the patient's condition is indeed in a different condition. severe due to previous underlying pain. The etiology of this kidney failure is due to hypertension and diabetes mellitus. Chronic kidney sufferers are usually also disturbed by their food intake, for example because of loss of appetite, nausea, vomiting and gastrointestinal disorders so that if not monitored, the hemoglobin level will continue to decrease over time. Decreased renal function (characterized by an increased stage and decreased GFR), the more severe anemia will be [12].

## CONCLUSION

Based on the research that has been done, it can be concluded that from 24 samples of diabetes mellitus patients with kidney complications in Toto Kabila Regional Hospital who were subjected to hemoglobin examination and the results obtained were 15 samples with a percentage (62.5%) having decreased hemoglobin levels. While the normal ones were 9 patients with a percentage (37.5%).

## REFERENCES

- [1] Airam, Y. 2018. "Hemoglobin". <http://www.academia.edu>. Accessed on 14 September 2018
- [2] Astutik, R, Y. Ertiyana, D. 2018. Anemia in Pregnancy. Prints 1. (E-Book). ISBN: 978-602-5570-64-3. Surabaya.
- [3] Bustan, N, M. 2015. Non-communicable disease control management. PT Rineka Cipta: Jakarta.
- [4] Gorontalo Provincial Health Office. (2018). Gorontalo Province Health Profile. Gorontalo.
- [5] Gandasoebrate R. 2013. Clinical Laboratory Guidance. Edition 15. Dian Rakyat. Jakarta.
- [6] Gunarto, M. 2018. "Statistical Analysis with Structural Equation Models" Bandung: Alfabeta
- [7] Gusti A PWSP et al. 2017. Description of serum creatinine levels in patients *diabetes mellitus* Type 2 In the central General Hospital, Sanglah Denpasar. ISSN Online: 2549-1520, Vol. 5, No. 2, December 2017 Pg. 107 - 117, <http://ejournal.poltekkes-denpasar.ac.id>
- [8] Ismatullah A. 2015. Management of Anemia Therapy in Patients with Chronic Renal Failure. Faculty of Medicine, University of Lampung. Medula Journal. Vol. 4 No. 2.
- [9] Ito H, and Yuichiro, Takeuchi, Hidenori Ishida, Aya Otawa, Akane Shibayama, Shinichi Antoku, Mariko Abe, Mizuo Mifune, Michiko Togane. 2010. Mild Anemia Is Frequent and Associate With Micro- and Macroangiopathies in Patients With Type 2 Diabetes Mellitus. Journal of Diabetes Investigation. 1: 273-78.
- [10] Ministry of Health RI. 2015. Indonesia Health Profile Report. Jakarta: Ministry of Health RI.
- [11] Marsden PA. Treatment of anemia in chronic kidney disease-strategies based on evidence. N Engl J Med. 2017; 261 (21): 2089-90.
- [12] Nasution N, S, R, 2018. Examination of Hemoglobin Levels in Type 2 Diabetes Mellitus patients with diabetic nephropathy at the H. Adam Malik Central General Hospital, Medan. Health Polytechnic of the Ministry of Health, Medan, Department of Health Analyst, 2018.
- [13] Notoadmojo, 2015. "Health Research Methods". Revised Edition. Jakarta. Rineka Cipta.
- [14] Purnamasari, D, 2010. Type II Diabetes Melitus with Obesity Grade I In Elderly Woman, Medula, Vol. 4 No.2.
- [15] Ramadhan, M, 2017. Factors related to the incidence of diabetes mellitus in RSup Dr. Wahidin Sudirohusodo and RSH Hasanuddin University, Makassar in 2017. Hasanuddin University Faculty of Public Health Epidemiology.
- [16] Riskesdas. 2018. National Riskesdas 2018 report. Indonesian Ministry of Health. health research and development agency.
- [17] Sugiyono. 2014. Educational Research Methods with Quantitative Approaches, Qualitative, and R & D. Alfabeta. Bandung.
- [18] Sulistyaningsih, D. 2015. "The description of the habit of taking Fe



- tablets and the incidence of worms in pregnant women who are anemia". (bachelor thesis health science faculty). Surakarta: Muhammadiyah University of Surakarta.
- [19] Tandra, H. 2017. Everything you should know about diabetes. The complete guide to knowing and overcoming diabetes quickly and easily, E-Book. PT Gramedia Pustaka Utama: Jakarta.
- [20] Tersiana, A. 2018. Research Methods. Start Up: Yogyakarta.
- [21] Trihartati M, V, and Budiman A, Hartini H, 2019. Overview of serum urea and creatinine levels in patients with type-2 diabetes mellitus at Santa Maria Hospital Pekanbaru. Journal of Medical Laboratory Science and Technology - Vol. 4 No. 2 (2019)
- [22] Utami, R, P. and Fuad, K. 2018. Description of hemoglobin levels in people with diabetes mellitus with kidney complications. Pioneer health journal. Volume 5 Number I Year 2018.
- [23] Wiwik A and Wardani K E. 2019. Decreased Hemoglobin in Chronic Kidney Disease After Hemodialysis at RSU "KH" Batu. Nursing Study Program, STIKes Maharani Malang, Indonesia. Journal of Nurses and Midwifery, Volume 6, Number 2.
- [24] Wong W and Olivia. 2017. Analysis of Hemoglobin Changes in Chronic Kidney Disorders (GKK) Patients Underwent Hemodialysis for 3 Months at a State University Hospital (Rsptn). Medical Education Study Program, Faculty of Medicine, Hasanuddin University Makassar.
- [25] *World Health Organization*(WHO). (2018). Diabetes. ([https://www.who.int/health-topics/diabetes#tab=tab\\_1](https://www.who.int/health-topics/diabetes#tab=tab_1)). (On line)