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Research Article

Surveillance Pattern of Cases of Type 2 Diabetes Mellitus in Bone Regency

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Abstract

Background and Objective: The prevalence of diabetes mellitus among the world's populations continues to increase yearly. This study aimed to analyze the surveillance of the case pattern of type 2 diabetes mellitus at 9 Local Government Clinics during the year 2016 in Bone Regency. **Materials and Methods:** This was an observational study using a cross-sectional analysis. The population of the study was patients with type 2 diabetes mellitus at 9 Local Government Clinics in Bone Regency from January-July, 2016. The sampling method used in this study was multistage sampling. Analysis of the data was conducted using SPSS software, the frequency and ArcView Geographical Information System (GIS) 9.1 software programs. **Results:** The results of the study revealed that the cases of type 2 diabetes mellitus among all respondents were more prevalent in the 45-54 age group (35.4%) and significantly higher in the female group than in the male group (68.6%). The highest number of visitations was found at the Watampone Local Government Clinic (42.6%) and the highest number of cases of type 2 diabetes mellitus was diagnosed in January (21.5%). Based on the spatial analysis using the GIS program, a low number of cases of type 2 diabetes was found at Awangpone, Pacing, Ulaweng, Cina, Kading and Sibulue, whereas a moderate number was found at Biru and Bajoe and the highest was found at the Local Government Clinic of Watampone. The number of cases of type 2 diabetes mellitus in the 45-54 age group was low at Awangpone, Pacing and Cina, moderate at Ulaweng, Watampone, Biru and Cina, low was also found at Pacing, Ulaweng, Bajoe, Kading and Sibulue. The female group had a higher rate of type 2 diabetes mellitus than the male group. In addition, the cases of type 2 diabetes mellitus were more numerous in urban areas than in rural areas and the most cases of type 2 diabetes mellitus were diagnosed in January due to the new year and short-term screening of sugar glucose. **Conclusion:** Based on the analysis results in this study, it was suggested that a screening approach and the Integrated Health Counseling Unit (Posbindu) be established at each working unit of the local government for the early detection of cases of type 2 diabetes mellitus. A high number of cases was not found at Bajoe, Kading and Sibulue and females have a higher risk of type 2 diabetes mellitus than males. The lowest number of cases was found at Awangpone.

Key words: Diabetes mellitus, surveillance, spatial pattern, location category, time period

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Diabetes atlas 2007 by Alberti *et al.*¹ stated that the total Indonesian population above 20 years old will reach 125 million people by the year 2016, of whom 5.6 million will have diabetes mellitus, equivalent to a 4.6% national prevalence rate. The total Indonesian population for the year 2020 is expected to reach 21.3 million, with the same age scale and national prevalence rate as in the year 2016 and the number of Indonesians with diabetes mellitus will reach 21.3 million in the year 2030. Urban populations are expected to have higher percentages of individuals with diabetes mellitus than rural populations. Moreover, information from the report of the Indonesian National Health Survey of 2007 commissioned by Riskesdas² stated that the 45-54 age group of the population presents the highest incidence of diabetes mellitus, ranking second in the national NCD prevalence and that the rural populations rank 6th in the national NCD prevalence. As confirmed in the survey report of the Indonesian National Health Survey of 2008, diabetes mellitus contributes to 3% of the mortality associated with the total NCD incidence among all age groups in Indonesia^{3,4}.

The number of cases of diabetes mellitus increases yearly with the increasing world population and this increase in prevalence is related to the progressive transformation of a traditional lifestyle into a modern standard of living due to urbanization, the increase of obesity prevalence and the decrease of physical activity. Therefore, the incidence and prevalence of diabetes mellitus should be regularly monitored as this disease is progressively chronic and has potential negative impacts. The diabetes mellitus statistics at the Indonesian national level, correspond to those at the regional level in Bone Regency, the research region chosen in this study. Referring to the regional visitation data for both in-patients and out-patients at 38 Local Government Health Clinics published by the Regional Health Department of Bone Regency, there were 160 patients in 2013, 3,070 patients in 2014 and 4,826 patients in 2015 with type 2 diabetes mellitus in this regency^{5,6}.

One of the effective approaches to analyzing cases of diabetes mellitus is the use of Geographic Information System (GIS) technology. The GIS can be used as an important informational tool to obtain a more detailed analysis on the incidence and prevalence of diabetes mellitus using spatial analysis to assist government servants and stakeholders in planning and developing health policies in a more integrated, efficient and effective manner. The GIS provides more advantages, including (1) Measurement/inventory, (2) Mapping, (3) Monitoring and (4) Modeling.

To date, the conventional approach used for the registration of diabetes mellitus in Bone Regency involves the use of both tabular analysis and graphs, which have certain limitations. Such an approach analyzes the distribution of the incidence and prevalence of diabetes mellitus using the aggregate technique at both the village and subdistrict government administration levels; however, this approach does not use the mapping technique. To assess the cases of diabetes mellitus in more detail, the implementation of a surveillance system should be capable of not only identifying the spatial distribution of the incidence and prevalence of diabetes mellitus at an aggregate level but should also identify it at an individual level. Hence, GIS can be used to identify the incidence and prevalence of diabetes mellitus, even at the individual level as the data of diabetes mellitus patients can be recorded to detect both the incidence and prevalence of diabetes mellitus.

MATERIALS AND METHODS

This observational study used a cross-sectional analysis. A cross-sectional analysis is a type of observational study that analyzes independent and dependent variables sampled from a population or a subset at one specific point in time.

The study was conducted at the Regional Health Department of Bone Regency and 9 Local Government Clinics in each of the 9 subdistricts of Bone Regency. The study period was May-August, 2016. There were 9 Local Government Clinics in each of the 9 subdistricts of Bone Regency that were selected as the study samples, derived from the total 38 Local Government Clinics in Bone Regency which included a total of 1,675 cases of type 2 diabetes mellitus for the January-July period, 2016.

The method used to collect the selected samples was multistage sampling consisting of three steps. The first step was the selection of samples drawn from the total 38 Local Government Clinics in Bone Regency. The second step was the selection of the number of cases of type 2 diabetes mellitus and the number of selected Local Government Clinics using a drawing technique derived from the total 38 Local Government Clinics in Bone Regency. The selected samples drawn from the total 38 Local Government Clinics in Bone Regency were 9 Local Government Clinics located in each of the 9 subdistricts consisting of 36 cases from Awaru, 220 cases from Bajoe, 128 cases from Biru, 11 cases from Cina, 95 cases from Kading, 38 cases from Pacing, 42 cases from Sibulue, 78 cases from Ulaweng and 480 cases from Watampone. The third step was data analysis using the ArcView GIS 9.1 software to detect the spatial distribution of cases of type 2 diabetes mellitus.

RESULTS AND DISCUSSION

Epidemiologically, the general pattern of diabetes mellitus in this study was determined according to three characteristics: Individual, location and time period. The epidemiological descriptions of individual characteristics of type 2 diabetes mellitus patients were reported as age and gender. The epidemiological descriptions of the location characteristic of type 2 diabetes mellitus patients were reported as the number of patients from each of the 9 Local Government Health Clinics where they were treated and the epidemiological descriptions of the time period characteristic were reported as the number of type 2 diabetes mellitus patients in the specific months at each of the 9 Local Government Clinics located in 9 subdistricts of Bone Regency.

Characteristics of respondents based on the age group: The spatial distribution of cases of type 2 diabetes mellitus by age at each of the 9 Local Government Clinics in 9 subdistricts is shown in Fig. 1 and Table 1.

In Table 1, the highest number of cases of type 2 diabetes mellitus based on the age group observed at each of the 9 Local Government Clinics was 27.8% for the 55-64 age group at Awaru, 37.3% for the 45-54 age group at Bajoe, 40.6% for the 45-54 age group at Biru, 36.4% for the 65-74 age group at Cina, 38.9% for the 55-64 age group at Kading, 47.4% for the 35-44 age group at Pacing, 38.1% for the 45-54 age group at Sibulue, 35.9% for the 55-64 age group at Ulaweng and 36.9% for the 45-54 age group at Watampone.

Characteristics of respondents based on the gender group:

The spatial distribution of cases of type 2 diabetes mellitus by gender at each of the 9 Local Government Clinics in 9 subdistricts is indicated in Fig. 2 and Table 2.

The distribution of type 2 diabetes mellitus patients in the female group as shown in Table 2 was higher than that of the male group among all respondents at each of the 9 Local Government Clinics in Bone Regency in 2016. The highest number of diabetes mellitus patients in the female group was 82.1%, which was found at both the Kading and Ulaweng

Table 1: Tabulated spatial distribution of type 2 diabetes mellitus patients based on the different groups at 9 Local Government Clinics in Bone Regency in 2016

Location/ subdistrict (Local Government Clinic)	Age groups														Total	
	18-24		25-34		35-44		45-54		55-64		65-74		≥75		n	%
	n	%	n	%	n	%	n	%	n	%	N	%	n	%		
Awaru	0.0	0.0	0	0.0	8	22.2	7	19.4	10	27.8	3	8.3	8	22.2	36	100.0
Bajoe	0.0	0.0	5	2.3	43	19.5	82	37.3	66	30.0	22	10.0	2	0.9	220	100.0
Biru	1.0	0.8	1	0.8	8	6.3	52	40.6	42	32.8	17	13.3	7	5.5	128	100.0
Cina	0.0	0.0	1	9.1	1	9.1	1	9.1	3	27.3	4	36.4	1	9.1	11	100.0
Kading	0.0	0.0	2	2.1	12	12.6	32	33.7	37	38.9	12	12.6	0	0.0	95	100.0
Pacing	0.0	0.0	2	5.3	18	47.4	6	15.8	10	26.3	2	5.3	0	0.0	38	100.0
Sibulue	0.0	0.0	1	2.4	3	7.1	16	38.1	14	33.3	8	19.0	0	0.0	42	100.0
Ulaweng	0.0	0.0	5	6.4	9	11.5	26	33.3	28	35.9	9	11.5	1	1.3	78	100.0
Watampone	0.3	0.6	8	1.7	40	8.3	117	36.9	163	34.0	68	14.2	21	4.4	480	100.0
Total	4.0	4.0	25	2.2	142	12.6	399	35.4	373	33.1	145	12.9	40	3.5	1128	100.0

Table 2: Tabulated spatial distribution of cases of type 2 diabetes mellitus based on gender groups at 9 Local Government Clinics in Bone Regency in 2016

Location/subdistrict (Local Government Clinic)	Gender				Total	
	Male		Female		N	%
	N	%	N	%		
Awaru	10	27.8	26	72.2	36	100.0
Bajoe	46	20.9	174	79.1	220	100.0
Biru	45	35.2	83	64.8	128	100.0
Cina	4	36.4	7	63.6	11	100.0
Kading	17	17.9	78	82.1	95	100.0
Pacing	8	21.1	30	78.9	38	100.0
Sibulue	8	19.0	34	81.0	42	100.0
Ulaweng	14	17.9	64	82.1	78	100.0
Watampone	202	42.1	278	57.9	480	100.0
Total	354	31.4	774	68.6	1128	100.0

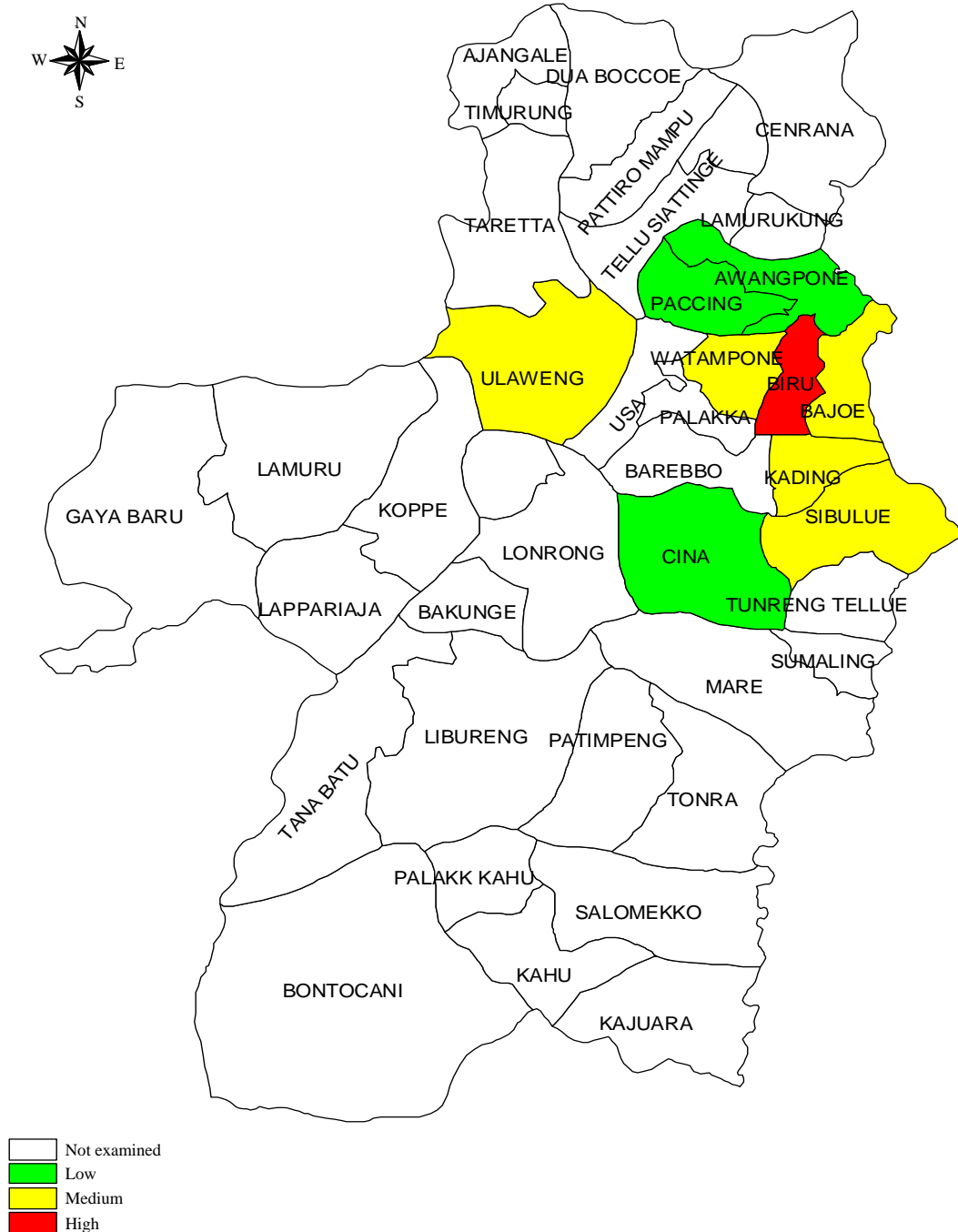


Fig. 1: Map of spatial distribution of cases of type 2 diabetes mellitus based on the different age groups at 9 Local Government Clinics in Bone Regency in 2016

Government Clinics, whereas the lowest was 57.9% at the Watampone Government Clinic.

Characteristics of respondents based on the location category: The distribution of cases of type 2 diabetes

mellitus by location at each of the 9 Local Government Clinics in 9 subdistricts is indicated in the following Fig. 3 and Table 3.

The highest number of diabetes mellitus patients at 9 Local Government Health Clinics located in

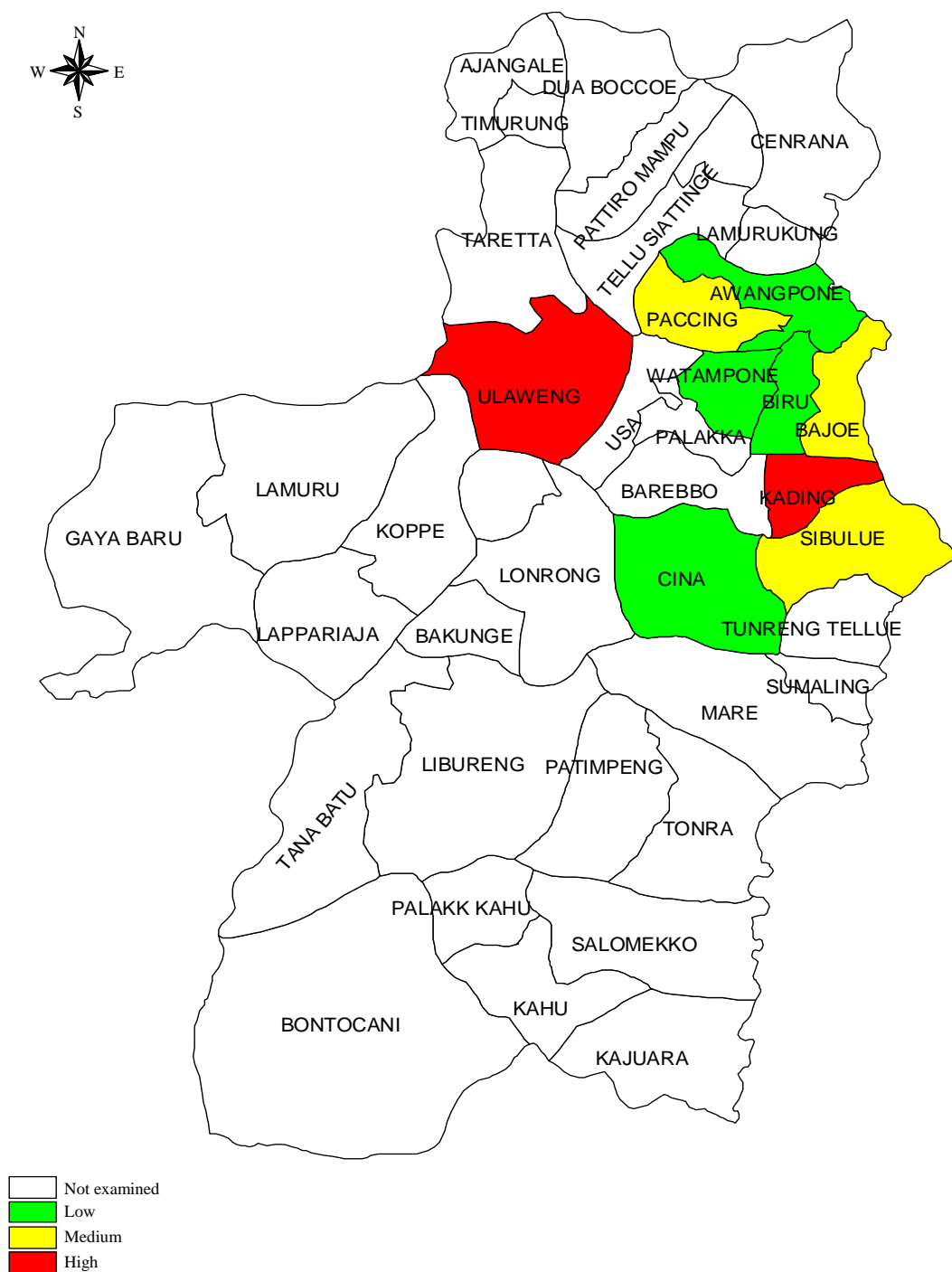


Fig. 2: Map of the spatial distribution of type 2 diabetes mellitus based on the gender at 9 Local Government Clinics in Bone Regency in 2016

9 subdistricts as shown in Table 3 was 42.6% at the Watampone Government Clinic, whereas the lowest was 1.0% at the Cina Government Clinic.

Characteristics of respondents based on the time period: The spatial distribution of cases of type 2 diabetes mellitus by time period (month) at each of the 9 Local

Table 3: Tabulated Spatial distribution of cases of type 2 diabetes mellitus based on the location category (subdistrict) at each of the 9 Local Government Clinics in 9 subdistricts in Bone Regency in 2016

Location/Subdistrict (Local Government Clinic)	n	%
Awaru	36	3.2
Bajoe	220	19.5
Biru	128	11.3
Cina	11	1.0
Kading	95	8.4
Packing	38	3.4
Sibulue	42	3.7
Ulaweng	78	6.9
Watampone	480	42.6
Total	1128	100.0

Table 4: Tabulated spatial distribution of cases of type 2 diabetes mellitus based on the time period (Month) at 9 Local Government Health clinics in Bone Regency in 2016

Location/ subdistrict (Local Government Clinic)	Months														Total	
	January		February		March		April		May		June		July			
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Awaru	10	27.8	5	13.9	7	19.4	6	16.7	2	5.6	4	11.1	2	5.6	36	100.0
Bajoe	57	25.9	49	22.3	51	23.2	35	15.9	0	0.0	0	0.0	28	12.7	220	100.0
Biru	29	22.7	24	18.8	19	14.8	17	13.3	14	10.9	16	12.5	9	7.0	128	100.0
Cina	0	0.0	2	18.2	0	0.0	3	27.3	1	9.1	1	9.1	4	36.4	11	100.0
Kading	24	25.3	12	12.6	20	21.1	15	15.8	7	7.4	12	12.6	5	5.3	95	100.0
Packing	8	21.1	3	7.9	4	10.5	5	13.2	6	15.8	9	23.7	3	7.9	38	100.0
Sibulue	9	21.4	4	9.5	4	9.5	11	26.2	4	9.5	9	21.4	1	2.4	42	100.0
Ulaweng	24	30.8	0	0.0	17	21.8	15	19.2	11	14.1	5	6.4	6	7.7	78	100.0
Watampone	81	16.9	53	11.0	62	12.9	68	14.2	63	13.1	63	13.1	90	18.8	480	100.0
Total	242	21.5	152	13.5	184	16.3	175	15.5	108	9.6	119	10.5	148	13.1	1128	100.0

Government Clinics in 9 subdistricts is indicated in Fig. 4 and Table 4.

The highest number of type 2 diabetes mellitus patients based on the time category (month) (Table 4) in 2016 at each of the 9 Local Government Clinics in 9 subdistricts of Bone Regency was 27.8% in January at Awaru, 25.9% in January at Bajoe, 22.7% in January at Biru, 36.4% in July at Cina, 25.3% in January at Kading, 23.7% in June at Packing, 26.2% in April at Sibulue, 30.8% in January at Ulaweng and 18.8% in July at Watampone.

Characteristics of individuals, location and time period: The cases of diabetes mellitus increase with age because diabetes mellitus is a degenerative disease related to a reduction in tissue function in the body due to functional alterations of the involved tissues. The distribution of the disease by age is highly correlated with patterns of exposure and the process of pathogenesis. Budiyoanto in Suiroaka⁷ stated that the older the individual, the lower the capability of tissues to retain blood glucose. This disease is mostly found among individuals over 40 years old⁸⁻¹⁰.

Type 2 (non-insulin-dependent) diabetes tends to develop gradually, mainly in people over the age of 40. This

type is becoming more common in younger people, however and is probably linked to dieting. Although insulin is still produced, there is not enough to meet the body's needs because the tissues become relatively resistant to its effects, and affected people often have close relatives with the condition. Diabetes mellitus affects more than 347 million people worldwide¹¹. Type 2 diabetes is by far the more common form of the disease. About 1 in 50 people in the UK has type 2 diabetes. It is 3-4 times more common in black people and 7 times more common in Asians. It also becomes more common with increasing age¹¹.

Type 2 diabetes mellitus commonly develops in middle aged or older individuals (approximately 40 years old) and it does not show a tendency to develop into ketosis. Commonly, type 2 diabetes mellitus patients are over-weight. Therefore, type 2 diabetes mellitus patients are classified into two categories: (1) Obese and (2) Non-obese. Diabetes mellitus is sometimes observed in individuals who are older due to a decrease of physiological function in the body and reduced secretion of or resistance to insulin, leading to elevated glucose levels in the blood and resulting in a condition commonly known as high blood sugar, in which the body produces insulin but cannot use it optimally¹².

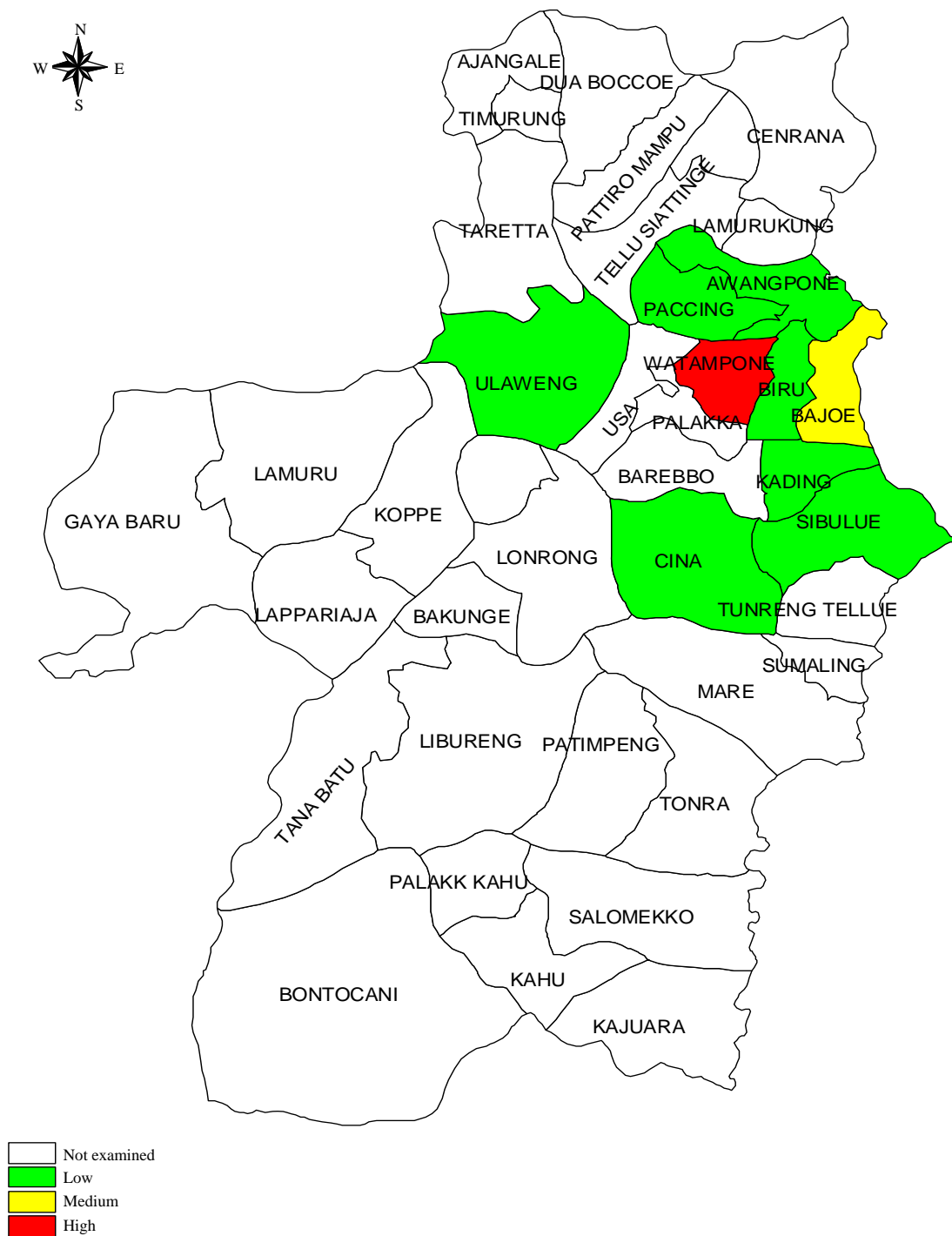


Fig. 3: Map of the spatial distribution of cases of type 2 diabetes mellitus based on the location category at 9 Local Government Clinics in Bone Regency in 2016

Referring to the results of the spatial analysis of type 2 diabetes mellitus patients by age, the lowest number of cases of type 2 diabetes mellitus in the male group was found at 5 Local Government Health Clinics: Paccing, Ulaweng, Bajoe,

Kading and Sibulue. The respondents at those locations had a lower mean percentage of cases than the total mean percentage of all cases (lower than the mean value $\pm 2SD$). Meanwhile, a moderate number of cases of type 2 diabetes

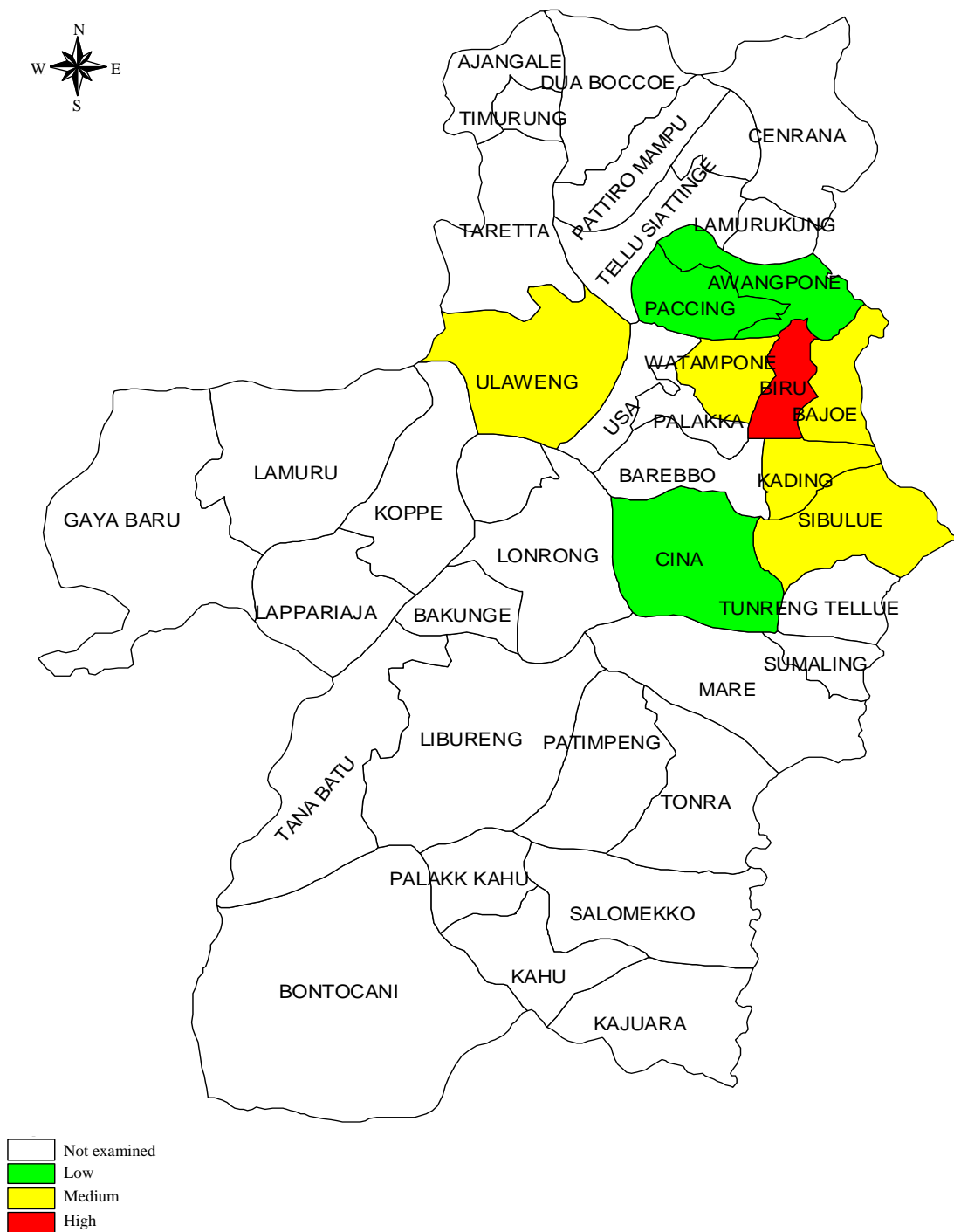


Fig. 4: Map of the spatial distribution of cases of type 2 diabetes mellitus based on the time period at 9 Local Government Clinics in Bone Regency in 2016

mellitus for the male group was found at 4 Local Government Health Clinics, namely, Awangpone, Watampone, Biru and Cina (within the range mean value $\pm 2SD$) and there were no cases of type 2 diabetes mellitus for the male group in the high category (higher than the mean value $\pm 2SD$).

Alternatively, referring to results of the spatial analysis for type 2 diabetes mellitus patients based on the age group, the lowest number of cases of type 2 diabetes mellitus for the female group was found at 4 Local Government Health Clinics: Awangpone, Watampone, Biru and Cina. The

respondents at those locations showed a lower percentage of cases of type 2 diabetes mellitus compared to the total mean percentage of all cases (lower than the mean value $\pm 2SD$). Meanwhile, a moderate number of cases of type 2 diabetes mellitus for the female group was found at 5 Local Government Health Clinics, namely; Pacing, Ulaweng, Bajoe, Kading and Sibulue and there were no cases of type 2 diabetes mellitus for the female group in the high category (higher than the mean value $\pm 2SD$). Based on the results of the spatial analysis for both gender groups, the female group had a higher mean value of cases of type 2 diabetes mellitus (the total mean value was 68.6%) than the male group (the total mean value was 31.4%), as the female group had higher LDL or "Bad" cholesterol and higher triglycerides than the male group. Moreover, there was a discrepancy of lifestyles between the two groups, which contributed to the significant difference in the number of cases of diabetes mellitus between the two gender groups.

On a global scale, the prevalence of diabetes mellitus patients is similar between the male and female populations. However, in specific populations, the prevalence of diabetes mellitus is three fold higher for females than for males. This significant difference is due to a higher accumulation of fat in the body in females than in males. According to the Riskesdas (The Indonesian National Basic Health Research) survey performed in 2013, cases of diabetes mellitus were more prevalent in females (1.7%) than in males (1.4%)^{10,13}.

A shift from choosing to consume traditional food (natural) to consuming instant food is common among the populations with type 2 diabetes mellitus investigated in this study. This habit triggers an increase in the levels of both LDL and blood glucose. To anticipate the increase of cases of diabetes mellitus, including type 2 diabetes mellitus, the Local Government Clinic of Watampone should establish Integrated Community Health Posts (Posbindu) at each working unit under its regional authority to conduct early detection of type 2 diabetes mellitus and assist in the prevention of complications, physical defects and death and in the early management of the disease. Alternatively, the Local Government Clinic of Cina is located in a rural area in which most individuals seldom check their blood glucose. The lifestyles of populations who remain in rural areas is significantly different from those in urban areas. Urban populations tend to consume fast food that commonly contains non-degradable compounds.

Based on the results of the spatial analysis in this study, there was a high number of cases of type 2 diabetes mellitus

at the Local Government Clinic of Watampone. In addition, the results of the spatial analysis also revealed that type 2 diabetes mellitus patients were observed with the highest frequency in January (21.5%) and with the lowest frequency in May (9.6%). The early detection of NCDs in January was performed by short-term blood sugar screening (GDS). The results of this screening indicate the importance of early prevention by performing health interventions of type 2 diabetes mellitus. As stated on a previous survey of the recapitulation of NCDs conducted at the Local Government Clinic of Glugur Darat, there was a total of 338 cases of NCDs that consisted of 83 cases of DM (24%), 105 cases of DM (25%), 266 cases of DM (15%) and 265 cases of DM (29%) in January 2014 among the total cases of NCDs. Based on those data, DM ranked second in NCDs at the Local Government Clinic of Glugur Darat, leading to health policies for early prevention^{11,14,15}.

Spatial pattern of cases of type 2 diabetes mellitus based

on age, gender and time period: The spatial distribution of cases of type 2 diabetes mellitus based on age, gender and time period at each of the 9 Local Government Clinics in 9 subdistricts is indicated in Fig. 5 and Table 5.

The map of spatial distribution of cases of type 2 diabetes mellitus based on the age, gender, time period and location at 9 Local Government Clinics in Bone Regency of the year 2016.

As shown in the results of the spatial analysis of type 2 diabetes mellitus patients in the 18-24 age group in Bone Regency in January-July, 2016, the lowest number of cases of type 2 diabetes mellitus for the male group was found at 7 Local Government Health Clinics, namely, Awangpone, Pacing, Ulaweng, Bajoe, Kading, Sibulue and Cina. The respondents at those locations had a lower mean percentage of cases than the total mean percentage of all cases (lower than the mean value $\pm 2SD$). Meanwhile, a moderate number was found at 1 Local Government Health Clinic in Watampone (within the range mean value $\pm 2SD$) and the highest number was found at 1 location at the Local Government Health Center of Biru (higher than the mean value $\pm 2SD$). Alternatively, referring to the results of the spatial analysis for type 2 diabetes mellitus patients based on the 55-56 age group in January-July, 2016, the lowest number of cases of type 2 diabetes mellitus was found at 3 Local Government Health Clinics: Awangpone, Pacing and Cina. The respondents at those locations had a lower percentage of cases of type 2 diabetes mellitus compared to the total mean percentage of all cases (lower than the mean value $\pm 2SD$).

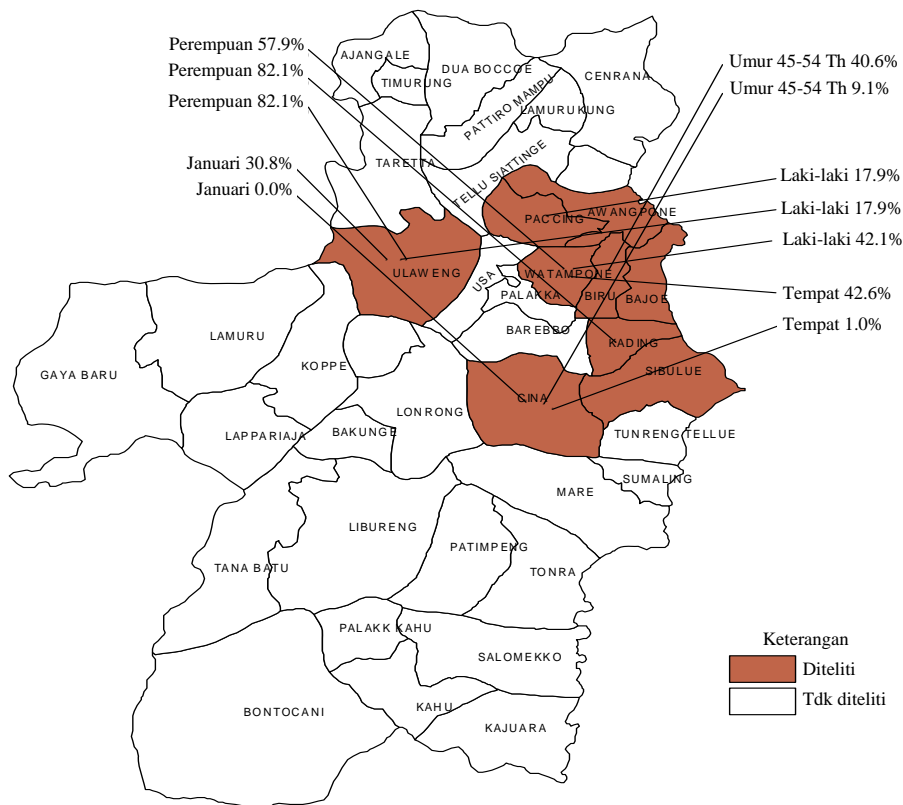


Fig. 5: Map of spatial distribution of cases of type 2 diabetes mellitus based on age, gender and time period at 9 Local Government Clinics in Bone Regency in 2016

Table 5: Distribution of cases of type 2 diabetes mellitus based on the age at 9 Local Government Clinics in bone regency of the year 2016

Parameters	n	%
Age group		
18-24	4	0.4
25-34	25	2.2
35-44	142	12.6
45-54	399	35.4
55-64	373	33.1
65-74	145	12.9
≥75	40	3.5
Total	1128	100.0
Gender		
Male	354	31.4
Female	774	68.6
Total	1128	100.0

Meanwhile, a moderate number of cases of type 2 diabetes mellitus was found at 5 Local Government Health Clinics, namely, Ulaweng, Watampone, Biru, Kading and Sibulue and there were no cases of type 2 diabetes mellitus in the high category (higher than the mean value $\pm 2SD$). Based on the results of the spatial analysis of type 2 diabetes mellitus for the male group, the lowest number was found at 5 Local

Government Health Clinics: Pacing, Ulaweng, Bajoe, Kading and Sibulue. The respondents at those locations had a lower mean percentage of cases than the total mean percentage of all cases (lower than the mean value $\pm 2SD$). Meanwhile, a moderate number of cases of type 2 diabetes mellitus was found at 3 Local Government Health Clinics, namely, Awangpone, Watampone and Biru (within the range mean value $\pm 2SD$) and the highest number of cases of type 2 diabetes mellitus was found at 1 location, the Local Government Health Clinic of Cina (higher than the mean value $\pm 2SD$).

Based on the results of the spatial analysis of type 2 diabetes mellitus for the female group, low numbers were found at 4 Local Government Health Clinics: Awangpone, Watampone, Biru and Cina. These locations had a lower mean percentage of cases than the total mean percentage of all cases (lower than the mean value $\pm 2SD$). Meanwhile, a moderate number of cases of type 2 diabetes mellitus was found at 4 Local Government Health Clinics: Pacing, Ulaweng, Bajoe and Kading (within the range mean value $\pm 2SD$) and the

highest number of cases of type 2 diabetes mellitus was found at 1 location, the Local Government Health Clinic of Sibulue (higher than the mean value $\pm 2SD$). As stated by the Riskesdas (the Indonesian National Basic Health Research) report in 2013, the prevalence of cases of type 2 diabetes mellitus was 2.1% in 2013 compared to 1.1% in 2007¹⁰. In addition, the prevalence of type 2 diabetes mellitus in 2013 was 1.7% for the female group compared to 1.4% for the male group. This condition is more prevalent in the female group than the male group because the female group had higher LDL or "Bad" cholesterol and higher triglycerides than the male group and the discrepancy of lifestyles between the two groups also led to the significant difference of the number of cases of diabetes mellitus^{7,10,13-15}.

Referring to the results of the spatial analysis of type 2 diabetes mellitus based on the location category, a high number of cases of type 2 diabetes mellitus was found at Watampone, a moderate number of cases was found at Bajoe and a low number of cases was found at Biru, Kading, Pacing, Ulaweng, Cina, Awangpone and Sibulue. Additionally, the results of the spatial analysis of type 2 diabetes mellitus based on the month category showed that a low number of cases was found in January-July, 2016 at Awangpone, Pacing, Ulaweng, Cina, Kading and Sibulue (lower than the mean value $\pm 2SD$), a moderate number of cases was found at Biru and Bajoe (within the mean value $\pm 2SD$) and a high number of cases was found at Watampone (above the mean value $\pm 2SD$).

Spatial distribution pattern of cases of type 2 diabetes mellitus by age: The map of spatial distribution of cases of type 2 diabetes mellitus based on the age group at 9 Local Government Clinics in Bone Regency in 2016, the number of cases of type 2 diabetes mellitus in the >45-54 age group was higher than that in the <45 age group. This phenomenon is consistent with the study conducted by Trisnawati and Setyorogo¹⁶, in which the age factor was significantly correlated with the number of cases of type 2 diabetes mellitus, where the <45 age group had 72% fewer cases of type 2 diabetes mellitus than the >45-54 age group. The number of cases of type 2 diabetes mellitus was significantly correlated with the increase in age and another study reported by Hendra¹⁷ confirmed that the >45-54 age group had the highest number of cases of type 2 diabetes mellitus (47.5%) because this group had decreased glucose tolerance¹⁶⁻¹⁸.

Spatial distribution pattern of cases of type 2 diabetes mellitus by gender: Figure 5 and Table 5 show that spatial distribution of cases of type 2 diabetes mellitus based on the gender group at 9 Local Government Clinics in Bone Regency in 2016, the number of cases of type 2 diabetes mellitus in the female group was higher than that in the male group. The female group produced higher LDL or cholesterol and higher triglycerides than the male group. In addition, lifestyle is a significant causal factor for the occurrence of specific diseases, including type 2 diabetes mellitus. This fact is related to the study conducted by Trisnawati and Setyorogo¹⁶, in which the obese population had a 7.14-fold higher risk having type 2 diabetes mellitus than the non-obese population and a higher prevalence of cases of type 2 diabetes mellitus was found in the female population than in the male population.

Spatial distribution pattern of cases of type 2 diabetes mellitus by location (population density): Figure 5 and Table 5 show that on the spatial distribution of cases of type 2 diabetes mellitus based on the location category at 9 Government Clinics in Bone Regency in 2016, the highest number of cases of type 2 diabetes mellitus was found at Watampone; this region is densely populated compared with other locations in Bone Regency and is the capital of Bone Regency. A previous study conducted by Achmadi¹⁹ showed a similar trend: An urban area can trigger the degenerative disease due to behavior adaptations to modern society or modern lifestyles, especially consuming instant food and more advanced technology restricting physical activities as shown in South Jakarta. This phenomenon influences the development of specific diseases in people who live in urban areas. As depicted in the Riskesdas Ministry of Health¹³, the prevalence of diabetes mellitus in urban areas is two-fold higher than that in populations that stay in rural areas. In general, urban populations have more sedentary lifestyles and consume more high-calorie fast food and junk food^{14,15}.

The stated facts can lead to the higher number of cases of diabetes mellitus and are consistent with the highest number of cases of type 2 diabetes mellitus occurring in Watampone (42.6%) compared with the lowest number of cases of type 2 diabetes mellitus in Cina (1.0%).

Spatial distribution pattern of cases of type 2 diabetes mellitus by time period: In the tabulated spatial distribution of cases of type 2 diabetes mellitus based on the time period category at 9 Local Government Clinics in Bone Regency in 2016, the highest number of cases of type 2 diabetes mellitus

was found in January (21.5%), whereas the lowest was found in May (9.6%), because the intensities of activities for early detection of NCDs were highest in January through the activities of the Integrated Community Health Posts (Posbindu), which conducted short-term screening of glucose sugar (GDS). This approach provides significantly important data for early detection by performing health interventions through early prevention for type 2 diabetes mellitus during monthly periods in an effective and efficient manner.

As stated in a previous study of the recapitulation of NCDs conducted at the Local Government Clinic of Glugur Darat, 83 cases of DM (24%) of the 338 total cases of NCDs were diagnosed in January 2014, 105 cases of DM (25%) of the 405 total cases of NCDs were diagnosed in April, 41 cases of DM (15%) of the total 266 NCDs were diagnosed in May and 77 cases of DM (29%) of the total 265 NCDs were diagnosed in June. Based on these data, DM ranks second among NCDs at the Local Government Clinic of Glugur Darat, leading to early prevention activities for this disease^{11,12,14}.

CONCLUSION

- The results of the spatial analysis of cases of type 2 diabetes mellitus based on the characteristics of age, gender and location demonstrated that Watampone, Kading and Ulaweng were classified as having a high number of cases of type 2 diabetes mellitus compared to other Local Government Clinics in Bone Regency
- Regarding the surveillance pattern for cases of type 2 diabetes mellitus, patients >45-54 years old represented a greater number of cases of type 2 diabetes mellitus than patients ≤45-54 years old for the age characteristic. The number of cases of type 2 diabetes mellitus in the female group was higher than that in the male group for the gender characteristic, the number of cases of type 2 diabetes mellitus for urban areas were higher than for rural areas for the location characteristic (density of population) and the number of cases of type 2 diabetes mellitus for January was higher than other months due to the change of year and short-term screening of sugar glucose

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