

Analysis of Voters Mapping on 2014 Presidential Election in Indonesia Based on Standardized Incidence Ratio Method

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Abstract: Voters mapping of relative potential votes is useful in knowing the geographical distribution of provinces that have a high or low potential votes. It will be a useful reference for presidential candidates or supporting parties to identify their votes. They must keep provinces with high potential votes and increase voters in provinces with low potential votes. Voters mapping is usually based on number of voters without considering population size differences on each provinces but voters map based on raw data which is number of voters can be misleading. Therefore, the main aim of this research is to estimate relative potential votes for election based on Standardized Incidence Ratio (SIR) method. SIR is a direct estimation method in which standardization is based on population size. SIR is appropriate to be used in large population size such as provinces. The study is using data of voters at Indonesia presidential election in 2014. According to the election results, Sumatera Barat and Nusa Tenggara Barat are two provinces with relatively high potential votes to Prabowo-Hatta. However, Sumatera Barat is province with relatively very low potential votes to Jokowi-JusufKalla. The greater total number of provinces with medium relatively potential votes and the lower total number of provinces with low relatively potential votes are two main factors that affect Jokowi's victory.

Key words: 2014 Indonesia Presidential Election, SIR, relative votes, mapping, Indonesia

INTRODUCTION

On Tuesday (July 22, 2014) night, the General Election Commission (Indonesian: Komisi Pemilihan Umum (KPU)) released the official results of Indonesia's 2014 presidential election. Jokowi is officially Indonesia's seventh President, he secured 70,997,833 (53.15%) votes and his rival, Prabowo garnered 62,576,444 votes (46.85%). There are a total of 133,574,277 valid votes, representing 68.87% of Indonesia's total eligible voters, including eligible voters residing outside Indonesia. Boredom rate is one of major factors which affecting the number voters of presidential candidate (Yong and Samat, 2016), so, getting voters as many as possible is the most important thing for a presidential candidate or supporting parties to win the election.

Choropleth maps are extremely popular, probably the most common thematic map in use today. One reason they are popular is that much of our geodata is reported by enumeration units such as census data and so we are

accustomed to thinking of the world as divided into spatial units like census tracts, counties and provinces. Choropleth map is suitable for mapping discrete phenomena. Choropleth maps based on raw data/counts can be misleading. To make phenomena comparable for administrative units, it should be quite often standardized. The value of the map can be improved by applying a statistical method. Choropleth maps is especially appropriate for showing standardized data such as rates, ratios, densities or percentages.

Many researchers have discussed Standardized Mortality/Morbidity Ratio (SMR) method for estimating relative risk in disease mapping as we seen by Clement (2014), Lawson *et al.* (2000), Meza (2003), Samat and Maarof (2013) and Wakefield (2007). Most of these consider the disease. This study discusses about Standardized Incidence Ratio (SIR) method and its application to 2014 presidential election of Indonesia. First, we describe the SIR method in estimating relative potential votes. This method is then applied to observed votes data of 2014 presidential election in Indonesia.

MATERIALS AND METHODS

Standardized Incidence Ratio (SIR): Incidence in epidemiology expresses the number of new cases of event which occur in a defined population of disease-free individuals and the incidence ratio is the number of such events in a specified period of time. Thus, incidence ratio in disease is ratio number of new cases of event in a period of time over population at risk. This measure provides a direct estimate of the probability risk of illness and is of fundamental importance in epidemiological studies. Standardization may be also used if we want to compare a small population such as province to a larger population such as country.

In disease mapping, relative risk is the ratio of the probability of an event occurring in an exposed group to the probability of the event occurring in a comparison, non-exposed group. A relative risk of 1 means there is no difference in risk between the two groups; the number of outcomes in the sample population and that which would be expected in the standard population. A relative risk less than 1 means the event within this area is generally less likely to occur compared with people in the overall population. A relative risk of greater than 1 means the event within this area is generally more likely to occur compared with people in the overall population.

SMR is a statistical method in disease mapping to estimate the relative risk of a disease in a map (Lawson, 2013; Wakefield and Elliot, 1999). When applied to incidence data, it is commonly known as the Standardized Incidence Ratio (SIR) (Boyle and Parkin, 1991). SIR in voters mapping represents a value of relative potential votes of the event counts and a map of the ratio between a person within a specified area votes the presidential candidate and a person in the population votes the presidential candidate. SIR is used to determine whether the occurrence of incidence in a population is high or low.

Suppose the area to be mapped is divided into M mutually exclusive provinces $i = 1, 2, \dots, M$. Each province has its own observed number of voters Y_i and the expected number of voters E_i . The SIR in the i th province is $\theta_i = Y_i/E_i$. This SIR is very large in provinces where the expected numbers of voters are small and small for provinces where the expected numbers of voters are large.

Application of standardized incidence ratio to voters mapping: In this study, choropleth maps of voters in each province will be created. The choropleth maps display SIR of 2014 Indonesia presidential election. The SIR is expressed as the ratio of observed over expected incidence and reflects the relative potential votes of each

province. SIR is a reliable measure of relative risk for large geographical regions such as countries or provinces but it is unreliable for small provinces such as counties. A different color is used for each value of standardized incidence ratio, allowing users to identify which provinces have low, middle/medium or high potential votes. Some reasons why users use voters map are the contents of the voters map provides information on voters in form of a map thus it is easy to read, easy to understand and relate data to location, a quick way of finding high or low potential votes provinces and help users to identify geographic trends in the data. Second, the presentation of the voters map is interesting and the structure is easily understood, informative and systematic. Remember, maps are not reflections of reality but selections of reality. Presidential candidates and their supporting parties must use these maps for knowing completely the situation of their voters in each province. Based on these maps, the presidential candidate and supporting parties can make a strategy to increase their votes in the presidential election day.

RESULTS AND DISCUSSION

First of all, the number of voters data used in this paper are from KPU in 2014 presidential election. Data from KPU showed that the number of total valid votes from 33 provinces in Indonesia is 132,896,420 (not including overseas voters).

Table 1 shows the number of voters indices by provinces in Indonesia. The outcomes of relative potential votes estimation in all provinces of Indonesia are also displayed in Table 1. From Table 1, it can be seen that by SIR method, people within the province of Sumatera Barat have the highest potential votes to Prabowo-Hatta, while people within the province of Sulawesi Barat have the lowest potential votes to Prabowo-Hatta, when compared with people in the overall population. The corresponding values of relative potential votes are approximately 1.64 and 0.57, respectively. Conversely, people within the province of Sumatera Barat have the lowest potential votes to Jokowi-JusufKalla while people within the province of Sulawesi Barat have the highest potential votes to Jokowi-JusufKalla, when compared with people in the overall population. The corresponding values of relative potential votes are approximately 0.43 and 1.38, respectively.

Figure 1 displayed about names of 33 provinces in Indonesia. Since 25 October 2012, Indonesia has the 34th province, namely Kalimantan Utara but votes from this newest province were combined with votes in Kalimantan Timur.

Table 1: Number of voters in each province and its relative potential votes estimation based on SIR method

ID (SNI 7657, 2010)	Province	Voters Prabowo-Hatta(i)	SIR PH(i)	Voters Jokowi-Jusuf Kalla(i)	SIR JJ(i)
AC	Aceh	1,089,290 (54.39%)	1.16	913,309 (45.61%)	0.86
SU	Sumatera Utara	2,831,514 (44.76%)	0.96	3,494,835 (55.24%)	1.04
SB	Sumatera Barat	1,797,505 (76.92%)	1.64	539,308 (23.08%)	0.43
RI	Riau	1,349,338 (50.12%)	1.07	1,342,817 (49.88%)	0.94
JA	Jambi	871,316 (49.25%)	1.05	897,787 (50.75%)	0.95
SS	Sumatera Selatan	2,132,163 (51.26%)	1.09	2,027,049 (48.74%)	0.92
BE	Bengkulu	433,173 (45.27%)	0.97	523,669 (54.73%)	1.03
LA	Lampung	2,033,924 (46.93%)	1.00	2,299,889 (53.07%)	1.00
BB	Bangka Belitung	200,706 (32.74%)	0.70	412,359 (67.26%)	1.27
KR	Kep Riau	332,908 (40.37%)	0.86	491,819 (59.63%)	1.12
JK	Jakarta	2,528,064 (46.92%)	1.00	2,859,894 (53.08%)	1.00
JB	Jawa Barat	14,167,381 (59.78%)	1.28	9,530,315 (40.22%)	0.76
JT	Jawa Tengah	6,485,720 (33.35%)	0.71	12,959,540 (66.65%)	1.25
YO	Yogyakarta	977,342 (44.19%)	0.94	1,234,249 (55.81%)	1.05
JI	Jawa Timur	10,277,088 (46.83%)	1.00	11,669,313 (53.17%)	1.00
BT	Banten	3,192,671 (57.10%)	1.22	2,398,631 (42.90%)	0.81
BA	Bali	614,241 (28.58%)	0.61	1,535,110 (71.42%)	1.34
NB	Nusa Tenggara Barat	1,844,178 (72.45%)	1.55	701,238 (27.55%)	0.52
NT	Nusa Tenggara Timur	769,391 (34.08%)	0.73	1,488,076 (65.92%)	1.24
KB	Kalimantan Barat	1,032,354 (39.62%)	0.85	1,573,046 (60.38%)	1.14
KT	Kalimantan Tengah	468,277 (40.21%)	0.86	696,199 (59.79%)	1.12
KS	Kalimantan Selatan	941,809 (50.05%)	1.07	939,748 (49.95%)	0.94
KI	Kalimantan Timur	687,734 (36.62%)	0.78	1,190,156 (63.38%)	1.19
SA	Sulawesi Utara	620,095 (46.12%)	0.98	724,553 (53.88%)	1.01
ST	Sulawesi Tengah	632,009 (45.17%)	0.96	767,151 (54.83%)	1.03
SN	Sulawesi Selatan	1,214,857 (28.57%)	0.61	3,037,026 (71.43%)	1.34
SG	Sulawesi Tenggara	511,134 (45.10%)	0.96	622,217 (54.90%)	1.03
GO	Gorontalo	378,735 (63.10%)	1.35	221,497 (36.90%)	0.69
SR	Sulawesi Barat	165,494 (26.63%)	0.57	456,021 (73.37%)	1.38
MA	Maluku	433,981 (49.48%)	1.06	443,040 (50.52%)	0.95
MU	Maluku Utara	306,792 (54.45%)	1.16	256,601 (45.55%)	0.86
PA	Papua	769,132 (27.51%)	0.59	2,026,735 (72.49%)	1.36
PB	Papua Barat	172,528 (32.37%)	0.69	360,379 (67.63%)	1.27



Fig. 1: Map of Indonesia

In Fig. 2, the Indonesian provinces are colored blue or red according whether the majority of their voters were Prabowo or Jokowi, respectively. It can be seen that there is more red than blue which suggests a win for Jokowi-JusufKalla. Prabowo-Hatta won more than 50% of the votes only in 10 provinces; four provinces in Sumatera (Aceh, Sumatera Barat, Riau, Sumatera Selatan), two provinces in Java (Jawa Barat, Banten), Nusa Tenggara

Barat, Kalimantan Selatan, Gorontalo and Maluku Utara, while Jokowi and his running mate JusufKalla won more than 50% in 23 provinces; six provinces in Sumatera (Sumatera Utara, Jambi, Bengkulu, Lampung, Bangka Belitung, Kepulauan Riau), four provinces in Jawa (Jakarta, Jawa Tengah, Yogyakarta, Jawa Timur), three provinces in Kalimantan (Kalimantan Barat, Kalimantan Tengah, Kalimantan Timur), five provinces in Sulawesi

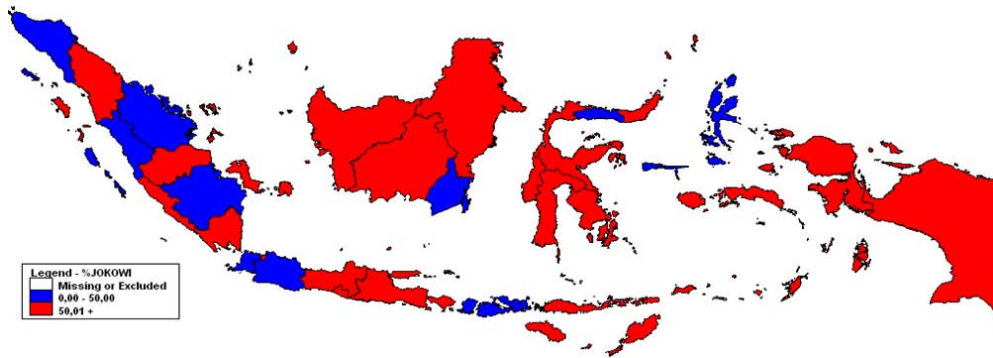


Fig. 2: Voters map of Prabowo-Hatta and Jokowi-Jusuf Kalla on 2014 Indonesia presidential election based on percentage dominant votes in each province (Blue color denotes provinces won by Prabowo-Hatta and red color denotes provinces won by Jokowi-Jusuf Kalla)

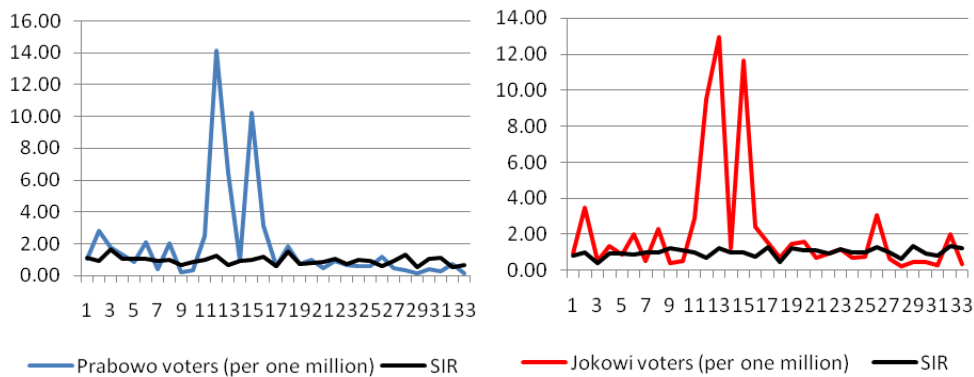


Fig. 3: Comparison between number of voters and its relative potential votes estimation of both presidential candidates in each province

(Sulawesi Utara, Sulawesi Tengah, Sulawesi Selatan, Sulawesi Tenggara, Sulawesi Barat), Bali, Nusa Tenggara Timur, Maluku, Papua and Papua Barat.

From Table 1, it can be seen that the three biggest contributors to Jokowi-JusufKalla votes were Jawa Tengah, Jawa Timur and Jawa Barat. Jokowi-JusufKalla won 66.65% of the votes in Jawa Tengah, securing nearly 13 million votes. Although Jawa Barat was the third largest contributor to Jokowi's votes, he suffered a big loss, only securing 40.22% (9,530,315) votes over Prabowo's 59.78% (14,167,381) votes.

Map in Fig. 2 fail to take account of some basic realities. First of all, there is no representation of population. The reality is that the population of the red provinces is on average significantly higher than of the blue ones. So, while the blue are small in province, they represent large numbers of voters. Second, more importantly for the results of election, the maps take no account of the distribution of electoral presidential votes. Third, they take no account of the often fine-grained distribution of voter preferences within provinces.

In Fig. 3, the relative potential votes results which were obtained by using SIR method compared to the real number of voters for both presidential candidates.

From Fig. 3, it is not suggested to assess the spread of votes only using the observed votes but also considering the relative potential votes estimation, because it takes the spread of votes into account. For example, Jawa Barat (SIR = 1.28) is the province with the highest number of voters to Prabowo-Hatta with 14,167,381 votes but the highest relative potential votes to Prabowo-Hatta is Sumatera Barat (SIR = 1.64) with only 1,797,505 votes.

Maps of the relative votes estimates for voters mapping in the 33 provinces in Indonesia: The focus of mapping is to highlight provinces of a voters map which deserve further attention, for example, presidential candidates and their supporting parties must make strategies to increase the votes in provinces with low relative votes. Voters map assign a color representing the value of a variable to each province. A lighter shade represents a lower value while

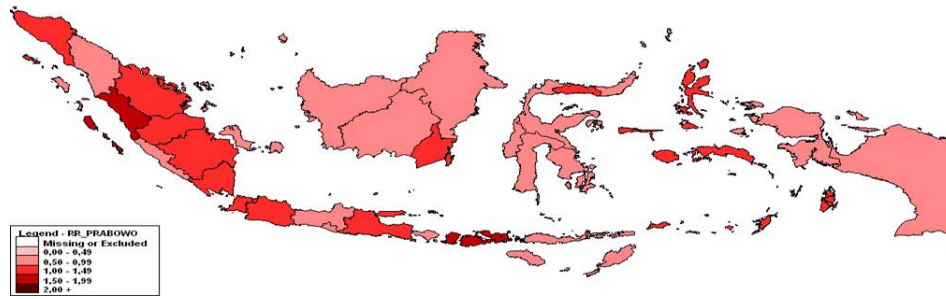


Fig. 4: Prabowo-Hatta voters map of estimated relative potential votes based on the SIR method

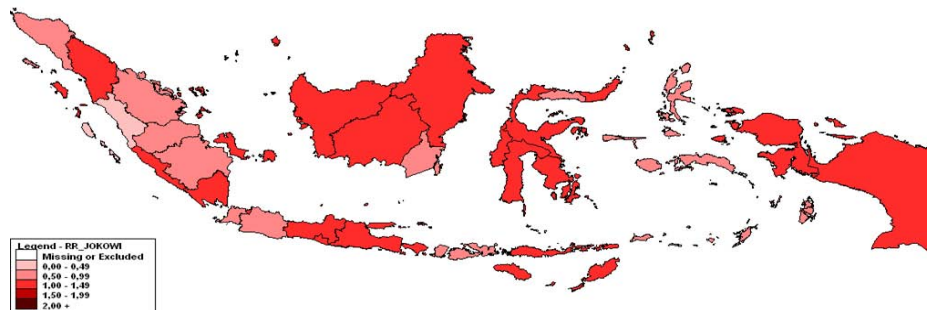


Fig. 5: Jokowi-JusufKalla voters map of estimated relative potential votes based on the SIR method

a darker shade represents a higher value. Provinces with similar value all receive the same color shade. While the results are determined by the number of people who vote for each presidential candidate, each geographical province is simply presented as won by Prabowo-Hatta or Jokowi-JusufKalla as displayed in Fig. 2. Map in Fig. 2 uses count data, i.e., the number of voters in each province. However, the provinces with larger populations are often larger in extent so no settlement pattern is obvious. Much better is the map showing population density, percentage, rate or ratio. From this map, the settlement pattern is obvious.

Figure 4 and 5 show the voters maps of Prabowo-Hatta and Jokowi-JusufKalla for relative potential votes estimation based on SIR method in the 33 provinces of Indonesia. The purpose of using this map is depicting and differing between the high and low potential provinces of votes for each province in 2014 Indonesia presidential election. Each province is assigned one of five different levels of relative potential votes, which are very low, low, medium, high and very high potential votes with respective intervals of (0.0, 0.5), (0.5, 1.0), (1.0, 1.5), (1.5.0, 2.0) and (2.0, ∞), respectively.

In Prabowo-Hatta voters map, one can see the darkest color with interval (1.5.0, 2.0) in two provinces, indicating that the majority of high potential votes is in Nusa Tenggara Barat (SIR = 1.55) and Sumatera Barat (SIR = 1.64). It is consistent with Table 1, those provinces are the two highest of percentage number of voters in each province. Figure 4 shows that most provinces

(18 provinces) have relative potential votes less than one. It can be seen clearly from this figure that 12 provinces have relative potential votes greater than one which indicates that people within these 12 provinces is generally more likely to vote Prabowo-Hatta compared with people in the overall population of Indonesia. Three other provinces; Lampung, Jakarta and JawaTimur have relative potential votes one.

When analyzing Sumatera island in Fig. 4, the voters mapping of Prabowo-Hatta showed that Sumatera Barat is the province with high potential votes. The provinces with medium potential votes are Aceh, Riau, Jambi, Sumatera Selatan and Lampung, while the provinces with low potential votes are Sumatera Utara, Bengkulu, Bangka Belitung and Kepulauan Riau. In Java island, the voters mapping showed that Jakarta, Jawa Barat, JawaTimur and Banten are provinces with medium potential votes. Jawa Tengah and Yogyakarta are provinces with low potential votes. In Kalimantan island, the voters mapping showed that Kalimantan Selatan is the only one province with medium potential votes. The other provinces; Kalimantan Barat, Kalimantan Tengah and Kalimantan Timur are provinces with low potential votes. In Sulawesi island, the voters mapping showed that Gorontalo is the only one province with medium potential votes. The other provinces; Sulawesi Utara, Sulawesi Tengah, Sulawesi Selatan, Sulawesi Tenggara, Sulawesi Barat are provinces with low potential votes. In other islands, Nusa Tenggara Barat is province with high potential votes, Maluku and

Maluku Utara are provinces with medium potential votes, while Bali, Nusa Tenggara Timur, Papua and Papua Barat are provinces with low potential votes.

Map in Fig. 5 is used to represent the relative potential votes to Jokowi-JusufKalla of each province that has been estimated by SIR method. In Jokowi-JusufKalla voters map, one can see the darkest color with interval [1.0, 1.5) in 21 provinces, indicating that the majority of medium potential votes is in these provinces. Figure 5 shows that most provinces (18 provinces) have relative potential votes greater than one. It can be seen clearly from this figure that 12 provinces have relative potential votes lower than one which indicates that people within these 12 provinces is generally less likely to vote Jokowi-Jusuf Kalla compared with people in the overall population of Indonesia. Three other provinces; Lampung, Jakarta and JawaTimur have relative potential votes one.

From Fig. 5, the voters mapping of Jokowi-JusufKalla in Sumatera island showed that Sumatera Barat is the province with very low potential votes. The provinces with low potential votes are Aceh, Riau, Jambi and Sumatera Selatan. The other provinces with medium potential votes are Sumatera Utara, Bengkulu, Lampung, Bangka Belitung and Kepulauan Riau. In Java island, the voters mapping showed that Jakarta, Jawa Tengah, Yogyakarta and JawaTimur are provinces with medium potential votes. Jawa Barat and Banten are provinces with low potential votes. In Kalimantan island, the voters mapping showed that Kalimantan Barat, Kalimantan Tengah and Kalimantan Timur are provinces with medium potential votes. Kalimantan Selatan is the only one province with low potential votes. In Sulawesi island, the voters mapping showed that Gorontalo is the only one province with low potential votes. The other provinces; Sulawesi Utara, Sulawesi Tengah, Sulawesi Selatan, Sulawesi Tenggara, Sulawesi Barat are provinces with medium potential votes. In other islands, Nusa Tenggara Barat, Maluku and Maluku Utara are provinces with low potential votes while Bali, Nusa Tenggara Timur, Papua and Papua Barat are provinces with medium potential votes.

CONCLUSION

Relative potential votes estimation based on Standardized Incidence Ratio (SIR) has been demonstrated in voters mapping. The estimated relative votes values based on the SIR method can be displayed to show high and low potential votes province of voters. The main aim of voters mapping is to identify provinces of low or high potential votes so that action or strategy could be given to these priority provinces. Voters maps can be used by presidential candidates and their supporting parties to present the results of election

survey and to analyze these results. The voters map of 2014 Indonesia presidential election showed that in both presidential candidates, there is no province with very high potential votes. There are two provinces, which are Sumatera Barat and Nusa Tenggara Barat with relatively high potential votes to Prabowo-Hatta but no provinces with similar level to Jokowi-Jusuf Kalla. Sumatera Barat is province with relatively very low potential votes to Jokowi-Jusuf Kalla but no provinces with similar level to Prabowo-Hatta. Total number of provinces with relatively low potential votes to Prabowo-Hatta is 18 provinces compared with Jokowi-Jusuf Kalla 11 provinces. The total number of provinces with relatively medium potential votes to Prabowo-Hatta is 13 provinces compared with Jokowi-Jusuf Kalla 21 provinces. Even though Prabowo-Hatta has two provinces with relatively high potential votes, Jokowi-JusufKalla still won in the 2014 presidential election. It is happened because Jokowi-JusufKalla has greater total number of provinces with relatively medium potential votes and lower total number of provinces with relatively low potential votes. In these levels, medium and low potential votes both of total number of provinces are significantly different.

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