

PEER REVIEW HISTORY

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ARTICLE DETAILS

TITLE (PROVISIONAL)	Changing trends in suicide rates in South Korea from 1993 to 2016: A descriptive study
AUTHORS	Lee, Sang Uk; Park, Jong-Ik; Lee, Soojung; Oh, In-Hwan; Choi, Joong-Myung; Oh, Chang-Mo

VERSION 1 – REVIEW

REVIEWER	Dr. Ranil Abeyasinghe University of Peradeniya Sri Lanka
REVIEW RETURNED	01-Apr-2018

GENERAL COMMENTS	<p>The main observation in this paper is that the overall suicide rate in South Korea has dropped from 2010 onwards to the rate that existed in 2004. The authors conclude that this drop in suicide rate is due to the government initiated suicide prevention measures. The trouble with this conclusion is that the government initiated suicide prevention programs actually started in 2004. Then the conclusion must be that some specific measures such as the banning of paraquat and screens for subway stations, which started in 2010, would have prevented many suicides. The authors should look at suicide in subway stations and deaths due to paraquat poisoning if these figures are available separately.</p> <p>Instead of stating a definite relationship between government initiated suicide prevention program and drop in suicide it would be rational to state 'there exists a possible relationship between the two'. Or else an iconoclastic argument can be raised that it is the government initiated suicide prevention that created the initial increase and now it is dropping off! Suicide rates in countries rise and fall due to many reasons and depression and alcohol abuse are the well known factors. Large government initiated programs are often ineffective but specific measures such as reduction of access to lethal methods (paraquat and subways), improvement in mental health programs and reduction in alcohol abuse are well known to reduce suicide rate. Therefore authors should be a little more skeptical in concluding that it is the state initiated programs such as welfare programs that worked.</p>
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REVIEWER	Jingju Pan Institute of Chronic Non-Communicable Disease Control and Prevention, Hubei Provincial Center for Disease Control and Prevention, Wuhan, Hubei, China
REVIEW RETURNED	07-Apr-2018

GENERAL COMMENTS	Thank you for the opportunity to review this manuscript, which examined the changing trends of suicide rates in South Korea from 1993 to 2016 using the Joinpoint regression modeling. I have a few
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	<p>specific points for the authors to consider:</p> <ol style="list-style-type: none"> 1. Abstract: Trends for suicide rates in South Korea were only mentioned since 2010 in page 2 row 32, not covered from 1993 to 2016 as the title suggested. 2. Method section: <ol style="list-style-type: none"> 2.1 ICD-10 code “X60-X84” was utilized for analyzing suicide rates, how about ICD-10 code “Y87.0”, sequelae of intentional self-harm? Were there any cases coding from “Y87.0”? How did the authors deal with this part of data? 2.2 The authors used the mid-year Korean population in 2005 as the standard population. Is there any particular reason for this? I am wondering why the authors did not use the latest population as the standard population. 2.3 About Joinpoint regression modeling, the authors did not provide information about why this method be used, how it works, etc. 3. Results section: <ol style="list-style-type: none"> 3.1 In “Baseline characteristics” and table 1, the authors analyzed the proportion of deaths due to suicide among different age groups, including children aged 0-19 years. However it is quite rare that children younger than 10 years old suicide. The authors might need to re-categorize the age group to make sense. 3.2 In “Baseline characteristics” and table 1, number of death due to suicide were presented and analyzed, not the mortality rate, the latter is more appropriate. 3.3 In table 1, the proportion of deaths due to suicide are provided in parentheses, but without any explanation, for tables and figures in scientific papers should be self-explicit. 3.4 In table 1, the exact p value should be provided, not in the form of “p<0.01”. 3.5 Table 2 and 3 might be combined into one table. 4. Discussion section: <p>“Increase in suicide rate of middle-aged men” and page 15 row 49 “the suicide rate of middle-aged men in their 30s and 40s had continued to increase”: the authors have to be careful that by definition the middle-aged probably refers to 45-64 years old.</p> 5. Some other questions the authors should pay attention to, for example: <ol style="list-style-type: none"> 5.1 page 5 row 10: “Mental Health Action 2013-2010” probably should be “Mental Health Action 2013-2020”. 5.2 Same suicide prevention program but different explanation provided: page 11 row 24 used “watch, listen, and speak”, but page 29 row 34 used “Look and Listening and Say”.
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VERSION 1 – AUTHOR RESPONSE

Comments from Reviewer 1:

The main observation in this paper is that the overall suicide rate in South Korea has dropped from 2010 onwards to the rate that existed in 2004. The authors conclude that this drop in suicide rate is due to the government initiated suicide prevention measures.

Answer: Thank you for your thorough and thoughtful comment. We appreciate your valuable time and considerations.

1. The trouble with this conclusion is that the government initiated suicide prevention programs actually started in 2004. Then the conclusion must be that some specific measures such as the banning of paraquat and screens for subway stations, which started in 2010, would have prevented many suicides.

Answer: We agreed with your opinion. As we mentioned in the discussion, we don't think that 1st suicide prevention programs, which was started in 2004, were effective to reduce suicide rates. We agreed with you that 2nd suicide prevention program since 2009 has led to a decline in suicide rates in South Korea. The 2nd suicide prevention program also includes the access restriction to method of suicide such as banning of paraquat and it also includes the expansion of screen doors. In order to describe this point more clearly, we revised the abstract and discussion as follows:

(Page 2 Line 24 – Page 3. Line 1) Our finding suggests that there was a possible relationship between implementation of second national suicide prevention policies and a decline in suicide rate. (Page 16 Line 17-19) Our findings also showed that there were significant changes in trends Korea's suicide rate after 2004 to 2005 and 2008 to 2011. These changes in suicide rate coincided with those when the 2nd suicide prevention initiative enacted in 2009.

2. The authors should look at suicide in subway stations and deaths due to paraquat poisoning if these figures are available separately.

Answer: Unfortunately, we could not use the microdata from Statistics Korea. Therefore, we could not look at the mortality rates by method of suicide. The purpose of this study was to explore the effectiveness of 2nd suicide prevention policy in terms of comprehensive viewpoint, because there were comprehensive and various policies including not only access restriction to method of suicide, expansion of screen doors, but also management and psychiatric counseling for suicide attempts who visit the emergency room, Strengthening the responsibility of the mass media, establishment of suicide prevention laws and regulations, training the mental health workers, police officers and firefighters, the expansions of suicide attempt and dependents management programs, etc. The 2nd suicide prevention policy also includes management and psychiatric counseling for suicide attempts who visit the emergency room [1]. The effectiveness of an emergency department-based suicide attempt survivor management program was shown in the randomized clinical trial in Japan [2]. In South Korea, the suicide rate of the intervention group was 3.7%, which was significantly lower than control group's suicide rate of 7.5%, although the study findings were not reported yet [3]. Moreover, the Korean government has supported the community mental health system to provide case-management services to those at a high risk of suicide who have depression or alcohol addiction [1]. Therefore, we believe that the decline of suicide rates is not associated with simply the effect of one or two suicide prevention policies, but rather the effects of a comprehensive nationwide suicide prevention policy. (Especially, due to 2nd national suicide prevention policy)

Reference) 1. Jo SJ, Lee MS, Yim HW, Kim HJ, Lee K, Chung HS, Cho J, Choi SP, Seo YM. Factors associated with referral to mental health services among suicide attempters visiting emergency centers of general hospitals in Korea: does history of suicide attempts predict referral? *Gen Hosp Psychiatry*.;33(3):294-9.

2. Kawanishi C, Aruga T, Ishizuka N, Yonemoto N, Otsuka K, Kamijo Y, Okubo Y, Ikeshita K, Sakai A, Miyaoka H, Hitomi Y, Iwakuma A, Kinoshita T, Akiyoshi J, Horikawa N, Hirotsune H, Eto N, Iwata N, Kohno M, Iwanami A, Mimura M, Asada T, Hirayasu Y; ACTION-J Group. case management versus enhanced usual care for people with mental health problems who had attempted suicide and were admitted to hospital emergency departments in Japan (ACTION-J): a multicentre, randomised controlled trial. *Lancet Psychiatry*. 2014 Aug;1(3):193-201.

3. <http://www.monews.co.kr/news/articleView.html?idxno=91207>

3. Instead of stating a definite relationship between government initiated suicide prevention program and drop in suicide it would be rational to state 'there exists a possible relationship between the two'. Or else an iconoclastic argument can be raised that it is the government initiated suicide prevention that created the initial increase and now it is dropping off! Suicide rates in countries rise and fall due to many reasons and depression and alcohol abuse are the well known factors.

Answer: Thank you for nice suggestion. As you suggested, we toned down the association between government led suicide prevention program and decline in suicide rates. We also focused more on

well-known factors such as paraquat banning, assertive emergency department-based suicide attempt survivor management program, community-based registration and intensive management for mental disorder including depression and alcohol abuse according to your recommendation.

(Page 14, Line 10-14) Some important national suicide prevention activities were carried out during the 2nd suicide prevention initiative, such as the installation of more screen doors to prevent people from throwing themselves into the subway train²⁵ and a ban on the sale of paraquat pesticides.²⁶ The one of the most effective suicide prevention intervention is to restrict of assessment to lethal methods.²⁷

(Page 14, Line 18-Page 15 Line 1) After the introduction of the national suicide prevention initiative in 2009, the community mental health center has endeavoured to register and manage more people with severe mental disorder and people with alcoholism. Indeed, the mental health service utilization rates among people with alcoholism has increased from 8.1% in 2008 to 12.1% in 2015.²⁸ The registration and management rate for people with severe mental disorder in the community mental health center has also increased from 19.2% in 2008 to 26.4% in 2016. In addition, the government implemented an emergency department-based suicide attempt survivor management program, announced the recommendation for media reporting of suicide in 2013.⁷

4. Large government initiated programs are often ineffective but specific measures such as reduction of access to lethal methods (paraquat and subways), improvement in mental health programs and reduction in alcohol abuse are well known to reduce suicide rate. Therefore authors should be a little more skeptical in concluding that it is the state initiated programs such as welfare programs that worked..

Answer: As you suggested, we more focused on the specific policies such as restriction of access to suicide methods, emergency department-based suicide attempt survivor management program, coordinated with department of psychiatry, registration and intensive care for people with severe mental disorder or alcoholism which were known as high risk group for suicide. The description of the welfare program has been largely removed from discussion.

(Page 14, Line 10-14) Some important national suicide prevention activities were carried out during the 2nd suicide prevention initiative, such as the installation of more screen doors to prevent people from throwing themselves into the subway train²⁵ and a ban on the sale of paraquat pesticides.²⁶ The one of the most effective suicide prevention intervention is to restrict of assessment to lethal methods.²⁷

(Page 14, Line 18-Page 15 Line 1) After the introduction of the national suicide prevention initiative in 2009, the community mental health center has endeavoured to register and manage more people with severe mental disorder and people with alcoholism. Indeed, the mental health service utilization rates among people with alcoholism has increased from 8.1% in 2008 to 12.1% in 2015.²⁸ The registration and management rate for people with severe mental disorder in the community mental health center has also increased from 19.2% in 2008 to 26.4% in 2016. In addition, the government implemented an emergency department-based suicide attempt survivor management program, announced the recommendation for media reporting of suicide in 2013.⁷

(Page 15, Line 11-14) and the risk of suicide among men arising due to the unemployment rate and economic crisis was also shown to be higher.^{29, 30} However, the current suicide prevention policies only included the development of an office worker gatekeeper program for men in their 30s and 40s.

Comments from Reviewer 2:

Thank you for the opportunity to review this manuscript, which examined the changing trends of suicide rates in South Korea from 1993 to 2016 using the Jointpoint regression modeling. I have a few specific points for the authors to consider:.

Answer: Thank you for your careful comment. We thank you for your valuable comments and efforts.

1. Abstract: Trends for suicide rates in South Korea were only mentioned since 2010 in page 2 row 32, not covered from 1993 to 2016 as the title suggested.

Answer: In response to your comments, we changed the abstract as following:

(Page 2, Line 14-19) Results: From 2010 to 2016, the suicide rates in South Korea have been decreasing by 5.5% (95% CI: -10.3% to -0.5%) annually. In terms of sex, the suicide rate for men had increased by 5.0% (95% CI: 3.6% to 6.4%) annually from 1993 to 2010. However, there has been no statistically significant change from 2010 to 2016. For women, the suicide rate had increased by 7.5% (95% CI: 6.3% to 8.7%) annually from 1993 to 2009, but since 2009, the suicide rate has been significantly decreasing by 6.1% (95% CI: -9.1% to -3.0%) annually until 2016.

2.1. Method section: ICD-10 code “X60-X84” was utilized for analyzing suicide rates, how about ICD-10 code “Y87.0”, sequelae of intentional self-harm? Were there any cases coding from “Y87.0”? How did the authors deal with this part of data?.

Answer: Of course, as you comment, “Y87.0” could also be included in category of suicide. However, the classification of cause of death usually follows the international standard classification for international comparison. In general, the ICD-10 codes for suicide are in the range X60-X849 according to the WHO. Please see the reference of Ajdacic-Gross V et al. We just followed the WHO classification of cause of death data.

Reference) Ajdacic-Gross V, Weiss MG, Ring M, Hepp U, Bopp M, Gutzwiller F, Rössler W. Methods of suicide: international suicide patterns derived from the WHO mortality database. *Bull World Health Organ.* 2008 Sep;86(9):726-32.

2.2. Method section: The authors used the mid-year Korean population in 2005 as the standard population. Is there any particular reason for this? I am wondering why the authors did not use the latest population as the standard population.

Answer: Because, Korean National Statistical Office uses the mid-year Korean population in 2005 as the standard population in South Korea, we also used the mid-year Korean population in 2005 as the standard population.

Reference) Kwon JW, Chun H, Cho SI. A closer look at the increase in suicide rates in South Korea from 1986–2005. *BMC Public Health.* 2009 Feb 27;9:72. doi: 10.1186/1471-2458-9-72.

2.3. Method section: About Joinpoint regression modeling, the authors did not provide information about why this method be used, how it works, etc.

Answer: Joinpoint statistical software was developed by SEER in the National Cancer Institute in the United States. Joinpoint regression model was usually used to know whether there were changes of the trends in incidence or mortality rate. Further, Joinpoint regression model could detect point where a significant change in rates over time. Joinpoint regression is used to fit a better multi-segmented model compared with a simple linear regression model using a Monte Carlo permutation method. (Page 7 Line 18~ 23) We used Joinpoint regression program to know whether there were changes in trends in mortality rates. Joinpoint statistical software was developed by the National Cancer Institute in the United States. Joinpoint regression modelling was used to test the trends in age-standardized suicide rates for suicide and detect significant changes over time to fit a better multi-segmented model compared to a simple linear model using a Monte Carlo permutation method.¹ Further, it could detect point where significant change in rates over time.

Reference) Kim HJ, Fay MP, Feuer EJ, Midthune DN. Permutation tests for joinpoint regression with applications to cancer rates. *Stat Med* 2000;19:335-51 (correction: 2001;20:655).

Joinpoint regression software Homepage: <https://surveillance.cancer.gov/joinpoint/>

Kwon JW, Chun H, Cho SI. A closer look at the increase in suicide rates in South Korea from 1986–

2005. BMC Public Health. 2009 Feb 27;9:72. doi: 10.1186/1471-2458-9-72.

3.1. Result section: In “Baseline characteristics” and table 1, the authors analyzed the proportion of deaths due to suicide among different age groups, including children aged 0-19 years. However it is quite rare that children younger than 10 years old suicide. The authors might need to re-categorize the age group to make sense.

Answer: We agreed your opinion. There only small number of death among children aged less than 10 years old. Therefore, we excluded children aged less than 10 years old in age group in table 1. Although it may be statistically unstable, the suicide rate of children and adolescent has an important issue in public health field. Indeed, suicide rates have doubled in the 15- to 19- year age group and tripled in the 10- to 14- year age group between 1960s and 1990s in the United States [1]. Not only in the United States, but also in the European countries, there were increasing trends in suicide rates among adolescent aged 15-19 years old between 1965 and 1998 [2]. Therefore, in this point of view, we thought that it was important to show how the trends in suicide rates in children and adolescent has changed in South Korea.

Reference)

1. Efforts to reduce the toll of injuries in childhood require expanded research. American Academy of Pediatrics. Committee on Injury and Poison Prevention. Pediatrics 1996; 97:765.
2. Wasserman D1, Cheng Q, Jiang GX. Global suicide rates among young people aged 15-19. World Psychiatry. 2005;4(2):114-20.

3.2. Result section: In “Baseline characteristics” and table 1, number of death due to suicide were presented and analyzed, not the mortality rate, the latter is more appropriate.

Answer: As you suggested, we presented additionally the mortality rate due to suicide in the supplementary table 1. We just presented the number of death due to suicide in table 1 to know the magnitude and current status of suicide problems.

3.3. Result section: In table 1, the proportion of deaths due to suicide are provided in parentheses, but without any explanation, for tables and figures in scientific papers should be self-explicit.

Answer: We added the footnotes in table 1 for readers to understand more easily.

(Table 1 footnotes) †The denominator for percentage of number of deaths due to suicide was total number of deaths.

‡The number and percentage of death due to suicide by sex and age group were presented among people aged ≥ 10 years old.

3.4. Result section: In table 1, the exact p value should be provided, not in the form of “ $p < 0.01$ ”.

Answer: We tried to present the exact p-value according to your suggestion, but the p-values were too small to present with exact p-value. Please see the below results. Instead, we presented as “p-value < 0.0001 ”

```
> m1 <- rbind(men, women)
> m1
[,1] [,2] [,3] [,4]
men 23733 35619 51525 59086
women 10331 15794 27149 25848
> chisq.test(m1)
```

Pearson's Chi-squared test

data: m1
 X-squared = 401.02, df = 3, p-value < 2.2e-16

3.5. Result section: Table 2 and 3 might be combined into one table.

Answer: As you recommended, we combined table 2 and 3 into one table (Table 3).

4. Discussion section: "Increase in suicide rate of middle-aged men" and page 15 row 49 "the suicide rate of middle-aged men in their 30s and 40s had continued to increase": the authors have to be careful that by definition the middle-aged probably refers to 45-64 years old.

Answer: In response to your suggestion, we deleted "middle-aged men" in the manuscript. Instead, we presented as men in their 30s and 40s or men aged between 30 and 49 years old.

5.1. page 5 row 10: "Mental Health Action 2013-2010" probably should be "Mental Health Action 2013-2020".

Answer: I'm sorry. It's a typo. we changed from "Mental Health Action 2013-2010" to "Mental Health Action 2013-2020".

(Page 5, Line 4-7) The WHO established the Mental Health Action 2013-2020 plan to implement a national, multi-sectorial promotion and prevention program for promoting mental health and reducing suicide rates of each country by 10% until 2020.

5.2. Same suicide prevention program but different explanation provided: page 11 row 24 used "watch, listen, and speak", but page 29 row 34 used "Look and Listening and Say".

Answer: I'm sorry to make you confused. Because there were no official terms for "Look and Listening and Say", we used various terms. In this paper, we used the terms "Look and Listening and Say" only.

(Page 11, Line 10-12) The Act for the Prevention of Suicide was enforced in 2012, and the Korean gatekeeper training program for suicide prevention entitled 'Look and Listening and Say' was introduced to the general population in South Korea.

VERSION 2 – REVIEW

REVIEWER	Dr. Ranil Abeyasinghe University of Peradeniya Sri Lanka
REVIEW RETURNED	22-May-2018

GENERAL COMMENTS	The authors have come to the conclusion that it is the government sponsored suicide prevention program that led to reduction of suicide rate. They do not state why the suicide rate actually increased till 2010 after the first phase of the suicide prevention program started in 2004. If they do not know why they must state that in their conclusion. The reasonable conclusion of this study is that the female suicide rate has dropped since 2009 while the government program of suicide prevention was on going, while there were no celebrity deaths since 2009. The nature of the study does not allow any other conclusion such as why male suicide has not dropped or if the ongoing suicide prevention program had no effect on males.
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REVIEWER	Jingju Pan Institute of Chronic Non-Communicable Disease Control and Prevention, Hubei Provincial Center for Disease Control and Prevention, Wuhan, Hubei 430079, China
REVIEW RETURNED	13-May-2018

GENERAL COMMENTS	<p>The authors have made efforts to revise the manuscript. However the authors might need to check the whole manuscript carefully before it gets published.</p> <p>For example:</p> <ol style="list-style-type: none"> 1. In Results section, page 8 line 33, “the total number of deaths due to suicide was 249,085 (4.1%)”, here the 4.1% probably should be 4.2% according to Table 1. 2. In Results section, page 8 line 40, “the highest age-standardized suicide rate from suicide (29.1 per 100,000 person-year) in 2011 (Table 2)”, Table 2 shows the data for the highest age-standardized suicide rate was 29.5 per 100,000 person-year. 3. In Results section, page 10 line 28, “Suicide rates in women aged 20-29 years had increased by 20.0% annually from 2001 to 2008”, here 20.0% probably should be 19.9% according to Table 3. 4. In Discus section, page 12 line 28, “...was effective way” probably should be “...was an effective way”. 5. In Discus section, page 14 line 45, “The one of the most effective suicide prevention intervention is to...” I am not sure about “The”. Is it necessary to put “The” here? 6. In Conclusion section, page 16 line 54, “...in trends Korea’s suicide rate...” probably a preposition is missing between “trends” and “Korea’s...” 7. There is probably inconsistency in tense for suicide prevention program tem “Look and Listening and Say”. “Watch, Listen and Talk” might be suitable? The authors might need to consult experts in order to get it right. <p>Finally in the authors’ response, the authors stated “Answer: As you suggested, we presented additionally the mortality rate due to suicide in the supplementary table 1.” But I couldn’t find the supplementary table 1 in the manuscript.</p>
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VERSION 2 – AUTHOR RESPONSE

Comments from Reviewer 2:

Thank you for the opportunity to review this manuscript again.

The authors have made efforts to revise the manuscript. However, the authors might need to check the whole manuscript carefully before it gets published.

Answer: Thank you for your through and thoughtful comment. We appreciate your valuable time and considerations.

1. In Results section, page 8 line 33, “the total number of deaths due to suicide was 249,085 (4.1%)”, here the 4.1% probably should be 4.2% according to Table 1.

Answer: According your suggestion, we revised 4.1% to 4.2% as follows:

(Page 8, Line 11) Of these, the total number of deaths due to suicide was 249,085 (4.2%).

2. In Results section, page 8 line 40, “the highest age-standardized suicide rate from suicide (29.1 per 100,000 person-year) in 2011 (Table 2)”, Table 2 shows the data for the highest age-standardized suicide rate was 29.5 per 100,000 person-year.

Answer: Thank you for thoughtful comments. We revised that sentence as follows:

(Page 8, Line 12-15) In terms of the time period, South Korea had the highest number of deaths from suicide (n=15,906) in 2011 and the highest age-standardized suicide rate from suicide (29.5 per 100,000 person-year) in 2009 (Table 2).

3. In Results section, page 10 line 28, "Suicide rates in women aged 20-29 years had increased by 20.0% annually from 2001 to 2008", here 20.0% probably should be 19.9% according to Table 3.
Answer: Thank you for thoughtful comments. We revised that sentence as you suggested:
(Page 10, Line 9) Suicide rates in women aged 20-29 years had increased by 19.9% annually from 2001 to 2008.

4. In Discus section, page 12 line 28, "...was effective way" probably should be "...was an effective way".
Answer: As you suggested, we added "an" as follows:
(Page 12, Line 6-7) They showed that a national level of suicide prevention intervention was an effective way to reduce suicide rate except for working-age adults in 21 OECD countries.

5. In Discus section, page 14 line 45, "The one of the most effective suicide prevention intervention is to..." I am not sure about "The". Is it necessary to put "The" here?
Answer: As you suggested, we removed "the" before one as follows:
(Page 15, Line 3-4) One of the most effective suicide prevention intervention is to restrict of assessment to lethal methods

6. In Conclusion section, page 16 line 54, "...in trends Korea's suicide rate "probably a preposition is missing between "trends" and "Korea's..."
Answer: In response to your comments, we added "of" between "trends" and "Korea's" as follows:
(Page 17, Line 7-8) Our findings also showed that there were significant changes in trends of Korea's suicide rate especially among elderly people after 2010 to 2011

7. There is probably inconsistency in tense for suicide prevention program tem "Look and Listening and Say". "Watch, Listen and Talk" might be suitable? The authors might need to consult experts in order to get it right.
Answer: As you suggested, we changed from "Look and Listening and Say" to "Watch, Listen and Talk".
(Page 11, Line 10-13) the Korean gatekeeper training program for suicide prevention entitled 'Watch, Listen and Talk' was introduced to the general population in South Korea

8. Finally in the authors' response, the authors stated "Answer: As you suggested, we presented additionally the mortality rate due to suicide in the supplementary table 1." But I couldn't find the supplementary table 1 in the manuscript.
Answer: I'm sorry to make you confused. Supplementary table 1 has changed to table 2. I forgot about the changes (Supplementary table 1 \diamond table 2) and made a mistake. It's my fault. Table 2 shows the age-standardized mortality rate for suicide from 1993 to 2016.

Comments from Reviewer 1:

Thank you for your through and thoughtful comment. We appreciate your valuable time and considerations.

1. The authors have come to the conclusion that it is the government sponsored suicide prevention program that led to reduction of suicide rate.

Answer: As you suggested, we toned down the association between government led suicide prevention program and decline in suicide rates in the first revision. We also focused more on well-known factors such as paraquat banning, assertive emergency department-based suicide attempt survivor management program, community-based registration and intensive management for mental disorder including depression and alcohol abuse in discussion.

2. They do not state why the suicide rate actually increased till 2010 after the first phase of the suicide

prevention program started in 2004.

Answer: I'm sorry that I have not fully explained the situation of Korean society and background. I have added the reason for increase of suicide rate until 2010 as follows:

(Page 12, Line 11-20) The suicide rates of South Korea have increased continuously from 1993 to 2010. According to the study of Kwon et al, the recent increase in suicide during 1986-2005 was mainly attributed to increase in suicide in elderly people.¹⁵ The rapid social change such as the increasing tendency of smaller family size may make the elderly feel isolated. In addition, insufficient social security system and economical problem may lead to an increase in suicide rates in the elderly.¹⁵ However, suicide rate of young people aged less than 45 years old have also increased significantly.¹⁵ The rising economic inequality and increasing unemployment rate due to economic crisis in 1997 of Korea may contribute to the increase in suicide rate among young people. In addition, the fragmentation of social integration may have weakened the social ability to overcome mental problem such as depression.¹⁵

We thought that the reason for the increase in the suicide rate since the introduction of the first suicide prevention program started in 2004 as follows:

For the first national suicide prevention strategy, there was very little support for the manpower and financial resources to support the strategy, although there was object, strategy for national suicide prevention. As Korea Herald says, there was no legal basis to invest additional budgets to prevent suicide before the Act for the Prevention of Suicide was passed in year 2011 [1]. The government budget to prevent suicide had increased 10-fold from 2011 to 2013 [1].

(Page 13, Line 9-14) Although the 1st suicide prevention initiative was implemented in 2004, the government did not earmark funding for the 1st suicide prevention initiative.¹⁶ In other words, this project had just added suicide prevention program to the existing mental health care service without sufficient additional budgets and manpower. In addition, the scope of this policy was mainly focused on the individuals with mental disorder, and there was not sufficient consideration for social and environmental changes.

(Page 13, Line 22-23) These changes in the suicide rate, however, were found to be not a statistically significant decline in the suicide rate overall but a change in the increasing trend of the suicide rate.

(Page 14, Line 13-14) The importance of the 2nd suicide prevention initiative is that the national budget was allocated for suicide prevention unlike the 1st suicide prevention initiative.

Reference)

1. The Korea Herald. [Voice] How can Korea reduce suicide? Jan 21, 2013, Available from: <http://www.koreaherald.com/view.php?ud=20130121000560>
2. Kwon JW, Chun H, Cho S. A closer look at the increase in suicide rates in South Korea from 1986–2005. BMC Public Health 2009;9:72

3. If they do not know why they must state that in their conclusion. The reasonable conclusion of this study is that the female suicide rate has dropped since 2009 while the government program of suicide prevention was on going, while there were no celebrity deaths since 2009.

Answer: We agreed that young women could affected by celebrity suicide. We already mentioned that a reduction in the suicide rate of young women after 2009 was likely to attributed to the declines of celebrity suicides.

(Page 14, Line 21-23) Considering these results, it is a reasonable interpretation to view a reduction in the suicide rate of young women after 2009 as a decline in the suicide rate surged previously due to the effect of a series of specific events—celebrity suicides.

However, celebrity suicide could not explain why suicide rates among women aged ≥ 50 years old have decreased since year 2010. As we mentioned #1 & 2, effective suicide prevention strategy and sufficient budget for suicide prevention was implemented after year 2010. Paraquat banning, assertive emergency department-based suicide attempt survivor management program were

representative suicide prevention program which were implemented after year 2010.

4. The nature of the study does not allow any other conclusion such as why male suicide has not dropped or if the ongoing suicide prevention program had no effect on males..

Answer: The largest proportion of suicide in Korea was the suicide in the elderly. Our study findings showed that suicide rate of men aged ≥ 70 years old has decreased after year 2010 or year 2011. The descriptive study could be used to know the effects of national policy. For example, the effects of tobacco control policy on smoking prevalence was also examined using descriptive study [1]. The association between gun law reforms and firearm death could be also explained by descriptive study design [2]. The effect of mandatory seat belt laws on mortality due to traffic accident could be also explained by descriptive study design [3].

Like them, the Korean society has little change in social aspects that affect suicide, such as social security systems, socioeconomic inequalities, fragmented social cohesion, and small family structure, rather, the unemployment rate has increased and socioeconomic inequality has worsened [4-6]. In this situation, we believe that it was reasonable explanation that the reduction in suicide rates in Korea was due to the implementation of suicide prevention policies.

Indeed, previous studies have shown that paraquat banning could reduce suicide mortality due to pesticides [7] and the screen-door installations could reduce subway suicide [8]. These are individual programs included in the national suicide prevention program [8, 9, 10]. In addition, clear and significant reduction in suicide mortality rates were found in the elderly since 2011. On the other hands, there was no significant reduction in suicide mortality rates among most working-age group aged 30-59. These findings were consistent with the study of Matsubayashi et al, which showed that national level of suicide prevention program was an effective way to reduce suicide rate except for working-age adults among OECD countries [11]

Accordingly, we have slightly modified the conclusion in a more rational way based on result findings.

(Page 4, Line 2-3) λOur findings show that efforts to reduce suicide at the national level may lead to a decline in suicide rates especially among elderly people through natural experiment.

(Page 17, Line 7-8) Our findings also showed that there were significant changes in trends of Korea's suicide rate especially among elderly people after 2010 to 2011.

(Page 17, Line 10-11) it is considered that government-level suicide prevention interventions had a potential effect on decreasing the suicide rate among elderly people,

Reference)

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VERSION 3 – REVIEW

REVIEWER	Ranil Abeyasinghe University of Peradeniya Sri Lanka
REVIEW RETURNED	05-Jul-2018

GENERAL COMMENTS	The original submission had stated that the suicide prevention program started in 2004 and I pointed that the suicide rate seems to have increased until 2010 with a fall since 2010. The present version has omitted that 2004 to 2010 period. I believe it is an interesting finding that should be reported. There may be causes other than the suicide prevention program, such as more awareness of suicide in the country leading to higher reporting rates or more such verdicts by coroners.
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REVIEWER	Jingju Pan Hubei Provincial Center for Disease Control and Prevention, China
REVIEW RETURNED	08-Jul-2018

GENERAL COMMENTS	I would like to thank the authors for having addressed all recommendations. I believe the paper is now suitable for publication.
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VERSION 3 – AUTHOR RESPONSE

Comments from Reviewer 1:

1. The original submission had stated that the suicide prevention program started in 2004 and I pointed that the suicide rate seems to have increased until 2010 with a fall since 2010. The present version has omitted that 2004 to 2010 period. I believe it is an interesting finding that should be reported. There may be causes other than the suicide prevention program, such as more awareness of suicide in the country leading to higher reporting rates or more such verdicts by coroners.

Answer: According to the 2008 National Survey of the National statistics office, the most common causes for suicidal ideation was economic difficulties (36.2%), followed by family trouble (15.6%) and loneliness (14.4%). Especially, the proportion of suicidal ideation due to economic difficulties was the highest among people aged 40-59 years old. Please see the below table (Statistics Korea. Social Survey 2008. <http://kosis.kr/en>. (Accessed on 30 July 2018).

The hypothesis suggested by the reviewer are very interesting, however, we did not have any data about awareness of suicide or reporting rates by coroners.

Therefore, we could only explain about the causes for increase in suicide from 2004/2005 to 2010 among middle aged people by the economic difficulties, changes of alcohol abuse, the effect of celebrity suicide.

(Page 14 Line 3 – Page 15 Line 1) Trend in suicide rates among middle aged people between 2004/2005 and 2010

Comments from Reviewer 2:

I would like to thank the authors for having addressed all recommendations. I believe the paper is now suitable for publication.

Answer: Thank you for your valuable time and efforts to review our paper.

VERSION 4 – REVIEW

REVIEWER	Dr. Ranil Abeyasinghe University of Peradeniya Sri Lanka
REVIEW RETURNED	05-Aug-2018
GENERAL COMMENTS	The initial increase of suicide rate despite the national suicide prevention program may not be due to lack of finances. It could be that coroners became more aware of suicidal deaths and reported more.