Original article

# Suicide and the standardized mortality ratio among Republic of Korea Armed Forces personnel, 2011–2016

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ABSTRACT

Purpose: This study examined the number of suicides in the Republic of Korea (ROK) Armed Forces and compared the relative suicide risk of military personnel with that in the general population.
Methods: Age-, sex-, and calendar year-adjusted standardized mortality ratios (SMRs) and 95% confidence intervals were calculated to compare the number of suicides between the ROK Armed Forces and the general population.
Results: Between 2011 and 2016, there were 405 suicides by ROK Armed Forces Personnel. The ROK Armed Forces had significantly fewer suicides than expected compared with the general population (SMR = 0.46, 95% confidence interval 0.41~0.50, based on 405 deaths). This was evident for both rank groups (soldiers and officers). In addition, a significant decrease was observed in the soldier group when comparing the SMR in 2016 with the previous 5-year average.
Conclusions: Overall, during the period 2011–2016, the ROK Armed Forces had fewer suicides than expected when compared with the general population.

## Introduction

Suicide is defined as self-inflicted death with evidence (either explicit or implicit) that the person intended to die [1]. Suicide is a major public health problem, with far-reaching social, emotional, and economic consequences [2]. According to OECD statistics, Korea's suicide rate has been one of the highest in the world over the past decade [3]. Suicide prevention is a major issue not only in the general population but also in military personnel. The occurrence of suicide in the military is a tragedy that affects families, communities, and the people left behind. It also has a large social impact and is associated with declining morale and distrust of the military organization.

The Republic of Korea (ROK) uses conscription and most healthy male conscripts serve on active duty. The Ministry of National Defense (MND) and each service have implemented the following preventive policies and activities under the premise that "suicide is preventable" and additional effort is being made to create "a culture of respect for life" to enhance the effectiveness of suicide-prevention activities [4]. First, the MND and each service conducts regular suicide-prevention education (e.g., 2 hours every quarter) to promote awareness of suicide and to train all service members serving as gatekeepers. Second, standardized psychological tests are administered in each stage of service, such as during the intake physical examinations, military training, and unit deployment, to identify service members who may be at higher risk for suicide. Since 2010, all service members have completed psychological tests developed by the Korea Institute for Defense Analyses. Third, psychological counseling and support services are provided by expert counselors. In principle, counseling is available to all service members. However, it is primarily offered to members who are at higher risk, especially soldiers. The number of counselors was increased from 95 in 2011 to 383 in 2017 to extend counseling opportunities for all service members. The MND also started the "Armed Forces Life Line" program in December 2011 that has expert counselors on 24-hour standby telephone counseling services. Fourth, a short-term intensive-care camp is operated for service members who are at high risk of suicide by separating them temporarily from their units and providing multidisciplinary intervention. The decision on admission to the camp depends on the judgment of the commander and the advice of the specialist considering the risk of the service members.

As such, various efforts have been undertaken by our military to prevent suicide. Nevertheless, further efforts are required for the systemic analysis and evaluation of suicide rates in the military. Currently, our military uses only the crude suicide rate, which is calculated by dividing the total number of suicides by the total number of military organizations, and the crude rate is compared only with the suicide rate among males in their 20s in the general population. However, for the comparison of crude rates to be meaningful, the distribution of basic characteristics such as age and sex should be similar between the groups. Unfortunately, the military population differs from the general population in many aspects including age, sex, and birth cohort. Therefore, a simple comparison of the crude rate may result in an underrepresented relative risk implied by a particular group in the military, or vice versa.

When the basic characteristics are different, the distribution of the target population is artificially adjusted to the standard distribution and compared. Two methods of standardization are commonly used in epidemiological studies, namely direct and indirect standardization [5]. The direct method of standardization requires the age-specific rates for all populations studied to be available, while the indirect method is commonly used when age-specific rates within the target population are unavailable. The age-specific suicide rates within the ROK military have not been defined in advance; therefore, the indirect method of standardization will be used in this study. Thus, rather than taking one population structure as standard and applying sets of rates to it to estimate a number of expected events, a set of rates from a standard population will be applied to each of the populations being compared to calculate a standardized mortality ratio (SMR). In addition, adjusted rates can be calculated by multiplying the total rate within the standard population by the SMR.

The SMR was used to compare suicide-specific mortality between service members and the general population. The SMR is the ratio of the observed number of suicides to the expected number of suicides based on the suicide rate in the standard population, adjusting for age, sex, and year of death.

Together with the suicide rate, the SMR is one of the indicators that can be used to compare the degree of seriousness of the suicide rate in the military population with that of the rate in the general population. The SMRs of service members are often reported to be lower than for the general population [6], which is explained by the many selection and screening procedures used before and during service, the demand to stay fit while in service, and better access to multiprofessional support during and after service [7]. In some cases, however, SMRs that are similar to or significantly higher than in the general population are reported. These results seem to be age-specific or related to high conflict exposure during deployment [8—11]. It is known that the general population suicide rate in Korea is extremely high compared with that in other OECD countries. However, the relative risk of suicide in the military population compared with the general population has not been determined.

To our knowledge, no epidemiological study has evaluated suicide rates in the Korean Armed Forces. Therefore, as an initial step toward improving our understanding of the suicide risk among Korean military personnel, we compared the suicide risk of the ROK Armed Forces with the general population. We also assessed the recent change in suicide risk among the ROK Armed Forces considering the change of the risk for the general population to use this information to implement policies designed to prevent future suicides.

## Methods

To compare suicide-specific mortality between service members and the general population, annual SMRs were computed.

The general population refers to the entire population including those in the armed forces, and it was used as the standard population to calculate the SMR. We also calculated the adjusted suicide rates (per 100,000 persons) using the computed annual SMRs and the change in the SMRs during the study period for all military personnel and the soldier/officer groups. We chose 2011 to 2016 as the analysis period for SMRs for several reasons. First, there was a considerable change in the Ministry of National Defense's suicide prevention policy in 2011. Second, we aimed to analyze recent changes in the suicide rates, and 2016 was the latest available year with official statistics. Annual population data for the period 2011—2016 were obtained for the ROK Armed Forces from Defense-Manpower Analysis Programming Plan & Support, which is used for personnel management and personnel structure analysis [4]. The numbers of military suicides occurring between 2011 and 2016 were obtained from the National Defense Statistics Year Book, which is open-source information provided by the MND annually [12]. The numbers of suicides by class (i.e., soldiers and officers) were confirmed from internal MND data. For reference, the number of military suicides reported in the National Defense Statistics Year Book includes the suicides of civil servants attached to the military. However, the scope of analysis in this study was limited to soldiers and officers, and the suicides of civil servants attached to the military were not considered for several reasons. First, it was difficult to obtain information on the civil servant population from Defense-Manpower Analysis Programming Plan & Support. Second, there may be statistical instability in the estimation of the SMR and confidence interval because the reported number of suicides among civil servants attached to the military was only 1—6 per year [13].

The reference suicide rates for the general population were obtained from the Cause of Death, which is published annually by Statistics Korea [14] (Appendix A). The SMR for class and sex—age

**Table 1**
Number of suicides, standardized mortality ratio, and 95% CI for the ROK armed forces, 2011—2016

| CY | Soldiers + officers | | | | Soldiers | | | | Officers | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | O | E | SMR | 95% CI* | O | E | SMR | 95% CI | O | E | SMR | 95% CI |
| 2011 | 94 | 178.48 | 0.53 | 0.43—0.64 | 58 | 117.49 | 0.49 | 0.37—0.64 | 36 | 60.98 | 0.59 | 0.41—0.82 |
| 2012 | 71 | 150.72 | 0.47 | 0.37—0.59 | 38 | 96.09 | 0.40 | 0.28—0.54 | 33 | 54.63 | 0.60 | 0.42—0.85 |
| 2013 | 76 | 140.99 | 0.54 | 0.42—0.67 | 45 | 85.40 | 0.53 | 0.38—0.71 | 31 | 55.59 | 0.56 | 0.38—0.79 |
| 2014 | 61 | 147.45 | 0.41 | 0.32—0.53 | 40 | 91.16 | 0.44 | 0.31—0.60 | 21 | 56.29 | 0.37 | 0.23—0.57 |
| 2015 | 53 | 136.05 | 0.39 | 0.29—0.51 | 22 | 84.83 | 0.26 | 0.16—0.39 | 31 | 51.22 | 0.61 | 0.37—0.78 |
| 2016 | 50 | 134.37 | 0.37 | 0.28—0.49 | 21 | 84.03 | 0.25 | 0.15—0.38 | 29 | 50.34 | 0.58 | 0.39—0.83 |
| Overall | 405 | 888.06 | 0.46 | 0.41—0.50 | 224 | 559.00 | 0.40 | 0.35—0.46 | 181 | 329.05 | 0.55 | 0.47—0.64 |

CY = calendar year; E = expected suicides, calculated using age- and sex-specific stratum rates from the standard population in the Cause of Death Statistics Korea (2011, 2012, …, 2016); O = observed number of suicides; SMR = standardized mortality ratio.
* The 95% confidence intervals (CIs) were defined assuming a Poisson distribution of the observed number of deaths and a CI that did not include 1.0 was considered statistically significant; all the SMRs reported in this table were significant (*P* < .001).

**Table 2**
Suicide rates per 100,000 for the population and the ROK armed forces, 2011–2016

| CY | Republic of Korea population rate[*] | Armed forces crude rate[†] | Armed forces adjusted rate[‡] | | |
|---|---|---|---|---|---|
| | | | Soldiers + officers | Soldiers | Officers |
| 2011 | 31.7 | 15.2 | 16.7 | 15.6 | 18.7 |
| 2012 | 28.1 | 11.1 | 13.2 | 11.1 | 17.0 |
| 2013 | 28.5 | 12.2 | 15.4 | 15.0 | 15.9 |
| 2014 | 27.3 | 10.2 | 11.3 | 12.0 | 10.2 |
| 2015 | 26.5 | 8.7 | 10.3 | 6.9 | 16.0 |
| 2016 | 25.6 | 8.2 | 9.5 | 6.4 | 14.7 |

[*] Population rate is reported annually by Statistics Korea, the Cause of Death Statistics Korea (2011, 2012, …, 2016).

[†] Armed Forces crude rate is reported by Ministry of National Defense (MND), the National Defense Statistics Year Book (2011, 2012, …, 2016).

[‡] Adjusted rate: age, sex, and per year army population distribution adjusted suicide rate applying indirect standardization method; for reference, we compared the percentage change in the adjusted rate between 2016 and 2011. The adjusted rate was reduced to 43% for all military personnel with 59% for soldiers and 21% for officers.

groups was calculated as the ratio of the observed and expected numbers of deaths. In this study, an SMR equal to 1.0 indicates that the rate is the same as in the general population.

## Results

Table 1 lists the total suicides and SMR. During the 6-year period from 2011 to 2016, 405 service personnel died by suicide. Of the 405 suicides during this period, 224 (55%) involved soldiers and 181 (45%) involved officers. The overall suicide rate for service personnel during the 6-year period was lower than what would be expected if the military had the same age and sex composition as the general population (SMR 0.46; 95% CI 0.41–0.50). Furthermore, significantly lower SMRs among all military personnel were reported for each year in the period (SMR 0.37–0.54). This pattern continued within the soldier and officer groups overall and for each year of the study period.

Table 2 shows the crude and adjusted suicide rates of the military population. Over the study, the ROK population's suicide rates decreased from 31.7 to 25.6 suicides per 100,000 persons.

The crude military suicide rates were decreased from 15.2 per 100,000 in 2011 to 8.2 per 100,000 in 2016. After adjusting for the age, sex, and annual population of the army, the adjusted military suicide rates were higher than the crude suicide rates. The adjusted suicide rate of the military population was 16.7 per 100,000 in 2011 and 9.5 per 100,000 in 2016. The adjusted suicide rate of enlisted persons was 15.6 per 100,000 in 2011, which gradually decreased to 6.4 in 2016. The adjusted suicide rate of the officers was 18.7 per 100,000 in 2011 and 14.7 in 2016. Until 2014, the suicide rates of the officers and soldiers were largely similar, but since 2015, the adjusted rates for officers have been around twice as high as those of soldiers. This has been caused by the suicide rate of soldiers dropping sharply since 2015, while the rate for officers decreased only slightly.

Figure 1 shows the change in SMRs during the 6-year period for all military personnel and the soldier/officer groups. The 2016 calendar year (CY) rates for all personnel and officers did not differ statistically from the average for CY 2011–2015 (the gray shaded region in Fig. 1); however, the 2016 CY rate for soldiers was significantly lower than expected given the confidence interval for the 5-year average.

## Discussion

This study used SMRs to compare the ROK Armed Forces and the general population. There were two principal findings. First, overall, for the 6-year period 2011–2016, the ROK Armed Forces had significantly fewer suicides than expected. Similar results were found in both soldier and officer groups. Second, when analyzing the recent change in the suicide rate in the ROK Armed Forces considering the change in the general population, the suicide rate of young soldiers was significantly lower than the previous 5-year average, while there was no significant change in the ROK Armed Forces and officer group over the 5-year average.

One notable point is that the suicide rates of officers have constantly been higher than those of soldiers and the difference has risen since 2015. This is unlike what has been observed, where substantially lower suicide rates are generally seen among officers relative to enlisted soldiers [15]. One possible explanation for higher suicide rates among officers is that the age-specific suicide
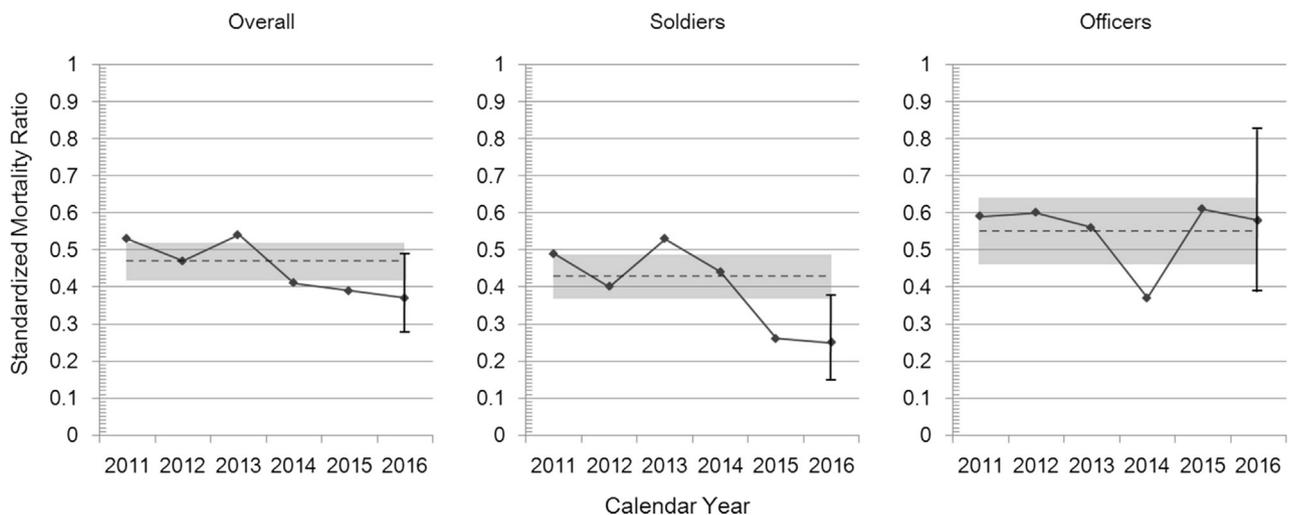


**Fig. 1.** Standardized mortality ratios of suicide in the ROK Armed Forces, CY 2011–2016. The gray dashed line is the 5-year average for CY 2011–2015. The gray shaded area is the 95% confidence interval for the 5-year average. The black bracket for CY 2016 is the 95% confidence interval around the CY 2016 point estimate. The overlap of this interval with the gray dashed line indicates that there is no significant difference between CY 2016 and the average of the five previous CYs. For reference, we compared the percent change in the SMR between 2016 and 2011. The SMR of all military personnel was decreased by 30% during the study period. The SMR of soldiers was decreased by 49%, and the SMR of officers was decreased by 2%.

rate in Korea is higher as age increases, and this trend is particularly relevant to males. In general, suicide rates increase with age [16], but the trend is more dramatic in the Korean male group. Most soldiers are in their 20s, while half of officers are in their 30s or older. This result should be taken as evidence of the need for further expansion of preventive programs targeting officers in the Korean military.

The ROK Armed Forces has implemented active suicide-prevention policies and these seem to have had some positive effects. In particular, the significant decrease in the suicide rate of the soldier group may be related to the fact that the suicide-prevention policy is focused on the soldier group. Before enlistment, in the conscription system, soldiers who have a high risk of mental health problems are identified at the first and second physical examinations and during military training, while officers are screened only at the time of selection. In addition, during service, mental health assessments are mandatory once a year for officers, while soldiers are assessed at least twice a year. This seems to facilitate timely intervention in the problems of soldiers. The intensive-care program for those who are at high risk of suicide is mainly provided for soldiers, not officers. There is still no support system for officers. To reduce the overall suicide rate in the Armed Forces, it is necessary to review the current suicide-prevention policy for each class and rank, especially officers, from a long-term perspective and to prepare a customized support policy for each group.

Although this study produced several meaningful findings, its limitations should also be mentioned. First, the relationships between the suicide rate and determinants that are known or suspected to be associated with suicide were not analyzed due to the limited data obtained. For example, data on other explanatory and confounding factors are currently limited, including demographic characteristics (education, ethnicity, and marital status), military characteristics (active/reserve component, service type, and deployment experience), and behavioral health history [13]. A systemic, ongoing analysis of military suicide and the suicide rate is needed to improve our understanding of military suicide and to evaluate the effectiveness of suicide-prevention policies. To do this, it is necessary to establish and manage a uniformed information acquisition system for suicide-related information and to establish and operate a dedicated organization responsible for this analysis. Second, we analyzed the SMR only for personnel on active service. A follow-up study that targets the reserve is needed to analyze the effects of service experience on the long-term suicide risk. Third, in this study, the adjusted suicide rate was determined by selecting the Korean population as the standard population, and the distribution of the military was determined on a yearly basis. However, there is also another method of selecting the military population as the standard population or setting a specific year as the set point. The definition of a standard population can lead to changes in the adjusted rates [17]. Therefore, further studies will be needed to determine the appropriate standard population considering the various methodological issues in the calculation of military suicide rates. Fourth, because the indirect method of standardization was applied, the general population data used as a reference include the number of military suicides. This factor should be taken into consideration when drawing conclusions from these results. Although the indirect method was applied in this study due to the absence of relevant data at this point, a review using the direct method would be required for more accurate analysis. For this purpose, in future research, it will be necessary to organize and analyze the suicide data more rigorously.

## Conclusion

Despite being exposed to continuous stress in the tense confrontation between South and North Korea, it is reassuring that the ROK Armed Forces experience fewer than expected suicides in comparison with the general population of ROK. Nevertheless, efforts to develop suicide-prevention systems are essential. Therefore, MND, each service, and related organizations should continue to cooperate.

## Acknowledgment

## References

[1] Jacobs DG, Badessarini RJ, Conwell Y, Fawcett JA, Horton L, Meltzer H, et al. Assessment and treatment of patients with suicidal behaviors. Washington, DC: APA Pract Guidel; 2010.

[2] WHO. Preventing suicide: a resource for media professionals, update 2017. Geneva: WHO; 2017.

[3] OECD. Suicide rates (indicator). https://doi.org/10.1787/a82f3459-en. [Accessed 6 August 2018].

[4] MND. Defense white paper. Seoul: Ministry of National Defense Republic of Korea; 2016.

[5] Naing NN. Easy way to learn standardization: direct and indirect methods. Malays J Med Sci 2000;7(1):10—5.

[6] Kang HK, Bullman TA. Is there an epidemic of suicides among current and former US military personnel? Ann Epidemiol 2009;19(10):757—60.

[7] Kang HK, Bullman TA. Mortality among US veterans of the Persian Gulf War. N Engl J Med 1996;335(20):1498—504.

[8] Fear NT, Ward VR, Harrison K, Davison L, Williamson S, Blatchley NF. Suicide among male regular UK Armed Forces personnel, 1984—2007. Occup Environ Med 2009;66(7):438—41.

[9] Kang HK, Bullman TA, Smolenski DJ, Skopp NA, Gahm GA, Reger MA. Suicide risk among 1.3 million veterans who were on active duty during the Iraq and Afghanistan wars. Ann Epidemiol 2015;25(2):96—100.

[10] Strand LA, Martinsen JI, Fadum EA, Borud EK. External-cause mortality among 21 609 Norwegian male military peacekeepers deployed to Lebanon between 1978 and 1998. Occup Environ Med 2017;74:573—7.

[11] Bullman T, Schneiderman A, Bossarte R. Suicide risk by unit component among veterans who served in Iraq or Afghanistan. Arch Suicide Res 2018;22:1—10.

[12] MND. National statistics year book. Seoul: Ministry of National Defense Republic of Korea; 2016.

[13] Pruitt LD, Smolenski DJ, Reger MA, Bush NE, Skopp NA, Campise RL. Department of defense suicide event report (DoDSER) calendar year 2014 annual report. Washington: National Center for Telehealth and Technology (T2) Joint Base Lewis-McChord United States; 2015.

[14] Statistics Korea. Annual report on the cause of death statistics. Daejeon: Statistics Korea; 2016.

[15] Schoenbaum M, Kessler RC, Gilman SE, Colpe LJ, Heeringa SG, Stein MB, et al. Predictors of suicide and accident death in the army study to assess risk and resilience in servicemembers (Army STARRS): results from the army study to assess risk and resilience in servicemembers (Army STARRS). JAMA Psychiatry 2014;71(5):493—503.

[16] OECD. Suicide rates increase with age, except in the first years of retirement: suicide rate per 100,000 persons by age group and gender, OECD average, 2013 (or nearest year). Pairs: Health indicators, Publishing; 2016. https://doi.org/10.1787/soc_glance-2016-graph82-en. [Accessed 28 November 2018].

[17] Watkins EY, Spiess A, Abdul-Rahman I, Hill C, Gibson N, Nichols J, Mitchell T, Pecko JA, Cox K. Adjusting suicide rates in a military population: methods to determine the appropriate standard population. Am J Public Health 2018;108(6):769—76.

# Appendix

**Appendix A**
Age, sex, and year-specific suicide rates per 100,000 for the general population of Korea

| Age | Male | | | | | | Female | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10—19 | 20—29 | 30—39 | 40—49 | 50—59 | 60—69 | 10—19 | 20—29 | 30—39 | 40—49 | 50—59 | 60—69 |
| 2011 | 6.2 | 28.2 | 38.7 | 47.7 | 61.5 | 78.3 | 4.8 | 20.0 | 22.0 | 19.8 | 20.7 | 24.4 |
| 2012 | 5.5 | 23.5 | 34.6 | 42.9 | 53.2 | 66.8 | 4.7 | 15.2 | 19.8 | 18.3 | 17.2 | 19.9 |
| 2013 | 5.6 | 20.9 | 36.4 | 47.2 | 58.0 | 64.6 | 4.1 | 14.8 | 20.0 | 17.8 | 18.0 | 18.4 |
| 2014 | 5.5 | 21.8 | 36.6 | 46.6 | 55.2 | 59.8 | 3.4 | 13.4 | 18.9 | 17.7 | 17.4 | 16.5 |
| 2015 | 4.6 | 20.3 | 32.0 | 42.1 | 53.7 | 57.5 | 3.8 | 12.0 | 17.9 | 17.3 | 14.7 | 17.4 |
| 2016 | 5.6 | 19.9 | 31.3 | 42.3 | 48.3 | 55.7 | 4.1 | 12.5 | 17.7 | 16.5 | 16.3 | 14.6 |

Age, sex, and year specific rate is reported annually by Statistics Korea, the Cause of Death Statistics Korea (2011, 2012, …, 2016).