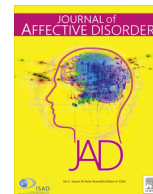




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Short communication

The effectiveness of platform screen doors for the prevention of subway suicides in South Korea

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ABSTRACT

Background: Subway suicide can significantly impact the general public. Platform Screen Doors (PSDs) are considered to be an effective strategy to prevent suicides at subway stations, but the evidence on their effectiveness is limited.

Methods: We assessed the effectiveness of installing half- and full-height platform screen doors in reducing subway suicides using Poisson regression analysis. Ten-year monthly panel data for 121 subway stations between 2003 and 2012 in the Seoul metropolitan area were used for the analysis.

Results: We found that installing PSDs decreases fatal suicide cases by 89% (95% CI: 57–97%). We also found that the installation of full-height PSDs resulted in the elimination of subway suicides by completely blocking access to the track area; however, half-height PSDs, which do not extend to the ceiling of the platform, were not as effective as full-height ones.

Limitation: Our findings were based on the data from a single subway operator for a limited period of time. Accordingly, we did not consider the possibility that some passengers choose to die at a station run by other operators. Our study did not examine the potential substitution effects of other suicide methods.

Conclusion: Installing physical barriers at subway stations can be an effective strategy to reduce the number of subway suicides; however, half-height PSDs are not as effective as full-height ones, even when they are as high as the height of an adult. Thus, these barriers should be made high enough so that nobody can climb over them.

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1. Introduction

Railway and subway suicides can considerably impact the general public, causing not only delays and disruptions in train schedules but also tremendous psychological burden on those who witness the incident, including train conductors and other passengers (Cothreau et al., 2004; Farmer et al., 1992; Kim et al., 2013; Limosin et al., 2006; Weiss and Farrell, 2006; Yum et al., 2006). To resolve the problem of suicides as well as accidents, platform screen doors (PSDs) installed on station platforms are perceived as an effective strategy (Ladwig et al., 2009; Law and Yip, 2011; Mishara, 2007). PSDs open only when a train stops at the station, thus limiting track area access to individuals who may attempt suicide as well as preventing unintentional accidents.

Given these factors, the installation of PSDs has become increasingly popular among train operators around the world, including those in Copenhagen, Guangzhou, London, Paris, Taiwan, Japan, Singapore, and Hong Kong.

However, despite their growing popularity, there is limited evidence on the effectiveness of such barriers for suicide prevention and few studies have attempted to examine the effectiveness of PSDs. For instance, studies on Hong Kong (Law et al., 2009; Law and Yip, 2011) and Japan (Ueda et al., 2015) showed that the number of suicides at stations decreased after PSDs were installed. To the best of our knowledge, no study analyzed the effectiveness of PSDs in South Korea, where the number of subway and railway suicides had alarmingly increased from 18 cases in 1995 to 94 cases in 2004 (Ministry of Land, Infrastructure and Transport (MoLIT) and Korea Transportation Safety Authority (TS), 2011). As of 2012, South Korea had the highest overall suicide rate of 29.1 per 100,000, which was significantly higher than the OECD average of 12.1 (Statistics Korea, 2014). In fact, in its National Transport

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Safety Basic Plan 2012–2016, the Ministry of Land, Infrastructure and Transport instructed train operators across the nation to install PSDs at stations that remained unprotected (MolIT, 2013). Given these statistics, an impact assessment of PSDs is critical, particularly in South Korea.

To bridge the gap in the literature on the effectiveness of PSDs in suicide prevention, this study examined ten-year monthly panel data between 2003 and 2012 from Seoul Metro, a major subway operator that functions throughout the Seoul metropolitan area in South Korea. During 2005–2009, Seoul Metro installed PSDs at 121 stations at the cost of USD 194.06 million (USD 1 = KRW 1153 as of January 4, 2010). The data from Seoul Metro allowed us to conduct a comparative analysis of the effects of half- and full-height PSDs on the number of suicides after their installation across the single subway system. Half-height PSDs do not extend to the ceiling of the platform, and in theory, can be climbed over by an adult. While Ueda et al. (2015) focused on half-height PSDs, Law et al. (2009) and Law and Yip (2011) examined the effectiveness of full-height PSDs, which extend from the ceiling to the floor of the platform and thus, block access to the train tracks. Because Seoul Metro installed both types of PSDs during our study period, we were able to compare the effectiveness of full- and half-height PSDs in preventing suicides.

2. Data and methods

In Seoul, multiple public corporations are responsible for operating the subway, including Seoul Metro (line numbers 1–4) and the Seoul Metropolitan Rapid Transit Corporation (line numbers 5–8). We adopted data on individual suicide cases that occurred between 2003 and 2012 at subway stations operated by Seoul Metro, which operates 50% of the subway stations in Seoul. The data included information on the date and time of incident, station name, and gender and age of victims. Since Seoul Metro only provided information on fatal suicides cases, we did not account for suicide attempts.

Seoul Metro runs 121 subway stations: 10 on Line 1 (from Cheongnyangni to Seoul Station), 51 on Line 2 (entire section), 34 on Line 3 (from Jichuk to Ogeum), and 26 on Line 4 (from Dangogae to Namtaeryeong). We adopted monthly data of suicide counts at all 121 stations for our analysis. Thus, our unit of observation was station-month: the total number of station-month observations was 14,520 (121 stations*120 months).

Our analysis used the number of suicides per station-month as the dependent variable. The main independent variable was an indicator variable which takes 1 if the station had PSDs installed in a particular month and zero otherwise. In 2005, Seoul Metro commenced installation of PSDs across all its subway stations and completed the installation in 2009. Thus, none of the 121 stations had PSDs at the beginning of our study period in 2003, and subsequently, the stations were retrofitted with PSDs at various time intervals. Among these, two stations that are located above the ground had half-height PSDs, measured at 1.65 m (65 in.), and the remaining 119 stations had full-height PSDs that completely or almost extend to the ceiling of the platforms.

We examined the relationship between the installation of PSDs and the number of suicides in two different ways. First, we calculated the total number of suicides per year by PSD availability. Second, we estimated a Poisson regression model using a difference-in-differences (DID) approach. We regressed the number of suicides for a particular station-month observation on the indicator variable that equals 1 if the station had PSDs and zero otherwise. In addition, to account for differences among stations (e.g., number of passengers and proximity to psychiatric hospitals), we included station-specific fixed effects in the model. By

including these fixed effects, we were able to control for station-specific time-invariant unobserved heterogeneities, which allowed us to estimate temporal differences in the mean number of suicides pre- and post-installation. Furthermore, to account for the effects of time-varying unobserved factors (e.g., macroeconomic conditions) at the national level, which might also affect the frequency of subway suicides, we included year-specific and month-specific dummy variables (i.e., fixed effects). Finally, to address the potential heterogeneity and autocorrelation in the error terms within each station, we adjusted the standard errors using a heteroskedasticity–autocorrelation consistent estimator.

3. Results

During our study period, the average number of suicides per station-month was 0.01 (s.d.=0.10). The minimum number was 0, while the maximum was 2. The total number of suicides during our 10-year study period was 135.

Table 1 shows the total number of suicides per year at stations with and without PSDs that include both the full- and half-height doors. The number of suicides is significantly higher when the stations were not equipped with PSDs. However, the table also shows cases of suicides after the PSD installation. In total, three suicides were observed at two stations with PSDs (Gangbyeon and Konkuk University stations), both of which were equipped with half-height PSDs.

Table 2 reports the estimation results for the Poisson regression. As mentioned previously, the station, year, and month fixed effects were included in the estimation; however, their coefficients are not reported in the table. Column (1) in Table 2 shows that the regression coefficient associated with the PSD dummy variable was estimated to be negative, indicating that the number of suicides was lower post-PSD installation. To interpret the magnitude of the PSDs' effect, we computed the incident relative ratio (IRR) at 0.113 with a 95% confidence interval, 0.030–0.431, suggesting that the introduction of PSDs decreased the number of suicides by 89% (CI: 57–97%).

In addition, we estimated the effects of full- and half-height PSDs separately. The results are reported in column (2) in Table 2. The results suggest that the stations equipped with full-height PSDs experienced a drop in the suicide rate since the installation. The corresponding IRR is approximately zero, suggesting that the full-height PSDs were effective in completely preventing suicides. By contrast, half-height PSDs did not seem to reduce the number of suicides, as indicated by the estimated coefficient statistically indistinguishable from zero. However, since there were only two

Table 1
Number of suicides by the presence of platform screen doors (PSDs).

| Year | No PSD Installed | | PSD Installed | | Total |
|-------|--------------------|----------|--------------------|----------|----------|
| | N (station-months) | Suicides | N (station-months) | Suicides | Suicides |
| 2003 | 1452 | 21 | 0 | – | 21 |
| 2004 | 1452 | 20 | 0 | – | 20 |
| 2005 | 1450 | 18 | 2 | 0 | 18 |
| 2006 | 1300 | 18 | 152 | 0 | 18 |
| 2007 | 1216 | 24 | 236 | 0 | 24 |
| 2008 | 1053 | 18 | 399 | 1 | 19 |
| 2009 | 846 | 13 | 606 | 1 | 14 |
| 2010 | 0 | – | 1452 | 0 | 0 |
| 2011 | 0 | – | 1452 | 1 | 1 |
| 2012 | 0 | – | 1452 | 0 | 0 |
| Total | – | 132 | – | 3 | 135 |

Note: Data are obtained from Seoul Metro (2014a, 2014b).

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