INTRODUCTION

Social relationships in human society are essential to well-being and are related to the maintenance of health. Social isolation, defined as an objective, quantifiable reflection of the lack of social connections or interaction, usually known as deprivation of social relationships, has a crucial effect on health status and is known as a major risk factor for mortality. However, loneliness is defined by the subjective experience of being lonely, related to dissatisfaction with the discrepancy between the desired and actual frequency of social contact. Both social isolation and loneliness focus on social relationships; however, social isolation is thought to be more related to number of relationships, while loneliness is more related to the quality of social relationships. Loneliness can occur regardless of the presence of social isolation, and social isolation can occur regardless of whether they feel lonely. This distinction explains that feeling lonely does not necessarily mean being alone nor does being alone mean feeling alone. There are multiple factors related to social isolation and loneliness. Loneliness has been associated with old age, living or spending time alone, financial resources, religion, and ownership of a dog or cat. Social isolation also has been associated not only with old age, living alone, but also an individual who has little contact with friends and family. Also, living alone, limited opportunities to participate in social activities, and limited access to services and public transport are associated with an increased risk of social isolation.

A growing body of research indicates that social isolation and loneliness have both been associated with physical and mental health. Social isolation and loneliness are correlated with increased risks of coronary heart disease (CHD) and stroke. Furthermore, loneliness has been shown to be associated with high blood pressure, acceleration of physiological aging, and depression. Loneliness has a significant effect on different age groups; for instance, lonely adolescents have...
a higher risk of experiencing poorer psychological and somatic health across countries. Furthermore, older people who experience high levels of loneliness are at increased risk of becoming physically frail. Socially isolated individuals may suffer more psychiatric stress, such as depression, anxiety, insomnia, and suicidal thoughts and behavior. Moreover, lonely individuals may more likely be addicted to harmful health behaviors such as smoking, excess alcohol consumption, binge eating or transient sexual encounters as a psychological relief means.

Some studies have evaluated social isolation and loneliness and their effect on mental health worldwide. Few studies have examined the prevalence and hallmark of social isolation and loneliness, and their effect on mental health in South Korea. Furthermore, these studies focus on specific age groups such as adolescents, or old age groups, which cannot explain the effect of age differences. This study aims to investigate the prevalence of social isolation and loneliness in community-dwelling participants in South Korea, their sociodemographic characteristics, and evaluate their mental health status compared to healthy participants.

METHODS

Participants and procedures

This study was conducted between 23rd July and 30th August 2019. Participants were selected from three representative districts (Gangnam-gu, Seoul for metropolitan area, Paju-si, Gyeonggi-do for rural areas, Jung-gu, Daegu for mid-sized cities) in South Korea. We used a multistage, cluster sampling method based on administrative districts. We selected three catchment areas (Si/Gun/Gu in Korean) based on population size and accessibility to research centers. Next, three subdivisions (Eup/Myeon/Dong) per catchment area were randomly selected. We adopted 50 household blocks as sampling units. Every household in each unit was included in the survey, and one individual per household was randomly chosen as the respondent. The target population included community residents aged 15 to 74 years. Face-to-face interviews were performed by trained field workers who conducted preliminary surveys by visiting every household to compile a list of eligible subjects. Household visits were repeated at least five times to contact individuals who were temporarily unavailable. A total of 1,700 people participated in this study. All subjects were fully informed about the aims and methods of the study before completing the interview, and informed consent was obtained prior to participation. This study was approved by the Institutional Review Board of Samsung Medical Center (SMC 2020-05-145).

Measures

Sociodemographic data

Socio-demographic information included gender, age, marital status, education, subjective financial satisfaction, frequency of religious service attendance and self-rated health status. Age group was divided into four categorical variables (15–29, 30–44, 45–59, and 60–74 years). Marital status was classified into married, never married and separated/divorced/widowed. Education years were dichotomized into two groups with the criteria of twelve years which is a mandatory education period in South Korea. Subjective financial information was answered by four categorical variables (very satisfied, satisfied, less satisfied, and not satisfied at all). Self-rated health status was collected by three categorical variables (good, fair, and poor).

Social isolation

The Lubben Social Network Scale (LSNS) is one of the widely used instruments to assess perceived social support received from family and friends, which consists of 10 items. LSNS-6 is an abbreviation of LSNS to effectively screen for social isolation using six questions. LSNS-6 is constructed from a set of three questions that evaluate familial networks and a comparable set of three questions that evaluate non-familial networks. The items include the following: “How many relatives do you see or hear from at least once a month?” “How many relatives do you feel close to such that you could call on them for help?” “How many relatives do you feel at ease with that you can talk about private matters?” These three items are repeated by replacing the word relatives with friends. Each item is answered through 0 (no relatives/friends) to 5 (9 or more relatives/friends), and the sum of each item is calculated. The overall scores range from 0 to 30 and participants who had an LSNS-6 <12 were considered to be at risk for social isolation. The Lubben Social Support Network Scale-Korean version is used in Korea to assess social network among Korean population and its reliability and validity have been established. In this study, we used the Korean version of LSNS-6 to assess social isolation of participants, and participants who had an LSNS-6 <12 were designated as the social isolation group.

Loneliness

We measured loneliness with single-item loneliness questions used in the English Longitudinal Study of Ageing (ELSA), which was “How often do you feel lonely?” The response ranged from 1 (hardly lonely), 2 (lonely some of the time), and 3 (often lonely). Participants who answered 3 (often lonely) were designated as the loneliness group.
Mental health status

Frequency of alcohol usage was measured by Alcohol Use Disorder Identification Test-Consumption (AUDIT-C), as 0=not at all, 1=monthly or less, 2=two to four times a month, 3=two or three times per week, 4=four or more times a week. Those who reported drinking “four or more times a week” were considered heavy drinkers. Smoking status was measured as the number of cigarettes a person smoked a day. Those who reported smoking more than one pack a day were considered heavy smokers.

The Korean version of the Patient Health Questionnaire-9 (PHQ-9) was used to screen participants’ depression. PHQ-9 is a well-validated screening tool for depression and consists of nine questions on depression over the past two weeks. Each score of the questions ranged from 0 to 3. The summed score over nine questions on depression over the past two weeks. Each item scores 0 to 4, and the sum of each item is calculated. In addition, we aimed to evaluate participants’ preference for solitude by asking “Do you prefer being alone rather than being together?” Participants answered the question as 1 (not at all), 2 (usually not), 3 (sometimes yes), and 4 (usually).

Statistical analysis

Our analysis focused on community-dwelling participants from three major cities in South Korea to examine the national prevalence of social isolation and loneliness. We used analytic survey weights based on the 2018 Korean Census (Korea National Statistical Office, 2018) to account for differential selection probabilities. For demographic and clinical characteristics, we used t-tests or chi-squared tests for group differences. We also performed unadjusted multinomial logistic regression to test the association between sociodemographic characteristics and mental health status as well as social isolation and loneliness. Lastly, after adjusting for sociodemographic factors, we performed a multinomial multivariable logistic regression to determine the association between sociodemographic characteristics and mental health status as well as social isolation and loneliness. All statistical analyses were performed using IBM SPSS Statistics version 20.0 (IBM Corp., Armonk, NY, USA).

RESULTS

Sociodemographic characteristics of Social Isolation and Loneliness Group

Table 1 presents the sociodemographic characteristics of all the participants in the social isolation and loneliness groups. A total of 1,700 subjects (699 males and 1,001 females) completed the interview. 4.1% of the subjects reported they were often lonely (n=63), and 17.8% of the subjects reported that they were socially isolated (n=295). Loneliness was more frequent in females (74.6% vs. 58.9%, p=0.009), while social isolation was more frequent in males (48.5% vs. 41.1%, p=0.005). There was no statistical age difference between the reference group and loneliness group, whereas age groups of 30–44 years and 60–74 years reported more social isolation than the reference group. The loneliness group was more likely to be widowed/separated/divorced (19.0% vs. 6.1%, p=0.000) and less educated (63.5% vs. 45.5%, p=0.004) compared to the reference group. However, there was no statistical difference in marital status and education years between the social isolation and reference groups. Both loneliness and social isolation groups were more likely to be economically unstable than reference group, responding “Less satisfied (32.8% in loneliness group, 29.2% in social isolation group)” and “Not satisfied at all” (39.1% in loneliness group, 19.0% in social isolation group)” more than reference group, which is statistically significant (p<0.05). Furthermore, most participants reported their self-rated health as “poor” in both loneliness and social isolation groups (47.6% in loneliness group, 28.6% in social isolation group, p<0.001).
Neither group showed statistical differences in the frequency of religious service attendance.

**Comparison of mental health status among social isolation group and loneliness group**

Table 2 presents comparison of heal behaviors and mental health status among social isolation and loneliness groups. Concerning health behaviors, both social isolation and loneliness groups were more likely to be heavy smokers. Suicidal thoughts were significantly more in both groups (19.7% for social isolation group and 52.4% for loneliness group); moreover, even it was reported about five times more in group with loneliness than the group without (11.3%, p<0.000). About 39% of the loneliness group and 13% of the social isolation group reported depressive symptoms, scored ten or more in PHQ-9, which were statistically higher than reference group (p=0.000). Also, both social isolation (35.9%) and loneliness (52.4%) groups reported more social anxiety symptoms, scored 6 or more in Mini-SPIN (p<0.000).

**Unadjusted and adjusted odds ratio of social isolation and loneliness with sociodemographic characteristics, health behaviors and mental health status**

Associations between social isolation, loneliness, sociodemographic variables, health behavior, and mental health status are presented in Table 3. Model 1 was adjusted for only gender and age, while model 2 included all variables using multivariate logistic regression analysis. Males were significantly associated with social isolation in both model 1 (AOR 1.44, 95% CI=1.12–1.86) and model 2 (AOR 1.85, 95% CI=1.37–2.50). Males were associated with a decreased risk of loneliness in model 1 (AOR 0.49, 95% CI=0.28–0.87), but the effect was not
significant in model 2 (AOR 0.46, 95% CI=0.21–1.01). Compared to the youngest age group, the older age group tended to increase the odds of social isolation. In particular, the young–mid-age group (30–44 years) was associated with nearly three times as high odds of social isolation (AOR 2.61, 95% CI=1.52–4.48). Financially unsatisfied and poor level of self-rated health were significantly associated with higher odds of both social isolation and loneliness. Heavy smoking increased the odds of both social isolation and loneliness in model 1, but not in model 2.

As expected, experiencing depression was also strongly associated with social isolation and loneliness. The presence of depressive symptoms increased the odds of loneliness by about 18 times in model 1 (AOR 17.07, 95% CI=9.62–30.28), which decreased to 3 times in model 2 (AOR 3.42, 95% CI=1.61–7.26), but was still statistically significant. Participants with social anxiety symptoms were also more likely to experience social isolation (AOR 2.74, 95% CI=2.01–3.75) and loneliness (AOR 3.06, 95% CI=1.65–5.68) with similar effects. Suicidal thoughts were significantly associated with loneliness in both model 1 (AOR 8.23, 95% CI=4.89–13.87) and model 2 (AOR 4.21, 95% CI=2.21–8.02). For social isolation, suicidal thoughts increased the odds in model 1 (AOR 2.07, 95% CI=1.48–2.90), but not in model 2 (AOR 1.22, 95% CI=0.82–1.83).

**DISCUSSION**

This study is the first to investigate the prevalence of social isolation and loneliness and its association with sociodemographic characteristics and different health behaviors and mental health status among a community sample of 1,700 participants in South Korea. This study is meaningful as it tried to include a diverse range of age groups from early to late adulthood (15 to 74 years), contrary to previous studies that were limited to old age or adolescents. After adjusting for sociodemographic variables, social isolation and loneliness were strongly associated with depressive symptoms, social anxiety symptoms, and suicidal thoughts.

The prevalence of social isolation was 17.8% for study participants, which was lower than previous research results (24.1% to 38.85%), probably because our research included a wide range of age groups, including early adulthood from 15 to 29 years of age compared to previous research which focused in older adults. Among participants, male gender, less financial satisfaction, and poor level of self-rated health were associated with higher odds of both social isolation and loneliness. Heavy smoking increased the odds of both social isolation and loneliness in model 1, but not in model 2.

As expected, experiencing depression was also strongly associated with social isolation and loneliness. The presence of depressive symptoms increased the odds of loneliness by about 18 times in model 1 (AOR 17.07, 95% CI=9.62–30.28), which decreased to 3 times in model 2 (AOR 3.42, 95% CI=1.61–7.26), but was still statistically significant. Participants with social anxiety symptoms were also more likely to experience social isolation (AOR 2.74, 95% CI=2.01–3.75) and loneliness (AOR 3.06, 95% CI=1.65–5.68) with similar effects. Suicidal thoughts were significantly associated with loneliness in both model 1 (AOR 8.23, 95% CI=4.89–13.87) and model 2 (AOR 4.21, 95% CI=2.21–8.02). For social isolation, suicidal thoughts increased the odds in model 1 (AOR 2.07, 95% CI=1.48–2.90), but not in model 2 (AOR 1.22, 95% CI=0.82–1.83).

**Table 2. Comparison of mental health status among social isolation group and loneliness group**

|                          | Social isolation group |              |  | Loneliness group |              |  |
|--------------------------|-----------------------|-------------|---|------------------|-------------|---|
|                          | No (N=1,405)          | Yes (N=295) | p | No (N=1,637)     | Yes (N=63)  | p |
| Frequent alcohol use (N, %) |                       |             |   |                   |             |   |
| More than 4 times per week | 58 (4.1)              | 16 (5.4)    | 0.345 | 69 (4.2)          | 5 (7.8)     | 0.197 |
| Usage of Tobacco (N, %) |                       |             |   |                   |             |   |
| More than 1 pack per day | 44 (3.2)              | 22 (7.7)    | 0.001 | 59 (3.7)          | 7 (11.3)    | 0.010 |
| Suicidal thought (N, %) |                       |             |   |                   |             |   |
| Yes                      | 158 (11.3)            | 58 (19.7)   | <0.001 | 184 (11.3)        | 33 (52.4)   | <0.001 |
| Depression (N, %) |                       |             |   |                   |             |   |
| Yes                      | 42 (3.0)              | 38 (12.9)   | <0.001 | 57 (3.5)          | 25 (39.1)   | <0.001 |
| Social phobia (N, %) |                       |             |   |                   |             |   |
| Yes                      | 213 (15.2)            | 106 (35.9)  | <0.001 | 286 (17.5)        | 33 (52.4)   | <0.001 |
| Present life satisfaction score (M, SD) | 6.24 (1.74) | 5.23 (1.93) | <0.001 | 6.15 (1.76) | 4.02 (2.17) | <0.001 |
| Preference of online social interaction (M, SD) | 9.11 (4.72) | 9.47 (5.10) | 0.269 | 9.18 (4.78) | 8.85 (4.95) | 0.584 |

Depression: PHQ-9 ≥ 10; Social phobia: Mini-SPIN ≥ 6. PHQ-9: Patient Health Questionnaire-9, Mini-SPIN: Mini-Social Phobia Inventory
Table 3. Unadjusted and adjusted odds ratio of social isolation and loneliness with sociodemographic characteristics and mental health status

|                          | Social isolation group (N=295) | Loneliness group (N=63) |
|--------------------------|--------------------------------|-------------------------|
|                          | Model 1                        | Model 2                 | Model 1                        | Model 2 |
| Sex                      |                                |                         |                                |         |
| Female                   | 1.00                           | 1.00                    | 1.00                           | 1.00    |
| Male                     | 1.44 (1.12, 1.86)^†             | 1.85 (1.37, 2.50)^†     | 0.49 (0.28, 0.87)*              | 0.46 (0.21, 1.01) |
| Age group                |                                |                         |                                |         |
| 15–29                    | 1.00                           | 1.00                    | 1.00                           | 1.00    |
| 30–44                    | 1.99 (1.37, 2.89)^†             | 2.61 (1.52, 4.48)^†     | 0.61 (0.29, 1.30)              | 1.00 (0.33, 3.07) |
| 45–59                    | 1.46 (1.00, 2.13)*              | 2.02 (1.13, 3.61)*      | 0.81 (0.41, 1.59)              | 0.90 (0.28, 2.88) |
| 60–74                    | 1.49 (0.98, 2.26)               | 2.01 (1.08, 3.74)*      | 1.34 (0.67, 2.68)              | 1.24 (0.37, 4.21) |
| Marital status           |                                |                         |                                |         |
| Married                  | 1.00                           | 1.00                    | 1.00                           | 1.00    |
| Never married            | 1.02 (0.68, 1.52)               | 1.26 (0.77, 2.08)       | 2.55 (1.16, 5.62)*              | 1.00 (0.36, 2.82) |
| Separated/divorced/widowed | 1.55 (0.95, 2.51)              | 1.56 (0.89, 2.73)       | 4.22 (2.08, 8.54)^†             | 2.07 (0.84, 5.12) |
| Education (years)        |                                |                         |                                |         |
| 12 or less               | 1.00                           | 1.00                    | 1.00                           | 1.00    |
| More than 13             | 0.95 (0.73, 1.24)               | 0.88 (0.65, 1.21)       | 0.48 (0.28, 0.82)^†             | 0.54 (0.27, 1.06) |
| Financial satisfaction   |                                |                         |                                |         |
| Pretty well satisfied    | 1.00                           | 1.00                    | 1.00                           | 1.00    |
| Satisfied                | 1.55 (1.08, 2.21)^*             | 1.45 (0.99, 2.12)       | 0.78 (0.30, 2.00)              | 0.52 (0.18, 1.48) |
| Less satisfied           | 2.48 (1.71, 3.59)^†             | 1.83 (1.21, 2.75)^†     | 3.26 (1.47, 7.23)^†             | 1.41 (0.56, 3.60) |
| Not satisfied at all     | 5.27 (3.39, 8.18)^†             | 3.52 (2.12, 5.84)^†     | 12.49 (5.62, 27.76)^†           | 4.43 (1.68, 11.67)^† |
| Self-rated health        |                                |                         |                                |         |
| Good                     | 1.00                           | 1.00                    | 1.00                           | 1.00    |
| Fair                     | 1.39 (1.03, 1.89)^*             | 1.25 (0.90, 1.73)       | 2.04 (0.96, 4.37)              | 1.22 (0.53, 2.80) |
| Poor                     | 3.04 (2.14, 4.30)^†             | 1.85 (1.24, 2.75)^†     | 7.42 (3.54, 15.55)^†            | 2.67 (1.14, 6.27)^* |
| Frequency of alcohol use |                                |                         |                                |         |
| 3 times or less per week | 1.00                           | 1.00                    | 1.00                           | 1.00    |
| More than 4 times per week | 1.19 (0.67, 2.12)             | 0.83 (0.44, 1.57)       | 2.19 (0.84, 5.72)              | 1.30 (0.39, 4.36) |
| Usage of Tobacco         |                                |                         |                                |         |
| Less than 1 pack per day | 1.00                           | 1.00                    | 1.00                           | 1.00    |
| More than 1 pack per day | 2.02 (1.17, 3.51)^*             | 1.43 (0.76, 2.69)       | 7.74 (2.87, 20.90)^†            | 2.96 (0.85, 10.33) |
| Suicidal thought         |                                |                         |                                |         |
| No                       | 1.00                           | 1.00                    | 1.00                           | 1.00    |
| Yes                      | 2.07 (1.48, 2.90)^†             | 1.22 (0.82, 1.83)       | 8.23 (4.89, 13.87)^†            | 4.21 (2.21, 8.02)^† |
| Depression               |                                |                         |                                |         |
| No                       | 1.00                           | 1.00                    | 1.00                           | 1.00    |
| Yes                      | 5.15 (3.24, 8.17)^†             | 2.28 (1.30, 4.02)^†     | 17.07 (9.62, 30.28)^†           | 3.42 (1.61, 7.26)^† |
| Social phobia            |                                |                         |                                |         |
| No                       | 1.00                           | 1.00                    | 1.00                           | 1.00    |
| Yes                      | 3.37 (2.53, 4.47)^†             | 2.74 (2.01, 3.75)^†     | 5.25 (3.14, 8.80)^†             | 3.06 (1.65, 5.68)^† |

Depression: PHQ-9≥10; Social phobia: Mini-SPIN≥6. Model 1 was adjusted for only gender and age. Model 2 included all variables/model 1: univariate logistic regression (adjusted for only gender and age), model 2: multivariate logistic regression. *p<0.05, †p<0.01. OR: odds ratio, CI: confidence interval, PHQ-9: Patient Health Questionnaire-9, Mini-SPIN: Mini-Social Phobia Inventory
cused to their coworkers or colleague, which do not correspond with friend or relative category. Further studies are needed to explore the characteristics of social isolation in young adults. Furthermore, another study showed that social isolation is associated with older age, due to reduced social connect and physical inconveniences. Therefore, a growing body of study focuses engaging older adults to social interventions. In Japan, a 3-year longitudinal study showed that participation in social activities reduces future social isolation in older people. Therefore, future social engagement programs such as community services, senior clubs, hobbies, volunteering, and religious activities is needed for socially isolated people to improve their physical and mental health.

The prevalence of loneliness was 4.1% among the study participants. In England, the prevalence of loneliness reported by ELSA over the age 50 years was 6–8% from 2006 to 2016, which was higher than our result which covers wide range of age groups. Our result revealed that older adults reported more that they were lonely than younger adults, which is consistent with previous results that old age is associated with loneliness. Fe 0.2% males were strongly associated with loneliness, which corresponds with numerous previous studies. Separated/divorced/widowed status, less educated, financial dissatisfaction and poor self-rated health status were also associated with loneliness in participants. Unlike previous results, the frequency of religious service attendance was unrelated to loneliness and social isolation.

Both social isolation and loneliness were clearly associated with mental health status, such as suicidal thoughts, depressive symptoms and social anxiety symptoms. Further, 52.4% of the participants who felt lonely reported that they had suicidal ideation, which was nearly five times more than the non-loneliness group, which is higher than pervious results (11.69% to 41.8%). The proportion of participants with depressive and social anxiety symptoms was higher in the loneliness group than in the social isolation group. In previous research, loneliness was associated with depressive symptoms and its relationship was stronger than that of social isolation and depressive symptoms. Since loneliness is more perceived, subjective emotion of “being alone,” this seems to have a greater impact on an individual’s mood, such as depression or anxiety and vice versa. In addition, loneliness is a mediator in the relationship between social engagement and depressive symptoms. Moreover, both social isolation group and loneliness group answered their present life satisfaction score lower than non-social isolation group and non-loneliness group, respectively. Pessimistic views of the present or the future is an important component in depressive symptoms, suggesting that both social isolation and loneliness have higher impact on depressive symptoms in participants. Interestingly, the mean score of preference of online social interaction (POSI) had no significant difference between social isolation and non-social isolation group. Also, there was no statistical difference in mean score of POSI between loneliness and loneliness group. This result was contrary to what we have expected, that socially isolated, lonely people prefer online communication, to avoid immediate face-to-face relationship and to enjoy the anonymity of online communication. A reasonable explanation for this result may be that socially isolated, lonely individuals have a similar desire for face-to-face social interaction with others.

Several limitations of this study need to be discussed. First, we conducted a cross-sectional analysis aimed at identifying the prevalence and correlation of social isolation and loneliness among participants but were not able to test causality or longitudinal changes. Second, since the survey was conducted in three major cities in South Korea, sampling might not be representative of South Korea's population. Third, underestimation of social isolation and loneliness could occur due to the unresponsiveness of truly socially isolated or lonely people. Moreover, psychiatric evaluation of participants was only assessed by a questionnaire, not by the clinician’s interview. To accurately explore the mental health status of people who are socially isolated or lonely, further in-depth psychiatric examinations are needed.

This study is the first to investigate the prevalence of social isolation and loneliness among community-dwelling participants and their health behavior and mental health status in South Korea. This study is meaningful as it tried to include a diverse range of age groups contrary to previous studies that were limited to old age or adolescents. Male gender, financial dissatisfaction, and poor self-rated health were associated with social isolation. Also, female gender, non-marital status, less educated, financial dissatisfaction and poor self-rated health status were also associated with loneliness in participants. After adjusting for sociodemographic variables, social isolation and loneliness were strongly associated with depressive symptoms, social anxiety symptoms and suicidal thoughts. This study informs the actual state of social isolation and loneliness and offers useful resources for public health policy makers to establish governmental intervention and mental health care support.

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Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

Author Contributions

Conceptualization: Jin Pyo Hong, Ji Hyun An. Data curation: Soo Jin Hwang, Myung Hyun Kim. Formal analysis: Myung Hyun Kim, Ji Hyun An. Funding acquisition: Jin Pyo Hong. Investigation: Myung Hyun Kim, Ji Hyun An. Methodology: Jin Pyo Hong, Soo Jin Hwang. Project adminis-
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