Short Note

A Critical Note on Contradictions in South Korean Cancer Incidence Rates: The Paradox of Crude Rates Derived from the Kim HJ et al. Cohort (*Biomark Res*, 13:114, 2025) Showing Concurrent Increases in the Vaccinated and Overall Decrease

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A Critical Note on Contradictions in South Korean Cancer Incidence Rates: The Paradox of Crude Rates Derived from the Kim HJ et al. Cohort (*Biomark Res*, 13:114, 2025) Showing Concurrent Increases in the Vaccinated and Overall Decrease

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Abstract

This note examines a pronounced epidemiological paradox that emerges when calculating the crude incidence rates (CRs) using the raw figures provided in the study, "1-year risks of cancers associated with COVID-19 vaccination: a large population-based cohort study in South Korea" (*Kim HJ et al., Biomark Res, 13:114, 2025*). Sourced from the Korean National Health Insurance database, the Kim et al. study suggests a higher rate of new cancer cases among the vaccinated population compared to the unvaccinated. However, when the raw figures (12,133 total cancer cases among 2,975,035 individuals) are used to calculate the overall Crude Incidence Rate (CR) for the study cohort, the estimated rate is 40.78 per 10,000 population. This value deviates downwards by over 22% from the official national average CR of 52.46 per 10,000 for all cancers recorded by the Korean Central Cancer Registry in the years immediately preceding the vaccination campaign (2020–2022). This fundamental discrepancy creates a paradox: the study simultaneously suggests a rising risk within the majority group (vaccinated CR: 42.63/10,000) while yielding an overall CR significantly lower than the established national baseline. We conclude that this pronounced lack of representativeness in the cohort's crude incidence rate likely introduced unidentified confounding factors, potentially biasing the final association results. To resolve this dilemma and enable comprehensive independent validation of the observed statistical association, the underlying Korean National Health Insurance database must be made publicly accessible to the international scientific community.

Keywords: crude incidence rate; epidemiological paradox; COVID-19 vaccination; cancer incidence; cohort representativeness; computational epidemiology and modelling

A CRITICAL NOTE

The **Crude Incidence Rate (CR)** per 10,000 population is a fundamental epidemiological measure that indicates the frequency of new cases of a specific disease (or event) within a population over a defined period. Crucially, it is calculated without statistical adjustment (or standardization) for confounding demographic factors such as age or sex. The formula for its calculation is:

$$\text{Crude Incidence per 10,000} = \frac{\text{Number of new cases during a given period}}{\text{Average population at risk during the same period}}, \quad (1)$$

where the Number of new cases is the count of all individuals who developed the disease for the first time during the observation period. The Average population at risk is the mean size of the population susceptible. The scaling factor of per 10,000 (or per 100,000, depending on the event's rarity) converts the resulting fraction into a more practical whole number. The term *Crude* emphasizes that the rate has not been adjusted for differences in demographic composition. Therefore, while suitable for tracking internal trends (as is the case here, limited strictly to South Korean data), this measure can be misleading if used to compare populations with vastly different demographic structures.

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The official cancer statistics, provided by the **Korean Central Cancer Registry**, show a rising trend in the Crude Incidence Rate (CR) for all cancers in South Korea over the three-year period considered:

- In **2020**, the CR for both sexes was 482.9 new cases per 100,000 population, which, converted to a per 10,000 basis, equals **48.29** [1].
- In **2021**, the rate rose to 540.6 cases per 100,000 population, equivalent to **54.06** per 10,000 [2].
- In **2022**, the actual cancer burden was 550.2 new cases per 100,000 population, translating to **55.02** per 10,000 [3].

Based on these three years of official data, the average CR per 10,000 population for all cancers in South Korea was **52.46**, with a standard deviation of 2.97. For completeness, an estimate for 2023 [4] suggests a CR of 531.1 per 100,000 persons, which translates to **53.11** per 10,000. It is also relevant to note, to complete this point, that South Korea began its COVID-19 vaccination campaign at the end of February 2021, with the first doses administered to healthcare workers and residents/patients in long-term care facilities and similar institutions. Meanwhile, the campaign for younger age groups (adults aged 18-49) only fully took off starting in August 2021 [5]. Based on this, it is therefore quite improbable that any effects of the vaccination on the incidence of cancer, subsequently recorded as new cases, could have been reflected in the annual crude incidence values provided for the years 2020 and 2021, and probably not even in 2022.

Study [6] is a retrospective, cohort-based, and predominantly observational analysis spanning 2021-2023, drawing data from an unspecified Korean National Health Insurance database. The opening lines of Table S4 in the Supplementary Material of the manuscript (the Table is titled "Cumulative incidences of overall cancers in the matched cohort between vaccinated and unvaccinated individuals") furnish the raw data necessary for estimating the CR within the study's cohort. The authors started with an initial South Korean cohort of 8,407,849 individuals between 2021 and 2023. They then performed a 1:4 Propensity Score Matching (PSM), which resulted in a final study population of **2,975,035 individuals** (595,007 unvaccinated and 2,380,028 vaccinated). This large final cohort represents approximately 5.7% of South Korea's total population (51.7 million) at the time [7]. The total number of cancer cases that developed during the observation period was **12,133**. Applying the established Crude Rate (CR) formula to these total figures yields an estimated Raw Incidence Rate for all cancers of **40.78** per **10,000 population** for the sample.

Furthermore, the data allow for separate CR estimates:

- **Vaccinated Group:** With 10,144 cases among 2,380,028 vaccinated individuals, the estimated CR is **42.63** per 10,000 (10,144 × 10,000 / 2,380,028).
- **Unvaccinated Group:** With 1,989 cases among 595,007 unvaccinated individuals, the estimated CR is **33.43** per 10,000 (1,989 × 10,000 / 595,007).

The pivotal finding this note aims to highlight is the clear discrepancy between the official average CR and the study's estimates. If one estimates the raw cancer incidence in South Korea based on the data provided by [6], an overall CR of **40.78** per 10,000 is obtained, which deviates downwards from the officially calculated average CR of **52.46** per 10,000 by approximately **22.26%**. Even considering the incidence rate of the apparently most disadvantaged group, the **vaccinated** (42.63 per 10,000), the discrepancy from the official average remains substantial at **18.74%**. Translating these discrepancies into absolute numbers underscores their magnitude. By considering a raw incidence rate equal to that of the vaccinated group (42.63 per 10,000) and using the reference value of 51.77 million South Korean inhabitants, we would obtain an equivalent of **220,840** new cases in one year. Conversely, using the average of the official values measured by the Korean Central Cancer Registry (52.46 per 10,000), the new cancer cases would be **271,957**, that is, approximately 50,000 fewer new cancer cases overall in one year if we were to support the findings of [6].

It is now clear what strange paradox study [6] has led us to: on the one hand, it suggests a statistically significant increase in new cancer cases within the vaccinated population. Since this group constitutes the large majority of the overall cohort, one would expect this finding to ultimately

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drive an increase in the overall raw incidence of new cancer cases for the entire population. Instead, when using the incidence estimates derived from that very study, the overall raw incidence rate of 40.78 per 10,000 deviates significantly downwards from the official national average (52.46 per 10,000). According to [6] this would suggest that cancer cases are rising among the majority group, while the overall raw incidence rate is lower than the official national data by approximately 11.68 cases per 10,000 inhabitants.

Ultimately, one of two things must be true: either the raw incidence for all cancers in South Korea is inexplicably decreasing following COVID-19 vaccination, or (which we believe is more probable) the selected sample of 2,975,035 individuals examined in [6] is **poorly representative** of the true cancer incidence per 10,000 population in South Korea. This lack of representativeness may have concealed a combination of confounding factors that biased the final results towards lower values compared to the national reality.

We must pay close attention, nonetheless, to the following fact: we absolutely do not intend to diminish the relevance of [6], both because we believe it should still be subject to further investigation and because, like many other independent researchers, we do not have access to the database on which we could perform analyses. Therefore, until proven otherwise, we are not discussing the statistical association found in that study, which seems to correlate the anti-COVID-19 vaccination with a higher number of new cancer cases compared to the non-vaccinated population. What we do want is to highlight the paradox, however, that would arise if one were to use those data to estimate the crude incidence of new cancer cases, which would turn out to be significantly lower than the one calculated by the official South Korean bodies in the years immediately preceding the vaccination.

A solution to this dilemma is necessary: this database must be made **public and accessible** to every independent researcher, with the possibility for all to carry out in-depth analyses from every possible perspective. The international scientific community would be extremely grateful.

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Data Availability Statement: The data presented here is either included directly or was extracted from the referenced documents. All calculations are easily reproducible based on the definitions provided

Ethics approval and consent to participate: This study uses publicly available, aggregated data that contains no private information. Therefore, ethical approval is not required

Consent for publication: Not applicable.

Conflicts of Interest: The author declares no competing interests.

References

1. Kang MJ, Jung K-W, Bang SH, Choi SH, Park EH, Yun EH, Kim HJ, Kong H-J, Im J-S, Seo HG, Cancer Statistics in Korea: Incidence, Mortality, Survival, and Prevalence in 2020. *Cancer Res Treat*. 2023, 55(2):385-399. https://doi.org/10.4143/crt.2023.447.
2. Park EH, Jung K-W, Park NJ, Kang MJ, Yun EH, Kim HJ, Kim J-E, Kong H-J, Im J-S, Seo HG, Cancer Statistics in Korea: Incidence, Mortality, Survival, and Prevalence in 2021. *Cancer Res Treat*. 2024, 56(2):357-371. https://doi.org/10.4143/crt.2024.253
3. Park EH, Jung K-W, Park NJ, Kang MJ, Yun EH, Kim HJ, Kim J-E, Kong H-J, Im J-S, Seo HG, Cancer Statistics in Korea: Incidence, Mortality, Survival, and Prevalence in 2022. *Cancer Res Treat*. 2025, 57(2):312-330. https://doi.org/10.4143/crt.2025.264
4. Jung K-W, Kang MJ, Park EH, Yun EH, Kim HJ, Kong H-J, Im J-S, Seo HG, Cancer Prediction of Cancer Incidence and Mortality in Korea, 2023. *Cancer Res Treat*. 2025, 55(2):400-407. https://doi.org/10.4143/crt.2023.448
5. The Strait Times Editor, South Korea opens Covid-19 vaccine reservations for all adults, 2023 (August). *The Straits Times*. https://www.straitstimes.com/asia/east-asia/south-korea-opens-covid-19-vaccine-reservations-for-all-adults (accessed online 9 October 2025)

 doi:10.20944/preprints202510.0883.v1

6. Kim HJ, Kim M-H, Choi MG, Chun EM, 1-year risks of cancers associated with COVID-19 vaccination: a large population-based cohort study in South Korea. *Biomark Res*, 2025, 13, 114. https://doi.org/10.1186/s40364-025-00831-w
7. WHO, Republic of Korea: Health data overview. *World Health Organization*, 2023, https://data.who.int/countries/410 (accessed online 9 October 2025)