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LETTER

Methodological Critique: Misinterpretation of Decomposition Analyses in Population Aging and Ergonomic-Related Low Back Pain [Letter]

Wenting Zhao, Huan Du

Department of Rehabilitation Medicine, Suzhou Ninth People's Hospital, Suzhou, 215200, People's Republic of China

Correspondence: Huan Du, Email xykk@qq.com

Dear editor

We read with great interest the article by Yang et al[1] titled "The Impact of Population Aging on Ergonomic-Related Low Back Pain Across Regions with Different Development Levels" (*J Pain Res*. 2026;19:575648). The authors used decomposition analysis to quantify the contributions of population aging, population growth, and epidemiological rate changes to the global burden of ergonomic low back pain. While the study addresses an important topic, we identified two critical methodological errors in their interpretation of the attributable fraction (aging percentage) and the ratio R, which could mislead readers and potentially influence regional health policies.

The "127.9%" Attributable Fraction in High-Middle SDI Regions is an Artifact of Denominator-Driven Inflation

In Table 2, for high-middle SDI regions, the overall change in DALYs from 1990 to 2021 was only 191,918.12, while the absolute contribution from aging was 245,459.21. The authors calculated the aging percentage as (245,459.21 / 191,918.12) × 100% = 127.9%. This inflated attributable fraction is a statistical artifact caused by an extremely small total change in the denominator – not because aging is the dominant driver in any meaningful sense. In fact, the epidemiological rate change reduced DALYs by 665,712.44, more than completely offsetting the aging-related increase. The correct interpretation should be: aging contributed positively, but its effect was entirely neutralized by improvements in DALY rates. Reporting a percentage >100% without explicit warning of denominator-driven distortion is misleading. A fundamental principle in decomposition analysis is that absolute contributions should be reported as primary findings, and percentages should be avoided or accompanied by confidence intervals when the total change is small.[2]

The R Value in Low SDI Regions (R = 14.64) is Mathematically and Conceptually Invalid

The authors define R as (DALYs attributable to epidemiological changes) / (DALYs attributable to aging). For low SDI regions, Table 2 shows:

- Aging contribution = −20,954.08 (negative)
- Epidemiological change contribution = −306,689.18 (negative)

Thus, R = (−306,689.18) / (−20,954.08) = +14.64. Both numerator and denominator are negative, meaning both factors reduced the burden. A positive R in this context does not indicate that rate changes "outweighed" aging in the sense of offsetting an increase; rather, both worked in the same direction (reduction). The authors' interpretation – "the impact of rate change was substantially greater than that of aging" – is technically correct only if one ignores the sign, but the

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framing in the discussion ("the effect of rate decline was much greater than that of aging") implies a competitive offset dynamic that does not exist when aging itself is already reducing burden.

More importantly, a negative aging contribution (ie, aging reducing DALYs) is biologically and demographically implausible. Within GBD decomposition models, negative aging effects typically arise from interaction terms (Ipa, Ipam) absorbing explanatory variance – a well-documented limitation in age–period–cohort and GBD decomposition frameworks.[3] The authors did not report the raw decomposition components (Ma, Iam, Ipa, Ipam), which are essential to verify whether the negative aging contribution is real or a statistical artifact. Without these data, the negative value should be interpreted with extreme caution, if not discarded.

The Ratio R Loses Interpretability When the Denominator is Negative or Near Zero

The authors' classification system for R (eg, $R < -1$, $-1 < R < 0$, etc.) assumes that aging and epidemiological changes have opposite directions of effect.[2] However, in low SDI regions both are negative, and in high SDI regions aging is positive (14,144.37) while epidemiological change is negative (−170,521.99), giving $R = -12.06$ (falling into "$R < -1$"). While this classification works for high SDI, it fails for low SDI where both signs are identical. A ratio of two negative numbers is mathematically positive but conceptually different from a ratio of two positive numbers. Treating them under the same interpretive framework is invalid.

Implications for Public Health Policy

The authors conclude that high-middle SDI regions face a 127.9% attributable burden and that low SDI regions show a 14.64-fold greater effect from rate changes. These numbers are statistical artifacts rather than meaningful epidemiological measures. If taken at face value, they could lead to misguided policy prioritization – for example, overemphasizing aging in high-middle SDI regions while underestimating the role of DALY rate improvements, or misinterpreting low SDI results as evidence of successful public health response when the negative aging contribution is likely an artifact. We believe that correct interpretation of these decomposition metrics is essential to prevent misleading inferences and inappropriate policy decisions.

Recommendations

For future GBD-based decomposition studies:

1. Report absolute contributions as primary findings; avoid percentages when the total change is small, or provide confidence intervals.
2. Disclose all interaction terms (Ma, Iam, Ipa, Ipam) to allow verification of negative main effects.
3. Refrain from calculating R when the denominator is negative or near zero, or provide a sign-stratified interpretation.
4. Use sensitivity analyses (eg, bootstrap or jackknife) to assess the stability of negative aging contributions.

We appreciate the authors' effort.

Disclosure

The authors report no conflicts of interest in this communication.

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