

## Original Article

# Urban-rural differences in cancer incidence and pattern in Punjab and Chandigarh: Findings from four new population-based cancer registries in North India

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### ABSTRACT

**Background:** Establishment of a cancer registry is the first step in cancer control, and population-based cancer registries (PBCRs) are considered the gold standard for providing information on cancer incidence and mortality at population level.

**Materials and Methods:** Earlier surveys reported a high prevalence of cancer in Punjab state. To address this issue and to provide reliable data on cancer incidence and mortality, four PBCRs were set up in Punjab and Chandigarh in year 2013 covering a total population of 4.5 million with PBCR Chandigarh and SAS Nagar, predominantly urban (covering 2.9 million population) and Mansa and Sangrur, predominantly rural (covering 2.6 million population).

**Results:** Among males, Chandigarh and SAS Nagar have the age-standardized incidence rates (ASRs) of 93.5 and 73.5/100,000, respectively, whereas PBCR Mansa and Sangrur have age-standardized incidence rates (ASIRs) of only 45.3 and 43.7/100,000, respectively. Similarly, in females, PBCR Chandigarh and SAS Nagar have the ASIRs of 105.0 and 104.5/100,000, respectively, which was almost 2 times that seen at PBCR Mansa (55.8/100,000) and Sangrur (52.8/100,000). The incidence of breast cancer in females was 4–5 times higher in urban registries as compared to rural ones, whereas incidence of lung cancer was 4–7 times higher in urban registries. The most common cancer was lung cancer among males and breast cancer among females at PBCR Chandigarh and SAS Nagar, whereas it was esophagus among males and cervical cancer among females at PBCR Mansa and Sangrur.

**Conclusion:** There were wider urban–rural differences with respect to incidence and pattern of cancers among the four registries which may be due to urbanization, lifestyle, and environmental factors which need to be explored further. Cancer incidence and pattern of cancer in Punjab are comparable with rest of the country.

**Keywords:** Age-standardized incidence rates, GLOBOCAN, low- and middle-income countries, population-based cancer registries

### Introduction

According to estimates, there were 17.5 million cancer cases and 8.7 million cancer deaths in 2015 with 33% increase in cancer cases in the past 10 years.<sup>[1]</sup> The burden of cancer is disproportionately higher in low- and middle-income countries where two-third of all cancer-related deaths are occurring.<sup>[2]</sup> The cancer incidence estimates given by GLOBOCAN for year 2012 show an

alarming increase in cancer incidence in developing countries.<sup>[3]</sup> The possible reasons attributed to this are higher life expectancy, sedentary lifestyles, westernization, and urbanization in developing countries.<sup>[4]</sup> Urbanization

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as a cause of increased incidence of certain cancers such as breast and lung cancer have been reported by studies.<sup>[5-8]</sup>

In India, data on cancer incidence and mortality mainly come from population-based cancer registries (PBCRs) operating in different regions of the country. However, they cover around only 10% of the total 1.2 billion population.<sup>[9]</sup> Currently, there are 29 PBCRs under the National Cancer Registry Programme (NCRP) of Indian Council of Medical Research which are reporting data on cancer incidence and mortality. In Punjab, a state in North West of India, some preliminary studies have shown regional variations,<sup>[10,11]</sup> and a house-to-house survey by state government too showed some regional variations and comparatively higher burden of cancer as compared to rest of the country.<sup>[12]</sup> To address this question and to provide reliable data on cancer incidence and mortality from the region, School of Public Health, PGIMER, Chandigarh and Tata Memorial Centre, Mumbai, jointly started four PBCRs in cooperation with Department of Health and Family Welfare, Government of Punjab, and Health Department, Chandigarh Administration covering a total of 4.5 million population. These registries cover three districts of Punjab and Union Territory of Chandigarh since 2013.

The aim of this paper is to describe the incidence, pattern, and urban–rural differences in cancers in Punjab and Chandigarh based on 1<sup>st</sup>-year data of the four PBCRs. It also tries to answer whether cancer burden is higher in Punjab as compared to rest of the country.

## Materials and Methods

The 1<sup>st</sup> year data of four PBCRs, i.e., 2013 were examined to look for the incidence and mortality of cancers in the four regions. As these four registries have a different distribution of urban population under them, the urban–rural differences in the incidence and pattern of cancers were examined too. While PBCR Chandigarh and SAS Nagar are predominantly urban, PBCR Mansa and Sangrur are rural. The detailed methods have been described in the report of individual PBCR for 2013.<sup>[13-16]</sup>

PBCR Chandigarh covers the whole population of Union Territory of Chandigarh. Chandigarh has 97.3% of its population as urban and remaining (2.7%) as rural (census 2011). PBCR SAS Nagar covers the District SAS Nagar of Punjab, a state in North West of India. District SAS Nagar is situated adjacent to Chandigarh on its North West and has 54.8% of the population as urban and 45.2% of population

as rural (census 2011). There were 414 villages in SAS Nagar. PBCR Mansa and Sangrur covered two districts of Punjab which are predominantly rural comprising 2.9% and 6% of total population of Punjab state. Mansa has 78.7% of its population as rural whereas Sangrur has 68.8% of its population as rural (census 2011).

This estimated population of the four districts on July 1, 2013, was calculated for reporting the incidence rates of various cancers and overall. The estimated midyear population was calculated using the exponential growth rate for 2001–2011 census [Table 1].

Data on cancer incidence and mortality were obtained from multiple sources which included government and private hospitals, pathology laboratories, office of birth and death registrar, and cancer cells. Trained social workers abstracted the information on cancer cases from the above sources and filled their details in a structured Pro forma designed by the investigators containing information on sociodemographic parameters and details of tumor with staging. Then, addresses of all the cancer cases registered were confirmed through home visits by the registry staffs. A period of at least 1 year of residence was considered to register the case as a resident of that particular area. Once address is confirmed and residency status is known, the finalized cancer cases were entered into CanReg5 Software and checked for duplicity by software. The CanReg5 is specialized software, developed by International Agency

**Table 1: Cancer incidence and mortality across the four population-based cancer registries, Punjab and Chandigarh, 2013**

	Chandigarh	SAS Nagar	Mansa	Sangrur
<b>Male</b>				
Estimated population	606,811	573,093	419,289	902,730
Number of incident cases registered	406	334	187	378
Age-adjusted incidence rate per 100,000	93.4	74.3	45.3	43.7
Number of death cases registered	164	176	112	243
AADRs	37.9	38.9	27.1	28.4
<b>Female</b>				
Estimated population	500,616	503,924	370,714	798,646
Number of cases registered	427	433	216	420
Age-adjusted incidence rate per 100,000	105.0	104.2	55.8	52.6
Number of death cases registered	123	146	121	205
AADRs per 100,000	32.7	33.6	30.5	26.0

AADRs - Age-adjusted death rates

for Cancer Registries, for cancer registration and is used widely world over by cancer registries.<sup>[17]</sup>

For PBCR Chandigarh, in total, there were twenty data sources for cancers with majority of incident cancer cases being reported from PGIMER, the premier tertiary care institute having specialized treatment for all type of cancers, situated in Chandigarh only whereas there were 36 data sources for cancer cases for PBCR SAS Nagar with majority of cancer cases being registered from PGIMER, Chandigarh, due to close proximity of SAS Nagar to it.

In Mansa and Sangrur, trained social worker of the registries regularly visits the villages as well as the different hospitals, pathology laboratories, birth and death register offices, and even cremation grounds to collect data on cancer incident and death cases. The villages were visited periodically every 6 months to avoid missing any incident or death case as the specialized cancer treatment centers where patient went for diagnosis and treatment were not located in these districts. These districts lack any specialized cancer centers and most of cancer patients from these regions have to travel to other places such as Patiala, Delhi, Chandigarh, and neighboring state of Rajasthan for cancer diagnosis and treatment. Hence, method of data collection in these districts was primarily through periodic village visits by the social workers through coordination with the local Accredited Social Health Activists ASHAs and the auxiliary nurse midwives. The cases registered through village visits were confirmed by visiting the diagnostic and treatment centers from where the patient took the treatment. For this, the registry staffs of these two registries coordinated with registry staffs working in those districts where patient's investigations for confirmation of cancer were done or where patient underwent treatment. However, few patients in these districts did not keep their treatment records or were diagnosed solely on the basis of clinical and radiological findings and did not go for biopsy or fine-needle aspiration cytology for confirmation. Hence, cancer cases which underwent microscopic or histological confirmation were somewhat lower in these registries.

Data collected by the registry field workers were entered in the CanReg5 software which performs the various internal consistency/validation checks and also checks for duplicate cases and performs analysis. The estimated population covered by each of the registries for year 2013 was standardized to the standard world population across the

various age groups, and age-standardized incidence rates of different cancers in males and females were calculated.

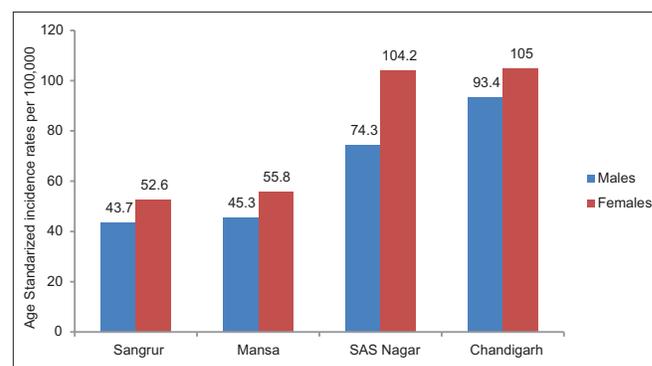
The age-adjusted incidence rates (AARs) of urban registries (Chandigarh and SAS Nagar) were compared with AARs of the rural registries (Mansa and Sangrur). As some previous studies done in the past have shown that urbanization was attributing to higher incidence of breast cancer in females and lung cancer in males, the incidence of these two cancers was compared across the urban and rural PBCRs

## Results

Cancer incidence and mortality pattern in the four regions are shown in Table 1. Chandigarh registered the highest number of incident cancer cases among the four PBCRs both among males and females.

Figure 1 shows the age-standardized incidence rates (ASRs) of all site cancers in the four registries. PBCR Chandigarh has the highest incidence rates of cancer both among males and females as compared to other three registries. The ASRs of all site cancers among males in Chandigarh (93.4) and SAS Nagar (74.3) are almost twice times than in Mansa (43.7) and Sangrur (45.3). Similarly, ASRs of all site cancers among females both in Chandigarh (105.0) and SAS Nagar (104.2) are twice than that found in Mansa (55.8) and Sangrur (52.6) [Figure 2].

Figures 2 and 3 show the age-standardized incidence rates (ASRs) of lung cancer among males and breast cancer among females in the four registries. Incidence of both lung and breast cancer is highest in Chandigarh as compared to other three registries. The incidence rate of breast cancer was similar at SAS Nagar and Chandigarh which is almost



**Figure 1: Age-standardized incidence rates, males and females, of all site cancers in the four population-based cancer registries of Punjab and Chandigarh, 2013**

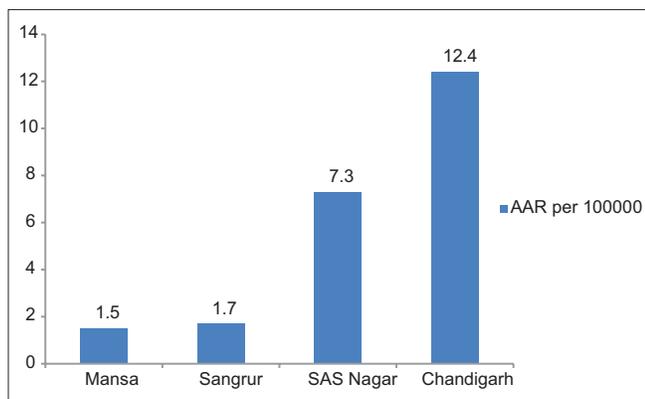


Figure 2: Age-standardized incidence rate of lung cancer among males in the four population-based cancer registries of Punjab and Chandigarh, 2013

3 times incidence in Mansa and Sangrur [Figure 3]. Similarly, incidence rates of lung cancer were almost 5–7 times higher in Chandigarh (urban) and SAS Nagar (predominantly urban) than rural regions of Mansa and Sangrur [Figure 4].

The most common cancer was lung cancer among males and breast cancer among females at PBCR Chandigarh and SAS Nagar, whereas it was esophageal cancer among males at both PBCR Mansa and Sangrur. Cancer of cervix uteri was most common cancer among females at PBCR Mansa, whereas it was second most common cancer after breast cancer at PBCR Sangrur [Tables 2 and 3].

Figures 4 and 5 compare the ASRs of all site cancers at the four PBCRs with AARs of PBCRs under NCRP and AAR estimate of India for the year 2012 by GLOBOCAN among males and females, respectively. Incidence rates at urban registries of Chandigarh and SAS Nagar were found comparable to other urban PBCRs, whereas incidence rates at PBCR Mansa and Sangrur were found comparable to other rural PBCRs in India both among males and females.

The four PBCRs were also assessed based on internationally acceptable quality control parameters. PBCR Chandigarh and PBCR SAS Nagar has 96.2% and 92.8% of all registered cases respectively as morphologically verified whereas for rural registries of Mansa & Sangrur, it was 89.3% and 87.4% respectively. Higher the proportion of morphologically verified cases, higher is the validity of the registration. Similarly, proportion of cases registered on basis of death certificate only i.e. DCO cases varied across the four PBCRs. While PBCR Chandigarh & SAS Nagar has 1.4% and 3.9% of all registered cases as DCO cases, PBCR Mansa and Sangrur had 6.4% and 6.3% of all registered cases as DCO. Lower the proportion of DCO cases, higher is the validity of registration

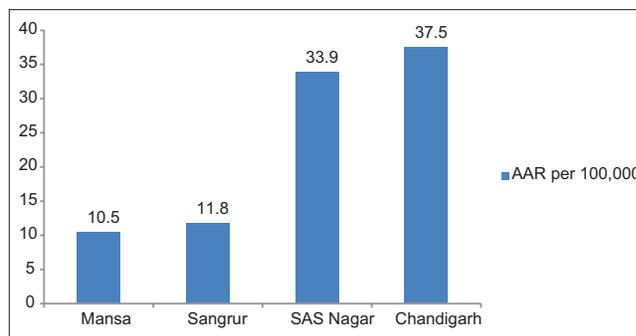


Figure 3: Age-standardized incidence rate of breast cancer among females in the four population-based cancer registries of Punjab and Chandigarh, 2013

Table 2: Five most common sites of cancers in the four population-based cancer registries of Punjab and Chandigarh among males, 2013

Urban PBCRs		Rural PBCRs	
Chandigarh	SAS Nagar	Mansa	Sangrur
1. Lung	1. Lung	1. Esophagus	1. Esophagus
2. Prostate	2. Prostate	2. Oral cavity	2. Prostate
3. Lymphoma	3. Esophagus	3. Leukemia	3. Brain
4. Esophagus	4. Larynx	4. Larynx	4. Liver
5. Oral cavity	5. Tongue	5. Lung	5. Lung

PBCRs - Population-based cancer registries

Table 3: Five most common sites of cancers in the four population-based cancer registries of Punjab and Chandigarh among females, 2013

Urban PBCRs		Rural PBCRs	
Chandigarh	SAS Nagar	Mansa	Sangrur
1. Breast	1. Breast	1. Cervix	1. Breast
2. Cervix	2. Cervix	2. Breast	2. Cervix
3. Ovary	3. Ovary	3. Esophagus	3. Esophagus
4. Gallbladder	4. Gallbladder	4. Gallbladder	4. Gallbladder
5. Uterus	5. Uterus	5. Uterus	5. Uterus

PBCRs - Population-based cancer registries

## Discussion

PBCRs systematically collect information on all reportable neoplasm occurring in a geographically defined population from multiple sources and represents the gold standard for the provision of information on cancer incidence in a defined population. They provide unbiased data on cancer mortality and survival as well.<sup>[18]</sup>

The 1<sup>st</sup> year data of the PBCRs from Punjab show that the cancer incidence in Punjab and Chandigarh is comparable to other regions of India. The comparison of AARs of the four registries shows the AARs of all site cancers at PBCR Chandigarh (93.4 among males and 105.0 among females) and SAS Nagar (74.3 among males and 104.5 among females), which covers predominantly urban population, are comparable to other urban registries such as Mumbai,

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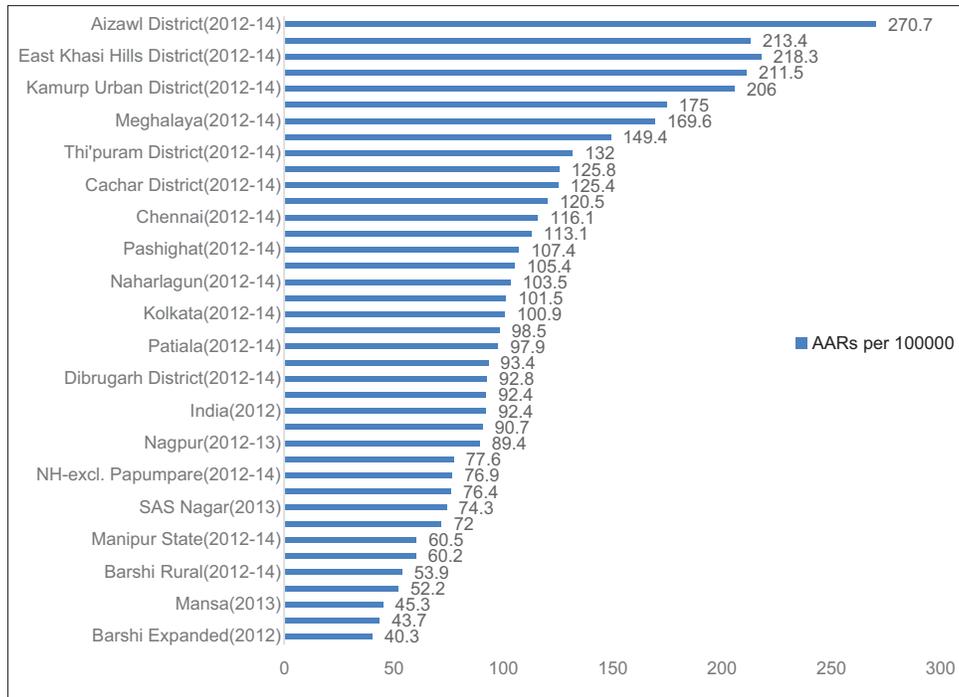


Figure 4: Comparison of age-adjusted incidence rates among males of population-based cancer registries under National Cancer Registry Programme with the Four population-based cancer registries of Punjab and Chandigarh

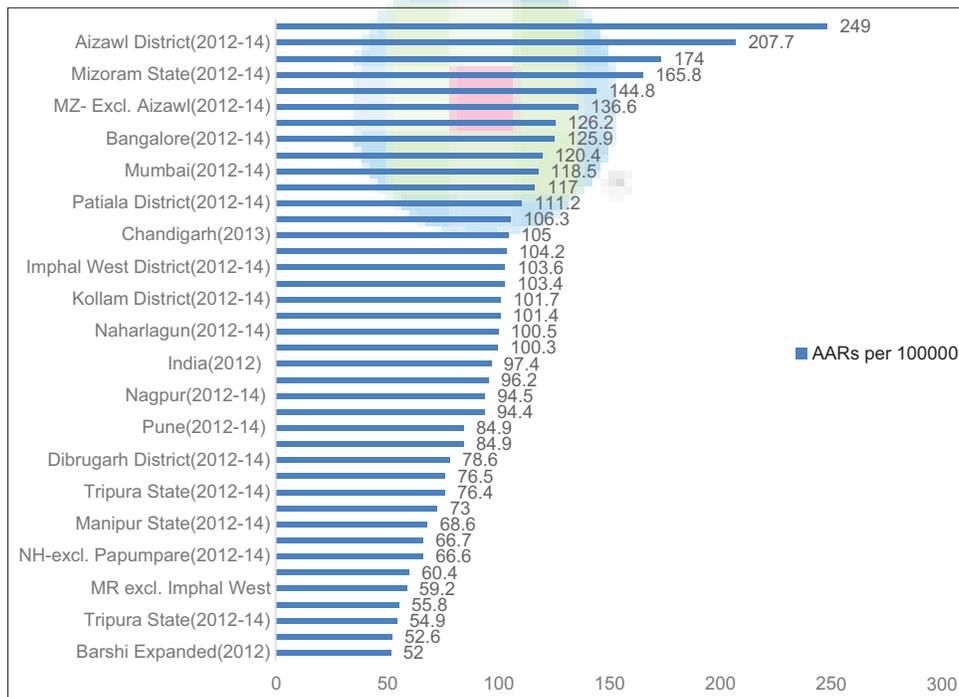


Figure 5: Comparison of age-adjusted incidence rates among females of population-based cancer registries under National Cancer Registry Programme with the four population-based cancer registries of Punjab and Chandigarh

Chennai, and Patiala.<sup>[9]</sup> Similarly, the AARs of all site cancers at PBCR Mansa (45.3 among males and 55.3 among females) and Sangrur (43.7 among males and 52.6 among females), which covers predominantly rural populations, are comparable to other rural registries such as Barshi

Rural and Wardha.<sup>[9]</sup> Furthermore, the incidence of SAS Nagar was found comparable to those reported for this district by cancer atlas of Punjab state which was based on pathology-based reporting of cancer cases in different districts of Punjab.<sup>[19]</sup>

Regarding urban–rural differences in cancer incidence, the AARs of all site cancers in males were 2 times higher in Chandigarh and 1½ times higher at SAS Nagar as compared to Mansa and Sangrur. Similarly, in females, the AARs of all site cancers at PBCR Chandigarh and SAS Nagar were almost 2 times higher than PBCR Mansa and Sangrur. Similar urban–rural differences in cancer incidence have been reported in China too.<sup>[6]</sup> The finding from our study too confirms the hypothesis that urbanization is a risk factor of cancer. The urban–rural differences in incidence of cancer is also seen at PBCRs under NCRP where incidence rates of all site cancers at urban registries such as Delhi (149.4 among males and 144.8 among females), Chennai (116.1 among males and 126.2 among females), and Mumbai (113.1 among males and 118.5 among females) are almost 2–3 times higher than Barshi Expanded (43.0 among males and 52.0 among females), Barshi Rural (53.9 among males and 60.4 among females), and Wardha (60.2 among males and 66.7 among females) which are rural registries.<sup>[9]</sup>

The age-standardized incidence rate of lung cancer at PBCR Chandigarh (12.4) and SAS Nagar (7.3) was much higher than seen at PBCR Mansa (1.5) and Sangrur (1.7). Several other studies have also found this urban–rural difference in the incidence of lung cancer.<sup>[5,7]</sup> Similarly, the incidence of breast cancer in females was almost 4–5 times higher among the urban registries of Chandigarh and SAS Nagar as compared to the two rural registries. A study from China too found a higher incidence of breast cancer reported from urban registries as compared to rural ones.<sup>[6]</sup> These findings suggest that the urbanization does have impact on increased occurrence of certain cancers which needs to be explored further. This may be attributed to the sedentary lifestyles and environmental factors such as a higher air pollution level in urban areas which needs to be investigated further.

However, being 1st year of the registry, under-ascertainment of cancer cases due to under registration could not be ruled out, particularly in rural areas which is always a problem faced in the first few years of any registry.<sup>[20,21]</sup> Similarly, there may be variation in the pattern of cancer.

## Conclusion

Cancer incidence in Punjab and Chandigarh was found comparable to other PBCRs in India. Chandigarh has the highest age-standardized incidence rates of 93.5 and 105.0/100000 among males and females, respectively, among the four PBCRs. There is wider rural–urban

difference in incidence and pattern of various cancers among the four registries. The incidence rates at PBCR Chandigarh and SAS Nagar were 2 times and 1½ times higher than that seen at rural PBCRs (Mansa and Sangrur) among males and almost 2 times higher both at Chandigarh and SAS Nagar among females. The incidence of breast cancer in females was 4–5 times and of lung cancer was 5–7 times higher in the two urban registries as compared to the two rural registries. The most common cancer was lung cancer among males and breast cancer among females at PBCR Chandigarh and SAS Nagar, whereas it was esophagus among males and cervical cancer among females at PBCR Mansa and breast cancer in Sangrur. Hence, there were wider urban–rural differences in incidence and pattern of cancers across the four registries which need to be investigated further. Based on our findings, urbanization may be attributing to a higher incidence of breast cancer in females and lung cancer in males in urban areas of North India.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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