

Original article

# Prevalence of hypertension and hypertension control rates among elderly adults during the cold season in rural Northeast China: a cross-sectional study

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## Abstract

**Objective:** The burden of noncommunicable diseases (NCDs) is increasing in China, together with economic development and social changes. The prevalence of risk factors for NCDs, such as overweight/obesity, hypertension, diabetes, and dyslipidemia, is reported to be high even among poor residents of rural areas. We aimed to investigate the prevalence of hypertension among elderly adults in rural Northeast China and the proportion with controlled hypertension among those on antihypertensive medication (hypertension control rate). We also aimed to examine the association of hypertension control with health facilities that provide treatment.

**Methods:** We conducted a community-based cross-sectional study in six rural villages of Northeast China from February to early March, 2012. We interviewed 1593 adults aged 50–69 years and measured their blood pressure. We examined the differences in mean blood pressure between participants who obtained antihypertensive medication from village clinics and those who obtained medication from other sources, using analysis of covariance adjusted for several covariates.

**Results:** The prevalence of hypertension among participants was as high as 63.3%, but the hypertension control rate was only 8.4%. Most villagers (98.1%) were not registered in the chronic disease treatment scheme of the public rural health insurance. The mean

systolic blood pressure, adjusted for the covariates, of participants who obtained antihypertensive medication from village clinics was significantly lower than that of participants who obtained medication from township hospitals (by 16.5 mmHg) or from private pharmacies (by 7.3 mmHg).

**Conclusion:** The prevalence of hypertension was high and the hypertension control rate low among elderly villagers during the cold season. As treatment at village clinics, which villagers can access during the cold season seems to be more effective than self-medication or treatment at distant hospitals, improving the quality of treatment in village clinics is urgently needed.

**Key words:** hypertension, elderly adults, rural village, Northeast China, hypertension control rate

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## Introduction

Noncommunicable diseases (NCDs) are a growing threat to global health<sup>1)</sup>, and the burden of NCDs is increasing in China, together with dramatic economic development and social changes<sup>2)</sup>. The prevalence of NCD risk factors such as overweight/obesity, hypertension, diabetes, and dyslipidemia has been reported to be high even among poor residents of rural areas, as well as among wealthy urban dwellers in China<sup>3–8)</sup>.

In response to health needs in rural areas, the Chinese government launched a rural health insurance scheme in 2003<sup>9–11)</sup>. Health services in rural areas are delivered by a three-tier system of public health care providers: 1) village clinics, 2) township hospitals, and 3) county hospitals. Village clinics provide outpatient primary health care by medical assistants. Township hospitals provide primary level in-

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patient and outpatient services by general physicians, and county hospitals provide secondary level specialized care and surgical procedures. The rural health insurance covers outpatient services at village clinics and township hospitals, as well as inpatient services at township hospitals and county hospitals up to a certain ceiling. The insurance also covers long-term medication for treating chronic diseases such as hypertension, but patients must register in this optional scheme. Rural residents may opt to visit better-equipped and higher-quality hospitals in urban areas; however, the rural health insurance covers these services only to a very limited extent.

Whereas village clinics play an important role in providing health care in rural areas and are trusted by the local residents, services are provided by medical assistants who have very basic skills; they are trained and qualified by the local government for practicing in villages only<sup>12</sup>. Several previous studies have reported that village clinics provide low-quality health services<sup>13</sup>. Medical assistants are not well prepared for managing chronic NCDs, such as hypertension, which are mostly asymptomatic. Rural residents also lack knowledge about hypertension and its potentially serious consequences, such as stroke. Thus, hypertension control rates in rural areas are reported to be low, even if patients are receiving antihypertensive medication<sup>5</sup>. In addition, there are no systematic interventions for preventing hypertension in rural China.

Aging is a well-known risk factor of high blood pressure. Blood pressure also increases with decreased outdoor temperatures<sup>14</sup>. Low temperatures during the cold season affect rural residents much more than urban residents, as the former often live in houses equipped only with space heating and outdoor toilets<sup>15</sup>. Hypertension control rates also decrease among rural residents during the cold season<sup>14</sup>, partly due to the difficulty of accessing health services. Therefore, elderly people in Northeast China, where the mean temperature is below 0 °C during the cold season, are considered to have greater risk of developing serious hypertension. Furthermore, rural villagers who engage in agricultural labor often prefer to eat salty foods, such as pickled vegetables<sup>16</sup>, which increase the risk of hypertension.

Although several epidemiological studies on hypertension have been conducted in various regions, including Northeast China<sup>17</sup>, studies in rural areas during the cold season are scarce. The objective of this study was to examine the prevalence of hypertension among elderly residents in rural villages of Northeast China during the cold season and the hypertension control rates among people on anti-hypertensive medication. We also aimed to explore differences in the effectiveness of hypertension treatment among health service providers in rural areas.

## Methods

### *Study design and setting*

We conducted a population-based cross-sectional study in rural areas of Jilin Province in Northeast China. The province comprises nine prefectures (five in the western plain area and four in the eastern hill–mountain area), and each prefecture is composed of five to seven cities and counties (60 in total)<sup>18</sup>. The total population of Jilin Province was 27.5 million in 2010, of which about 90% were ethnic Han, and 11.9 million people lived in villages in rural areas of the province<sup>19</sup>. The average temperature in summer is more than 23°C, but in winter, the average temperature is less than –11°C.

We conducted this study in Changchun Prefecture in the western plain area and Jilin Prefecture in the eastern hilly area. The total population of Changchun and Jilin is the largest and second-largest, respectively, among the nine prefectures of the province. The rural population of Changchun and Jilin is 3.3 million and 1.7 million, respectively<sup>19</sup>, accounting for 42% of the rural population of Jilin Province.

### *Sampling*

Adapting a stratified cluster sampling strategy, we first chose the above two most populous prefectures, one from the western area and another from the eastern area of the province. Each prefecture has a central city and surrounding rural counties (five counties in Changchun Prefecture and six counties in Jilin Prefecture). We chose one county adjacent to the central city in each of the two prefectures, in which county health personnel had experience with health surveys. Then, in each of the two selected counties, we selected one township that was located within an accessible distance to public hospitals: it took less than 60 minutes by public bus transportation to reach the county hospital or city hospitals in the central city. Finally, we selected two villages in one township and four villages in a second township (a total of six villages) that were located within a 30-minute drive by car to each township hospital.

We defined the target population as elderly adults aged 50–69 years, living in one of the six selected villages, who were not hospitalized at the time of the survey. We conveniently sampled study participants until the number of participants reached more than two-thirds of all adults in the same age group in each village. According to official residential records, there was a total 2244 adults in the same age group among the six villages; therefore, we targeted a sample of more than 1496 participants.

### *Data collection*

The field survey was conducted between February 11 and

March 12, 2012. The mean outdoor temperature in the study area during the survey period was  $-11.4^{\circ}\text{C}$ . Most elderly villagers were expected to be at home during the agricultural off-season. Nurses, assistant nurses, or physicians of the township hospitals were recruited to conduct the surveys. Face-to-face interviews in the local language were carried out either at home or at a nearby village clinic. We used a structured questionnaire, querying whether the participant had ever been diagnosed with hypertension, whether they were currently on antihypertensive medication, and where they obtained the antihypertensive medication, as well as demographic and socioeconomic information.

After each participant had rested for at least 15 minutes, blood pressure was measured twice on the right upper arm, with at least a 5-minute interval between measurements, using an automatic digital sphygmomanometer (HEM-7420; Omron, Kyoto, Japan). Systolic blood pressure, diastolic blood pressure, and pulse per minute were recorded, and the arithmetic mean of the two blood pressure readings was used for the analysis.

#### *Data analysis*

Participants' names were separated from the original data collection sheets, which were coded with serial numbers. The anonymized data were entered into a data entry template. Hypertension was defined as systolic blood pressure  $\geq 140$  mmHg and/or diastolic blood pressure  $\geq 90$  mmHg and/or on antihypertensive medication<sup>20</sup>. The hypertension control rate was defined as the ratio of individuals with systolic blood pressure  $< 140$  mmHg and diastolic blood pressure  $< 90$  mmHg and on antihypertensive medication among all individuals taking antihypertensive medication. Sources of antihypertensive medication were classified according to the health facility where the study participants obtained prescribed antihypertensive drugs (village clinics, township hospitals, county hospitals, and city hospitals in urban areas) or self-medication, which implied the use of antihypertensive drugs purchased at private pharmacies without a prescription.

Differences in the mean blood pressure of participants who obtained antihypertensive medication from village clinics, hospitals, and private pharmacies were examined using analysis of covariance adjusted for age, sex, education, annual household income, distance to the township hospital, and enrollment in the public rural health insurance. The analysis of covariance was supplemented with a test of parallel lines, to determine whether the slope of blood pressure with respect to a continuous variable (age and distance to a township hospital) did not change among the sources of antihypertensive medication. All data analyses were done using Stata 14.0 (StataCorp., College Station, TX, USA).

#### *Ethical considerations*

This study was approved by the Bioethics Review Committee of Nagoya University School of Medicine, Japan (approval number 1326). The health bureaus of the two selected counties in Jilin Province, China, also approved the study. Written informed consent was obtained from all participants after they had received adequate explanation of the study objectives and procedures in the local language.

## **Results**

In total, 1608 adults aged 50–69 years participated in the study, which accounted for 71.7% of all adults of the same age group in the six villages. Excluding participants with missing basic demographic information, such as for age or sex ( $n = 15$ ), the data of 1,593 participants (71.0%) were included in the statistical analysis.

As shown in Table 1, the mean age of participants was 58.1 years; 73.7% of participants had completed 6 years or less of schooling, and 68.9% of households earned 4000 USD or less annually. Most participants (96.7%) were enrolled in the public rural health insurance, but only 1.9% registered for the scheme to support long-term treatment for chronic diseases; the registration rate was as low as 11.9% even among people on antihypertensive medication.

The mean systolic/diastolic blood pressure of all participants was 147.9 mmHg/86.2 mmHg; that of individuals in whom hypertension was detected was 159.8 mmHg/91.3 mmHg, and that of people on antihypertensive medication was 171.8 mmHg/96.1 mmHg. The prevalence of hypertension was 63.3% (95% confidence intervals (CI): 61.0–65.7). Among the 1009 participants with detected hypertension, 278 (27.6%; 95% CI: 24.8–30.3) had ever been diagnosed with hypertension by a health professional. Among these 278 ever-diagnosed participants, 227 (81.7%; 95% CI: 77.1–86.2) were currently on antihypertensive medication, indicating that 51 failed to be treated even though they were aware of their hypertension. More women (66.1%) than men (33.9%) were taking medication. The hypertension control rate was only 8.4% (95% CI: 4.7–12.0) because only 19 individuals among the 227 taking medication were controlled.

Table 2 shows the differences in hypertension control according to the different sources of antihypertensive medication. Among the 227 participants on antihypertensive medication, 85 (37.4%) obtained antihypertensive medication from village clinics, 16 (7.1%) from township hospitals, 3 (1.3%) from county hospitals, 2 (0.9%) from city hospitals in urban areas, and 121 (53.3%) from private pharmacies without a prescription (self-medication). The hypertension control rate was 10.6% among participants treated at village clinics and 8.3% among those on self-medication; however,

**Table 1** Participants' demographic and socioeconomic characteristics and blood pressure

	All	Hypertension <sup>a</sup>	On medication <sup>b</sup>
N	1593	1009	227
Mean age, years	58.1 ± 5.0 <sup>d</sup>	58.5 ± 5.0 <sup>d</sup>	58.8 ± 5.1 <sup>d</sup>
Male	787 (49.4%)	482 (47.8%)	77 (33.9%)
Female	806 (50.6%)	527 (52.2%)	150 (66.1%)
Formal education, years			
≤ 6	1174 (73.7%)	752 (74.5%)	169 (74.4%)
> 6	419 (26.3%)	257 (25.5%)	58 (25.6%)
Annual household income, USD			
≤ 1000	432 (27.1%)	294 (29.1%)	74 (32.6%)
1001–4000	666 (41.8%)	409 (40.5%)	89 (39.2%)
> 4000	495 (31.1%)	306 (30.3%)	64 (28.2%)
Enrollment on the rural health insurance			
enrolled	1540 (96.7%)	981 (97.2%)	223 (98.2%)
not enrolled	53 (3.3%)	28 (2.8%)	4 (1.8%)
Registration for chronic disease treatment scheme			
Registered	30 (1.9%)	30 (3.0%)	27 (11.9%)
Not registered	1563 (98.1%)	979 (97.0%)	200 (88.1%)
Mean distance from home to a hospital, km			
Township hospital	4.8 ± 4.4 <sup>d</sup>	4.8 ± 4.4 <sup>d</sup>	5.1 ± 4.0 <sup>d</sup>
County hospital	41.3 ± 9.8 <sup>d</sup>	41.1 ± 9.7 <sup>d</sup>	44.5 ± 10.6 <sup>d</sup>
City hospital in urban areas	41.3 ± 6.5 <sup>d</sup>	41.2 ± 6.5 <sup>d</sup>	42.2 ± 6.1 <sup>d</sup>
Mean blood pressure, mmHg			
Systolic blood pressure	147.9 ± 22.3 <sup>d</sup>	159.8 ± 18.9 <sup>d</sup>	171.8 ± 22.5 <sup>d</sup>
Diastolic blood pressure	86.2 ± 12.2 <sup>d</sup>	91.3 ± 11.5 <sup>d</sup>	96.1 ± 14.4 <sup>d</sup>
Hypertension <sup>a</sup>	1009 (63.3%)	1009 (100.0%)	–
On medication <sup>b</sup>	227	227 (22.5%)	227 (100.0%)
Under control <sup>c</sup>	19	19 (1.9%)	19 (8.4%)

<sup>a</sup> Systolic blood pressure ≥ 140 mmHg or diastolic blood pressure ≥ 90 mmHg or on antihypertensive medication.

<sup>b</sup> Participants with hypertension and currently on antihypertensive medication. <sup>c</sup> Systolic blood pressure < 140 mmHg and diastolic blood pressure < 90 mmHg and on antihypertensive medication. <sup>d</sup> Standard deviation.

USD, United States dollars.

no participants treated at township hospitals, county hospitals, or city hospitals had controlled hypertension.

The mean systolic/diastolic blood pressure was 167.3/91.9 mmHg in participants treated at village clinics, 182.5/103.6 mmHg in those treated at township hospitals, and 173.4/97.9 mmHg in people on self-medication. After adjusting for covariates (sex, age, education, annual household income, distance to township hospital, and enrollment in the public rural health insurance), the mean blood pressure of participants treated at village clinics was significantly lower than that of participants treated at township hospitals (systolic 16.5 mmHg,  $p < 0.05$ ; diastolic 11.7 mmHg,  $p < 0.01$ ) and those on self-medication (systolic 7.3 mmHg,  $p < 0.05$ ; diastolic 6.4 mmHg,  $p < 0.01$ ).

## Discussion

In this study, we showed that the prevalence of hypertension among elderly villagers in Northeast China during the cold season was as high as 63.3%. About a quarter of hypertensive individuals had ever been diagnosed and were aware of their hypertension; however, about 20% of them did not seek treatment. The hypertension control rate was only 8.4% among participants on antihypertensive medication, and mean blood pressure was higher in those on medication than in all hypertensive individuals.

The prevalence of hypertension revealed in our study was higher than that among people of similar age groups in a previous nationwide study during 2007–2008 (36.7% in participants aged 45–64 years, and 56.5% for those aged

**Table 2** Differences in hypertension control according to source of antihypertensive medication

Source of anti-hypertensive medication <sup>a</sup>	On medication <sup>c</sup>	Under control <sup>d</sup>	Hypertension control rate <sup>e</sup> (95% CI)	Mean blood pressure (mmHg)		Differences in an adjusted mean blood pressure <sup>f</sup> (mmHg) Coef <sup>g</sup> (95% CI)	
				Systolic	Diastolic	Systolic	Diastolic
Village clinic	85 (37.4%)	9	10.6% (3.9–17.3)	167.3	91.9	0 (reference)	0 (reference)
Township hospital	16 (7.1%)	0	0%	182.5	103.6	16.5 * (4.0–28.9)	11.7 ** (3.8–19.7)
County hospital	3 (1.3%)	0	0%	186.3	100.3	19.9 (–7.1–47.0)	10.0 (–7.3–27.3)
City hospital in urban areas	2 (0.9%)	0	0%	164.5	97.0	1.0 (–31.2–33.1)	3.4 (–17.2–24.0)
Self-medication <sup>b</sup>	121 (53.3%)	10	8.3% (3.3–13.2)	173.4	97.9	7.3 * (0.6–14.0)	6.4 ** (2.1–10.6)

<sup>a</sup> Health facilities where antihypertensive medication was provided. <sup>b</sup> Antihypertensive drugs obtained from private pharmacies without a prescription. <sup>c</sup> Currently on antihypertensive medication. <sup>d</sup> Systolic blood pressure < 140 mmHg and diastolic blood pressure < 90 mmHg and on antihypertensive medication. <sup>e</sup> Percentage of individuals with systolic blood pressure < 140 mmHg and diastolic blood pressure < 90 mmHg and on antihypertensive medication, among all individuals on antihypertensive medication. <sup>f</sup> Differences in mean blood pressure of participants according to source of antihypertensive medication, adjusted for sex, age, education, annual household income, distance to township hospital, and enrollment in the public rural health insurance. <sup>g</sup> A variable's coefficient; or the difference of mean blood pressure in individuals by each source of antihypertensive medication, with village clinic as the reference. CI, confidence interval. \*  $p < 0.05$ , \*\*  $p < 0.01$ .

> 65 years)<sup>21</sup>) and a study in Jilin Province during July and August 2012 (53.5% in participants aged 55–64 years)<sup>17</sup>). Whereas caution is required when comparing our findings with these studies, which applied probability sampling methods and targeted a large number of participants, there might be several possible factors contributing to the increase of the hypertension prevalence in our study.

First, the low socioeconomic status of our study participants might have contributed to the increased prevalence of hypertension<sup>22, 23</sup>). A previous nationwide survey reported that people with lower education and household income levels were less likely to be aware of their hypertension and receive antihypertensive treatment<sup>24</sup>). Unlike other studies that included participants of various socioeconomic levels, most of our study participants were low-income, under-educated farmers. The low educational level of our participants might be responsible for their lack of knowledge about risky behaviors, such as high salt intake and smoking, and their poor adherence to antihypertensive medication owing to poor understanding of the instructions given by health care providers<sup>25</sup>). Overall poverty and seasonal income fluctuation might have also made it difficult to regularly access good quality health services. Because farmers perform physically demanding labor, they tend to prefer a salty diet, such as pickled vegetables<sup>16</sup>).

Second, we conducted this study during the cold season, when blood pressure tends to increase and the hypertension

control rate tends to decrease, in comparison with warmer seasons<sup>14, 26</sup>). The average outside temperature during this study period was  $-11.4^{\circ}\text{C}$ ; however, the temperature was over  $20^{\circ}\text{C}$  in another study conducted in the summer<sup>17</sup>). In addition, difficulty in accessing health services and decreased physical activity during the cold season might have contributed to the increased blood pressure and decreased control rate observed in the present study.

We found that the mean blood pressure and hypertension control rate were most favorable among participants treated at village clinics, less favorable in those on self-medication, and least favorable among participants treated at hospitals, which supposedly provide better quality services than village clinics and pharmacies. The proximity of village clinics might encourage villagers to check their blood pressure more frequently and take antihypertensive medication regularly, thus resulting in a better control rate<sup>27–29</sup>). Although a village clinic aims to provide primary health care services, it also serves as the only pharmacy in the village, where no private drug stores are available. Furthermore, poor elderly villagers might find it easy to access village clinics, as they provide low-priced home-based care and allow villagers to pay on credit or give them a discount<sup>30</sup>). However, it is not easy for elderly villagers to commute to hospitals located far from their village, particularly in winter. Another possibility is that the condition of people who attend hospitals may be more serious than that of people who attend village



clinics.

People who are self-medicating can easily purchase antihypertensive drugs without a prescription at private pharmacies in townships<sup>31</sup>. They sometimes do not bother to go to the pharmacy themselves but instead ask a family member or friend to buy drugs on their behalf. They can stock up on medication and might use drugs more frequently than people who only occasionally visit hospitals, which might have resulted in the somewhat better hypertension control rate among participants on self-medication in this study. In addition, individuals can choose their preferred medication from among a variety of antihypertensive drugs that are always available at private pharmacies; however, drugs prescribed at village clinics and township hospitals are restricted to those on the National Essential Drug List<sup>32</sup> and are often unavailable due to shortages in supply<sup>33</sup>.

We found that the hypertension control rates among participants treated at public health facilities were low. This might be owing in part to participants' lack of awareness about the importance of following the instructions of health service providers to continue to take antihypertensive medication. This poor awareness might also be caused by insufficient medical knowledge and communication skills on the part of health service providers, who often do not follow clinical guidelines, such as the Chinese Hypertension Guideline<sup>34</sup>, or are confused by inconsistent information in different guidelines<sup>35</sup>. The low quality of health services provided in village clinics and township hospitals has been previously reported, as medical assistants and physicians often fail to follow clinical guidelines and they often give incorrect diagnoses and prescriptions<sup>13</sup>. Because the rural health systems were not initially designed to control NCDs, medical assistants who run village clinics are not sufficiently trained in controlling NCDs at the primary health care level. However, many elderly villagers prefer village clinics to hospitals because of their proximity, affordable and flexible medical services, and trustworthiness of the medical assistants who have lived for a long time in the same village<sup>30</sup>. Therefore, it is critical to provide medical assistants in village clinics with in-service training on appropriate hypertension treatment and communication skills in encouraging clients to continue their treatment.

Whereas the coverage of the public rural health insurance reaches around 97%, very few elderly villagers and only 12% of those on antihypertensive medication were registered in the scheme for long-term treatment of chronic diseases. This suggests that many people are likely to opt for using antihypertensive drugs obtained at affordable prices from private pharmacies without a prescription or to be treated at village clinics without registering for long-term treatment, rather than be involved in a complicated regis-

tration process. In addition, there may be a lack of publicity promoting use of the long-term treatment scheme. The registration system should be revisited and adapted to be a more user-friendly process; in addition, the benefits of the scheme should be increased. These measures would contribute to improving compliance with chronic disease treatment and increasing the hypertension control rate.

There is insufficient attention paid to NCD prevention in rural China<sup>2, 36</sup>. There are no health check-up mechanisms in rural areas, although it is important to screen for hypertension and other NCD risk factors that are mostly asymptomatic before causing a serious disease, such as a stroke or heart attack. As the prices of medical services provided in public health facilities are set low by the government, health service providers are motivated to prescribe more drugs to increase their revenues<sup>37</sup>. Therefore, they have little incentive to provide services to prevent NCDs or to promote a healthy lifestyle.

It is not easy for individuals to modify their lifestyle, such as by reducing salt intake and refraining from tobacco smoking, because such risk behaviors are widely practiced in the communities<sup>16</sup>. Community-wide approaches to lifestyle improvement are effective, as demonstrated by Chinese traditional exercise practiced by groups of elderly people in the community<sup>16</sup>, and salt-reduction activities in rural Japan<sup>38, 39</sup>. An incentive mechanism should be installed for medical assistants in village clinics to lead such community-wide health promotion activities.

The strength of this study is that we conducted the surveys during the cold season in rural villages of Northeast China, targeting elderly villagers with low socioeconomic status, who are considered an underserved, high-risk population. Whereas villages were sampled purposively, our survey covered over 70% of the targeted age group in each village, thereby increasing the reliability of our findings. However, this study has several limitations. First, owing to the cross-sectional study design, we could not determine a causal relationship between hypertension control and the source of antihypertensive treatment. Second, we did not apply a probability sampling procedure; therefore, caution is required in comparing our results with those of previous large-scale studies in China. Third, we measured blood pressure twice and used the arithmetic mean of the two readings. The World Health Organization recommends measuring blood pressure three times and using the arithmetic mean of the second and third readings. We suppose that the difference would be negligible, but this might have shifted the blood pressure values to be slightly higher.

## Conclusion

In this study, we found that the prevalence of hypertension among elderly villagers in rural Northeast China was high during the cold season. Participants' blood pressure was not well controlled, even if they were taking antihypertensive medication. As treatment received at village clinics, which villagers can access during the cold season, seems to be more effective than self-medication or treatment at distant hospitals, improving the quality of treatment in village clinics is urgently needed. In addition to sufficiently extending hypertension treatment services at the primary health care level, a mechanism for providing regular health check-ups and community-wide health promotion activities should be integrated in the rural health care system of China.

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