

Burden of Disease in Japan: Using National and Subnational Data to Inform Local Health Policy

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The Global Burden of Disease (GBD) study has been instrumental in guiding global health policy development since the early 1990s. The GBD 2010 project provided rich information about the key causes of mortality, disability-adjusted life years, and their associated risk factors in Japan and provided a unique opportunity to incorporate these data into health planning. As part of the latest update of this project, GBD 2013, the Japanese GBD collaborators plan to update and refine the available burden of disease data by incorporating sub-national estimates of the burden of disease at the prefectural level. These estimates will provide health planners and policy makers at both the national and prefectural level with new, more refined tools to adapt local public health initiatives to meet the health needs of local populations. Moreover, they will enable the Japanese health system to better respond to the unique challenges in their rapidly aging population and as a complex combination of non-communicable disease risk factors begin to dominate the policy agenda. Regional collaborations will enable nations to learn from the experiences of other nations that may be at different stages of the epidemiological transition and have different exposure profiles and associated health effects. Such analyses and improvements in the data collection systems will further improve the health of the Japanese, maintain Japan's excellent record of health equity, and provide a better understanding of the direction of health policy in the region.

Key words: Burden of disease, Japan, Comparative risk factor analysis, Health policy, Non-communicable disease, Aging

INTRODUCTION

The Global Burden of Disease (GBD) is an essential tool in the global battle to improve health [1]. This project provides a systematic approach to calculating comprehensive, consistent, and comparable measures of health loss due to diseases, injuries, and their associated risk factors [2]. The latest GBD study,

known as GBD 2010, was conducted by the Institute for Health Metrics and Evaluation (IHME) in collaboration with six academic partners worldwide including the University of Tokyo and was published in December 2012 [3,4]. In this study, the GBD research team introduced new analytical methods and a wider range of data. They also called on experts around the world to inform estimation methods with local advice and insights. Through these new approaches, the project's scope has expanded to cover 291 diseases and injuries in 187 countries from 21 regions, with estimations of these trends since 1990 [5]. The GBD 2010 also expanded on previous comparative risk factor analyses to cover a total of 67 risk factors [6].

The current iteration of the GBD, with its heavy focus on comparable and consistent disease burden and risk factor analyses between regions, makes it a useful tool not only for comparative health system assessment but also for planning

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public health programs and preventive interventions [7] and identifying gaps in international data systems [8]. For example, the GBD 2010 was able to describe trends in morbidity and mortality associated with the epidemiological transition in China [9]. The GBD studies can also be used, to some extent, for comparative health system assessments that allow for consistent and rigorous comparisons of health outcomes between countries with diverse social and health systems. For example, comparisons between the UK and the European Union clearly elucidated areas that were underperforming in the UK health system compared to its European counterparts [10]. Individual countries have also used the results of these comparisons to inform policy debate on issues specific to their own health needs. For example, Khang used the GBD 2010 results and project's detailed metrics to publish a review of non-communicable diseases (NCD) and strategies for NCD management in Korea [11].

Since the release of the GBD 2010 results, the GBD project has been aiming to not only include country experts but also create more detailed burden estimates using data that are only accessible to local researchers as well as at a sub-national level, where possible [12]. Sub-national estimates of disease burden and comparative risk would enable researchers and policy makers to explore variation and inequality within countries to better inform domestic and international health policy planning. As part of this effort to create detailed national estimates, the Department of Global Health Policy at the University of Tokyo has commenced a three-year project to update the GBD 2012 results at the national and sub-national level for Japan. This article describes the burden of disease, achievements in administering

health care, future challenges, possible methods for estimating sub-national disease burden using the Japanese national burden of disease project, and the potential value of sub-national estimates of disease burden for policy makers in Japan.

THE BURDEN OF DISEASE IN JAPAN

Japan's achievements in health care administration have become a model for achieving good health at low cost. Japanese female life expectancy at birth has ranked number one globally since the 1980s. Life expectancy increased by 5.5% over 20 years, from 81.9 years in 1990 to 86.4 years in 2010 for females and from 75.9 years in 1990 to 79.6 years in 2010 among males [13]. After rapid improvements in life expectancy due to post-war advances in child health and vaccinations, this recent 20-year improvement has primarily resulted from the effective control of risk factors for NCD mortality [13,14]. For example, reductions in stroke-related mortality have occurred against a backdrop of low inequality and universal health coverage [15].

Table 1 shows the highest-ranked causes of disability-adjusted life years (DALYs) in Japan in 1990 and 2010 based on the GBD 2010 results [16]. In 2010, the highest-ranked causes of DALYs in Japan were lower back pain, cerebrovascular disease, and ischemic heart disease. These causes of DALYs are associated with increasing age and have been the highest-ranked causes of DALYs since 1990. Of the 25 most important causes of DALYs, road injury showed the largest decrease, falling by 42% from 1990 to 2010; however, self-harm remains one of the most important causes of DALYs.

Table 1. Top ten causes contributing to disability-adjusted life years in Japan in 1990 and 2010

Rank	1990	2010
1	Cerebrovascular disease	Low back pain
2	Low back pain	Cerebrovascular disease
3	Ischemic heart disease	Ischemic heart disease
4	Stomach cancer	Lower respiratory infections
5	Lower respiratory infections	Other musculoskeletal
6	Road injury	Lung cancer
7	Self-harm	Self-harm
8	Other musculoskeletal	Stomach cancer
9	Neck pain	Neck pain
10	Lung cancer	Falls

From Institute for Health Metrics and Evaluation. Global Burden of Disease country profile: Japan. Seattle: Institute for Health Metrics and Evaluation; 2012 [16].

Table 2. Top ten risk factors contributing to disability-adjusted life years in Japan in 1990 and 2010

Rank	1990	2010
1	Dietary risks	Dietary risks
2	High blood pressure	High blood pressure
3	Smoking	Smoking
4	Alcohol use	Physical inactivity
5	High fasting plasma glucose	High body mass index
6	Ambient PM pollution	High fasting plasma glucose
7	High body mass index	Alcohol use
8	Occupational risks	Ambient PM pollution
9	High total cholesterol	High total cholesterol
10	Drug use	Occupational risks

From Institute for Health Metrics and Evaluation. Global Burden of Disease country profile: Japan. Seattle: Institute for Health Metrics and Evaluation; 2012 [16].
PM, particulate matter.

Table 2 shows the contribution of the 10 most important risk factors to DALYs in Japan, also drawn from the GBD 2010 project [16]. In 2012, a country-specific comparative risk assessment was conducted in Japan under the GBD framework. This assessment explored these risk factors in more detail using 2007 datasets and focused on mortality rather than DALYs. This national assessment used a systematic review of the literature and analysis of locally available exposure data to build a more detailed picture of these risk factors than was otherwise made available at the global level by the GBD 2010 project. In doing so, this national assessment focused on only the top 16 risk factors for ill health in Japan and developed a measure of joint risk to represent the complexity of dietary risk factors, which are difficult to analyze separately. This national assessment also used richer data to estimate contributions to lost life expectancy and probability of death among these risk factors. In turn, this analysis provided a slightly different insight compared to results based only on DALYs such as in the GBD 2010 results. These results provide more detail about the relative balance of risks; however, the more detailed data sources and restricted set of risk factors has led to some differences with the GBD 2010. Nevertheless, both the GBD 2010 and this 2012 national assessment revealed the same top three risk factors including dietary risks, high blood pressure, and smoking, and the 2012 national assessment estimated the effect of these risk factors on life expectancy and mortality. The 2012 national burden of disease analysis was in broad agreement with GBD 2010 and demonstrates the power of a national burden of disease estimation conducted under the GBD framework [17].

Figure 1 shows the contribution of the top 16 risk factors in Japan to changes in life expectancy at 40 as well as the change in probability of death in the 15 to 60 and 60 to 75 year age groups. Smoking remains a key risk factor among men in Japan and is responsible for a total of nearly 2 years of lost life expectancy at the age of 40 and almost a 15% increase in mortality for men aged between 15 and 60 years old. For women and men, a complex joint risk factor profile built from high blood pressure, blood glucose, low-density lipoprotein cholesterol, and body mass index is responsible for a large proportion of the mortality. In women, this joint risk factor profile alone accounts for nearly a 1.5-year change in their life expectancy at 40. Therefore, Japan's preventive health and public health goals in the immediate future should be focused on the management of hypertension and risk factors for stroke

and coronary heart disease that are embedded in this joint risk factor model as well as continuing to emphasize dietary interventions and improved management of suicide risks and depression.

SUB-NATIONAL ESTIMATES OF RISK AND MORTALITY IN JAPAN

It has been suggested that inequality based on region, cause, and wealth [18] as well as other risk factors that influence mortality are increasing in Japan [19]; however, these trends have changed since the early 1990s due to economic stagnation and other social determinants of health [20]. Given the regional variations in health financing and performance [15] and the challenges facing Japan's health system in the future [21], a detailed understanding of the sub-national variations in the causes of death and illness as well as their associated risk factors is essential.

Initial research that focuses on identifying variations among the causes of death at prefectural and municipal level may be the most effective tool to inform sub-national health policy making. Figure 2 shows the crude mortality rate among 50 to 59 year olds in Japan in 2010 [22] and the different patterns of mortality across the country. A broad tendency towards higher mortality was found in the north. Variations in the culture of these areas, urban planning, and the different income structures and lifestyle patterns across Japan may explain these variations in risk.

The use of geographical differences in mortality demonstrates the role that sub-national burden estimates can play in identifying variations in health and indicate possible causes of future divergence in health outcomes between regions. By conducting a sub-national analysis, it is possible to identify region-specific health intervention needs and begin constructing a local policy framework from data collected at the national level.

THE ROLE OF SUB-NATIONAL ESTIMATION IN POLICY DEVELOPMENT

The 2011 *Lancet* series on Japan identified major policy challenges facing the Japanese health system, considering that its universal health care system serves one of the most rapidly aging populations. Moreover, this series recommended that prefectural governments play a key role in forming and

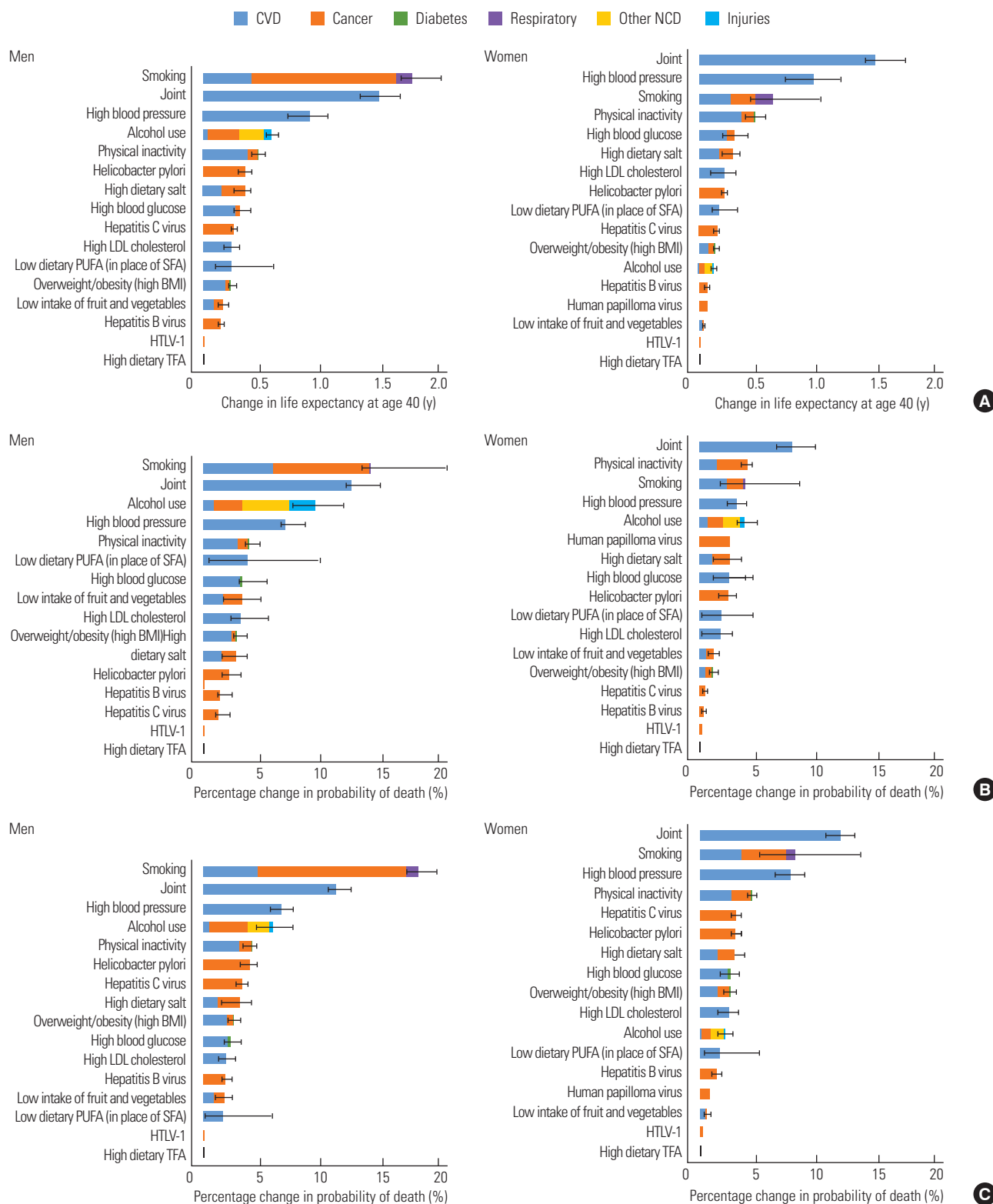


Figure 1. Influence of the 16 key risk factors on mortality outcomes in Japan in 2007. (A) Effect of risk factors on life expectancy at age 40. (B) Percentage change in probability of death at age 15 to 60. (C) Percentage change in probability of death at age 60 to 75 years. Ikeda N, et al. PLoS Med 2012;9(1):e1001160, according to the Creative Commons Attribution License [17]. LDL, low-density lipoprotein; PUFA, polyunsaturated fatty acids; SFA, saturated fatty acids; BMI, body mass index; HTLV-1, human T-lymphotropic virus-1; TFA, trans-fatty acids; CVD, cerebrovascular disease; NCD, non-communicable diseases.

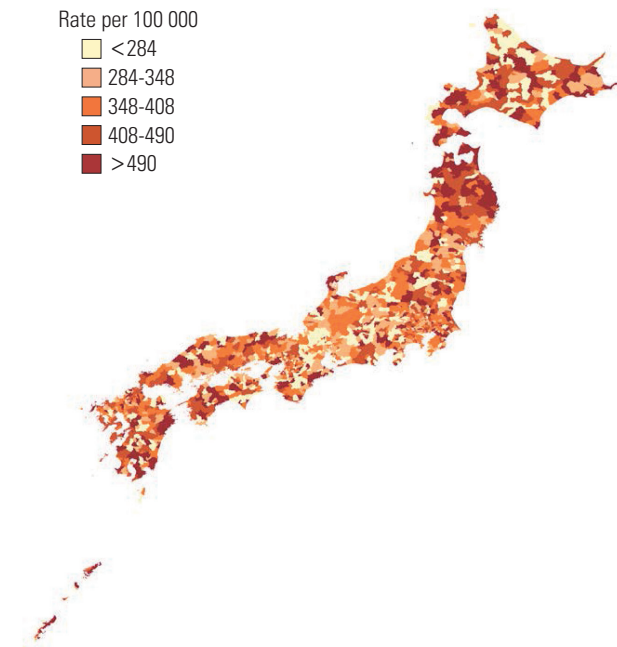


Figure 2. Mortality rate among 50 to 59 years old Japanese women in 2010. From Vital Health and Social Statistics Division. Vital statistics in Japan 2011. Tokyo: Ministry of Health Labour and Welfare; 2013 [22].

implementing health policy because of the huge regional variations in health insurance premiums within Japan [21]. However, for prefectural governments to play this role they will need to have access to high quality data on both the health challenges of their communities, the major risk factors for ill health, and past trends in these risk factors. Sub-national burden of disease estimates are an ideal tool for engaging with policy-makers, and the visualization tools developed by the IHME, such as the GBD compare tool [23], make it possible for policy-makers with little knowledge of epidemiology to quickly and easily compare their prefectural health profile with both their own historic profile and the profile of other prefectures.

In addition to enabling the development of locally driven plans to modify key risk factors and develop plans to reduce future health burdens, these local profiles also enable prefectural governments to identify gaps in the data and make investments in high quality data collection systems. For modern health planning, collecting high quality data is essential. Just as the GBD projects have revealed areas for improvement in data collection systems globally [8], so too will the local profiles naturally lead local organizations to improve their own lo-

cal data systems. This kind of local response to gaps in the data may also lead to bottom-up pressure for the development of high quality data at a national level as prefectural government planners who assign priorities and plan for future health needs begin to understand the importance of burden estimates where national-level data systems are lacking.

However, national and sub-national burden of disease calculations cannot be the only analyses. One of the key methodological advances of the GBD study is the use of data across regions so that nations with sparse data in one health area can draw information from data available for other countries in the region. This process of data synthesis can also be used for national and sub-national estimates. Regional collaborations will enable nations at the same stage of epidemiological transition to share data on exposure risks and effect sizes, especially where exposures are more common in one nation or sub-national region than another. This kind of collaboration will also enable these nations to draw on the experience of others further along this epidemiological pathway, enabling better estimates of current and future NCD burden. Both technically and institutionally, collaboration is essential to improving GBD estimates and national and sub-national burden estimations.

DISCUSSION

In 1990 and 2010, Japan had the lowest age-standardized mortality rate and age-standardized rate of years of life losts globally [24]. Japanese life expectancy increased from the late 1950s and remained the highest in the world at the end of the 1980s. The early increase in longevity during the 1950s to 1960s has been credited to the implementation of effective infectious disease control programs [14], with the Japanese government enacting 32 health laws within ten years after the end of World War II [24]. Interventions that prevented infant and child mortality at that time included clean water, institutional delivery, and universal vaccinations. Subsequently, the implementation of preventive measures against NCD mortality and the maintenance of an equitable and accessible universal health system assured continued gains in the health of the Japanese population throughout the epidemiological transition [13]. Because of these interventions, Japan came to represent a model for universal health development [15,25], and these achievements are reflected in the results of the GBD 2010 project.

Although Japan performed well in promoting the popula-

tion's health status, several challenges for the Japanese health system remain. Cancer, heart disease, and cerebrovascular disease, the three leading causes of death, have contributed to approximately 50% of the population's lifetime risk [17]. Therefore, reducing NCD mortality is the key to prolonging the population's longevity. Lifestyle risk factors such as smoking are the most important factors associated with NCDs. Japan has successfully reduced the population's average blood pressure, which can be associated with an unhealthy diet, but the management of other lifestyle risk factors is still important. The next challenge for dietary interventions involves improving the methods used to address the complex joint risk factors including high blood pressure, blood glucose, low-density lipoprotein cholesterol, and body mass index. These complex risk factors are associated with urbanization, aging, and dietary changes as more Western food is incorporated into Japanese diets. Therefore, sophisticated interventions and policies at both the national and local level will be required.

Although smoking rates have been declining in Japan, smoking is still the leading preventable risk factor accounting for approximately 50% of adult mortality among young men [26]. Highly effective policies for tobacco control are needed in Japan, such as higher cigarette prices and stricter tobacco control ordinances consistent with the Framework Convention on Tobacco Control [27]. Another challenge for the Japanese health system is reducing mortality and morbidity rates associated with self-harm. More than 30 000 suicides have occurred in Japan every year since 1998, and, although the government has implemented several interventions and strategies to prevent suicide, no substantial improvements have been noted [28]. Therefore, effective interventions in the community and in workplaces are necessary for self-harm prevention.

Although Japan's health system is famous for maintaining equity in health coverage [25], we have shown that significant variations in patterns of mortality and risk are evident by age, region, and wealth. Maintaining equity in the future will require interventions and policy instruments to target these regional- and wealth-based inequities. Moreover, any policy development should rely on the analysis of risk factors using high quality data available at the regional and local level. Beginning with analyses at the prefectural level, it is our goal to develop estimates of years of life lost to death and disability as well as the major contributing risk factors within the GBD framework to guide policy development and inform local

health decisions. These sub-national estimates will help to inform national and prefectural governments about evident health challenges and provide detailed assessments of disease burden to those who allocate resources and plan interventions. In addition, these sub-national estimates will provide renewed impetus to reform the relationships between central and local governments as well as improve data systems and research [21].

Results of the new GBD 2013 study, which will become the most recent burden of disease study, are scheduled to be published in late 2014 [4]. This new GBD study will estimate trends in the burden of disease throughout 1990 to 2013 with the addition of more risk factors than were included in the GBD 2010. This iteration of the GBD project also aims to use data that are directly available from national collaborators. Since the release of GBD 2010, the IHME has been actively seeking collaborators at the national level to provide more accurate, comprehensive, and detailed data as well as to give expert advice on the findings. A study as broad and complex as the GBD project requires many simplifications and approximations, but also has many gaps in the data and local knowledge. By incorporating national-level collaborators and detailed data, estimates that are even more accurate will hopefully be produced and updated frequently. We aim to incorporate our sub-national estimation process into the next round of the GBD project, thus enabling our results on sub-national variation and inequality to inform the data on national and sub-national variation in other parts of the region, which is similar to how the variations between nations has informed estimates within regions in the GBD 2010 project [5].

CONCLUSION

The GBD framework has been essential to understanding the successes and challenges in reducing mortality and the burden of health in Japan. By providing comprehensive information on the national and sub-national disease burden, the GBD studies will be crucial in informing future agendas and policies in countries throughout the region and especially in Japan. However, the quality of the GBD outcomes is dependent on the commitment and involvement of country-level collaborators. Nations throughout Asia should commit to this unique and challenging project and encourage epidemiologists throughout the region to participate.

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CONFLICT OF INTEREST

The authors have no conflicts of interest with the material presented in this paper.

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