



Indigenous ethnicity as a social determinant of exposure to riskier modes of transport: A survey study in Taiwan

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ABSTRACT

In Taiwan, indigenous persons are three times as likely to die of transport-attributed causes as non-indigenous Taiwanese. One contributing factor may be exposure to powered-two wheelers (PTW). Despite its high fatality rate relative to cars, PTW remain an economical and popular mode of transport used disproportionately by people of lower education and income throughout Asia. This study tests (1) indigenous ethnicity as a predictor of PTW usage, and (2) educational attainment and personal income as mediators between indigenous ethnicity and PTW usage. Based on data from the Taiwan Social Change Survey ($n=2209$), results indicated that most indigenous respondents reported PTW as their primary mode of transport (73%), and that odds of PTW usage among indigenous persons were 2.80 times higher than non-indigenous Taiwanese. The association between indigenous ethnicity and PTW usage was significantly mediated by educational attainment. Lower educational attainment and personal income were correlated with PTW usage. Indigenous Taiwanese appear to have greater exposure to PTW, and by extension, greater risk for transport-attributed injury or death. Ethnic differences in decisions pertaining to mode of transport are complex and unlikely the simple function of education or personal income. Community-led initiatives are needed to understand and address transport-attributed mortality among indigenous populations dependent on PTW.

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1. Introduction

Transport-attributed morbidity and mortality impose massive economic and social burdens on communities worldwide. Annually, road traffic injuries alone are responsible for over 1.3 million deaths and over \$500 billion USD in related costs (Global Road Safety Facility The World Bank, 2014). By 2030, road traffic injuries are projected to be the fifth leading cause of death globally (Chekijian et al., 2014). However, risk of transport fatality can be highly uneven between ethnic groups, and it has been well documented that compared with non-indigenous and ethnic majority groups, indigenous populations consistently face greater risk for premature death due to transport. At the national level, indigenous Americans, Australians, and Canadians are 2–3 times more likely than non-indigenous counterparts to die of transport-related injuries each year (Murphy et al., 2014; Short et al., 2013; Clapham et al., 2008).

In response, research of transport-injury prevention with indigenous communities has expanded rapidly in recent years, and the mechanisms underpinning certain indigenous populations' risk for transport-mortality have become more apparent. Low uptake of safety restraints, driving under the influence, insufficient driver training, older vehicles, exposure to poor road conditions, and rural residence have been identified as mediators of indigenous Australasian and North Americans' susceptibility to transport death, among other host

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and environmental factors (Short et al., 2013; Clapham et al., 2008; Ishikawa et al., 2014). However, some strategies may be of limited relevance for the hundreds of millions of indigenous peoples living outside Australia, New Zealand, or North America, and who remain underrepresented in the international injury prevention literature. In addition to qualitatively different historical experiences of colonization, indigenous communities outside Australasia and North America inhabit physical and social environments that present markedly distinct risks for transport-attributable death. For example, ~75% of road crash fatalities in North America occur within a motorized vehicle with three or more wheels, compared to only ~25% in East Asia, where road crash fatalities more often involve powered two-wheelers (PTW) and pedestrians struck by road vehicles (Global Road Safety Facility The World Bank, 2014). Despite the fact that 70% of the world's estimated 370 million indigenous people live in Asia (not including Australia or New Zealand) (Hall and Patrinos, 2012), and that rates of road injury deaths have increased by over 66% in Asia over the past 25 years (Global Road Safety Facility The World Bank, 2014), research regarding transport injury prevention with indigenous Asian communities remains remarkably scant.

1.1. Indigenous Taiwanese and transport-attributed mortality

In contemporary Taiwan, an estimated half million indigenous people (~2% of the total population) identify with at least one of 16 officially recognized tribes who have endured generations of socioeconomic and cultural marginalization by governing Spanish, Dutch, Japanese, and Chinese authorities (Hsieh, 1994; Shepherd, 2007; Simon, 2007; Lamley, 2007). Due in part to the legacies of these asymmetrical social structures, indigenous Taiwanese consistently lag behind non-indigenous Taiwanese in several basic social development indicators, such as health (Wen et al., 2004). According to a report by Taiwan's Council of Indigenous Peoples, the life expectancy of an indigenous male born in 2011 was a full 10 years shorter than that of a non-indigenous male (66 years vs. 76 years) (Council of Indigenous Peoples -- Executive Yuan, 2014a). One key factor underpinning this stark discrepancy in life expectancy has been early death due to transport injury. As of 2011, indigenous Taiwanese were 2.5 times more likely to die of transport-attributed injuries, and on average were killed at an age ten years younger when compared with non-indigenous Taiwanese (Council of Indigenous Peoples -- Executive Yuan, 2014a).

Though the disparity in transport-attributed mortality between indigenous and non-indigenous Taiwanese remains poorly understood and understudied, two explanatory theories have emerged. First, rural geography appears to strongly predispose indigenous Taiwanese to greater risk of transport-attributed death, similar to indigenous populations in North America and Australia (Falster et al., 2013). Due to underdeveloped public transportation in rural and indigenous districts with higher concentrations of indigenous residents, indigenous Taiwanese may be more likely to use alternative means of transport associated with higher risk of death (e.g., perambulation or PTW) (Yang et al., 1997). In contrast to urbanized areas with lower speed limits and more traffic congestion, rural districts with higher speed limits and less traffic congestion enable operators of motorized vehicles to travel at far higher speeds (Yang et al., 1997). As a potential consequence of greater energy exchange at collision, transport-attributed injuries in rural districts may be more severe in nature. Individuals involved in rural transport collisions are also prone to delayed medical attention given the reduced availability of health professionals and geographic distance to trained trauma specialists (Yang et al., 1997). Hence, lack of access to prompt post-collision medical care may be another critical factor increasing risk of transport death among Taiwan's indigenous population. That being said, indigenous non-indigenous disparities persist even after taking into account rural residency. Among rural districts in Eastern Taiwan, fatality rates of road traffic collisions have been shown to be twice as high for indigenous than non-indigenous districts (Li, 2007).

Second, alcohol consumption may be another contributing factor for disproportionate rates of transport injury among indigenous Taiwanese. Similar to indigenous communities elsewhere (Gracey and King, 2009), the health of indigenous Taiwanese are frequently beset by issues of alcohol misuse (Cheng and Chen, 1995). Among vehicle operators who survived motor vehicle injuries, indigenous Taiwanese are significantly more likely to report having imbibed alcohol prior to the crash incident (Chang et al., 2003).

1.2. Powered two-wheelers: risks and functional purposes

PTW include all classes of mopeds, electric bikes, and motorcycles, and are unequivocally more hazardous than most major modes of transport. Compared with car occupants, traffic collision mortality rates are approximately 20–30 times higher for operators of PTW when measured by distance traveled (National Center for Statistics and Analysis Research Development, 2006). Without the protective enclosure of a vehicle or passenger restraints, injuries are likely to be more severe for PTW operators. Trauma to the head contributes to approximately half of all fatal road injuries involving PTW (Lin and Kraus, 2009).

Prevalence and correlates of exposure to PTW transport differ starkly between Asian and Western countries. PTW represent only 2% of registered motor vehicles in the US, compared with 95% of all registered vehicles in Vietnam, 63% in mainland China, and 67% in Taiwan (Lin and Kraus, 2009). According to the international transport forum, Taiwan has the highest rate of PTW ownership in the world (~600 units per 1000 persons); in comparison, rates of PTW ownership are far lower in the US (< 35 units per 1000 persons) or even Vietnam (< 250 units per 1000 persons) (Rogers, 2008).

Motivations for PTW ownership are also distinct when comparing Asian and Western countries. At the risk of over generalizing, a larger proportion of PTW in Australasia and North America serve a recreational purpose and are purchased with discretionary personal income, while PTW in Taiwan and much of Asia largely serve as an affordable and functional mode of transport for the general population (Haworth, 2012). In Taiwan, lower income is associated with both higher PTW ownership (Chen and Lai, 2011) and indigenous ethnicity (Council of Indigenous Peoples -- Executive Yuan, 2011), but the authors are unaware of any research that has examined PTW ownership by ethnicity. Conceivably, indigenous Taiwanese may have greater exposure to PTW due to less favorable economic conditions precluding the purchase of less hazardous means of efficient transport (e.g., four-wheel cars).

1.3. Social determinants of transport injury mortality and mode of transport

In both Asian and Western countries, lower individual-level income and educational attainment have generally been linked to greater risk of transport-attributed mortality (Nantulya and Reich, 2010; Ameratunga et al., 2006; Laflamme et al., 2009). Americans in the lowest household income bracket are 1.5 times more likely to die in motor vehicle incidents (vs highest income bracket) (Cubbin et al., 2000);

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