Gender Disparity in the Incidence of Childhood Central Nervous System Cancers among Different Asian Pacific Islander Populations

Alistair C. K. Lam [1, 2]

[1] The Lawrenceville School, NJ, USA, [2] The International Youth Neuroscience Association (IYNA) Hong Kong Chapter

Introduction

Cancer is a leading cause of death in children and adolescents (ages 0-19). Of these, childhood nervous system cancers have the highest mortality rate. Such cancers are also the most common form of childhood solid tumors and have the second-highest incidence (one-fifth) among all childhood cancers. However, there is very limited investigation on gender differences and temporal trends in the incidence of childhood nervous system cancers among populations of the same race/ethnicity across multiple jurisdictions. Comparing incidence using data from the same race/ethnicity is important as cancer rates differ significantly between such groups. Also, comparing incidence rates across multiple jurisdictions is useful to provide a more comprehensive picture of the trends associated with different environments. This study seeks to achieve these objectives simultaneously by examining the temporal trends and gender disparities in the incidence of childhood CNS cancers (age 0-19) in the Asian Pacific Islander (API) populations.

Materials and Methods

This study examined the incidence of CNS cancer in children and adolescents among the API populations in 5 jurisdictions: the USA National Program of Cancer Registries (NPCR) API, Hong Kong, Japan, the Republic of Korea (5 registries), and Thailand (4 registries). Data between 1999 and 2010 are used in this study since data is available for all five jurisdictions during this time frame. Annual incidence data on "Brain, Central Nervous System" cancers, corresponding to code C70-72 in the International Classification of Diseases Tenth Revision (ICD-10, Version 2010), were collected from the Cancer Incidence in Five Continents Time Trends database (CI5plus) of the International Agency for Research on Cancer (IARC).

Temporal trends of Age-Standardized Rates (ASR) per million person-years were identified and compared between different jurisdictions, for each gender and both genders respectively. One-tailed *t*-tests were used to determine the statistical significance of differences between incidence in males and females for each jurisdiction and between jurisdictions, as it is well established that males have a higher incidence of childhood CNS cancers than females. Paired two samples for means were used for data with temporal trends. Unpaired *t*-tests were used for data without temporal trends, after conducting F-tests that indicated equal variance. Linear regression was used to analyze trends in annual incidence over time for each gender and jurisdiction. The statistical significance of the linear regression models was evaluated using *p*-values.

Results

In Korea, both male ($p = .029$) and female ($p = .042$) ASRs increased significantly over time. In Thailand, male ASR's increase over time was nearing significant ($p = .063$) while female ASR significantly decreased over time ($p = .014$). Among USA API, there was a strong and significant positive correlation between years and ASR of childhood CNS cancers for males, but an insignificant correlation for females. Temporal trends in Hong Kong and Japan populations were insignificant for both genders. See Table 1.

Table 1. Incidence of Childhood CNS Cancers: Temporal Trends

Jurisdiction	Gender	*r*	*p*
Hong Kong	Female	.217	.499
	Male	.095	.769
Japan	Female	.234	.464
	Male	.483	.112
Korea	Female	.593	**.042****
	Male	.627	**.029****
Thailand	Female	.683	**.014****
	Male	.551	.063*
USA API	Female	.238	.456
	Male	.583	**.047****

Note: $p < .01$(***), $p < .05$(**), $p < .1$ (*)

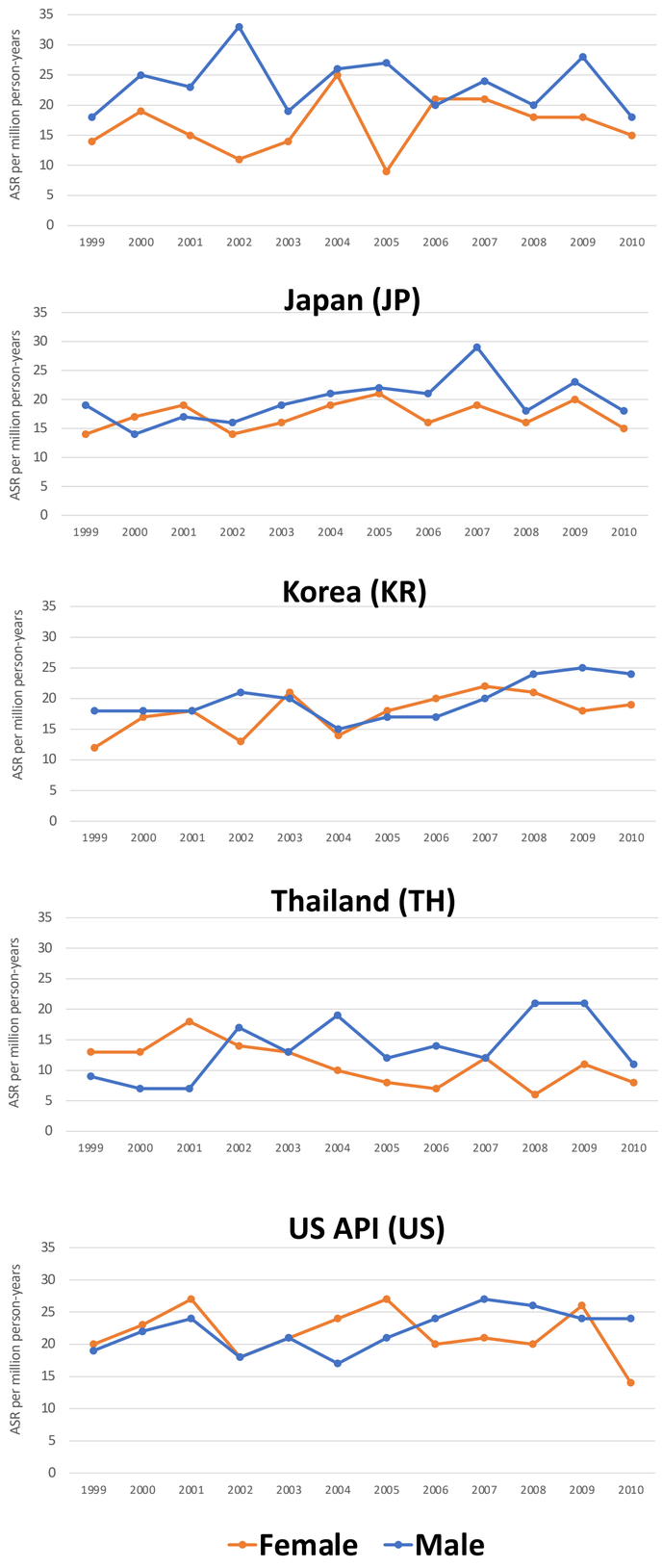
The male ASRs of childhood CNS cancers in Hong Kong, Japan, and Korea were consistently, significantly higher than female ASRs over the years, while there were no significant gender differences in Thailand and the US API populations. See Table 2.

Table 2. Incidence of Childhood CNS Cancers: Gender Differences

Jurisdiction	*t*	*p*
Hong Kong	3.602	**<.001*****
Japan	1.966	**.031****
Korea	1.864	**.045****
Thailand	1.186	.130
USA API	0.348	.366

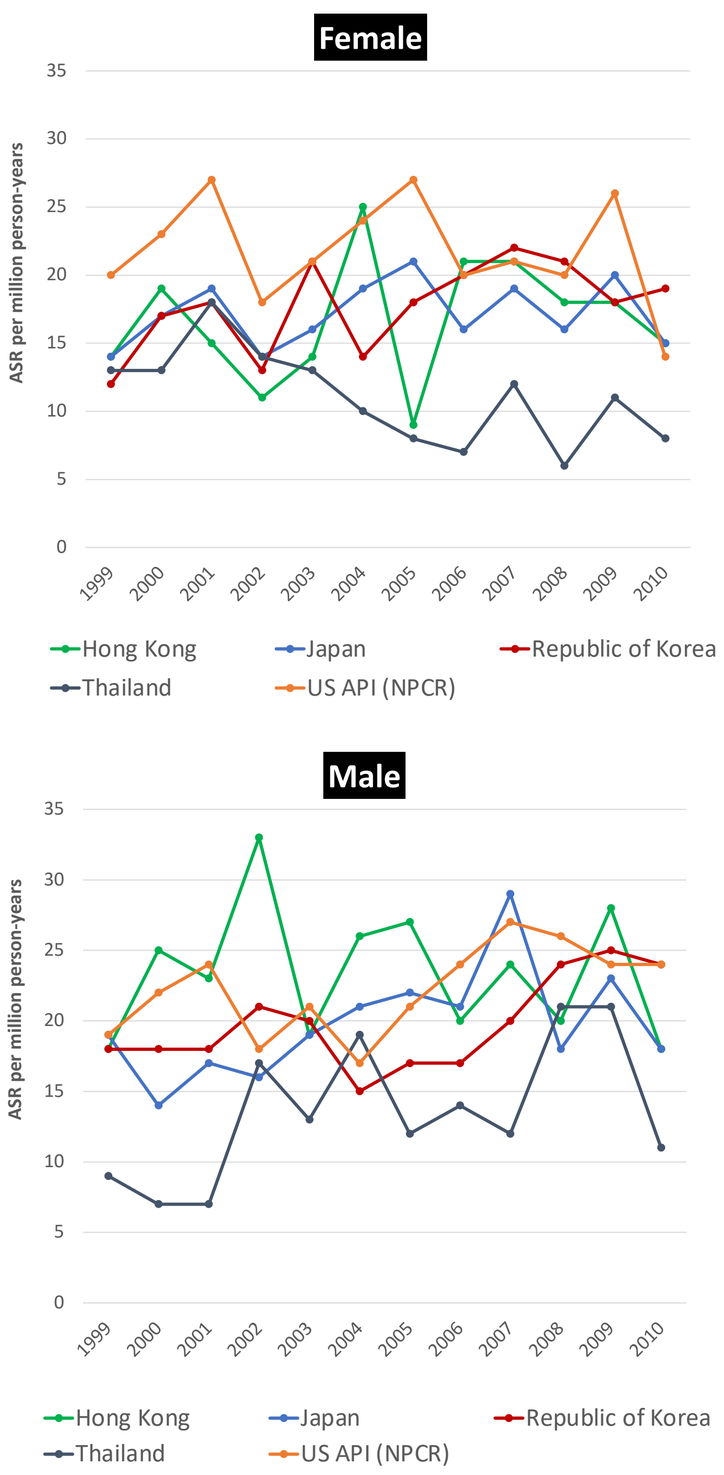
Note: $p < .01$(***), $p < .05$(**), $p < .1$ (*)

Figure 1. Incidence of Childhood CNS Cancers: Gender Differences and Temporal Trends within Jurisdictions.



The ASRs of childhood CNS cancers in Thailand for both genders were significantly lower than all other jurisdictions. Female ASR of the USA API population was significantly higher than all other jurisdictions. Male ASR in USA API was significantly higher than all other jurisdictions except Hong Kong. Male ASR in Hong Kong was significantly higher than all other jurisdictions except USA API.

Figure 2. Incidence of Childhood CNS Cancers: Gender Differences among Jurisdictions.



Discussion

A generally increasing trend in male ASRs can be observed consistently, but no consistent trends in female ASRs can be observed across the jurisdictions. As the USA and Korea are developed countries while Thailand is a developing country, their populations live in vastly differently environments. However, the male API in those 3 populations exhibited an increasing trend of incidence over time, possibly suggesting that environmental factors might not be a significant contributor to the gender difference in temporal trends, and other confounding variables might be involved. As a whole, these results indicate that incidence of childhood CNS cancers among API males in these 5 jurisdictions increased over time while no consistent temporal trends were observable in females.

The ASR of childhood CNS cancers in Thailand was significantly lower than all other jurisdictions for both genders ($p \leq .001$), see Table 3. This suggests that the state of economic development might be a significant contributor to the differences in childhood CNS cancer incidence regardless of gender, since Thailand is the only developing country being studied. This finding is consistent with the earlier observation that environmental factors might have a limited impact on the gender disparities in incidence, as the ASRs between Thailand and all other jurisdictions were significantly different for both females and males. In other words, the state of economic development is an environmental factor that was negatively correlated with the incidence of childhood CNS cancers generally irrespective of gender, but did not appear to be a significant contributor to the gender difference in incidence.

Table 3. Incidence of Childhood CNS Cancers: Comparison among Jurisdictions by Gender.

	TH	JP	US	HK	KR	
TH		*t*: 3.389 *p*: 0.001	*t*: -7.133 *p*: <0.001	*t*: 5.013 *p*: <0.001	*t*: 4.577 *p*: <0.001	Male Incidence
JP	*t*: 5.036 *p*: <0.001		*t*: -1.734 *p*: 0.048	*t*: 2.098 *p*: 0.024	*t*: 0.000 *p*: 0.500	
US	*t*: -5.038 *p*: <0.001	*t*: -3.503 *p*: 0.001		*t*: 0.721 *p*: 0.239	*t*: -2.726 *p*: 0.0098	
HK	*t*: 3.392 *p*: 0.001	*t*: -0.338 *p*: 0.370	*t*: -2.951 *p*: 0.004		*t*: 2.254 *p*: 0.017	
KR	*t*: 4.225 *p*: 0.001	*t*: -0.502 *p*: 0.310	*t*: -2.744 *p*: 0.006	*t*: -0.672 *p*: 0.254		
Female Incidence						

Note: $p < 0.01$, $p < 0.05$, $p < 0.1$

Moreover, both female ($p \leq .006$) and male ($p \leq .048$) US API incidence of childhood CNS cancers were found to be significantly higher than those in all other jurisdictions except males in Hong Kong, which could potentially be attributed to their relatively more advanced healthcare and reporting systems, or greater gender inequality in healthcare access in the rest of Asia. This potential reason of high incidence observed is corroborated by previous studies reporting that rigor in child health checks affects incidence. Male ASRs in Hong Kong and US API had no significant difference. See Table 3.

Hong Kong ($p < .001$), Japan ($p = .031$), and Korea ($p = .045$) all had significant gender differences in the incidence of childhood CNS cancers (see Table 2), with males having a higher incidence overall, a finding in line with past literature on sex differences in the incidence of general childhood cancers. Adding to prior understanding, these results demonstrate that there were significant gender differences in incidence of childhood CNS cancer generally, not just in developing countries but also in developed countries. No significant difference between female and male incidence was observed in Thailand, however, which is not in line with previous studies that developing countries had greater gender differences in the incidence of childhood cancers in general. This finding suggests that under-diagnosis or underreporting of female cancer incidence, or females' lacking access to healthcare might not be universal among developing countries.

Conclusions

This study identified a significant gender disparity in incidence of childhood CNS cancers between API male and female in developed jurisdictions, with male incidence increasing over time and significantly higher than female incidence. Further work is needed to discern the underlying shared factors that contribute to gender differences in the incidence of childhood nervous system cancers among API populations in developed and developing jurisdictions and provide the necessary scientific grounding to formulate sound, gender-specific policies for childhood nervous system cancers.

Acknowledgements

I would like to thank Dr. Dorita Chang at the University of Hong Kong, and Dr. Elizabeth Fox and Mr. Doug Piper at The Lawrenceville School, NJ, USA, for their guidance.

References

Please see: https://bit.ly/P08_References_Alistair_Lam