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Advancing Health Disparities Research: The Need to Include Asian American Subgroup Populations

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Abstract

Background Despite recognition that the health outcomes of Asian American subgroups are heterogeneous, research has mainly focused on the six largest subgroups. There is limited knowledge of smaller subgroups and their health outcomes. This scoping review identifies trends in the health outcomes, reveals those which are under-researched, and provide recommendations on data collection with 24 Asian American subgroups.

Methods Our literature search of peer-reviewed English language primary source articles published between 1991 and 2018 was conducted across six databases (Embase, PubMed, Web of Sciences, CINAHL, PsychINFO, Academic Search Complete) and Google Scholar, yielding 3844 articles. After duplicate removal, we independently screened 3413 studies to determine whether they met inclusion criteria. Seventy-six studies were identified for inclusion in this review. Data were extracted on study characteristics, content, and findings.

Findings Seventy-six studies met the inclusion criteria. The most represented subgroups were Chinese ($n = 74$), Japanese ($n = 60$), and Filipino ($n = 60$), while Indonesian ($n = 1$), Malaysian ($n = 1$), and Burmese ($n = 1$) were included in only one or two studies. Several Asian American subgroups listed in the 2010 U.S. Census were not represented in any of the studies. Overall, the most studied health conditions were cancer ($n = 29$), diabetes ($n = 13$), maternal and infant health ($n = 10$), and cardiovascular disease ($n = 9$). Studies showed that health outcomes varied greatly across subgroups.

Conclusions More research is required to focus on smaller-sized subgroup populations to obtain accurate results and address health disparities for all groups.

Keywords Asian American · Subgroups · Data disaggregation · Health · Health equity

Introduction

Asian Americans are the fastest-growing minority population in the United States (U.S.) and include a range of subgroup populations. According to the 2010 U.S. Census, an Asian individual is defined as a person who has origins in the Far East, Southeast Asia, or India [1]. In the U.S., there are more than 23 million Asian Americans, who are from more than 20 countries in East and Southeast Asia as well as the Indian subcontinent [1]. It is projected that the Asian American population will surpass 46 million by 2060 [1].

Research has demonstrated that Asian Americans differ in social characteristics, including language, education attainment, economics, insurance coverage, and health outcomes. For example, although the median annual income for Asian American households was $85,000 in 2019, only two Asian American groups exceeded this figure—Indians ($119,000) and Filipinos ($90,400). In contrast, Burmese ($44,400) and Nepalese ($55,000) had the lowest median household incomes [1]. Asian American subgroups not only differ socioeconomically but in citizenship status, immigration and refugee history, English proficiency, and acculturation, as well as by generation. Furthermore, nativity status, that is, the location of one's birth, can also influence one's health status and health outcomes. Research has shown that Asian individuals who are U.S.-born have different mental health, birth, cardiovascular health, and other outcomes

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than those who are foreign-born [2, 3]. Despite these differences, researchers often aggregate the subgroups under one racial label: "Asian." It was only in 2000 that the U.S. Census began separating Asians and Pacific Islanders in data reports and in 2003 that the Secretary of Human and Health Services approved this separation and added the following Asian subcategories: Asian Indian, Chinese, Filipino, Japanese, Korean, Vietnamese, and Other Asian. In addition, prior to 2003, only seven states required reporting of different subgroups—California, Hawaii, New York, New Jersey, Texas, Washington, and Illinois [4]. This brief overview of the history of data collection for Asian American subgroups provides some context for the difficulties in disaggregating Asian American data and highlights the omission of several subgroups in overall research efforts.

A common stereotype associated with Asian Americans is "the model minority," which argues that Asian Americans are not a disadvantaged or underprivileged minority group. The term "model minority" was coined in the mainstream media of the 1960s and used by white conservatives to oppose the message of the Black Power Movement during the 1960s and 1970s, which claimed that "America was a fundamentally racist society," and deny the existence of institutional racism [5]. This myth has negatively impacted Asian Americans by dividing them from other racial/ethnic groups and by being indiscriminately applied to all Asian American subgroups despite the differences in culture, history, and socioeconomic status as noted above. Moreover, it has trickled down into beliefs that Asian Americans do not experience health disparities and do not require assistance at an individual, societal, or governmental level [6]. The model minority myth, as well as the failure to disaggregate health data for Asian American subgroups, may mask disparities which result in inaccurate conclusions about such subgroups [7]. For example, in a women's health study, researchers found that Asian American women had the lowest median high-sensitivity C-reactive protein levels of all categories compared (Asian, non-Hispanic white (NHW), black, and Hispanic women) [117]. However, an international study conducted with Asian subgroups showed that Asian Indians in the UK have higher levels of C-reactive protein than their European counterparts [8].

In 2009, Executive Order 13515 was signed by President Obama to improve the collection of health data among Asian Americans. However, current national and research priorities only focus on the six largest Asian American groups—Chinese, Japanese, Vietnamese, Korean, Filipino, and Indian. Although reviews on Asian American groups exist, they have been carried out exclusively on one group, on the aforementioned larger groups, or on a specific health condition (e.g., colorectal cancer [9], overweight, obesity, type 2 diabetes [10], depression [11], and breast cancer [12]). Although a common conclusion from these reviews is that there is heterogeneity among Asian American subgroups, few studies have attempted to focus on all such subgroups; hence, many disparities remain unknown among the smaller subgroups.

The purpose of this study is to conduct a scoping review to increase understanding of the state of science in disaggregated data on 24 Asian American subgroups. We chose 24 subgroups, as outlined by the 2010 U.S. Census brief on the Asian American population, namely Asian Indian, Bangladeshi, Bhutanese, Burmese, Cambodian, Chinese, Taiwanese, Filipino, Hmong, Indonesian, Iwo Jiman, Japanese, Korean, Lao, Malaysian, Maldivian, Mongolian, Nepalese, Okinawan, Pakistani, Singaporean, Sri Lankan, Thai, and Vietnamese [1]. Our aims were to identify heterogeneity among subgroups, trends in disaggregating Asian American health outcomes, and under-researched subgroups, as well as to provide recommendations about how data could be collected on all 24 subgroups. Understanding health outcomes across Asian American subgroups will allow us to identify gaps and disparities.

Methods

Design

A scoping literature review was performed to synthesize knowledge regarding disaggregated data on the health outcomes of 24 adult Asian American subgroups in the U.S. According to Munn et al. (2018), a scoping review is preferred over a systematic review to identify certain characteristics or concepts in papers or studies and to map, report, or discuss these characteristics or concepts [13]. Arksey and O'Malley (2005) state that a scoping review can be utilized when a research area is complex or has not previously been comprehensively reviewed and can help in identifying research gaps in the existing literature [14]. Since no review has been carried out on the health outcomes of the 24 selected adult Asian American subgroups, a scoping study was chosen.

Search Strategy and Sample

A university librarian was consulted to determine which databases and keywords would identify qualitative, quantitative, and mixed-methods research reports that focus on disaggregated data on the health outcomes of adult Asian American subgroups. As outlined in Fig. 1, Embase, PubMed, Web of Sciences, CINAHL, PsychInfo, Google Scholar, and Academic Search Complete were utilized. The search terms were "disaggregate," "health," and "Asian" OR "Asian American."

Studies were included if they were written in the English language; focused on health outcomes in Asian American subgroups, including at least two subgroups; were U.S.-based;

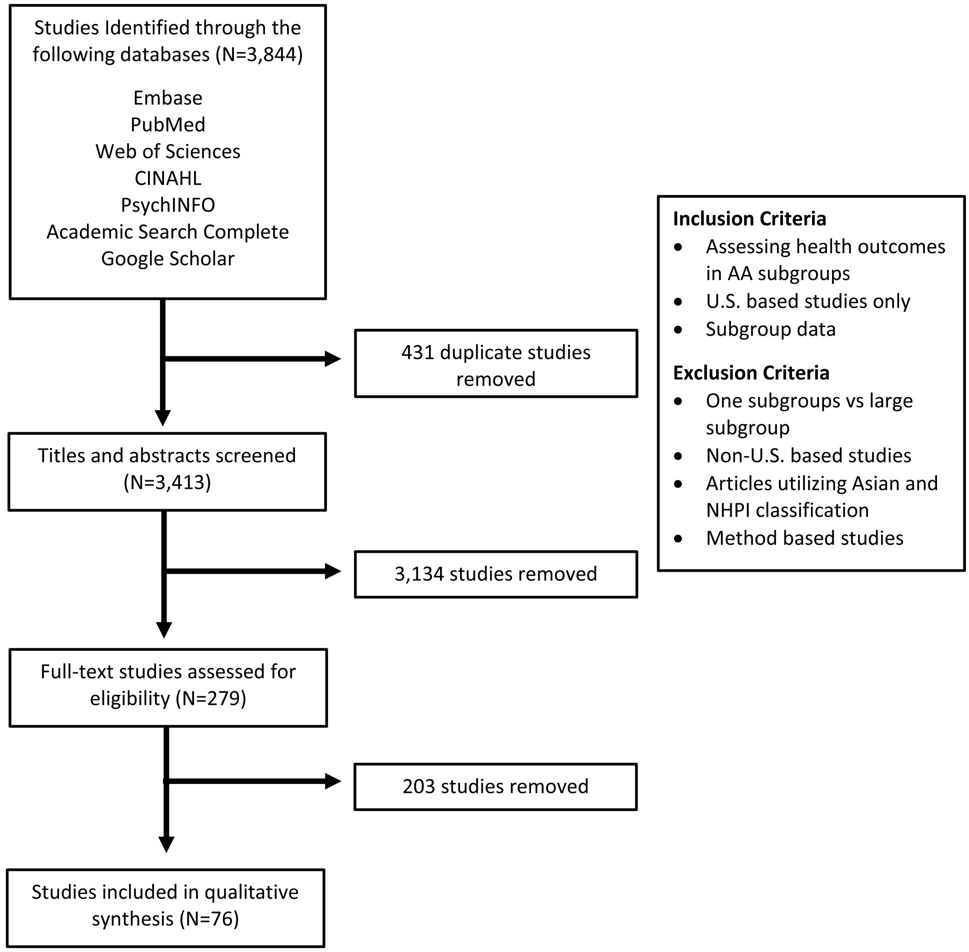

Fig. 1 Flow chart of paper selection and inclusion criteria

and were primary source articles. Studies were excluded if they did not focus on health outcomes, focused on the pediatric population, or were commentary or method papers.

Analytic Strategy

All studies from the search, including their abstracts and citations, were uploaded into Covidence.org, which is a systematic review management website. Through an iterative process, two members of our study team (SY and ML) individually reviewed and screened each article's abstract and full text based on the inclusion criteria. Afterward, they came together to consolidate their screenings, and if any discrepancies occurred between their selections, they reviewed the article's abstract and full text together. A total of 76 studies met the criteria (see Fig. 1). No specific time period was chosen, as the authors were interested in analyzing the temporal trends of studies published. The included studies were published between 1991 and 2018.

Data from studies that met the eligibility criteria were extracted into a Microsoft Excel spreadsheet. Data extraction included information about each study's purpose; the methods, including subgroups and geographical locations of the study being conducted; and the results. All study results were organized into themes based on the research area of focus.

Results Study Characteristics

A total of 76 articles met our inclusion criteria. The majority of the studies were conducted in California ($n = 34$) and nationally ($n = 18$). The number of studies focusing on Asian American subgroups increased after 2000, with most studies

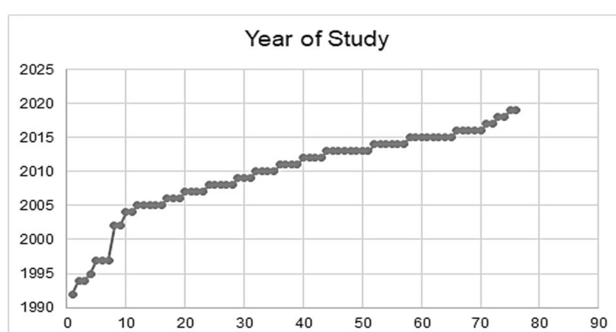

Fig. 2 Number of studies published by year

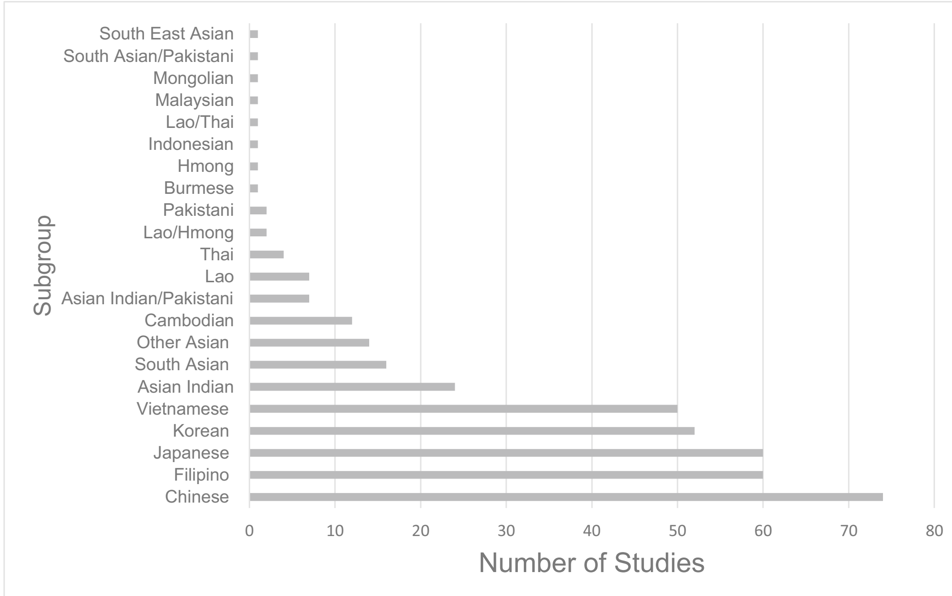

Fig. 3 Number of studies including each subgroup

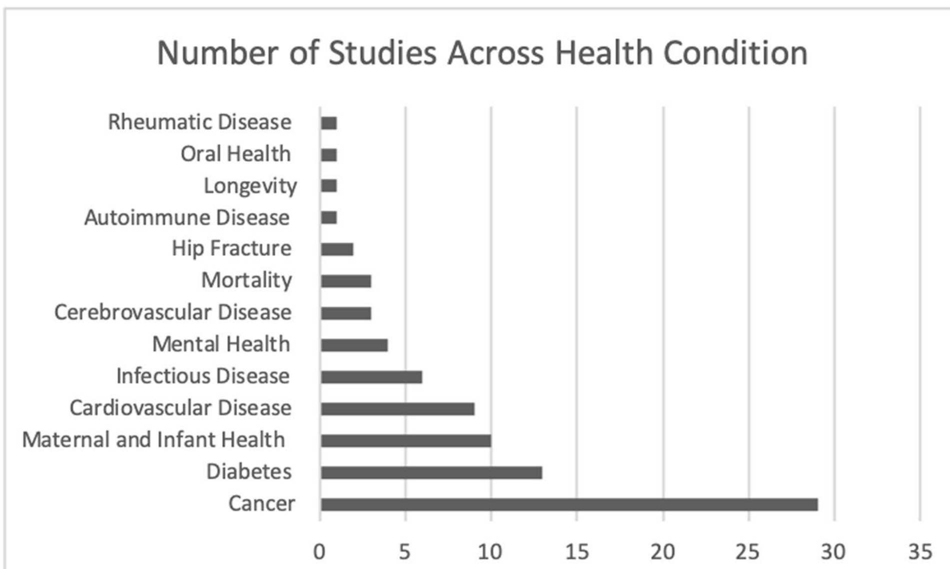

Fig. 4 Number of studies across health conditions

conducted in 2013 (see Fig. 2). The majority of the studies were secondary analysis or retrospective in nature, using either a cross-sectional ($n = 21$) or longitudinal ($n = 51$) design. Only four studies were prospective studies. The sample size ranged from 211 to 271,488,278.

The subgroups most represented in the studies were Chinese ($n = 76$), Japanese ($n = 60$), and Filipino ($n = 60$), while the following subgroups were only represented in one study: Burmese, Hmong, Indonesian, Lao/Thai, Malaysian, Mongolian, South Asian/Pakistani, and South East Asian (see Fig. 3). In these 76 studies, the South Asian category was often used as an aggregation of subgroups that could include Asian Indians, Pakistanis, Sri Lankans, Bangladeshis, Bhutanese, Nepalese, and Sikh, while Southeast Asian could include Cambodians, Laos, Burmese, Thai, Malaysians, Vietnamese, Singaporeans, and Indonesians.

Overall, cancer was the most studied health condition ($n = 29$), followed by diabetes ($n = 13$), maternal and infant health ($n = 10$), and cardiovascular disease ($n = 9$; see Fig. 4). In contrast, viral disease and tuberculosis (TB; $n = 5$), cerebrovascular disease ($n = 3$), hip fracture ($n = 2$), oral health ($n = 1$), and autoimmune disease ($n = 1$) were the least represented health conditions among the studies included in this review. In the following section, we report the findings of all the health conditions.

Cancer Results

Twenty-nine studies focused on cancers,[1] of which 20 focused on a single cancer, while nine considered multiple cancers. Breast cancer was the most included cancer type in the studies ($n = 13$), while laryngeal ($n = 1$), and testicular ($n = 1$) cancers were the least included types. These cancer studies focused mainly on incidence rate ($n = 10$), survival outcomes ($n = 8$), mortality rate ($n = 6$), histologic cell type ($n = 5$), staging differences ($n = 3$), treatment outcome ($n = 3$), and genetic subtypes ($n = 1$). Of the 29 studies, Chinese was included in all 29. Japanese was included in 28 of the 29 studies. Lao was included in only 3 of the 29 studies.

Six main data sources were used in the 29 cancer studies, namely the Surveillance, Epidemiology, and End Results (SEER) program ($n = 12$), the California Cancer Registry (CCR) ($n = 10$), the Death Statistical Master File for California and National Death Index ($n = 1$), census data ($n = 1$), national death certificates ($n = 1$), medical records ($n = 1$), and a registry ($n = 1$).

Among cancer studies, research questions related to incidence and mortality rates of cancers were most frequently studied. Overall, cancer incidence and mortality rates varied among Asian American subgroups based on the cancer type and data set used, as well as across time. Breast, colorectal, gastric, liver, and lung cancers were the most studied cancers relating to incidence and mortality, and lung and liver cancers were also the most studied forms of cancer regarding only mortality rates. Oral, nasopharynx ($n = 1$), larynx ($n = 1$), esophageal ($n = 1$), and melanoma ($n = 1$) cancers were less studied among Asian American subgroups.

In the following section, we summarized the results among the most frequently studied cancers. Tables 1, 2, and 3 contain all combined cancer data across Asian American subgroups [15–25].

Breast Cancer

Breast cancer was the most widely studied cancer. Researchers have examined the incidence ($n = 2$), mortality ($n = 3$), incidence and mortality ($n = 3$), genetics and staging differences ($n = 1$), and treatment outcomes ($n = 1$) of breast cancer among Asian American subgroups.

Among the breast cancer incidence studies, Japanese and Filipina women had the highest incidence rates of breast cancer, ranging from 102.5 to 126.5 and 97.4 to 102.4, respectively. However, breast cancer incidence rates among women showed that for Chinese, Japanese, Filipina, Korean, Vietnamese, and Asian Indian/Pakistani groups, breast cancer was the leading form of cancer from 1990 to 2008, with the exception of Kampuchean/Cambodian and Lao populations. For the Kampuchean/Cambodian population, breast cancer had been the third leading cancer site until it became the first in 2008. In contrast, for Laos, breast cancer was in fourth position in 1990 and then in first position in 2008 [21].

In regard to mortality rate, overall, Japanese and Filipina women had higher mortality rates than the other subgroups, ranging from 12.7 to 56.2 and 15.2 to 41.2, respectively. Lauderdale and Huo's (2008) study, which focused on adults aged 65 and older, reported significantly higher mortality rates for each subgroup [22].

Concerning genetic subtypes and staging differences of breast cancer, the Japanese tended to have better detection and treatment outcomes [26]. Iqbal (2015) reported the odds ratio of Asian American subgroups, compared to NHWs, being stage I breast cancer at diagnosis as 1.24 for Japanese, 0.97 for Chinese, 0.66 for South Asian, and 0.80 for Other Asian [27]. Furthermore, Gelber et al. found that Japanese and Filipina women were less likely to receive breast conserving surgery (BCS) for primary resection and that among women treated with BCS, radiation use seemed lower among Filipina women [28].

Colorectal Cancer

Nine studies focused on colorectal cancer. Researchers examined incidence ($n = 1$), mortality ($n = 3$), incidence and mortality ($n = 3$), and staging and survival outcomes ($n = 2$). Regarding colorectal cancer incidence, Chinese, Japanese, and Korean men had the highest colorectal cancer incidence rates, ranging from 52.2 to 54, 49.3 to 75.9, and 48.8 to 57.8, respectively [15, 16, 18]. For females, also, Chinese and Japanese subgroups had the highest incidence rates, ranging from 38.9 to 41.5 and 49.3 to 51.9, respectively[15, 16, 18]. When incidence rates were separated by sex and by age (< 50 and > 50 years old) among Chinese, Japanese, Filipino/a, Korean, Asian Indian/Pakistani, and Vietnamese subgroups, the rates were higher overall in males and among those in the 50-and-older category, with the highest incidences found in Japanese and Korean males aged 50 and older [29]. Among males, Koreans and Japanese had the highest incidence rates, while for females, the highest rates were found among Japanese, Chinese, and Koreans [29].

Regarding mortality, for both males and females, Chinese, Japanese, and Koreans had the highest mortality rates for colorectal cancer among the six subgroups represented. These results remained true in Lauderdale and Huo's study (2008), which sampled only adults aged 65 and older [22].

[1] The numbers reported in this result section are numbers from the initial cancer studies.

Table 1 Combined cancer incidence rates

	Chinese		Japanese		Filipina/o		Korean		Vietnamese		South Asian		Asian Indian/Paki-stani		Asian Indian		Cambodian		Lao		NHW	
Breast Cancer	**F**		**F**		**F**		**F**		**F**		**F**		**F**		**F**		**F**		**F**		**F**	
Kwong et al. 2005	71.9		105.5		97.4		49.1		54.9		–		–		–		–		–		–	
McCracken et al. 2007	75.1		102.8		102.4		50.7		55.5		–		–		–		–		–		152.9	
Miller et al. 2008	77.6		126.5		100.4		53.5		52.8		–		82.1		–		36.9		52.8		145.2	
Gomez et al. 2010	73.5		102.5		100.4		46.3		59.9		77.0		–		–		–		–		146.1	
Colorectal cancer	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Kwong et al. 2005	52.5	38.9	49.3	49.3	43.8	27.9	48.8	33.0	36.5	33.8	–	–	–	–	–	–	–	–	–	–	–	–
McCracken et al. 2007	52.2	41.5	64.4	50.2	48.4	29	57.8	33.1	39.1	33	–	–	–	–	–	–	–	–	–	–	59.1	42.8
Miller et al. 2008	54.0	40.2	75.9	51.9	50.4	29.4	55.9	35.9	41.2	33.3	–	–	23.1	18.8	–	–	30.0	21.1	30.2	27.5	65.6	47.6
Gastric cancer	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Kwong et al. 2005	18.5	11.5	26.6	15.1	8.3	5	54.2	26.1	26.1	14.2	–	–	–	–	–	–	–	–	–	–	–	–
McCracken et al. 2007	18.3	10.2	27.0	14	7.2	5	54.6	27.5	28.1	14.5	–	–	–	–	–	–	–	–	–	–	–	–
Miller et al. 2008	18.3	11.1	29.3	15	9.4	5.6	50.0	26.3	25.6	13.8	–	–	8.2	4.7	–	–	23.8	–	33.1	-	9.9	4.3
Liver cancer	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Kwong et al. 2005	23.6	6.1	7.6	7.0	14.9	4.4	30.4	12.7	53.5	15.6	–	–	–	–	–	–	–	–	–	–	–	–
McCracken et al. 2007	22.3	7.6	9.3	8.1	16.8	5.4	33.7	15.9	54.3	15.8	–	–	–	–	–	–	–	–	–	–	6.8	2.5
Miller et al. 2008	24.0	8.2	11.4	7.9	17.2	5.1	35.9	14.4	55.5	16.8	–	–	–	–	–	–	49.1	14.1	79.4	23.1	6.7	2.6
Pham et al. 2018	20.8	6.2	8.1	6.8	13.5	3.7	26.1	10.9	47.3	14.4	6.7	2.8	–	–	–	–	42.8	11.7	45.6	12.3	5.7	1.5
Lung cancer	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Kwong et al. 2005	51.3	29.0	46.0	25.9	70.0	23.2	63.7	23.7	72.9	33.6	–	–	–	–	–	–	–	–	–	–	–	–
McCracken et al. 2007	52.3	29.8	41.1	22.8	71.9	37.8	56.3	26.1	72.8	37.8	–	–	–	–	–	–	–	–	–	–	77.9	57.6
Miller et al. 2008	53.0	29.7	49.8	24.7	72.5	26.0	61.1	27.5	72.3	34.4	–	–	30.8	13.1	–	–	82.6	24.6	87.3	44.4	89.2	59.0
Non-Hodgkin's lymphoma	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Miller et al. 2008	14.8	10.0	18.3	12.2	19.4	12.2	14.5	7.4	14.7	12.0	–	–	15.8	9.4	–	–	22.1	–	20.3	–	24.6	17.2
Hodgkin's lymphoma	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Miller et al. 2008	1.3	0.7	1.5	–	1.5	1.6	–	–	–	–	–	–	2.0	1.8	–	–	–	–	–	–	3.5	2.9
Leukemia	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Miller et al. 2008	8.7	5.9	11.4	7.0	10.0	5.8	8.1	4.6	9.9	6.6	–	–	12.2	9.0	–	–	–	–	–	–	17.3	10.0
Myeloma	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Miller et al. 2008	2.7	2.5	2.8	2.2	5.8	4.2	2.1	2.0	2.7	4.3	–	–	4.8	4.3	–	–	–	–	–	–	6.6	4.1
Thyroid	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Kwong et al. 2005	2.6	8.5	3.2	7.0	5.0	15.4	3.3	10.4	4.1	11.5	–	–	–	–	–	–	–	–	–	–	–	–
Miller et al. 2008	3.2	10.0	3.3	8.2	6.1	17.7	3.7	9.8	4.0	13.3	–	–	2.7	8.3	–	–	–	13.4	–	–	4.3	11.8
Oral	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Miller et al. 2008	6.2	3.6	8.5	4.2	5.8	4.0	8.6	2.8	7.7	5.0	–	–	11.4	5.0	–	–	–	–	–	–	16.2	6.5

Table 1 (continued)

	Chinese		Japanese		Filipina/o		Korean		Vietnamese		South Asian		Asian Indian/Paki-stani		Asian Indian		Cambodian		Lao		NHW	
Nasopharynx	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Miller et al. 2008	8.9	3.5	–	–	4.8	1.6	1.7	–	6.7	2.3	–	–	–	–	–	–	–	–	–	–	0.6	0.2
Larynx	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Miller et al. 2008	3.0	–	3.1	–	2.9	–	3.2	–	4.3	–	–	–	4.5	–	–	–	–	–	–	–	7.1	1.7
Esophageal	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Miller et al. 2008	4.5	1.0	7.5	1.3	2.7	1.1	5.2	6.5	6.5	–	–	–	3.6	5.2	–	–	–	–	–	–	8.1	2.1
Pancreas	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Miller et al. 2008	9.8	6.8	12.5	11.3	9.2	7.7	12.5	8.4	11.4	10.0	–	–	8.0	4.4	–	–	–	–	21.6	–	13.0	9.8
Skin (melanoma)	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Miller et al. 2008	1.2	1.0	2.1	2.0	1.2	0.8	–	–	–	–	–	–	–	–	–	–	–	–	–	–	29.3	19.3
Kidney and renal pelvis	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Miller et al. 2008	7.2	4.0	11.5	4.8	9.2	4.8	9.4	4.2	5.0	1.7	–	–	8.4	2.8	–	–	–	–	–	–	17.5	8.5
Urinary bladder	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Miller et al. 2008	15.7	4.4	22.9	4.7	12.4	2.4	14.6	4.9	13.6	3.6	–	–	15.8	3.0	–	–	–	–	–	–	43.0	10.6
Brain and CNS	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Miller et al. 2008	4.3	2.7	4.3	2.8	3.8	2.4	2.9	2.4	4.9	2.7	–	–	6.7	5.6	–	–	–	–	–	–	8.9	6.2
Gallbladder	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Miller et al. 2008	0.9	1.3	-	0.9	1.0	1.4	4.3	3.4	-	2.2	–	–	–	3.5	–	–	–	–	–	–	0.7	1.2
Ovarian cancer	**F**		**F**		**F**		**F**		**F**		**F**		**F**		**F**		**F**		**F**		**F**	
Herrinton et al. 1994	11.7		11.5		8.1		–		–		–		–		–		–		–		15.6	
Miller et al. 2008	10.0		11.1		10.5		7.5		8.6		–		12.0		–		–		–		15.3	
Cervical cancer	**F**		**F**		**F**		**F**		**F**		**F**		**F**		**F**		**F**		**F**		**F**	
McCracken et al. 2007	5.4		5.6		8.5		11.4		14.0		–		–		–		–		–		–	
Wang et al. 2010	5.8		6.2		10.0		11.9		18.9		–		4.5		–		–		–		7.1	
Miller et al. 2008	5.6		6.2		10.0		10.8		16.8		–		6.1		–		15.3		24.8		8.1	
Corpus and uterus	**F**		**F**		**F**		**F**		**F**		**F**		**F**		**F**		**F**		**F**		**F**	
Kwong et al. 2005	10.8		16.7		16.5		8.1		9.1		–		–		–		–		–		–	
Miller et al. 2008	12.0		20.4		18.6		8.0		8.2		–		13.5		–		–		–		26.0	
Prostate	**M**		**M**		**M**		**M**		**M**		**M**		**M**		**M**		**M**		**M**		**M**	
Kwong et al. 2005	72.1		99.5		109.9		41.6		53.6		–		–		–		–		–		–	
McCracken et al. 2007	80.4		103.7		113.3		51.0		65.4		–		–		–		–		–		159.9	
Miller et al. 2008	84.8		115.0		121.9		55.7		59.1		–		98.4		–		39.7		30.9		170.0	
Testicular cancer	**M**		**M**		**M**		**M**		**M**		**M**		**M**		**M**		**M**		**M**		**M**	
Miller et al. 2008	1.7		4.6		1.8		–		1.2		–		2.3		–		–		–		7.0	

– Data not available for subgroup

Table 2 Cancer incidence trends from Gomez et al. (2013)†

	Chinese		Japanese		Filipina/o		Korean		Vietnamese		South Asian		Asian Indian/ Pakistani		Asian Indian		Cambodian		Lao		NHW	
Breast Cancer	**F**		**F**		**F**		**F**		**F**		**F**		**F**		**F**		**F**		**F**		**F**	
1990–1994	66.1 (#1)		98.8 (#1)		85.8 (#1)		34.9 (#1)		52.3 (#1)		–		56.1 (#1)		–		19.6 (#3)		22.5 (#4)		140.5 (#1)	
1998–2002	75.5 (#1)		120.1 (#1)		99.2 (#1)		53.9 (#1)		54.0 (#1)		–		76.2 (#1)		–		35.3 (#1)		34.4 (#2)		148.9 (#1)	
2004–2008	78.8 (#1)		104.9 (#1)		103.7 (#1)		69.5 (#1)		63.0 (#1)		–		88.3 (#1)		–		43.4 (#1)		41.3 (#1)		135.3 (#1)	
Colo-rectal Cancer	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
1990–1994	56.8 (#3)	39.6 (#2)	75.2 (#2)	47.1 (#2)	45.6 (#3)	27.8 (#2)	40.9 (#3)	27.5 (#2)	35.6 (#4)	30.5 (#4)	–	–	22.1 (#2)	14.4 (#2)	–	–	31.3 (#3)	22.8 (#2)	**	**	72.4 (#3)	50.0 (#3)
1998–2002	52.1 (#2)	38.8 (#2)	73.1 (#2)	50.5 (#2)	49.1 (#3)	28.8 (#2)	54.4 (#3)	35.7 (#2)	38.9 (#4)	32.5 (#3)	–	–	21.4 (#3)	16.9 (#2)	–	–	27.6 (#4)	19.3 (#3)	26.7 (#4)	25.0 (#2)	64.9 (#3)	47.2 (#3)
2004–2008	42.1 (#3)	35.7 (#2)	66.6 (#2)	43 (#2)	47..8 (#3)	31.8 (#2)	58.2 (#2)	40.9 (#2)	41.1 (#4)	35.8 (#2)	–	–	23.4 (#3)	18.8 (#3)	–	–	43.4 (#3)	42.2 (#2)	43.9 (#3)	33.7 (#2)	54.0 (#3)	40.6 (#3)
Gastric Cancer	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
1990–1994	19.2 (#5)	11.3 (#5)	37.7 (#4)	19.1 (#4)	**	**	55.9 (#2)	26.0 (#3)	30.8 (#5)	22.6 (#5)	–	–	**	**	–	–	**	**	45.5 (#3)	23.1 (#3)	–	–
1998–2002	17.7 (#5)	10.9 (#5)	28.5 (#4)	14.6 (#5)	**	**	49.2 (#4)	26.6 (#4)	24.6 (#5)	**	–	–	**	**	–	–	21.5 (#5)	**	49.2 (#4)	**	–	–
2004–2008	16.3 (#5)	**	24.2 (#5)	11.1 (#5)	**	**	52.5 (#4)	27.4 (#4)	21.2 (#5)	**	–	–	**	**	–	–	**	**	**	**	–	–
Liver Cancer	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
1990–1994	24.4 (#4)	**	**	**	13.8 (#5)	**	29.7 (#5)	**	45.3 (#3)	**	–	–	**	**	–	–	40.0 (#2)	16.8 (#5)	52.4 (#2)	19.5 (#5)	–	–
1998–2002	23.6 (#4)	**	**	**	16.6 (#5)	**	36.1 (#5)	15.1 (#5)	54.8 (#3)	17.7 (#4)	–	–	**	**	–	–	25.8 (#2)	12.6 (#5)	74.0 (#2)	74.0 (#2)	–	–
2004–2008	24.1 (#4)	**	**	**	17.1 (#5)	**	34.9 (#5)	**	56.0 (#3)	20.9 (#4)	–	–	**	**	–	–	52.7 (#1)	24.8 (#4)	64.5 (#2)	64.5 (#2)	–	–
Lung Cancer	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
1990–1994	60.5 (#2)	31.2 (#3)	51.1 (#3)	21.7 (#3)	68.1 (#2)	23.1 (#3)	67.4 (#1)	21.4 (#4)	79.0 (#1)	37.0 (#3)	–	–	20.4 (#3)	12.8 (#4)	–	–	81.8 (#1)	31.5 (#1)	92.5 (#1)	30.8 (#2)	96.7 (#2)	55.1 (#2)
1998–2002	51.5 (#3)	28.5 (#3)	48.0 (#3)	24.2 (#3)	70.1 (#2)	25.5 (#3)	60.1 (#1)	27.4 (#3)	69.9 (#1)	33.7 (#2)	–	–	28.1 (#2)	12.2 (#4)	–	–	73.2 (#1)	22.4 (#2)	85.9 (#1)	40.9 (#1)	83.7 (#2)	57.8 (#2)
2004–2008	52.0 (#2)	29.9 (#3)	52.4 (#3)	27.9 (#3)	68.4 (#2)	30.1 (#3)	57.5 (#3)	28.0 (#3)	73.4 (#1)	31.8 (#3)	–	–	30.1 (#2)	12.4 (#4)	–	–	51.7 (#2)	26.7 (#3)	70.6 (#1)	27.1 (#3)	74.0 (#2)	56.6 (#2)

Table 2 (continued)

	Chinese		Japanese		Filipina/o		Korean		Vietnamese		South Asian		Asian Indian/ Pakistani		Asian Indian		Cambodian		Lao		NHW	
Non-Hodgkin's Lymphoma	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
1990–1994	**	**	**	**	18.7 (#4)	**	**	**	**	**	–	–	11.0 (#5)	**	–	–	**	**	**	**	24.2 (#5)	–
1998–2002	**	**	**	**	18.8 (#4)	**	**	**	**	**	–	–	14.5 (#5)	**	–	–	**	**	**	**	–	–
2004–2008	**	**	**	**	19.6 (#4)	**	**	**	**	**	–	–	14.3 (#5)	**	–	–	17.0 (#5)	**	25.6 (#5)	**	–	–
Hodgkin's Lymphoma	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
1990–1994	**	**	**	**	**	**	**	**	**	**	–	–	**	**	–	–	**	**	**	**	–	–
1998–2002	**	**	**	**	**	**	**	**	**	**	–	–	**	**	–	–	**	**	**	**	–	–
2004–2008	**	**	**	**	**	**	**	**	**	**	–	–	**	**	–	–	**	**	**	**	–	–
Leukemia	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
1990–1994	**	**	**	**	**	**	**	**	**	**	–	–	**	**	–	–	**	**	**	**	–	–
1998–2002	**	**	**	**	**	**	**	**	**	**	–	–	**	**	–	–	**	**	**	**	–	–
2004–2008	**	**	**	**	**	**	**	**	**	**	–	–	**	**	–	–	**	**	**	**	–	–
Myeloma	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
1990–1994	**	**	**	**	**	**	**	**	**	**	–	–	**	**	–	–	**	**	**	**	–	–
1998–2002	**	**	**	**	**	**	**	**	**	**	–	–	**	**	–	–	**	**	**	**	–	–
2004–2008	**	**	**	**	**	**	**	**	**	**	–	–	**	**	–	–	**	**	**	**	–	–
Thyroid	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
1990–1994	**	**	**	**	**	15.6 (#4)	**	**	**	**	**	**	**	**	–	–	**	**	**	**	–	–
1998–2002	**	**	**	**	**	17.2 (#5)	**	**	**	**	**	**	**	**	–	–	**	**	**	**	–	–
2004–2008	**	12.2 (#5)	**	**	**	21.4 (#5)	**	15.3 (#5)	**	15.1 (#5)	**	**	**	11.9 (#5)	–	–	**	**	**	**	–	–

Table 2 (continued)

	Chinese		Japanese		Filipina/o		Korean		Vietnamese		South Asian		Asian Indian/ Pakistani		Asian Indian		Cambodian		Lao		NHW	
Oral	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
1990–1994	**	**	**	**	**	**	**	**	**	**	–	–	**	**	–	–	**	**	**	**	–	–
1998–2002	**	**	**	**	**	**	**	**	**	**	–	–	**	**	–	–	**	**	**	**	–	–
2004–2008	**	**	**	**	**	**	**	**	**	**	–	–	**	**	–	–	**	**	**	**	–	–
Naso-pharynx	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
1990–1994	**	**	**	**	**	**	**	**	**	**	–	–	**	**	–	–	**	**	**	**	–	–
1998–2002	**	**	**	**	**	**	**	**	**	**	–	–	**	**	–	–	**	**	**	**	–	–
2004–2008	**	**	**	**	**	**	**	**	**	**	–	–	**	**	–	–	**	**	**	**	–	–
Larynx	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
1990–1994	**	**	**	**	**	**	**	**	**	**	–	–	**	**	–	–	**	**	**	**	–	–
1998–2002	**	**	**	**	**	**	**	**	**	**	–	–	**	**	–	–	**	**	**	**	–	–
2004–2008	**	**	**	**	**	**	**	**	**	**	–	–	**	**	–	–	**	**	**	**	–	–
Esophagus	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
1990–1994	**	**	**	**	**	**	**	**	**	**	–	–	**	**	-	-	**	**	**	**	-	-
1998–2002	**	**	**	**	**	**	**	**	**	**	–	–	**	**	-	-	**	**	**	**	-	-
2004–2008	**	**	**	**	**	**	**	**	**	**	–	–	**	**	-	-	**	**	**	**	-	-
Pancreas	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
1990–1994	**	**	**	**	**	**	**	**	**	**	–	–	**	**	–	–	**	**	28.2 (#5)	**	–	–
1998–2002	**	**	**	**	**	**	**	**	**	**	–	–	**	**	–	–	**	**	**	**	–	–
2004–2008	**	**	**	**	**	**	**	**	**	**	–	–	**	**	–	–	**	**	**	**	–	–
Skin (melanoma)	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
1990–1994	**	**	**	**	**	**	**	**	**	**	–	–	**	**	–	–	**	**	**	**	–	–

Table 2 (continued)

	Chinese		Japanese		Filipina/o		Korean		Vietnamese		South Asian		Asian Indian/ Pakistani		Asian Indian		Cambodian		Lao		NHW	
1998–2002	**	**	**	**	**	**	**	**	**	**	–	–	**	**	–	–	**	**	**	**	31.2 (#5)	20.4 (#5)
2004–2008	**	**	**	**	**	**	**	**	**	**	–	–	**	**	–	–	**	**	**	**	37.1 (#5)	24.3 (#5)
Kidney and Renal Pelvis	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
1990–1994	**	**	**	**	**	**	**	**	**	**	–	–	**	**	–	–	**	**	**	**	–	–
1998–2002	**	**	**	**	**	**	**	**	**	**	–	–	**	**	–	–	**	**	**	**	–	–
2004–2008	**	**	**	**	**	**	**	**	**	**	–	–	**	**	–	–	**	**	**	**	–	–
Urinary Bladder	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
1990–1994	**	**	18.1 (#5)	**	**	**	**	**	**	**	–	–	14.6 (#4)	**	–	–	18.2 (#5)	**	**	**	–	–
1998–2002	**	**	22.7 (#5)	**	**	**	**	**	**	**	–	–	15.3 (#4)	**	–	–	**	**	**	**	–	–
2004–2008	**	**	24.4 (#4)	**	**	**	**	**	**	**	–	–	17.5 (#4)	**	–	–	**	**	**	**	–	–
Brain and CNS	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
1990–1994	**	**	**	**	**	**	**	**	**	**	–	–	**	**	–	–	**	**	**	**	–	–
1998–2002	**	**	**	**	**	**	**	**	**	**	–	–	**	**	–	–	**	**	**	**	–	–
2004–2008	**	**	**	**	**	**	**	**	**	**	–	–	**	**	–	–	**	**	**	**	–	–
Gallbladder	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
1990–1994	**	**	**	**	**	**	**	**	**	**	–	–	**	**	–	–	**	**	**	**	–	–
1998–2002	**	**	**	**	**	**	**	**	**	**	–	–	**	**	–	–	**	**	**	**	–	–
2004–2008	**	**	**	**	**	**	**	**	**	**	–	–	**	**	–	–	**	**	**	**	–	–
Ovarian	**F**		**F**		**F**		**F**		**F**		**F**		**F**		**F**		**F**		**F**		**F**	
1990–1994	**		**		**		**		**		–		9.6 (#5)		–		**		**		16.7 (#5)	

Table 2 (continued)

	Chinese	Japanese	Filipina/o	Korean	Vietnamese	South Asian	Asian Indian/ Pakistani	Asian Indian	Cambodian	Lao	NHW
1998–2002	**	**	**	**	**	–	10.9 (#5)	–	**	**	–
2004–2008	**	**	**	**	**	–	**	–	**	**	–
Cervical	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**
1990–1994	**	**	**	17.0 (#5)	38.6 (#2)	–	**	–	17.3 (#4)	38.6 (#2)	–
1998–2002	**	**	**	**	16.6 (#5)	–	**	–	13.5 (#4)	16.6 (#5)	–
2004–2008	**	**	**	**	**	–	**	–	16.7 (#5)	**	–
Corpus and uterus	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**
1990–1994	11.8 (#4)	16.4 (#5)	14.1 (#5)	**	**	–	13.6 (#3)	–	**	**	26.7 (#4)
1998–2002	11.6 (#4)	19.2 (#4)	18.3 (#4)	**	**	–	12.3 (#3)	–	**	**	26.9 (#4)
2004–2008	14.3 (#4)	20.0 (#4)	22.0 (#4)	**	**	–	16.4 (#3)	–	**	**	26.3 (#4)
Prostate	**M**	**M**	**M**	**M**	**M**	**M**	**M**	**M**	**M**	**M**	**M**
1990–1994	75.6 (#1)	132.5 (#1)	131.0 (#1)	40.6 (#4)	46.7 (#2)	–	85.1 (#1)	–	**	27.9 (#5)	198.0 (#1)
1998–2002	95.9 (#1)	112.7 (#1)	122.1 (#1)	57.0 (#2)	58.8 (#2)	–	95.9 (#1)	–	36.7 (#3)	24.8 (#5)	175.1 (#1)
2004–2008	84.8 (#1)	109.5 (#1)	117.2 (#1)	63.5 (#1)	56.0 (#3)	–	84.8 (#1)	–	38.1 (#4)	31.1 (#4)	154.7 (#1)
Testicular	**M**	**M**	**M**	**M**	**M**	**M**	**M**	**M**	**M**	**M**	**M**
1990–1994	**	**	**	**	**	–	**	–	**	**	–
1998–2002	**	**	**	**	**	–	**	–	**	**	–
2004–2008	**	**	**	**	**	–	**	–	**	**	–

** Data not available for subgroup

- Cancer was not one of the top five cancers for that subgroup

† Gomez SL, Noone A-M, Lichtensztajn DY, Scoppa S, Gibson JT, Liu L, et al. Cancer incidence trends among Asian American populations in the United States, 1990–2008. J Natl Cancer Inst. 2013;105:1096–110

For staging and survival outcomes of colorectal cancer, Lin et al. (2002) studied survival differences among Chinese, Japanese, and Filipino/a subgroups and NHWs using SEER data from 1988 to 2000 [30]. They found that among males, Filipinos were significantly less likely than other racial or ethnic groups to receive a diagnosis of localized or stage I disease, while for females, the proportions of stage I disease were lower among Chinese and whites. Moreover, among males, Filipino/as had poorer survival after colorectal carcinomas than other groups, while Chinese and white females had poorer five-year survival. Chien et al. (2005) assessed the same database as Lin and observed that, among Asian American subgroups, Japanese had a decreased risk of stage IV cancer but not of stage III; Chinese and Koreans had an increased risk of stage III cancers, but not of stage IV; and Filipino/as had increased risks of both stage III and IV cancers. These findings suggest that Filipino/as, especially males, are at higher risk of being diagnosed with colorectal cancers far later [31].

Gastric Cancer

Eight studies focused on gastric cancer. Researchers examined incidence ($n=1$), mortality ($n=3$), incidence and mortality ($n=3$), and outcome differences ($n=1$). The studies on incidence indicated that Korean, Japanese, and Vietnamese populations have the highest gastric cancer incidence rates, ranging from 50 to 54.6, 26.6 to 29.3, and 25.6 to 28.1, respectively, for males and 26.1 to 27.5, 14 to 15.1, and 13.8 to 14.5, respectively, for females [15, 16, 18]. One study demonstrated that Korean Americans had the highest incidence of gastric cancer between 1988 and 2012 in California [32].

The studies that focused on gastric cancer mortality rates examined data from 1997 to 2011 and found that overall, Koreans had the highest mortality rate for gastric cancer among the six subgroups, with the Japanese having the second highest rate [15, 16, 18, 22–24]. This remained true in Lauderdale and Huo's study (2008), which sampled only adults aged 65 and older [22].

Kim's study (2009) focused on gastric outcome differences among the Asian American subgroups from 1988 to 2006 [33]. Filipino/as had the worst overall survival, while Koreans had the best. Specifically, the median survival times for Korean, Japanese, Chinese, Vietnamese, and Filipino/a subgroups were 22.4 months, 13.7 months, 16.8 months, 16.3 months, and 10.3 months, respectively. When compared, Koreans generally had favorable features, with high rates of localized disease and low rates of lymph node metastasis, while Filipino/as had higher rates of distant metastatic disease [33].

Liver Cancer

Among the studies on liver cancer, researchers examined incidence rates ($n=2$), mortality rates ($n=3$), incidence and mortality rates ($n=3$), and survival outcomes ($n=2$). Although liver incidence rates appeared to be high across Asian American subgroups, Vietnamese, Cambodian, and Lao subgroups had the highest, ranging from 47.3 to 55.5, 42.8 to 29.1, and 45.6 to 79.4, respectively, for males and 14.4 to 16.8, 11.7 to 14.1, and 12.3 to 23.1, respectively, for females [15, 16, 18, 19]. Gomez's study (2013) demonstrated that liver cancer remained one of the top five cancers for Chinese males, Filipino males, Korean males, Vietnamese males, Cambodian males and females, and Lao males and females from 1990 to 2008 [21]. Likewise, Pham's study (2018) reported that Southeast Asian American subgroups (Vietnamese, Lao, and Cambodian) had an eight to nine times higher risk of developing hepatocellular carcinoma than other Asian ethnic groups and NHWs [19].

Based on the findings of the studies that focused on liver cancer mortality rates from 1988 to 2011, overall, Vietnamese had the highest mortality rate among the six subgroups for males, while mortality rates for females were lower than those of males[15, 16, 18, 22–24]. Moreover, Japanese, Filipino/a, and Asian Indian subgroups had lower mortality rates than the other ethnic groups [15, 16, 18, 22–24] (see Table 3).

With respect to the two studies that focused on outcome differences, first, Kwong's study (2010) compared median survival outcomes among nine subgroups [34]. The median survival outcomes for Chinese, Vietnamese, Filipino/a, Korean, Japanese, Lao/Hmong, Cambodian, South Asian, and Thai subgroups were 10 months, 12 months, 7 months, 11 months, 12 months, 2 months, 6 months, 12 months, and 4 months, respectively [34]. Second, in Stewart's study (2016), Lao/Hmong and Cambodians experienced significantly higher mortality rates, were less likely to receive curative treatment, and had the lowest cause-specific medial survival in weeks than the Chinese, Filipino/a, Japanese, Korean, South Asian, Thai, Vietnamese, Other Asians, and NHW [35].

Lung Cancer

Among the studies on lung cancer, researchers examined incidence rates ($n=1$), mortality ($n=3$), incidence and mortality ($n=3$), differences in histologic cell type ($n=3$), and survival outcomes ($n=1$). In general, lung cancer incidences were higher among males for all subgroups than for females. Filipino, Vietnamese, Cambodian, and Lao males had the highest incidence rates, ranging from 70.0 to 72.5 and 72.3 to 72.9 for the Filipino and Vietnamese groups, respectively, and Cambodian and Lao males had rates of 82.6 and 87.3,

Table 3 Combined cancer mortality rates

	Chinese		Japanese		Filipina/o		Korean		Vietnamese		South Asian		Asian Indian/ Pakistani		Asian Indian		Cam- bodian		Lao		NHW	
Breast Cancer	**F**		**F**		**F**		**F**		**F**		**F**		**F**		**F**		**F**		**F**		**F**	
Kwong et al. 2005	12.7		17.3		15.2		7.6		8.8		–		–		–		–		–		–	
Chu and Chu 2005	10.80–11.9		14.2–15.5		15.2–16.7		7.5–7.8		7.1–7.5		–		–		10.4–11.9		–		–			
McCracken et al. 2007	13.2		17.1		17.5		7.7		9		–		–		–		–		–		27.4	
Miller et al. 2008	12.3		15.1		17.2		7.8		7.6		–		–		11.2		–		–		27.8	
Thompson et al. 2016	9.9		12.7		15.2		8.1		6.6		–		–		–		–		–		23.3	
Lauderdale and Huo 2008*	47.8		56.2		41.2		21.2		23.5		–		–		62.9		–		–		129.3	
Colorectal cancer	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Kwong et al. 2005	16	13.6	26.8	15.9	15.4	8.7	16.9	12.6	9.7	7.8	–	–	–	–	–	–	–	–	–	–	–	–
Chu and Chu 2005	17.8–19.0	11.8–12.7	23.3–24.9	14.3–15.3	13.8–15.1	8.1–8.8	18.2–18.9	10.7–11.1	8.0–8.5	7.1–7.5	–	–	–	–	4.1–4.7	4.6–5.4	–	–	–	–	–	–
McCracken et al. 2007	18.2	13.8	27.1	15.1	16.6	9.3	19.1	12.8	11.1	7.1	–	–	–	–	–	–	–	–	–	–	21.3	15.7
Miller et al. 2008	19.5	12.8	25.8	15.3	16.1	9	17.6	12.1	8.8	7.4	–	–	–	–	4.1	5.3	–	–	–	–	24.6	17.3
Thompson et al. 2016	14.1	10.9	19.3	13.7	13.8	8.2	17.4	10.9	10	7.7	–	–	–	–	6.5	4.5	–	–	–	–	20.3	14.3
Lauderdale and Huo 2008*	112.1	74.7	160.5	87.2	86.4	46.6	89.5	57.5	62.6	52.8	–	–	–	–	48.2	41.7	–	–	–	–	150.7	115.1
Gastric cancer	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Kwong et al. 2005	12.3	7.0	17.8	11.1	5.2	3.1	34.6	14.5	12.4	8	–	–	–	–	–	–	–	–	–	–	–	–
Chu and Chu 2005	11.2–12.0	7.0–7.6	17.3–18.4	9.9–10.5	4.4–4.8	2.8–3.0	31.1–32.4	15.0–15.6	13.2–14.1	6.0–6.7	–	–	–	–	3.1–3.5	1.9–2.2	–	–	–	–	–	–
McCracken et al. 2007	11.4	6.6	18.1	11.6	4.1	3.2	35.2	13.9	15.5	8.9	–	–	–	–	–	–	–	–	–	–	–	–

Table 3 (continued)

	Chinese		Japanese		Filipina/o		Korean		Vietnamese		South Asian		Asian Indian/ Pakistani		Asian Indian		Cam-bodian		Lao		NHW	
Miller et al. 2008	11.7	7.3	16.6	10.2	4.9	3.2	31.5	14.5	12.7	7	–	–	–	–	3.7	2.4	–	–	–	–	5.8	2.8
Thompson et al. 2016	8.8	4.9	12.7	6.7	4.2	2.5	21.6	11.7	8.5	5.2	–	–	–	–	3.2	2.2	–	–	–	–	4.1	2.0
Lauderdale and Huo 2008 *	73.3	38.7	114.8	58.1	28.7	20	176.9	70.7	88	51.3	–	–	–	–	24.9	17.5	–	–	–	–	37.1	19.8
Liver cancer	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Kwong et al. 2005	20.7	5.6	6.4	6.5	9.4	3.1	22.1	10.9	32.2	11.4	–	–	–	–	–	–	–	–	–	–	–	–
Chu and Chu 2005	18.8–20.4	6.9–7.5	8.3–8.9	6.1–6.6	10.6–11.6	3.5–3.8	23.7–24.7	12.7–13.1	32.4–34.3	9.9–10.5	–	–	–	–	4.4–5.1	2.4–2.8	–	–	–	–	–	–
McCracken et al. 2007	19.9	7.8	8.3	7.8	12.0	4.2	26.6	11.5	35.5	10.4	–	–	–	–	–	–	–	–	–	–	6.0	2.7
Miller et al. 2008	20.3	7.4	9.1	6.5	11.3	3.9	26.3	11.7	33.8	10.9	–	–	–	–	5.3	2.6	–	–	–	–	6.1	2.7
Thompson et al. 2016	14.5	4.7	6.2	5.6	8.8	2.7	18.2	7.8	26.2	8.3	–	–	–	–	4.1	1.6	–	–	–	–	5.6	1.8
Lauderdale and Huo 2008*	97.1	42.3	53.1	32.9	49.6	16.5	125.0	64.0	141.8	61.9	–	–	–	–	–	–	–	–	–	–	28.2	14.6
Lung Cancer	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Kwong et al. 2005	46.1	24.8	40.1	20.9	45.8	17.0	55.3	20.8	46.6	21.1	–	–	–	–	–	–	–	–	–	–	–	–
Chu and Chu 2005	46.5–49.8	22.7–24.5	36.3–38.4	18.4–19.4	42.6–46.5	16.2–17.5	52.4–54.6	20.3–21.0	40.5–43.0	17.7–18.8	–	–	–	–	15.2–17.4	4.7–5.4	–	–	–	–	–	–
McCracken et al. 2007	46.6	23.9	36.0	19.5	49.8	17.5	52.3	22.7	47.2	23.3	–	–	–	–	–	–	–	–	–	–	64.0	44.9
Miller et al. 2008	47.0	23.8	39.5	19.7	47.9	17.2	50.6	20.7	43.9	20.2	–	–	–	–	17.2	6.4	–	–	–	–	72.2	44.5
Thompson et al. 2016	38.8	20.5	35.2	22.2	39.9	71.9	37.7	19.3	37.6	17.0	–	–	–	–	15.7	6.7	–	–	–	–	67.4	42.9
Lauderdale nd Huo 2008*	300.2	147.0	257.0	99.0	262.5	84.6	335.5	112.5	285.5	114.2	–	–	–	–	101.0	57.0	–	–	–	–	454.3	206.8

Table 3 (continued)

	Chinese		Japanese		Filipina/o		Korean		Vietnamese		South Asian		Asian Indian/ Pakistani		Asian Indian		Cam-bodian		Lao		NHW	
Non–Hodgkin's Lymphoma	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Chu and Chu 2005	5.8–6.2	3.6–3.9	6.0–6.4	4.7–5.1	8.9–9.7	3.5–3.7	5.9–6.2	3.2–3.3	5.7–6.0	3.7–3.9	–	–	–	–	3.0–3.4	2.0–2.3	–	–	–	–	–	–
Miller et al. 2008	6.0	4.1	7.5	5.0	9.1	4.4	6.2	2.9	5.2	4.0	–	–	–	–	3.7	2.6	–	–	–	–	10.6	6.8
Thompson et al. 2016	5.0	3.3	5.9	3.7	6.4	4.0	3.6	2.4	5.1	2.9	–	–	–	–	4.4	3.1	–	–	–	–	8.9	5.5
Lauderdale and Huo 2008*	37.6	23.8	45.0	20.6	51.1	26.2	33.2	22.0	25.7	18.0	–	–	–	–	19.9	19.5	–	–	–	–	54.2	41.8
Hodgkin's lymphoma	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Lauderdale and Huo 2008*	2.7	1.2	1.6	1.6	0.3	0.4	0	0	3.1	0.6	–	–	–	–	3.9	0	–	–	–	–	2.3	1.7
Leukemia	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Chu and Chu 2005	6.0–6.5	3.1–3.4	4.9–5.4	3.5–3.8	5.0–5.7	2.3–2.6	5.7–6.0	2.3–2.5	7.0–7.4	4.4–4.7	–	–	–	–	4.6–5.3	2.4–2.8	–	–	–	–	–	–
Miller et al. 2008	6.1	3.1	5.9	4.0	5.7	3.1	5.5	2.6	7.2	4.2	–	–	–	–	4.8	3.5	–	–	–	–	10.6	6.0
Thompson et al. 2016	4.9	2.9	5.1	2.7	5.6	3.8	3.9	2.2	4.8	2.9	–	–	–	–	4.4	3.1	–	–	–	–	10.1	5.6
Lauderdale and Huo 2008*	28.4	19.4	28.5	14.2	32.0	19.8	22.5	10.2	15.9	14.1	–	–	–	–	23.5	17.8	–	–	–	–	55.8	33.4
Myeloma	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Chu and Chu 2005	1.7–1.8	1.0–1.1	1.3	1.5–1.6	2.8–3.0	2.5–2.7	Nr**	1.4–1.5	7.0–7.4	4.4–4.7	–	–	–	–	1.4–1.5	2.2–2.5	–	–	–	–	–	–
Miller et al. 2008	1.7	1.2	1.4	1.6	3.2	2.4	–	1.4	–	1.6	–	–	–	–	2.2	2.1	–	–	–	–	4.5	2.9
Lauderdale and Huo 2008*	13.3	7.7	14.2	9.8	18.6	16.6	14.9	10.6	10.2	7.8	–	–	–	–	26.9	15.2	–	–	–	–	27.1	19.1
Thyroid	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Kwong et al. 2005	–	0.8	–	–	–	1.6	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Chu and Chu 2005	–	0.6	–	0.5–0.6	0.7–0.8	0.8–0.9	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table 3 (continued)

	Chinese		Japanese		Filipina/o		Korean		Vietnamese		South Asian		Asian Indian/ Pakistani		Asian Indian		Cam-bodian		Lao		NHW	
Miller et al. 2008	–	0.5	–	–	0.8	1.2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0.5	0.5
Oral	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Chu and Chu 2005	5.8–6.3	2–2.2	2–2.2	0.8	3.3–3.6	1.2–1.3	3.1–3.3	nr	5.9–6.2	2.1–2.2	–	-	-	-	2.6–3.0	nr	-	-	-	-	-	-
Miller et al. 2008	1.8	0.8	1.9	0.9	1.8	0.7	-	-	3.6	-	-	-	-	-	2.9	-	-	-	-	-	3.7	1.6
Nasophar-ynx	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Chu and Chu 2005	4.4–4.8	1.3–1.4	–	–	1.2–1.3	0.4–0.5	–	–	2.2–2.3	nr	–	–	–	–	–	–	–	–	–	–	–	–
Miller et al. 2008	4.5	1.4	–	–	1.5	0.5	–	–	1.7	–	–	–	–	–	–	–	–	–	–	–	0.3	0.1
Larynx	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Miller et al. 2008	0.9	–	–	–	0.8	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	2.2	0.5
Lauderdale and Huo 2008	7.2	0.0	1.2	0.3	6.3	0.6	7.9	0.0	6.1	0.6	–	–	–	–	9.6	0.0	–	–	–	–	13.3	2.7
Lip, oral pharynx	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Lauderdale and Huo 2008*	15.3	10.1	24.9	4.3	15.9	7.5	13.7	2.2	19.2	11.1	–	–	–	–	10	5.9	–	–	–	–	19.8	9.4
Esophageal	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Chu and Chu 2005	3.6–3.8	0.8–0.9	6.5–7.0	1.1–1.2	2–2.2	0.6–0.7	3.0–3.1	nr	3.3–3.5	nr	–	–	–	–	3.7–4.2	2.5–2.9	–	–	–	–	–	–
Miller et al. 2008	3.8	1.1	7.8	1.1	2.6	0.6	3.7	–	2.6	–	–	–	–	–	3.5	2.8	–	–	–	–	7.7	1.8
Lauderdale and Huo 2008*	23.7	8.4	22.7	6.0	16.2	5.7	37.8	1.0	20.9	5.6	–	–	–	–	37.0	10.4	–	–	–	–	35.2	9.6
Pancreas	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Chu and Chu 2005	7.9–8.4	6.7–7.2	12.1–12.9	10.1–10.6	6.5–7.1	5.7–6.2	10.6–11.1	7.9–8.2	7.0–7.4	5.6–6.0	–	–	–	–	5.0–5.7	3.2–3.7	–	–	–	–	–	–
Miller et al. 2008	8.5	6.7	12.2	10.6	7.0	6.3	11.4	7.5	8.9	6.2	–	–	–	–	5.8	3.5	–	–	–	–	12.6	9.5
Thompson et al. 2016	8.1	6.8	12.2	9.8	7.4	6.2	11.0	8.5	6.3	4.9	–	–	–	–	5.8	4.1	–	–	–	–	12.6	9.4
Lauderdale and Huo 2008*	55.3	45.5	73.0	54.8	53.0	37.1	56.9	47.6	37.8	32.0	–	–	–	–	50.6	29.3	–	–	–	–	65.1	54.8

Table 3 (continued)

	Chinese		Japanese		Filipina/o		Korean		Vietnamese		South Asian		Asian Indian/ Pakistani		Asian Indian		Cam-bodian		Lao		NHW	
Skin	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Chu and Chu 2005) Melanoma	0.5–0.5	nr	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Miller et al. 2008 Melanoma	0.6	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4.7	2.2
Lauderdale and Huo 2008*	2.9	2.3	1.5	1.5	8.9	3.1	0	1.7	1.9	0	–	–	2.8	0.8	–	–	–	–	–	–	16.9	7.7
Kidney and renal pelvis	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Chu and Chu 2005	2.9–3.2	1.2–1.3	3.8–4.1	1.2–1.3	2.2–2,5	1.3–1.4	3.3–3.4	1.8	2.8–3.0	nr	–	–	–	–	–	–	–	–	–	–	–	–
Miller et al. 2008	2.9	1.6	4.7	1.3	3.0	1.4	3.0	1.7	2.6	–	–	–	–	–	–	–	–	–	–	–	6.2	2.8
Lauderdale and Huo 2008*	15.9	10.7	21.4	7.4	12.5	6.5	17.7	11.2	11.4	3.2	–	–	–	–	18.3	7.4	–	–	–	–	30.7	15.5
Urinary bladder	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Chu and Chu 2005	3.2–3.4	1.0–1.1	4.8–5.0	1.2	1.9–2.0	0.7–0.8	3.6–3.8	nr	2.4–2.5	nr	–	–	–	–	3.1–3.6	nr	–	–	–	–	–	–
Miller et al. 2008	3.6	1.0	4.6	1.4	2.0	0.7	4.1	–	2.0	–	–	–	–	–	3.7	–	–	–	–	–	8.4	2.4
Lauderdale and Huo 2008*	25.3	9.3	14.1	10.9	13.1	4.5	18.7	6.4	13.4	7.4	–	–	–	–	28.0	4.9	–	–	–	–	48.1	16.1
Brain and CNS	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Chu and Chu 2005	2.0–2.2	1.6–1.8	1.4–1.8	1.0–1.2	2.5–2.8	1.2–1.4	1.3–1.4	1.3–1.4	2.6–2.7	1.4–1.5	–	–	–	–	3.4–3.9	2.2–2.5	–	–	–	–	–	–
Miller et al. 2008	2.5	1.8	2.6	1.2	2.7	1.4	2.0	1.5	2.9	1.5	–	–	–	–	3.3	2.4	–	–	–	–	6.3	4.2
Lauderdale and Huo 2008*	7.8	6.5	5.9	3.2	12.3	6.0	12.3	4.4	9.4	4.7	–	–	–	–	8.5	11.3	–	–	–	–	22.8	15.8
Gallbladder	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Chu and Chu 2005	0.5–0.6	0.7–0.8	–	–	0.6–0.7	0.6–0.7	2.2–2.3	2.0–2.0	–	–	–	–	–	–	nr	1.5–1.7	–	–	–	–	–	–
Miller et al. 2008	0.7	0.7	–	0.8	0.7	0.7	3.1	2.2	–	–	–	–	–	–	–	1.5	–	–	–	–	0.5	0.8

Table 3 (continued)

	Chinese	Japanese	Filipina/o	Korean	Vietnamese	South Asian	Asian Indian/ Pakistani	Asian Indian	Cam-bodian	Lao	NHW
Ovarian	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**
Chu and Chu 2005	5.0–5.4	5.1–5.5	5.4–5.9	4.5–4.6	4.2–4.5	–	–	3.2–3.7	–	–	–
Miller et al. 2008	5.2	5.1	5.6	4.5	4.5	–	–	5.0	–	–	9.8
Thompson et al. 2016	4.2	5.5	4.9–	4.4	3.1	–	–	5.8	–	–	8.8
Lauderdale and Huo 2008*	24.8	21.3	22.5	16.0	22.3	–	–	29.4	–	–	45.6
Cervical	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**
Chu and Chu 2005	1.9–2.1	1.8–2.0	2.6–2.9	2.8–3.0	4.3–4.5	–	–	2.0–2.3	–	–	–
McCracken et al. 2007	1.5	a	3.1	3.0	4.8	–	–	–	–	–	7.3
Miller et al. 2008	2.2	1.7	2.8	3.1	4.4	–	–	2.2	–	–	2.4
Lauderdale and Huo 2008*	12.6	4.9	8.1	11.8	13.7	–	–	16.4	–	–	7.7
Corpus and Uterus	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**	**F**
Kwong et al. 2005	1.8	2.5	2.3	a	a	–	–	–	–	–	–
Chu and Chu 2005	2.0–2.2	2.3–2.5	2.7–2.9	1.6	1.7–1.8	–	–	1.5–1.7	–	–	–
Miller et al. 2008	2.1	3.1	2.8	1.7	1.4	–	–	1.6	–	–	4.2
Lauderdale and Huo 2008*	10.0	13.0	10.3	8.2	7.5	–	–	19.9	–	–	23.2
Prostate	**M**	**M**	**M**	**M**	**M**	**M**	**M**	**M**	**M**	**M**	**M**
Kwong et al. 2005	9.9	14.3	17.5	8.0	8.5	–	–	–	–	–	–
Chu and Chu 2005	9.9–10.5	15.5–16.2	17.2–[9]18.6	8.1–8.4	6.4–6.8	–	–	8.6–10.0	–	–	–
McCracken et al. 2007	8.9	15.1	15.7	7.1	9.1	–	–	–	–	–	27.0

Table 3 (continued)

	Chinese	Japanese	Filipina/o	Korean	Vietnamese	South Asian	Asian Indian/ Pakistani	Asian Indian	Cam-bodian	Lao	NHW
Miller et al. 2008	10.4	15.2	17.8	6.8	6.7	–	–	10.6	–	–	27.7
Thompson et al. 2016	8.2	12.0	14.6	6.5	5.1	–	–	10.3	–	–	22.1
Lauderdale and Huo 2008*	88.6	120.5	147.0	70.5	42.7	–	–	85.9	–	–	213.5

*Lauderdale's study included a sample size that was 65+

Data not available for subgroup

respectively [15, 16, 18]. Gomez (2013) found that lung cancer remained one of the top five cancers for all eight subgroups from 1990 to 2008 [21].

In the studies that focused on mortality rates from 1988 to 2011, such rates were higher among males than females. Vietnamese, Korean, and Chinese males had the highest mortality rates, ranging from 26.2 to 35.5, 18.2 to 26.6, and 14.5 to 20.7, respectively [15, 16, 18, 22–24]. This remained true in Lauderdale's study (2008) [22].

Furthermore, the studies that focused on differences in histologic cell type for lung cancer found different rates among Asian American subgroups. For example, Cheng et al.'s study (2014) assessed trends in histologic cell types across AANHPI populations (Chinese, Filipino, Japanese, Korean, Vietnamese, Lao, Kampuchean, and Asian Indian/Pakistani subgroups) [36]. These researchers found significant increases in adenocarcinoma in Filipina and Korean women and increases in squamous cell carcinoma among Japanese women. However, trends in rates for the other histologic cell types were declining or remained stable in most subgroups. In addition, Epplein's study (2005) assessed lung cancer incidence among Chinese, Filipino/a, and Japanese subgroups, adjusting for smoking [37]. They reported that among Chinese women, the risks for adenocarcinoma and large cell undifferentiated carcinoma were six- and fourfold, respectively, while Filipina women had an appreciably higher lung cancer risk for adenocarcinoma. Moreover, Raz's study (2008) assessed epidemiologic data on the prevalence of non-small cell lung cancer (NSCLC) among Chinese, Filipino/a, Japanese, Korean, Vietnamese, and South Asian subgroups and reported that South Asians had the lowest incidence rates, while Vietnamese had the highest. Japanese and Koreans had intermediate rates of NSCLC. The author also found that Asian American men tended to have higher incidence rates than women and that foreign-born Asian Americans tended to have higher incidence rates, with the exception of South Asians [38].

Trinh's study (2015) focused on survival outcomes for lung cancer, examining lung-cancer-specific survival among Chinese, Filipino/a, Japanese, Korean, Asian Indian/Pakistani, Vietnamese, and Other Asian populations [39]. Trinh et al. (2015) observed no racial differences among lung cancer patients with stage 1 or 2 disease in receiving treatment; however, among patients with stage 3 disease who did not receive treatment, the Chinese, Filipino/as, and Other Asians had the lowest rates of receiving treatment among subgroups.

Other Cancers

Other cancers included lymphoid ($n=5$), leukemia ($n=4$), myeloma ($n=3$), thyroid ($n=3$), lip/oral/nasopharyngeal/laryngeal ($n=3$), esophageal ($n=3$), pancreatic ($n=4$), melanoma ($n=3$), kidney and renal pelvis/urinary bladder ($n=3$), brain and central neverous system (CNS; $n=3$), gallbladder ($n=3$), ovarian ($n=6$), cervical ($n=7$), uterine ($n=4$), prostate ($n=10$), and testicular cancers ($n=1$). Among the lymphoma studies, Miller's study (2008) reported that the overall incidence rate for Non-Hodgkin's lymphoma (NHL) was higher among males than females for each subgroup except for Cambodian and Lao women, as data for NHL were not available for these populations [18]. Of the seven subgroups, Japanese, Filipino, Cambodian, and Lao males had the highest incidence rates: 18.3, 19.4, 22.1, and 20.3, respectively [18, 22–24]. Similarly, Gomez's study (2013) reported that NHL remained one of the top five cancers for only Filipino and Asian Indian/Pakistani males from 1990 to 2008 [21].

The leukemia and myeloma studies showed mixed results across the Asian American subgroups. For instance, Carreon's study (2008) found that rates were generally higher among men of all subgroups except the Vietnamese; however, the data varied by lymphoid subtype [40]. Moreover, Miller's study (2008) found that leukemia incidence rates were higher among males than females for each subgroup. Furthermore, Asian Indian/Pakistani males had the highest leukemia incidence rate, at 12.2, and Korean females had the lowest leukemia incidence rate, at 4.6 [18]. In addition, Gomez's study (2013) demonstrated that leukemia was never among the top five cancers for all eight subgroups from 1990 to 2008 [21]. While leukemia mortality rates were lower among females than males across all six subgroups, older Filipino males (aged 65 and older) had the highest leukemia mortality rates, followed by Chinese and Korean: 32, 28.4, and 22.5, respectively [18, 22–24].

Similarly, myeloma incidence and mortality rates were overall low among the six subgroups [18], and myeloma was never among the top five cancers for all eight subgroups from 1990 to 2008 [21]. However, Miller (2008) reported that Filipino males had the highest myeloma incidence rate, at 5.8, and Korean females had the lowest incidence rate, at 2.0 [18]. See Tables 1, 2, and 3 for additional incidences and trends of other cancers.

Among the cervical cancer studies, Bates' study (2008) examined cervical cancer subtype variations among Chinese, Filipina, Korean, Japanese, South Asian, and Vietnamese women. The authors found that Chinese, Korean, South Asian, and Vietnamese women had a greater proportion of squamous cell carcinoma subtype and a lower proportion of adenocarcinoma subtype, while the opposite was observed for Japanese and Filipina women [41]. Another study also assessed cervical cancer subtype variations with some results differing from those presented by Bates. Wang et al. (2008) also found that Vietnamese and Korean women had the greatest rates for squamous cell carcinoma subtype; however, for adenocarcinoma, they found that Vietnamese and Filipina women had the highest rates [42].

Of the prostate cancer studies, four assessed variations in survival outcomes among Asian American subgroups. Chao's study (2016) examined Chinese, Japanese, Filipino/a, Korean, Vietnamese, Asian Indian/Pakistani, and other Asian subgroups and found that all subgroups had a higher chance of being diagnosed with metastatic disease than NHWs [43]. They also found that survival outcomes among Filipino/as and Asian Indian/Pakistani were higher than those of the other subgroups [43]. In addition, Lin's study (2002) demonstrated that Filipinos were less likely to contract a localized or stage I disease [30]. Robbins' study (2007) also assessed 10-year risk of death and found that all subgroups (Chinese, Filipino, Japanese, Korean, and Vietnamese), with the exception of South Asian men, had lower 10-year risks of death from prostate cancer [44].

Diabetes

Thirteen articles focused on or included diabetes prevalence and complications due to diabetes mellitus (DM) among the following subgroups: Chinese, Filipino/a, Japanese, Korean, Vietnamese, Asian Indian, South Asian (Asian Indian, Pakistani, Bangladeshi, Sri Lankan, or Nepalese), Southeast Asian (Cambodian, Lao, Burmese, Thai, Malaysian, or Indonesian), and Other Asian. Tables 4 and 5 show combined data on diabetes prevalence and incidence rates among the subgroups. Eight studies included prevalence rates, and, overall, Filipino/as, Asian Indians, South Asians—including Asian Indians, among others—had higher prevalence rates [45–53]. One study included incidence rates, and, similarly, Filipino/a and South Asian subgroups had higher rates [48]. Furthermore, studies that separated data by sex demonstrated that among men, rates and DM likelihood were higher among Filipino and South Asian populations, while among women, higher rates were found among Filipina and Korean women [45, 54]. Three studies included data on complications due to DM, namely renal disease, myocardial infarction, heart failure, stroke, and lower extremity amputation [55, 56].

Rheumatic Disease

One study included prevalence data for arthritis for the following subgroups: Chinese, Cambodian, Vietnamese, and U.S. Asians [51]. Data was collected from local health surveys conducted among Chinese, Cambodian, and Vietnamese communities in Chicago and the American Community Survey from 2005 to 2007. The study did not differentiate between types of arthritis. The study's results indicated that Cambodian and Vietnamese adults were diagnosed with arthritis twice as often as Chinese and U.S. Asian adults.

Table 4 Combined prevalence rates for all non–cancer diseases

	Chinese		Filipino/a		Japanese		Korean		Vietnamese		Mon-golian		Asian Indian		Paki-stani		South Asian		Cambo-dian		Bur-mese		Thai		Laos		Southeast Asian		Other Asian		Aggregate		NHW	
Diabetes																																		
Karter et al. 2013	8.15		16.13		10.28		9.85		9.85		–		–		–		15.85		–		–		–		–		10.52		12.12		–		7.25	
Islam et al. 2013	9.1		–		–		10.0		–		–		20.9		–		–		–		–		–		–		–		–		–		–	
Shih et al. 2014	5.2		10.7		6.7		6.3		5.9		–		–		–		11.8		–		–		–		–		–		14.3		7.1		5.7	
Kanaya et al. 2014	13.2		–		–		–		–		–		–		–		23.2		–		–		–		–		–		–		–		6.3	
Shah et al. 2010	7.1		–		–		–		12.9		–		–		–		–		12.0		–		–		–		–		–		8.9		–	
	M		**M**		**M**		**M**		**M**		**M**		**M**		**M**		**M**		**M**		**M**		**M**		**M**		**M**		**M**		**M**			
Mui et al. 2017	5.8		10.1		8.9		8.7		7.9		–		–		–		–		–		–		–		–		–		6.5		7.7		7.4	
	M	**F**	**M**	**F**	**M**	**F**	**M**		**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Huang et al. 2015	6.7	6.1	19.4	9.6	10.4	6.6	9.6	–	7.9	5.5	–	–	–	–	–	–	18.6	8.2	–	–	–	–	–	–	–	–	–	–	–	–	11.4	7.6	7.8	5.6
Wang et al. 2011	8.1	5.5	22.2	14.8	10.9	8.3	10.0	–	6.6	4.3	–	–	13.8	11.2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	11.2	7.8	8.1	5.8
Proteinuric DKD**																																		
Bhalla et al. 2013	27.6		37.9		–		–		–		–		24.8		–		–		–		–		–		–		–		–		–		24.8	
Non–proteinuric DKD**																																		
Bhalla et al. 2013	6.3		9.8		–		–		–		–		9.7		–		–		–		–		–		–		–		–		–		11.7	
Arthritis																																		
Shah et al. 2010	12.1		–		–		–		21.5		–		–		–		–		24.5		–		–		–		–		–		9.9		–	
Cardiovascular disease																																		
Holland et al. 2011	3.0		5.1		2.9		1.7		5.2		–		5.2		–		–		–		–		–		–		–		–		3.6		3.9	

Table 4 (continued)

	Chinese		Filipino/a		Japanese		Korean		Vietnamese		Mon-golian	Asian Indian		Paki-stani	South Asian		Cambo-dian		Bur-mese	Thai	Laos	Southeast Asian		Other Asian		Aggregate		NHW	
Carlisle et al. 2014	16.8		27.8		–		–		20		–	–		–	–		–		–	–	–	–		–		21.3		–	
Arterial disease																													
Holland et al. 2011	0.9		1.3		0.5		0.8		0.5		–	1.4		–	–		–		–	–	–	–		–		0.9		1.9	
Venous disease																													
Holland et al. 2011	0.4		0.6		0.5		0.3		0.4		–	0.6		–	–		–		–	–	–	–		–		0.5		1.7	
Hyper-tension																													
Shah et al. 2010	22.1		–		–		–		28.4		–	–		–	–		25.7		–	–	–	–		–		19.5		–	
	M	**F**	**M**	**F**	**M**	**F**	**M**		**M**	**F**		**M**	**F**		**M**	**F**	**M**	**F**				**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
Jung et al. 2019	33.3	12.1	–	–	–	–	37.3	–	45.9	16.1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	38.7	18.7	–	–
Lloyd–Jones ete al. 2005*	–	12.8	–	–	–	11.0	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	14.5
Ischemic stroke																													
Holland et al. 2011	0.9		1.5		0.8		0		1.1		–	0.9		–	–		–		–	–	–	–		–		0.9		1.0	
Hemor-rhagic stroke																													
Holland et al. 2011	0.2		0.3		0.4		0.3		0.7		–	0.1		–	–		–		–	–	–	–		–		0.3		0.2	
Hepatitis B																													
Hur et al. 2012	9.0		–		–		–		13.4		6.8	–		–	–		–		–	–	–	–		1.9		–		–	
Juon et al. 2019	8.1		1.7		–		4.6		8.2		–	–		1.4	–		11.9		3.4	3.3	6.1	–		–		–		–	

Table 4 (continued)

	Chinese	Filipino/a	Japanese	Korean	Vietnamese	Mon-golian	Asian Indian	Paki-stani	South Asian	Cambo-dian	Bur-mese	Thai	Laos	Southeast Asian	Other Asian	Aggregate	NHW
Hepatitis C																	
Juon et al. 2019	0.4	–	–	1.0	4.4	–	–	3.0	–	10.8	4.9	–	3.0	–	–	–	–

*Diabetes–related complications

**Lloyd–Jones' study focused on a sample of premenopausal and perimenopausal women

Autoimmune Disorders

One study included data regarding systemic lupus erythematosus (SLE) among Chinese, Japanese, and Filipino/a subgroups [57]. Data were collected from five medical centers, five rheumatologists, eight nephrologists, 190 primary care physicians in regard to patients diagnosed with SLE from 1988 to 1989, and the Hawaii Lupus Foundation. The researchers found a statistically significant difference in increased SLE prevalence odds ratios for Chinese and Filipino/a individuals compared to Caucasians.

Infectious Diseases

Hepatitis B and C

Four studies included prevalence data for hepatitis B and/or C (see Table 4). From the prevalence rates, Chinese, Vietnamese, and Cambodian subgroups had higher rates of hepatitis B than the other subgroups [58, 59]. Misra's study (2013) also noted that first-generation Chinese and Southeast Asian immigrants (from Burma, Cambodia, Indonesia, Laos, Malaysia, the Philippines, Myanmar, Singapore, Thailand, and Vietnam) had higher rates of hepatitis B and C than other Asian subgroups [60]. Likewise, Noah's study (2018) examined births among Asian American women with hepatitis B infection and found that Chinese American mothers were 10 times more likely to experience this infection than Asian Indian and Japanese American mothers [61].

Juon's study (2019) also included prevalence rates for hepatitis C. In comparison to other subgroups, hepatitis C infection was higher among Cambodians (10.8%), who also had the highest prevalence rate for hepatitis B in the study [59].

Tuberculosis

Two studies included data on TB, specifically examining the trends in TB case rates among Asian American subgroups from 2002 to 2007. There was a decline in rates among Vietnamese, Filipino/a, Asian Indian, Pakistani, and Korean subgroups, of 17.7%, 12.7%. 17.6, 4.3%, and 20.1%, respectively, while the rates increased among the Cambodian and Chinese subgroups by 20.2% and 4.2%, respectively [62]. Moreover, foreign-born individuals had higher rates than U.S.-born residents. Shah's study (2010) stated prevalence rates for the Chinese, Cambodian, and Vietnamese communities in Chicago of 6.2, 40.6, and 4.5, respectively [51].

Table 5 Combined incidence rates of non–cancer diseases

	Chinese	Filipino/a	Japanese	Korean	Vietnamese	Asian Indian	South Asian	Southeast Asian	Other Asian	Aggregate	NHW
Diabetes											
Karter et al. 2013	6.5	14.68	7.53	–	–	–	17.16	–	10.17	–	6.3
Myocardial infarction**											
Kanaya et al. 2011	3.6	4.7	3.3	–	–	–	5.9	–	–	4.1	5.9
Congestive Heart Failure**											
Kanaya et al. 2011	2.5	3.5	2.6	–	–	–	4.4	–	–	2.8	4.2
Stroke**											
Kanaya et al. 2011	3.2	3.2	2.8	–	–	–	3.4	–	–	3.1	3.9
End stage renal disease**											
Kanaya et al. 2011	1.9	3.9	3.0	–	–	–	1.1	–	–	2.9	2.4
Lower extremity amputation**											
Kanaya et al. 2011	1.9	3.9	3.0	–	–	–	1.1	–	–	2.9	2.4

**Diabetes–related complications

Cardiovascular Diseases

Nine studies involved data on cardiovascular disease, including hypertension, dyslipidemia, and cardiovascular disease mortality rates, odds ratios, and prevalence rates. The majority of the studies included subgroups of the six largest Asian American subgroups. A trend observed across studies was that Asian Indian men and women had higher proportional mortality ratios for coronary heart disease (CHD) among Asian American subgroups [63–65]. One study demonstrated that the odd ratios for CHD were significantly higher among Filipino/a men and women as well as among Asian Indian men [66]. Frank's study (2014) on dyslipidemia patterns noted that Asian Indian, Filipina, and Vietnamese women and Asian Indian men had the highest risk of having all three dyslipidemia patterns (high triglycerides (TG), low high-density lipoproteins (HDL), high low-density lipoproteins (LDL)) [67]. For data on hypertension, see Table 4 [51, 66, 68–70].

Cerebrovascular Disease

Three studies—all limited to subgroups from the six largest Asian American subgroups—focused on cerebrovascular disease, including overall cerebrovascular disease mortality rates, odds ratios, and prevalence rates. Holland's study (2011) noted that Filipina women had greater odds of overall stroke and ischemic stroke, while the odds of hemorrhagic stroke were greater for Korean women and Vietnamese men [66]. Furthermore, two studies included proportional mortality ratios (PMRs). First, Wild's study (1994) examined PMRs among Chinese, Japanese, and Asian Indian subgroups and found PMRs to be higher in the Chinese and Japanese groups than among NHWs and Asian Indians [65]. Second, Jose's study (2014) examined Chinese, Japanese, Asian Indian, Vietnamese, Korean, and Filipino/a subgroups and noted that PMRs were higher in every Asian American subgroup than among NHWs, particularly the Filipino/a and Vietnamese subgroups [63].

Mental Health

Four articles explored mental health conditions, with two studies assessing substance use disorders and two assessing depression. Park's study (2010) focused on Chinese and Korean Americans who were receiving alcohol use disorder treatment and noted differences in drinking patterns between the two subgroups [71]. Specifically, Korean Americans consumed significantly more alcohol than Chinese Americans. However, 75% of Chinese and Korean Americans were mandated to receive alcohol treatment by the criminal justice system [71].

Bersamira's study (2017), in comparison, examined past-year substance use—including marijuana, cocaine, and prescription drugs, among other substances—among Filipino/a, Chinese, Vietnamese, and other Asians. The authors noted heterogeneity among the prevalence rates for each subgroup [72]. Filipino/as had the highest (8.1%) and Vietnamese the lowest (1.5%) prevalence of past-year drug use among all Asian subgroups [72].

The remaining two studies focused on the prevalence of depressive disorders among middle-aged Chinese and Japanese women and on disease onset and prevalence among foreign-born Chinese, Filipino/a, and Vietnamese Americans [73, 74]. Lee and colleagues reported that 6.8% of Vietnamese, Filipino/a, and Chinese aged 18 and older have a major depressive disorder [71]. Among middle-aged women, Chinese and Japanese have a lower crude prevalence of depressive symptoms than either African American or Hispanic women [70].

Mortality

Three articles examined the overall mortality rates among the six largest subgroups: Chinese, Vietnamese, Filipino/a, Japanese, Asian Indian, and Korean. Overall, cardiovascular disease and cancer were the two leading causes of death for both males and females in each subgroup, while the third leading cause for males across all subgroups in 1992 was either cerebrovascular disease or accidents [75]. In comparison, Hastings (2015) examined mortality rates using U.S. mortality records from 2003 to 2011 and reported that for females, cancer was the leading cause of death for all subgroups with the exception of Asian Indians, for whom heart disease was the leading cause [76]. Among females in each subgroup, the top three causes of death were cancer, cardiovascular disease, and cerebrovascular disease, but beyond the top three, the causes varied by subgroup. For males, cancer was the leading cause of death in Chinese, Korean, and Vietnamese populations, whereas heart disease was the leading cause for Filipino, Japanese, and Asian Indian males, and beyond the top three, causes and rates varied similarly among females [76]. Lauderdale (2002) examined mortality rates among elderly Asian Americans enrolled in Medicare Part B from 1990 to 1999 and noted that (a) mortality rates were similar among the subgroups, with the exception of Vietnamese men, who had a somewhat lower probability of death than the other Asian male subgroups; and (b) mortality for Indian women was higher than for other Asian subgroups [77].

Oral Health

One article focused on oral health, assessing trends of edentulism—complete tooth loss—among older Asian

Table 6 Combined prevalence rates for maternal and infant health outcomes

Gestational diabetes mellitus	Chinese	Filipina	Japanese	Vietnamese	Korean	Asian Indian	Cambodian	Lao	Other Asian	NHW
Gestational Diabetes Mellitus										
Chu et al. 2009	6.22	7.05	3.65	6.19	4.71	8.56	–	–	6.00	–
Cripe et al. 2012	–	–	5.1	7.5	–	–	5.9	5.7	–	3.6
Pu et al. 2015	15.3	19.0	9.7	18.8	12.9	19.3	–	–	–	7.0
Cheng et al. 2015	6.8	6.6	4.7	7.0	3.7	7.4	–	–	–	2.6
Preeclampsia										
Cripe et al. 2012	–	–	2.8	2.3	–	–	2.8	2.6	–	6.2

Americans from the Chinese, Filipino/a, Asian Indian, and Other Asian subgroups using NHIS data from 1999 to 2008 [78]. Wu's study (2013) noted that Filipino/as had higher odds of edentulism than the other subgroups; however, overall, rates of decline were similar across the subgroups [78].

Hip Fracture

Two articles focused on hip fractures among Asian American subgroups: Lauderdale's study (1997) examined hip fracture incidences among Chinese, Japanese, and Korean subgroups, while Patel's study (2016) examined mortality rates following hip fractures among Chinese, Japanese, and Filipina women [79, 80]. Both studies noted that hip fracture incidence and mortality rates were lower in the Asian American subgroups than among NHW.

Longevity

One study by Park et al. (2009) examined longevity disparities among ethnic groups in Hawaii, including Chinese, Filipino/a, Japanese, and Korean subgroups [81]. Park et al. noted that the East Asian subgroups (Chinese, Japanese, and Korean) demonstrated the greatest longevity of all the Asian subgroups.

Maternal and Infant Health

Ten articles focused on or included maternal and infant health. See Tables 6 and 7 for prevalence and incidence rates, respectively, for the following maternal and infant health outcomes.

Gestational Diabetes Mellitus

Six articles included gestational diabetes mellitus (GDM), with four studies focusing on prevalence rates and two studies on incidence rates among Asian Indian, Japanese, Chinese, Filipina, Korean, Vietnamese, and Other Asian populations. For prevalence rates of GDM, Asian Indians ($n=3$ studies) had the highest prevalence rates of all Asian subgroups for GMD, followed by Filipina ($n=2$) and Vietnamese ($n=3$) (see Tables 6 and 7 for actual rates).

Pregnancy-Associated Hypertension, Preeclampsia, and Eclampsia

Five articles included pregnancy-associated hypertension, preeclampsia, and/or eclampsia [82, 83]. Two included incidence rates for preeclampsia for the Indian/Pakistani, Japanese, Chinese, Filipina, Korean, and Vietnamese subgroups, and one study included prevalence rates for Cambodian, Lao, Vietnamese, and Japanese females [84–86]. The five studies indicated that Filipina women had the highest incidences of PAH (2.86; 6.3), preeclampsia (6.8; 1.5), and eclampsia (0.19) of all the Asian subgroups considered (See Table 7 for incidence comparison).

Preterm Delivery, C-Section, and Cephalopelvic Disproportion

Four articles included incidence rates on either or both preterm deliveries less than 37 weeks and preterm deliveries less than 32 weeks among Chinese, Japanese, Filipina, Asian Indian, Indian/Pakistani, Korean, Vietnamese, Hmong, Cambodian, and Lao/Thai subgroups [82, 83, 85, 86]. Among the four studies, the results differed with regard to which subgroups had higher rates, as each study included different subgroups and largely considered different time periods. For example, Wong et al. (2008). Reported that Filipinas had higher incidence rates (12.62), while Rao et al. (2006) reported that Vietnamese had a higher incidence rate (12.4) of preterm delivery less than 32 weeks [83, 85]. However, one generally consistent finding across the studies was that the rates of preterm deliveries were lower in East Asian American subgroups (Chinese, Japanese, and Korean) than in other subgroups [82, 83, 85, 86]. See Table 7 for incidence rates.

Table 7 Combined incidence rates for maternal and fetal health outcomes

	Chinese	Filipina	Japanese	Vietnamese	Korean	Asian Indian	Indian/ Pakistani	Cambodian	Lao	Thai	Lao/Thai	Hmong	NHW
Gestational Diabetes Mellitus													
Rao et al. 2006*	6.1	6.3	2.2	5.7	4.7	_	6.7	_	_	_	_	_	_
Rao et al. 2006)**	4.0	6.8	3.7	–	–	–	–	–	–	–	–	–	–
Preeclampsia													
Rao et al. 2006)**	4.0	6.8	3.7	–	–	–	–	–	–	–	–	–	–
Vang et al. 2015	0.4	1.5	0.7	0.7	0.5	0.6	–	0.5	–	–	0.7	0.2	1.5
Pregnancy-associated hypertension (PAH)													
Wong et al. 2008	1.13	2.86	1.82	1.0	1.36	1.82	–	–	–	–	–	–	–
PAH/preeclampsia													
Rao et al. 2006*	1.8	6.3	1.8	1.0	1.2	–	3.3	–	–	–	–	–	–
Eclampsia													
Wong et al. 2008	0.07	0.19	0.21	0.08	0.05	0.09	–	–	–	–	–	–	–
Preterm delivery < 37 weeks													
Rao et al. 2006**	8.1	12.2	7.6	–	–	–	–	–	–	–	–	–	–
Rao et al. 2006*	7.5	10.7	6.6	12.4	5.3	–	11.4	–	–	–	–	–	–
Wong et al. 2008	7.74	12.62	9.90	9.98	7.44	10.20	–	–	–	–	–	–	
Vang et al. 2015	4.69	8.14	5.10	5.86	3.79	5.53	–	9.91	–	–	9.07	8.22	5.43
Preterm delivery < 32 weeks													
Rao et al. 2006*	0.8	2.3	0	1.7	1.2	–	3.7	–	–	–	–	–	–
Wong et al. 2008	0.98	1.69	1.17	1.21	1.20	1.37	–	–	–	–	–	–	–
Vang et al. 2015	0.49	1.00	0.56	0.51	0.40	0.63	–	0.92	–	–	1.02	0.97	0.60
Cesarean Delivery													
Rao et al. 2006)*	22.1	25.1	17.7	21.9	27.7	–	23.7	–	–	–	–	–	–
Wong et al. 2008	17.42	19.13	16.25	17.58	18.22	21.17	–	–	–	–	–	–	–
Birthweight < 2500 g													
Afflick et al. 1997)	4.28	6.67	5.32	4.67	3.45	7.98	–	7.48	6.98	5.84	–	–	–
Rao et al. 2006)*	4.2	9.2	7.0	9.5	5.3	–	11.5	–	–	–	–	–	–
Wong et al. 2008	5.39	8.85	8.59	6.60	5.02	9.69	–	–	–	–	–	–	–
Birthweight > 4000 g													
Afflick et al. 1997	6.0	6.4	6.2	4.2	7.7	5.1	–	3.7	3.6	8.5	–	–	–
Rao et al. 2006*	8.1	6.5	5.2	2.9	5.9	–	4.5	–	–	–	–	–	–
Wong et al. 2008)	5.94	5.18	3.93	3.75	6.46	3.91	–	–	–	–	–	–	–
Cephalopelvic disproportion													
Wong et al. 2008	2.11	2.25	1.72	3.01	1.76	1.87	–	–	–	–	–	–	–

*Rao AK, Daniels K, El-Sayed YY, Moshesh MK, Caughey AB. Perinatal outcomes among Asian American and Pacific Islander women. Am J Obstet Gynecol. 2006;195:834–8

**Rao AK, Cheng YW, Caughey AB. Perinatal complications among different Asian-American subgroups. Am J Obstet Gynecol. 2006;194:e39–41

Two articles included cesarean section incidence rates and mentioned the following subgroups: Asian Indian, Indian/Pakistani, Japanese, Chinese, Filipina, Korean, and Vietnamese [82, 83]. Rao (2006) did not note significant differences among the subgroups regarding cesarean delivery. However, Wong (2008) noted a higher incidence among Asian Indians (23.7) than among the other Asian American subgroups—Chinese [17.24], Filipina [19.13], Japanese [16.25], Vietnamese [17.58], and Korean [18.22] (see Table 7 for more details of incidence rates). Furthermore, one study included cephalopelvic disproportion (CPD) among the following subgroups: Chinese, Japanese, Filipina, Asian Indian, Korean, and Vietnamese [83]. Overall, the incidence of CPD was low among Asian American subgroups, with incidences ranging from 1.76 to 3.01.

Birth Weight and Infant Mortality

Three studies included birth weight, specifically assessing incidence rates for birthweight less than 2500 g and birthweight greater than 4000 g among the following subgroups: Cambodian, Chinese, Filipino/a, Asian Indian, Indian/Pakistani, Japanese, Korean, Lao, Thai, and Vietnamese [82, 83, 87]. See Table 7 for incidence rates.

A study by Wang et al. (1992) examined infant mortality rates among Japanese, Chinese, and NHW Americans. Wanget al. (1992) noted that although Japanese and Chinese Americans had somewhat lower rates of infant mortality than NHW Americans, they had a higher risk of sudden infant death syndrome than NHW Americans, particularly Chinese females (OR = 2.84) [88].

Discussion This scoping review provides a better understanding of health outcomes for 24 Asian American subgroups. Specifically, we found clear differences in the prevalence, incidence, and mortality of health outcomes across the subgroups, highlighting the heterogeneity of Asian Americans. Cancer was the most studied health condition, followed by diabetes, among Asian American subgroups. It is not surprising that cancer and diabetes are the most studied health conditions, as these areas have received the most funding through the National Cancer Institute and National Institute of Diabetes and Digestive and Kidney Diseases. Although multiple studies have documented differences in subgroups, most have compared two subgroups or were disease-focused [89–91]. Our study is the first to examine the incidences and prevalence of different health outcomes across 24 Asian American subgroups.

Although mental health and substance abuse are highly prevalent conditions in the U.S., we were surprised that such health conditions were not heavily focused on in the literature among Asian American subgroups, given they were addressed by only four studies. Mental health impacted 51.5 million people in the U.S. in 2019 [92]. Additionally, approximately 10 million people aged 12 and older misused opioids in 2019, including misuse of prescription pain relievers [93]. Such high prevalence warrants more research on substance abuse, including opioids, among subgroups of Asian American populations.

We also found that the existing studies on Asian American subgroups mainly focused on the six largest Asian American subgroups, and many subgroups remained underrepresented or omitted in research (see Fig. 3). Although listed in the 2010 U.S. Census, the following subgroups were omitted from any of the studies examined in this review as a single non-aggregated subgroup: Bangladeshi, Bhutanese, Taiwanese, Iwo Jiman, Maldivian, Nepalese, Okinawan, Singaporean, and Sri Lankan. In addition, many of the studies aggregated subgroups under larger labels, such as South Asian, Southeast Asian, or Other Asian [17, 19, 27, 29, 31, 34, 35, 38, 39, 41, 43–45, 48–50, 52, 54, 55, 58, 61, 72, 75, 78, 94, 95].

However, we observed a small increase in the inclusion of other, smaller, Asian American subgroups after 2009 (see Fig. 2). Half of the six most commonly represented Asian American subgroups are of East Asian origin (i.e., Chinese, Japanese, and Korean), which do not fully represent the heterogeneity of the Asian continent. It is possible that Executive Order 13515 signed by President Obama to improve the collection of health data among Asian Americans may have had some impact on this trend. Despite the recognition of the importance of including subgroups in research, a recent study has reported that Asians are underrepresented in high-impact medical research studies [96] and research funding [97]. Interestingly, the National Institute of Health (NIH) did not consider Asians to be an underrepresented minority (URM) in their recent analysis of R01 grant outcomes of T32 postdoctoral participants nor as a group that is underrepresented in biomedical research [98]. The NIH website lists the following groups as underrepresented: "Blacks or African Americans, Hispanics or Latinos, American Indians or Alaska Natives, Native Hawaiians, and other Pacific Islanders" [99]. This omission of Asian Americans is reflected in their research funding, as it has been reported that funding for Asian American populations at the NIH amounted to only 0.17% from 1992 to 2018 [100]. In addition, while there has been an increase in Asian American participation in NIH clinical trials, namely from 2.5% in 2011 to 12.1% in 2016, this increase has not translated into increased data disaggregation [97]. A plausible reason for the frequent omission of Asian American populations from the discussion regarding disparities and the fact they are not considered as a URM group may be the erroneous model minority myth. The myth of Asian Americans successfully adapting to the U.S. and being financially better off and physically healthier than other minorities may have resulted from limited and sample-biased studies. This myth has been and continues to be perpetuated in academia, which often categorizes Asian Americans as a monolith, consequently ignoring and masking any within-group socioeconomic and health disparities that exist [101, 102].

Representation and inclusion of all racial and ethnic minority populations is critical in providing equitable care. Aggregation and masking within-group differences is not unique to Asian Americans; rather, it an issue affecting several other races and ethnicities, including, but not limited to, Native Americans, Black and African Americans, and Hispanic and Latinx Americans [103]. Native Americans have over 500 recognized nations in the U.S. Meanwhile, Black and African Americans include individuals and families born and raised in the U.S. as well as immigrants from different countries in Africa and the Caribbean. Moreover, Hispanic and Latinx Americans include individuals and families who originate from several different countries, including, but not limited to, Mexico, Puerto Rico, Cuba, Peru, Honduras, and the Dominican Republic. Reflecting the heterogeneity of Asian American subgroups, these subgroups also have distinct languages, cultures, immigration histories, and generation statuses of their own that have varying impacts on health outcomes [103]. Arroyo-Johnson et al. (2016) and Griffith et al. (2011) examined heterogeneity among Hispanic and Black American subgroups, respectively [104, 105]. Arroyo-Johnson's study (2016) was the first to disaggregate diabetes prevalence trends over time among Hispanic subgroups, which included Mexican/Mexican American, Puerto Rican, and Cuban/Cuban American [104]. Arroyo-Johnson et al. noted that over the 15-year period studied, diabetes prevalence differed significantly by race/ethnicity and education. The 5-year trend in diabetes prevalence among participants with less than a high school education was highest among Cubans/Cuban Americans, Puerto Ricans, non-Hispanic blacks, and NHWs, while among participants with more than a high school education, non-Hispanic blacks had the highest prevalence [104]. These differences would have been masked by utilizing an aggregated Hispanic label. Hence, the need to study subgroup differences is greater than ever, as subgroup populations have diverse social determinants of health, including, but not limited to, immigration histories, immigration status, differing cultures, languages, English proficiency, economic status, educational status, and access to health care.

All of the studies reviewed only considered English-speaking individuals. However, the Asian American subgroups have diverse languages and cultural backgrounds. Over 40% of languages are spoken by Asian Americans in the U.S. [106], and over 67 million people speak a foreign language at home [107]. It is thus critical that non-English speakers, including Asian American subgroups, are included in research. Research has demonstrated that having limited English proficiency (LEP) is associated with poor access to healthcare, poor health outcomes, and higher levels of dissatisfaction with care [118, 119, 120]. The disparity gap in care may be larger for Asian American subgroups with LEP than among English-speaking Asian Americans subgroups. Therefore, it is critical that researchers do not see language as a barrier to participating in research. Researchers must urgently devise innovative solutions to target or reach all populations by starting with language-appropriate surveys.

This review has some limitations. First, we only included 24 Asian American subgroups; hence, interpretations of our findings should be made with caution. Second, our search terms were rather broad (i.e., "Disaggregate," "Health," and "Asian" OR "Asian American"); thus, we were unable to cover specific topics such as eye care, counseling, rehabilitation services, and more. Additionally, we did not search the gray literature. It is thus possible that we may have missed some studies. Future research could conduct a review on specific health topics to gain a deeper understanding of their impact on Asian American subgroups' health. Third, we did not review studies focusing on social determinants of health among Asian American subgroups. Future reviews could examine such areas of focus.

Research and Policy Recommendations

The majority of the studies reviewed were from existing databases, such as cancer registries, national surveys, Medicare, and/or electronic health records. Additionally, the majority of the studies were secondary or retrospective longitudinal analyses. These factors contribute to the existing challenge of data disaggregation, including small sample sizes, oversampling of certain Asian Americans, and/or uneven distribution of geographic representation [108, 109]. A limited number of studies were prospective works targeting smaller-sized Asian American subgroups in general. Therefore, we want to echo and emphasize many other scholars' recommendations to oversample Asian Americans, particularly the smaller-sized groups, eliminating the umbrella "Asian American" label, and allowing for the reporting of race and ethnicity to include Asian American subgroup categories, as well as many others [5, 110]. While it may appear challenging to oversample or include smaller-sized Asian American subgroups, and the use of traditional methods of recruitment and data collection may not be appropriate, community-based participatory research (CBPR) may offer a solution whereby individuals from each community can actively be involved and drive the research. There is strong evidence that CBPR is an effective and appropriate solution to working with minority or vulnerable populations [111, 112].

The lack of funding and recognition of Asians as a URM at the federal level is ultimately the underlying barrier to further investigating health disparities among Asian American subgroups. Additionally, most research on Asian American subgroups has historically been performed with East Asians. Therefore, we recommend that funders such as NIH include Asian American subgroups as URM and that researchers aim to recruit or include all 24 subgroups. Recruiting or including all 24 subgroups in research requires innovative solutions. First and foremost, there is a need for science to be applied in research recruitment and for racial and ethnic minority populations, including Asian American subgroups, to be engaged.

Conclusions This scoping review has examined trends in disaggregating 24 Asian American subgroups' health outcomes and identified under-researched subgroups. The study findings confirm that health outcomes vary greatly across subgroups, suggesting that certain subgroups are at higher risk than others. However, the reporting on health outcomes of small-sized subgroups was limited due to the underrepresentation of those populations in disaggregated research. This review also clearly shows that there are many Asian American subgroups that are not merely underrepresented but not represented at all in biomedical research and national health priorities. This finding calls for a dismantling and restructuring of how national policies, funding priorities, and academia perceive Asian American populations without the "model minority" lens. It also calls for a better understanding and education on the various historical, cultural, and immigration differences between these subgroups. With the current social and political climate (e.g., COVID and Asian hate crimes), different Asian American subgroups are disproportionately affected. However, data on Asian American subgroups continues to be aggregated as if describing a monolithic group at the national level (for example by the Centers for Disease Control and Prevention) [113]. As an aggregate, Asian American deaths from COVID-19 appear to be lower than their population share. However, aggregating such data obscures any disparities that exist among subgroups as well as any variation that can be seen by location, as Asian Americans are not uniformly spread across the nation [114]. In addition, Asian American deaths may be unknown in some states, such as Florida and South Carolina, which continue to classify Asian American as "Other" or aggregate them with other larger racial groups ([115, 116]. National efforts, including funders, are needed to address data aggregation among subgroup populations.

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