

Surveillance and outbreak reports

THE 2009 PANDEMIC H1N1 INFLUENZA AND INDIGENOUS POPULATIONS OF THE AMERICAS AND THE PACIFIC

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There are few structured data available to assess the risks associated with pandemic influenza A(H1N1)v infection according to ethnic groups. In countries of the Americas and the Pacific where these data are available, the attack rates are higher in indigenous populations, who also appear to be at approximately three to six-fold higher risk of developing severe disease and of dying. These observations may be associated with documented risk factors for severe disease and death associated with pandemic H1N1 influenza infection (especially the generally higher prevalence of diabetes, obesity, asthma, chronic obstructive pulmonary disease and pregnancy in indigenous populations). More speculative factors include those associated with the risk of infection (e.g. family size, crowding and poverty), differences in access to health services and, perhaps, genetic factors. Whatever the causes, this increased vulnerability of indigenous populations justify specific immediate actions in the control of the current pandemic including primary prevention (intensified hygiene promotion, chemoprophylaxis and vaccination) and secondary prevention (improved access to services and early treatment following symptoms onset) of severe pandemic H1N1 influenza infection.

Introduction

Five months into its progression, the pandemic H1N1 influenza has affected countries on all continents. In Mexico, where the pandemic is likely to have started, the outbreak affected the central states first and then extended to other parts of the country. In the northern hemisphere (United States, Canada, Japan and the United Kingdom), imported cases were followed by sustained community transmission and epidemics in some countries. Importation in the southern hemisphere of cases from the northern hemisphere coincided with the beginning of the austral winter and influenza season, with a much more intense epidemic in several of these countries.

To date, hundreds of thousands of confirmed cases have been reported throughout the world, including over 4,735 confirmed and notified deaths [1]. The actual number of clinical cases is probably in the millions. Much progress has been made in documenting the pandemic and the causative virus. Some major risk factors for severe disease and death have been described. The role of pregnancy, asthma, chronic obstructive pulmonary disease and metabolic conditions (diabetes mellitus - a recognized risk factor for severe disease associated with seasonal flu - and obesity which

has not been considered as a risk factor in previous pandemics or for seasonal influenza) in the occurrence of severe pandemic H1N1 influenza infection has been documented [2,3].

Initial data from several countries showed increased rates of hospitalisation and deaths associated with the current pandemic in indigenous populations [4-10]. We sought to estimate relative risks of hospitalisation and death associated with pandemic H1N1 influenza in indigenous populations of the Americas and the Pacific and discuss explanatory hypotheses.

Method

We use the term "indigenous populations" to refer to the ethnic groups related to the first recorded settlers in the various territories examined. In some countries such as Canada, Australia and New Zealand, the term "indigenous populations" has pertained to several, sometimes major, ethnic groups. Belonging to an indigenous population has been, in most data sources, self-declared.

Constant monitoring of international and national sources on public health alerts worldwide is ongoing at the Institut de Veille Sanitaire (InVS) [11]. Data on severe pandemic H1N1 influenza cases (hospitalised) and deaths by ethnicity were collected from countries or territories which published them on their official websites (institutes of public health and ministries of health). Data were also communicated by public health institutes in French territories of the Pacific during collaborative missions by InVS epidemiologists. The most recent population data, as available from official sources (governments, census organisations or indigenous populations health bureaus), were used as denominators to compute rates. Recent data on the prevalence for risk factors and relative risks in indigenous populations were obtained from official websites and scientific literature. Our search centred on diabetes, obesity (defined by the World Health Organization as a body mass index equal or more than 30 kg/m²) and pregnancy. When available, the birth rate in indigenous populations was used to estimate the relative proportion of pregnant women.

In Canada, the ethnic distribution of cases was only available as percentages. The number of cases by ethnic group was obtained by multiplying this percentage by the total number of cases. The same was done for deaths.

Rates of pandemic H1N1 influenza hospitalised cases and deaths per 100,000 inhabitants were computed in indigenous populations and in the rest of the population using official case figures and population denominator data. Relative risks between indigenous and non-indigenous groups for severe disease and death associated with pandemic H1N1 influenza were estimated using rate ratios. Prevalences for various risk factors were compared between these groups using risk ratios.

Results

Pandemic H1N1 influenza data

The most structured and easily accessible nationwide data were available from Canada, Australia and New Zealand. Pandemic H1N1 influenza data collected from official sources and data which we calculated from available sources are shown in Table 1.

In the Americas

In Canada [12] and the United States (US) [13], indigenous populations represent less than 5% of the general population. They account, however, for a much bigger proportion of hospitalised cases of pandemic H1N1 influenza: 17.6% in Canada [4] and 17.5% in Arizona, US [5] (Table 1). These indigenous populations, especially Amerindians and Inuit, also seem at higher risk of death due to pandemic H1N1 influenza as compared to non-indigenous populations.

Computed rate ratios for hospitalisation between indigenous and non-indigenous populations varied from 4.1 (Arizona) to 5.4 (Canada) (Table 1). Computed rate ratios for death varied from 3.5 (Canada) to 4.3 (Arizona). The risk of severe disease and death, however, may be unevenly distributed among ethnic groups in a given country. For example, Inuit are estimated to have a seven-fold higher rate of hospital admissions and deaths associated with pandemic H1N1 influenza as compared to First Nations people (rates for hospitalisation and death being 158.5 versus 22.5 per 100,000 and 4.0 versus 0.7 per 100,000, respectively) [4]. According to Canadian sources, Inuit cases tend to be younger, are less often admitted to intensive care units and have fewer underlying diseases than First Nations people [4].

There were no specific data on pandemic H1N1 influenza hospitalised cases and deaths by ethnicity in Brazil. The majority of influenza viruses isolated from patients with severe upper respiratory infections for epidemiological weeks 29-33* inclusive were pandemic H1N1 influenza [6]. Other data show that during July and August 2009, the incidence of severe acute respiratory illness in Amerindians was 4.5 times higher than in the rest of the population of Brazil (Table 1) [6,7,14,15].

In the Pacific

Computed rate ratios for hospitalisation in indigenous versus non indigenous populations varied from 3.0 (New Zealand) [9] to 7.7 (Australia) [8]. Computed rate ratios for death varied from 5.1 (Australia [8]) to 5.3 (New Caledonia [10]; JP Grangeon, personal communication, 27 September 2009) (Table 1). No medical data are routinely collected by ethnicity in all French territories. There are however indirect indications of greater vulnerability to pandemic H1N1 influenza in indigenous populations in the three French territories of the Pacific, where attack rates of influenza-like illness (ILI) were particularly high.

The percentage of Polynesians in French Polynesia (population: 270,000) is estimated at approximately 83% [16]. During the austral winter epidemic of 2009, the ILI attack rate was estimated by French Polynesia health authorities at approximately 13%, with some variation between the archipelagos (up to 20% in Moorea Island and Austral Islands).

In Wallis (pop. 9,200) and Futuna (pop. 4,200), where most (95%) inhabitants are of Polynesian origin [17], the attack rate for ILI was estimated by local public health authorities at 28% in Wallis and 38% in Futuna.

In New Caledonia (pop. 249,000), the percentage of indigenous Oceanians is estimated at approximately 57% (including Melanesians 44.1%, Wallisians 9.0%, Tahitians 2.6% and ni-Vanuatu 1.1%) [18]. Public health authorities in New Caledonia have estimated the attack rate for ILI during the austral winter wave of pandemic H1N1 influenza at about 18%. According to these authorities, higher attack rates were observed among Oceanian populations. In Nouméa, New Caledonia, among children hospitalised with pandemic H1N1 influenza between 27 July and 13 September 2009 with available data on ethnicity (n=62), 74% were of Melanesian origin, 10% of Wallisian origin and 8% of European origin (A Facchin, personal communication, 19 September 2009). According to local practitioners, the percentage of children of Oceanian origin seemed high as compared to foreseeable bed occupancy (JP Grangeon, personal communication, 27 September 2009).

Health status of indigenous populations

Almost all indigenous populations considered in this paper have greater prevalence of diabetes, obesity and chronic respiratory diseases such as asthma and chronic obstructive pulmonary disease [19-29] (Table 2).

Available data also show that fertility rates are higher in indigenous populations than in the rest of the population. In Canada, the 1996-2001 birth rate in Inuit women was 3.4, while the rates in First Nations people, Métis and all women in Canada were 2.9, 2.2 and 1.5, respectively [30]. In Australia, the average number of live births in indigenous women and all Australian women in 2003 was estimated to be 2.2 and 1.8, respectively [31]. In New Zealand, birth rates were also higher in Māori (2.59) and Pacific peoples (2.94) as compared to population of European descent (1.74) [32]. Indicators of fertility, however, seemed comparable between Native Americans and the rest of the population in Arizona. Tobacco use tends to be higher in indigenous populations in most, but not all, countries [20,26,27,33]. Furthermore, although tobacco seems linked with both risk of infection and severity of illness due to seasonal influenza [34], such an association has not been systematically found [35] and an independent link between tobacco use and severe pandemic H1N1 influenza infection and death has not been established to our knowledge. It is therefore not considered in our analysis.

Discussion

Indigenous populations were hard hit by the 1918-19 influenza pandemic: between 1 October 1918 and 30 June 1919, a total of 78,177 influenza cases and 6,632 deaths were reported in indigenous people of North America (computed case-fatality rate (CFR) of 8.5% versus 2.5% in the general population) [36]. The highest CFR was reported in Utah indigenous peoples (15.9%).

TABLE 1

Pandemic H1N1 influenza-confirmed cases, deaths and rates per 100,000 inhabitants, by ethnic group, Americas and the Pacific Region, 2009

Country or area Pandemic H1N1 influenza data sources	Population in million inhabitants (% of total population)	Data until	Hospitalisation			Deaths					
			Number (%) ¹		Rates (per 100,000)		Number (%) ¹		Rates (per 100,000)		
			Indigenous	Non- indigenous	Indigenous (a)	Non- indigenous (b)	Rate ratios (a/b)	Indigenous	Non- indigenous	Indigenous (c)	Non- indigenous (d)
Americas											
Canada [4]	31.60										
First Nations, Inuit and Métis	1.15 (3.64%)	26/09/2009	260	1,219	22.61	4	5.7	9	69	0.78	0.23
			(17.60)	(82.40)				(11.50)	(88.50)		
Arizona (United States) [5]	6.50										
American Indians	0.32 (4.90%)	16/09/2009	52	245	16.3	4	4.1	4	18	1.3	0.3
			(17.51)	(82.49)				(18.18)	(81.82)		
Brazil ² [6,7]	191.80										
Amerindians	0.46 (0.24%)	15/07 – 15/08/09	328	30,526	71	16	4.4	NA	NA	NA	NA
			(1.06)	(98.93)							
Pacific											
Australia [8]	20.70										
Aborigines and Torres Straits Islanders	0.52 (2.50%)	09/10/2009	796	4,048	153	20	7.7	21	162	4.1	0.8
			(16.43)	(83.57)				(11.48)	(88.52)		
New Zealand [9]	4.33										
Māori	0.63 (14.60%)		NA	NA	43.0			NA	NA	NA	NA
Pacific peoples	0.64 (14.70%)	23/09/2009	NA	NA	94.2			NA	NA	NA	NA
New Caledonia [10]	0.25										
Indigenous Oceanians ³	0.14 (56.80%)	07/09/2009	NA	NA	NA	NA	NA	7	1	4.93	0.93
											5.3

¹ Percentage of total cases for the country or area.

² Acute severe respiratory illness in Amerindians and others used as proxy for pandemic H1N1 influenza.

³ Includes Melanesians, Polynesians, Wallisians and ni-Vanuatu.

NA: not available.

TABLE 2

Estimated risk ratios of main risk factors for severe pandemic H1N1 influenza cases in Indigenous populations as compared to non-Indigenous populations in some countries in the Americas and the Pacific Region

Country or area	Risk ratio for DM	Risk ratio for obesity (BMI of at least 30)	Risk ratio for asthma	Risk ratio for COPD or emphysema
Americas				
Canada				
First Nations	7.1 ¹	2.4 ²	2.4 ¹	2.5 ¹
United States				
American Indians and Alaska Natives	1.7 ³	1.5 ⁴	2.1 ⁴	2.0 ⁴
Brazil				

Amerindians	NA	NA	NA	NA
Pacific				
Australia				
Aborigines and Torres Straits Islanders	5.6 ⁵	1.9 ⁶	2.7 ⁷	5.0 ⁷
New Zealand				
Māori	1.8 ⁸	1.9 ⁸	1.3 ⁸	2.0 ⁸
Pacific peoples	3.2 ⁸	2.8 ⁸	0.8 ⁸	0.9 ⁸
New Caledonia				
Melanesians	1.0 ⁹	2.7 ¹⁰	NA	NA
Polynesians	1.8 ⁹	3.0 ¹⁰	NA	NA

¹ Age-adjusted hospital separation rates (2000): First Nations compared to general population in West Canada (British Columbia, Alberta, Saskatchewan and Manitoba) [19].

² Prevalence among First Nations living on-reserve (2002-03) compared to total general Canadian population living off-reserve (2003), 18 years or older [20].

³ Prevalence among American Indians and Alaska Natives who receive care from the Indian Health Service compared to general population, 20 years or older, 2002 [21].

⁴ Age-adjusted prevalence among American Indians and Alaska Natives adults (18 years or older), 2004-2006 [22] compared to prevalence among general American adult (18 years or older) population in 2005 for obesity [23] and emphysema [24], in 2004-2006 for asthma [25].

⁵ Hospitalisations of Indigenous persons compared to other Australians for a principal diagnosis of diabetes for the two-year period July 2002 to June 2004 for Queensland, Western Australia, South Australia and the Northern Territory [26].

⁶ Age-adjusted prevalence among Indigenous Australians compared to other Australians, 18 years or older (2004-2005) [26].

⁷ Age-adjusted ambulatory care sensitive hospital admissions rate (2002-04). Indigenous compared to non-Indigenous [26].

⁸ Age-adjusted prevalence among Māori vs. non-Māori and Pacific peoples vs. non-Pacific peoples, 15 years or older (45 years or older for COPD), 2006-2007 [27].

⁹ Age-adjusted prevalence among Melanesians and Polynesians compared to Europeans, aged 30-59 years, 1992-1994 [28].

¹⁰ Prevalence in non-diabetic adults among Melanesians and Polynesians compared to Europeans, aged 30-59 years, 1992-1994 [29].

DM: diabetes mellitus (predominantly, but not exclusively, of type 2). BMI: body mass index. COPD: chronic obstructive pulmonary disease (defined by emphysema or chronic bronchitis), NA: not available.

Similarly in New Zealand, the mortality rate in Māori was seven times greater than in Europeans [37]. At present, indigenous populations in Canada and the US [19,38] are also more severely affected by seasonal influenza than the rest of the population.

Although information available to date does not permit to identify all determinants and causative mechanisms, these data show that indigenous populations seem to be at higher risk of severe pandemic H1N1 influenza infection in several countries of the Americas and the Pacific. The occurrence of more severe forms of the infection could be explained by the following hypotheses: much higher prevalence of identified risk factors for severe disease and death, differences in approaches to health, difficulties in accessing health care and increased genetic susceptibility. The impact of a close-knit community lifestyle on viral transmission dynamics is a plausible risk factor for infection, as well. High attack rates during a short period (around three weeks), especially in Wallis and Futuna and in some islands of French Polynesia deserve notice. In these cases, the small size of these islands may have played a role.

This study and data comparisons have several limitations. The first is that the analysis bore on data collected from multiple sources. Some rates were computed by the authors using approximate population numbers, in other cases the situation was well-documented but only for a limited part of a territory (such as Arizona instead of the entire US). Despite the fact that several countries have a sizeable indigenous population, only few have made surveillance data by ethnicity available on the web. This may be due, to a large extent, to the fact that many countries do not collect statistical data by ethnicity.

Furthermore, data pertain to small numbers of cases and must therefore be viewed with great caution, especially when using them for comparison between ethnic groups. There may also be underreporting of pandemic H1N1 influenza cases because of low testing rates during intense epidemic. Underreporting, however, is probably lower for hospitalised cases, especially in intensive care units [39], and deaths which are the focus of this analysis.

Differences in accessing health care may lead to various reporting biases. Special programmes and attention directed toward indigenous minorities may lead to differences in clinical management such as more systematic hospitalisation. Usually, however, difficulty in access to health care has the opposite effect resulting in an underestimation of severe forms.

There are no published data by both ethnicity and age group. The fact that there are more cases among indigenous populations in the countries examined could be partly explained by higher birth rates in indigenous compared to non-indigenous populations. Although the pandemic influenza A(H1N1)v virus targets younger age groups, severe cases, however, are found mainly among adults [2]. As older populations seem somewhat protected [40,41], a younger population age structure may overestimate the populations' intrinsic susceptibility to this virus, but probably not to severe or lethal forms, which are the object of this article.

Data on incidences by socio-economic groups were also lacking. It is known, however, that First Nations people in Canada, Australian Aborigines and Māori and Pacific peoples in New Zealand, to name a few examples, are overrepresented among the poor.

The absence of fine distinction between ethnic groups in a given country could lead to over- or underestimation for certain ethnic subgroups if well-identified vulnerabilities are documented in larger indigenous populations and extrapolated to all. Data are lacking, for instance, to determine with accuracy the exact risk in Aboriginal Australians and Torres Straits Islanders, respectively. Pacific populations of various origin probably do not share the same level of risk. Finally, self-declaration of “indigenous” ethnic status (e.g. Māori) by persons of mixed ancestry could lead to classification bias and underestimate risks in persons fully descended from these ethnic groups.

Conclusions

Means of prevention and case management for acute and chronic illness have progressed greatly since the influenza pandemic of 1918. Health inequities, however, remain rife between indigenous populations of the Americas and the Pacific and the rest of the populations in the countries considered. The role of access to care and economic status deserves further study. In countries which have data by ethnic group, baseline prevalence is higher for diabetes mellitus, obesity, asthma, chronic obstructive pulmonary disease, and greater numbers of pregnancies at an early age in indigenous populations. These factors are known to be closely associated with cases of severe illness and death due to pandemic H1N1 influenza infection. The available data does not allow for fine distinctions and it is not possible to precisely quantify risks by individual ethnic group within the indigenous populations of most countries. In a short-term perspective, the precise risk quantification, however, does not have any practical implications for the response to the pandemic and there is no public health need to distinguish these groups further at this stage. All indigenous populations described here should be considered at greater risk than the rest of the population, for a host of reasons. This observation does not preclude a potentially higher incidence of severe forms in other, non-indigenous population subgroups. It also does not mean that diabetes, obesity, asthma and chronic obstructive pulmonary disease should not be controlled in all populations.

Further research is needed to describe the impact of the 2009 H1N1 influenza pandemic in indigenous populations and document the determinants of severe forms. In the meantime and when feasible, Indigenous populations should be the focus of special, targeted and culturally acceptable interventions against the 2009 H1N1 influenza pandemic, such as implemented in Australia [42] and US [43]. These need to include primary prevention (intensified hygiene promotion, chemoprophylaxis and vaccination) and secondary prevention (improved access to services and early treatment following symptoms onset) of severe pandemic H1N1 influenza infection.

These conclusions are relevant to European countries for at least two reasons. Firstly, indigenous populations live in territories linked administratively to the European Union. France is the EU country with the largest number of citizens of indigenous origin, in the Americas (around 4,500 Amerindians in French Guyana [44]) and in the Pacific (224,000 Polynesians in Polynesia [16]; 142,000 Melanesians and Polynesians in New Caledonia [18]; 13,000 Wallisians in Wallis and Futuna [17]). There is also a sizeable indigenous (Inuit) population of EU citizens in Greenland (estimated at around 50,000 inhabitants) [45]. Secondly, further research on risk factors in indigenous populations worldwide may help in identifying and understanding mechanisms and risk factors

for severe diseases. These could be relevant to other population subgroups, such as those living in poverty or crowded settings, in cities of Europe and elsewhere.

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*Editor's note: Weeks in this article are numbered as epidemiological weeks as defined by the Pan American Health Organization (PAHO) and the World Health Organization (WHO): <http://amro.who.int/english/sha/be993calend.htm>

References

- World Health Organization. Pandemic (H1N1) 2009 - update 70. Available from: http://www.who.int/csr/don/2009_10_16/en/index.html
- Vaillant L, La Ruche G, Tarantola A, Barboza P, for the epidemic intelligence team at InVS. Epidemiology of fatal cases associated with pandemic H1N1 influenza 2009. *Euro Surveill*. 2009;14(33):pii=19309. Available from: <http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=19309>
- Jain S, Kamimoto L, Bramley AM, Schmitz AM, Benoit SR, Louie J, et al. Hospitalized patients with 2009 H1N1 influenza in the United States, April-June 2009. *N Engl J Med*. 8 October 2009. [Epub ahead of print]. doi:10.1056/NEJMoa0906695.
- Public Health Agency of Canada. Fluwatch: September 20, 2009 to September 26, 2009 (Week 38). Available from: http://www.phac-aspc.gc.ca/fluwatch/09-10/w38_09/index-eng.php
- Arizona Department of Health Services. Office of Infectious Disease Services. 2009 novel H1N1 influenza virus update. 16 September 2009. Available from: <http://www.azdhs.gov/phs/oids/epi/flu/>
- Secretaria de Vigilância em Saúde. Informe Epidemiológico - Influenza A(H1N1). Edição no 6 agosto de 2009. Available from: http://portal.saude.gov.br/portal/arquivos/pdf/informe_influenza_se_33_25_08_2009.pdf.
- Fundação Nacional de Saúde. Saúde Indígena Influenza A H1N1. Influenza A (H1N1) em populações indígenas do Brasil. Informe Técnico nº06/2009. Available from: http://www.funasa.gov.br/internet/desai/arquivos/informeTecnicoInfluenzaA_6.pdf.
- Australian Government, Department of Health and Ageing. Australian influenza surveillance summary report No.22, 2009, reporting period: 3 October 2009 – 9 October 2009. Available from: [http://www.healthemergency.gov.au/internet/healthemergency/publishing.nsf/Content/ozflu2009.htm/\\$File/ozflu-no22-2009.pdf](http://www.healthemergency.gov.au/internet/healthemergency/publishing.nsf/Content/ozflu2009.htm/$File/ozflu-no22-2009.pdf)
- Baker MG, Wilson N, Huang QS, Paine S, Lopez L, Bandaranayake D, et al. Pandemic influenza A(H1N1)v in New Zealand: the experience from April to August 2009. *Euro Surveill*. 2009;14(34):pii=19319. Available from: <http://www.eurosurveillance.org/ViewArticle.aspx?ArticleId=19319>
- Direction des Affaires Sanitaires et Sociales de Nouvelle-Calédonie. Alerte pandémie grippale grippe A/H1N1 en Nouvelle-Calédonie. Point au 08/09/09. Available from: http://www.dass.gouv.nc/dass/file/ah1n1_070909.pdf
- Rotureau B, Barboza P, Tarantola A, Paquet C. International epidemic intelligence at the Institut de Veille Sanitaire, France. *Emerg Infect Dis*. 2007;13(10):1590-2.
- Statistics Canada. 2006 census: Aboriginal peoples in Canada in 2006: Inuit, Métis and First Nations, 2006 census: highlights. [Accessed 18 October 2009]. Available from: <http://www12.statcan.ca/census-recensement/2006/as-sa/97-558/p1-eng.cfm>
- Office of Minority Health. American Indian/Alaska Native profile. [Accessed 18 October 2009]. Available from: <http://www.omhrc.gov/templates/browse.aspx?lvl=3&lvlid=26>
- Fundação Nacional do Índio. Os Índios - as sociedades. [Accessed 18 October 2009]. Available from: http://www.funai.gov.br/indios/fr_conteudo.htm
- Instituto Brasileiro de Geografia e Estatística. Popclock. [Accessed 18 October 2009]. Available from: <http://www.ibge.gov.br/home/>
- Secrétariat d'État à l'Outre-Mer. Présentation - Polynésie française. [Accessed 18 October 2009]. Available from: <http://www.outre-mer.gouv.fr/?presentation-polynesie-francaise.html&artpage=2-2>

17. Vice-Rectorat de Wallis et Futuna. La Population. [Accessed 18 October 2009]. Available from: http://www.ac-wf.wf/article.php3?id_article=63
18. Institut de la Statistique et des Etudes Economiques Nouvelle-Calédonie. Recensement 1996. [Accessed 18 October 2009]. Available from: <http://www.isee.nc/recenspop/telechargement/ind04.xls>
19. Health Canada. A statistical profile on the health of First Nations in Canada: Health services utilization in Western Canada, 2000. [Accessed 18 October 2009]. Available from: <http://www.hc-sc.gc.ca/fniah-spnia/pubs/aborig-autoch/2009-stats-profil-vol2/index-eng.php>
20. Health Canada. A statistical profile on the health of First Nations in Canada: determinants of health, 1999 to 2003. [Accessed 18 October 2009]. Available from: <http://www.hc-sc.gc.ca/fniah-spnia/pubs/aborig-autoch/2009-stats-profil/index-eng.php>
21. Centers for Disease Control and Prevention. National Center for Chronic Disease Prevention and Health Promotion. National diabetes fact sheet. [Accessed 18 October 2009]. Available from: <http://www.cdc.gov/diabetes/pubs/estimates.htm>
22. Barnes PM, Adams PF, Powell-Griner E. Health characteristics of the Asian adult population: United States, 2004-2006. *Adv Data*. 2008;(394):1-22.
23. Centers for Disease Control and Prevention. State-specific prevalence of obesity among adults – United States, 2005. *MMWR Morb Mortal Wkly Rep*. 2006;55(36):985-8.
24. Centers for Disease Control and Prevention. Summary health statistics for U.S. adults: National health interview survey, 2005. [Accessed 18 October 2009]. Available from: http://www.cdc.gov/nchs/data/series/sr_10/sr10_232.pdf
25. Centers for Disease Control and Prevention. Health, United States, 2008. [Accessed 18 October 2009]. Available from: <http://www.cdc.gov/nchs/hus.htm>
26. Australian Institute of Health and Welfare. Aboriginal and Torres Strait Islander health performance framework 2006 report. [Accessed 18 October 2009]. Available from: <http://www.aihw.gov.au/publications/index.cfm/title/10429>
27. Ministry of Health. A portrait of health. Key results of the 2006/07 New Zealand Health Survey. Wellington, 2008. Available from: <http://www.moh.govt.nz/moh.nsf/indexmh/portrait-of-health>
28. Papoz L, Barny S, Simon D. Prevalence of diabetes mellitus in New Caledonia: ethnic and urban-rural differences. CALDIA Study Group. CAledonia DIAbetes Mellitus Study. *Am J Epidemiol* 1996;143(10):1018-24.
29. Defay R, Jaussent I, Lacroux A, Fontbonne A. Relationships between glycaemic abnormalities, obesity and insulin resistance in nondiabetic Polynesians of New Caledonia. *Int J Obes (Lond)*. 2007;31(1):109-13.
30. Statistics Canada. 2006. Women in Canada. Statistics Canada, Catalogue no. 89-503 XIE. [Accessed 18 October 2009]. Available from: <http://www.statcan.gc.ca/pub/89-503-x/89-503-x2005001-eng.pdf>
31. Australian Institute of Health and Welfare. A statistical overview of Aboriginal and Torres Strait Islander peoples in Australia. [Accessed 18 October 2009]. Available from: http://www.aihw.gov.au/indigenous/health/mothers_babies.cfm
32. Statistics New Zealand. Age-specific fertility rates for the major ethnic groups (downloadable Excel spreadsheets). [Accessed 18 October 2009]. Available from: http://www.stats.govt.nz/methods_and_services/access-data/tables/births.aspx
33. Centers for Disease Control and Prevention. Highlights: American Indians and Alaska Natives and tobacco. [Accessed 18 October 2009]. Available from: http://www.cdc.gov/tobacco/data_statistics/sgr/1998/highlights/am_indian_alaska_native/index.htm
34. Kark JD, Lebiush M, Rannon L. Cigarette smoking as a risk factor for epidemic A(H1N1) influenza in young men. *N Engl J Med*. 1982;307(17):1042-6.
35. Cruijff M, Thijs C, Govaert T, Aretz K, Dinant GJ, Knottnerus A. The effect of smoking on influenza, influenza vaccination efficacy and on the antibody response to influenza vaccination. *Vaccine*. 1999;17(5):426-32.
36. Public Health Weekly Reports for October 17, 1919. *Public Health Rep* 1919;34(42):2289-333.
37. Wilson N, Baker M. Ninety years on: What we still need to learn from “Black November” 1918 about pandemic influenza. *N Z Med J*. 2008;121(1285):136-138.
38. Indian Health Service. 2008 National Summary. Performance measurement: improving healthcare for American Indians and Alaska Natives. Government Performance and Results Act (GPRA), February 2009. [Accessed 18 October 2009]. Available from: http://www.ihs.gov/cio/crs/documents/2008ExecutiveSummary_FINAL_508compliant.pdf
39. The ANZIC Influenza Investigators. Critical care services and 2009 H1N1 influenza in Australia and New Zealand. *N Engl J Med*. 8 October 2009 [Epub ahead of print]. doi:10.1056/NEJMoa0908481.
40. Itoh Y, Shinya K, Kiso M, Watanabe T, Sakoda Y, Hatta M, et al. In vitro and in vivo characterization of new swine-origin H1N1 influenza viruses. *Nature*. 2009;460(7258):1021-5.
41. Centers for Disease Control and Prevention. Serum cross-reactive antibody response to a novel influenza A (H1N1) virus after vaccination with seasonal influenza vaccine. *MMWR Morb Mortal Wkly Rep* 2009;58(19):521-4.
42. Massey PD, Pearce G, Taylor KA, Orcher L, Saggars S, Durrheim DN. Reducing the risk of pandemic influenza in Aboriginal communities. *Rural Remote Health* 2009;9(3):1290.
43. Groom AV, Jim C, LaRoque M, Mason C, McLaughlin J, Neel L, et al. Pandemic influenza preparedness and vulnerable populations in tribal communities. *Am J Public Health* 2009;99; Suppl 2:S271-8.
44. Conseil Général de la Guyane. La Guyane: Population. [Accessed 18 October 2009]. Available from: <http://www.cg973.fr/-Economie->
45. Statistics Greenland. Greenland Home Rule Government. Greenland in Figures, 2009. [Accessed 18 October 2009]. Available from: http://www.stat.gl/LinkClick.aspx?link=Intranet%2fGIF_2009_WEB.pdf&tabid=57&mid=473&language=en-US