Non-alcoholic fatty liver disease (NAFLD) in Filipino North American patients: Results from a multi-ethnic cohort

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ABSTRACT

BACKGROUND: Non-alcoholic fatty liver disease (NAFLD) is more prevalent in certain ethnicities due to a combination of genetic, environmental, and metabolic factors. North American Filipino populations may have lifestyle and metabolic risk factors for NAFLD; however, the prevalence of NAFLD in this group is unknown. We sought to determine whether Filipino patients are over-represented in a multi-ethnic NAFLD cohort and describe their clinical presentation, primarily compared to other ethnicities in the same geographical region and secondarily compared to Manila-based Filipino patients.

METHODS: A cross-sectional study was conducted with patients with NAFLD who were followed at the Hepatology Clinic at Vancouver General Hospital, Canada, from January 2015 to August 2018. Data were extracted for clinicodemographic data, ethnicity, anthropometric measures, blood work, and transient elastography (TE). External comparison data was obtained online from the Metro Vancouver census and a NAFLD study conducted in Manila, Philippines.

RESULTS: Of 317 patients meeting inclusion criteria for the study, 224 patients had complete datasets. The mean age was 51.1 years, and 50% were female. There were 139 (62%) Caucasian and other ethnicity patients, 55 (25%) Asian patients, and 30 (13%) Filipino patients. Compared to other ethnic groups, the Filipino group had similar clinical characteristics, including NAFLD fibrosis scores and TE. Of included NAFLD patients, the proportion of Filipino patients (13.39%) was significantly greater than the proportion of Filipino residents in Metro Vancouver (5.52%, \( p < 0.01 \)). Our Filipino Canadians seemed to be younger, with fewer females and a lower proportion of diabetes mellitus, but a higher proportion of hypertension than the previously reported cohort from Manila.

CONCLUSIONS: While Filipino patients have not previously been examined in multi-ethnic NAFLD studies, they may represent a high-risk population. Further research is needed to clarify the prevalence and presentation of NAFLD in Filipino Canadian patients, as this appears to be a significant health issue in this community.

KEYWORDS: cirrhosis; ethnicity; fibrosis; Filipino; non-alcoholic fatty liver disease

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INTRODUCTION

Non-alcoholic fatty liver disease (NAFLD) has an estimated prevalence of 25% in Canada (1). NAFLD is comprised of a spectrum of diseases, including simple steatosis, steatohepatitis, progressive liver fibrosis, and cirrhosis. The long-term consequences of NAFLD are cardiovascular morbidity and mortality, advanced liver fibrosis, hepatocellular carcinoma, and other liver-related mortality (2–4). Early identification allows for timely intervention, particularly intensive lifestyle changes such as weight loss and emerging pharmacotherapies.

The prevalence and behaviour of NAFLD differ by ethnic group. In the early 2000s, the Dallas Heart Study in the United States, with an enrollment of 2,287 patients, reported significant racial differences in NAFLD prevalence of 45% among Hispanic patients, 33% among Caucasian patients, and 24% among African American patients (5). More recently, this finding was confirmed in a meta-analysis that included 368,569 American patients in 34 studies, but Asian Americans were not included in the analysis (6). Globally, a recent meta-analysis reported a prevalence of 24% in North America, 27% in Asia, 30% in South America, and 31% in the Middle East (7). In addition to having a higher NAFLD prevalence, Asian and Hispanic populations also present at a younger age and with more severe disease (8). The “Asian paradox” has been well-described, whereby Asian patients develop NAFLD at a lower BMI and with more advanced histologic disease compared to higher BMI counterparts (9,10).

Metro Vancouver has a uniquely multi-ethnic population comprised of large visible minority groups, including East Asian (25%), South Asian (12%), and Filipino (5.5%) (11). Across Canada, Filipino immigration is growing, increasing from 662,600 persons in the 2011 census to 837,130 persons by the 2016 census (12). In 2016, the highest reported ethnic origin of recent immigrants was the Philippines, at 15.6% of all immigrants (13). Thus, the rapidly growing North American Filipino population warrants clinical scientific study as an independent population with a view to better serving this community. Based on anecdotal experience at our centre, Filipino patients appear to have a disproportionately high prevalence of NAFLD. Correspondingly, the literature suggests a higher prevalence of metabolic disease and lifestyle risk factors for NAFLD in North American Filipino populations (14,15). However, there is a paucity of literature on the prevalence of NAFLD in Filipino patients, and no studies have been conducted in a North American Filipino immigrant population. To our knowledge, only one study has been conducted in a Filipino cohort, and it was based in Manila, Philippines (16). We note that the prevalence of a disease within a North American ethnic community cannot be assumed to be the same as in the country of origin, given the environmental and cultural differences of North America. Given the variability in NAFLD globally and by ethnicity, we sought to study NAFLD prevalence in North American Filipino patients, as they comprise a significant local minority with significant risk factors. Further, we compared NAFLD prevalence and presentation between different groups, primarily comparing local Filipino patients to other ethnic groups in our centre and secondarily to Manila-based Filipino patients.

MATERIALS AND METHODS

Study design
This was an observational, retrospective cross-sectional study of patients referred for NAFLD evaluation at the Hepatology Clinic at Vancouver General Hospital from January 2015 to August 2018. Approval was obtained prior to chart review from the Clinical Ethics Review Board of the University of British Columbia. A convenience sample of patients was utilized.

Study population
The study included patients aged 18 years or greater, with liver disease compatible with NAFLD and who underwent transient elastography (TE). Liver disease compatible with NAFLD was defined as hepatic steatosis with no identified cause on global assessment and in the presence of metabolic disease risk factors including hypertension (≥140/90 mmHg), high serum triglyceride levels (≥1.7 mmol/L), glucose intolerance/diabetes (fasting plasma glucose >6.0 mmol/L, hemoglobin A1c ≥6.0%, 2-hour oral glucose tolerance test >7.7 mmol/L), truncal obesity (waist to hip ratio >0.9 or waist circumference >102 cm in men, and >0.85 or >88 cm, respectively, in women), or ethnic risk factors (Asian or Latin American descent).

Exclusion criteria were any genetic disorders of metabolism and other causes of liver disease,
Ethnicity data was collected from clinical charts and categorized into Caucasian, Filipino, East Asian, South Asian, and Other. For the purposes of analysis, ethnicity categories were collapsed into Filipino, Asian (not including Filipino), and Caucasian and Other ethnicity groups. Analysis was initially conducted using East and South Asian subgroups; however, as there were no significant differences on initial univariate analysis, the two groups were collapsed into an Asian ethnic group (excluding the Filipino group) for comparison with our group of interest. The 2016 Vancouver Metro Census (18) was utilized to compare the proportion of Filipino persons in the general population and proportion of Filipino persons in the NAFLD cohort. To compare the characteristics of a Filipino population with NAFLD in Manila, a recent study by De Lusong et al was utilized and designated by our team as “the Manila study” (16). The Manila study was a cross-sectional study collecting data from 134 patients diagnosed with NAFLD at the Philippine General Hospital in Manila from 1999 to 2004. This study was the most recent study on NAFLD in Filipino patients.

Data analysis
Mean and standard deviation (SD) were calculated for all continuous variables. Median and interquartile range (IQR) were collected for mean liver stiffness. Fisher’s exact test was used to compare categorical variables, and one-way ANOVA was used for continuous variables. To explore significant associations, Tukey’s multiple pairwise comparisons were conducted. A two-proportions z-test was used to compare the prevalence of each ethnicity with population data available from the 2016 Vancouver Metro Census (18). Categorical variables published in the Manila study (16) were compared to the study population using the z-test for two proportions. Boxplots were created to illustrate differences in BMI, LSM, and NFS by ethnicity. Statistical analyses were performed using R Statistical Software version 1.1.453 (Foundation for Statistical Computing, Vienna, Austria). Statistical significance was defined as a p value <0.05 with a two-tailed test.

RESULTS
On initial screening, 317 patients met the criteria to be included in the study. When patients with incomplete data were removed, 224 patients remained and contributed data to this study. For the entire sample,
Table 1: Patient characteristics

| Variable                                      | All          | Caucasian & other | Asian | Filipino | P     |
|-----------------------------------------------|--------------|-------------------|-------|---------|-------|
| N                                             | 224          | 139 (62)          | 55 (25) | 30 (13) |       |
| Female                                        | 112 (50)     | 64 (46)           | 26 (47) | 15 (50) | 0.22  |
| Age, y, mean (SD)                             | 51.1 (12)    | 51.7 (12)         | 49.4 (11) | 51.1 (13) | 0.52   |
| Mean estimated ethanol intake (g/wk)          | 25.1         | 36.0              | 7.9†   | 6.9     | 0.02  |

Comorbidities

| BMI, kg/m², mean (SD)                         | 29.1 (6.2)   | 30.1 (7.0)        | 27.1 (4.1)† | 28.1 (3.5) | <0.01 |
| BMI >30                                       | 76 (34)      | 59 (42)           | 11 (20)    | 6 (20)    | <0.01 |
| Impaired fasting glucose                      | 49 (22)      | 32 (23)           | 6 (11)     | 7 (23)    | 0.80  |
| Hypertension                                  | 83 (37)      | 51 (37)           | 19 (35)    | 12 (40)   | 0.96  |

Laboratory measures, mean (SD)

| LDL, mmol/L                                   | 2.83 (0.9)   | 2.91 (0.9)        | 2.52 (0.8)† | 2.97 (1)  | 0.04  |
| Triglycerides, mmol/L                         | 1.77 (1)     | 1.77 (1)          | 1.70 (1)    | 1.95 (1)  | 0.65  |
| HbA1c, %                                      | 6.0 (1)      | 5.9 (1)           | 6.2 (2)     | 6.1 (1)   | 0.55  |
| AST, IU/L                                     | 39 (39)      | 39 (46)           | 38 (20)     | 39 (26)   | 0.99  |
| ALT, IU/L                                     | 55 (50)      | 54 (55)           | 59 (41)     | 60 (36)   | 0.77  |
| Platelets, ×10³/L                             | 248 (66)     | 246 (61)          | 253 (79)    | 251 (63)  | 0.76  |
| Bilirubin, mmol/L                             | 11.0 (6)     | 10.6 (7)          | 11.5 (5)    | 11.0 (6)  | 0.72  |
| INR                                           | 1.0 (0.09)   | 1.0 (0.09)        | 1.0 (0.09)  | 1.0 (0.1) | 0.52  |
| Albumin, g/L                                  | 44 (4)       | 43 (4)            | 44.3 (4)    | 43.7 (3)  | 0.25  |
| Ferritin, µg/L                                | 269 (383)    | 236 (347)         | 364 (482)   | 245 (318) | 0.10  |
| NFS                                           | -2.05 (1.5)  | -1.86 (1.5)       | -2.42 (1.5)†| -2.28 (1.6)| 0.04  |

Transient elastography

| Median LSM, kPa (IQR)                          | 5.2 (4.4–6.8) | 5.1 (4.5–6.6)    | 5.4 (4.4–6.4) | 5.2 (4.7–7.9) | 0.43  |

Note: Boldface indicates statistically significant at P <0.05
*Unless otherwise indicated
† P <0.05 on Tukey multiple pairwise comparison to “Caucasian & other” group
LDL = Low-density lipoprotein; AST = Aspartate aminotransferase; ALT = Alanine aminotransferase;
LSM = Liver stiffness measure; NFS = NAFLD fibrosis score; NAFLD = Non-alcoholic fatty liver disease; IQR = Interquartile range

the mean age was 51.1 years, and 50% were female. Mean BMI was 29.1 kg/m², and 76 (34%) patients had a BMI greater than 30 kg/m². Forty-nine (22%) patients had impaired fasting glucose or diabetes, and 83 (37%) had hypertension. Mean LDL was 2.83 mmol/L, and mean HbA1c was 6.0%. Mean AST and ALT were 39 IU/L and 55 IU/L, respectively. Median LSM was 5.2 kPa (IQR 4.4–6.8) (Table 1).

When considering the ethnic origin of patients, 139 (62%) were Caucasian and other, 55 (25%) were Asian, and 30 (13%) were Filipino. Mean age and gender distribution were similar between groups. Compared to the Asian ethnicity group, the Caucasian and other group had significantly higher weekly ethanol intake (36 versus 27.1 g/wk), BMI (30.1 versus 21.2), LDL (2.91 versus 2.52 mmol/L), and NFS (−1.86 versus −2.42) (Figure 1). The Filipino group did not have any significantly different clinico-demographic characteristics when compared with the Asian or Caucasian and other group but did trend numerically toward having lower ethanol intake, BMI, and NFS compared to the Caucasian and
Table 2: Ethnic variability in NAFLD patients compared to local population

| Ethnic group       | Total, N | East Asian |  | South Asian |  | Filipino |  |
|--------------------|----------|------------|---|-------------|---|----------|---|
| NAFLD patient sample | 224      | 36 (16.07%)|   | 19 (8.48%)  |   | 30 (13.39%)|  |
| Vancouver (Metro) census | 2,426,235 | 607,295 (25.03%) |   | 287,900 (11.87%) |   | 133,925 (5.52%) |  |
| P                  |          | <0.01      |   | 0.14        |   | <0.01    |   |

Note: Boldface indicates statistically significant at P <0.05
NAFLD = Non-alcoholic fatty liver disease

Figure 1: Box plots of BMI, LSM, and NFS by ethnicity

LSM = Liver stiffness measure; NFS = NAFLD fibrosis score; NAFLD = Non-alcoholic fatty liver disease

Other group. Median liver stiffness was numerically highest in the Asian group at 5.4 kPa, followed by 5.2 kPa in the Filipino group and 5.1 kPa in the Caucasian and Other group (Table 1, Figure 1).

The proportion of Filipino patients in this NAFLD cohort (13.39%) was significantly higher than the proportion of Filipino residents in the Vancouver Metro census (5.52%, P <0.01). In contrast, the proportion of East Asian patients (16.07%) was significantly lower than the local census (25.03%, P <0.01). The proportion of South Asian patients was similar to the local census (8.48% versus 11.87%, respectively, P = 0.14) (Table 2).

Compared to the Manila study patients (16) (n = 134), the local NAFLD patients of Filipino origin (n = 30) did not demonstrate female predominance (15 [50%] versus 95 [71%] in Manila, P = 0.05) were also numerically older (mean age 51.1 years versus 42.2 years in the Manila study). When considering comorbidities, local Filipino patients had a lower prevalence of diabetes (7 [23%] versus 92 [69%] in Manila, P <0.01) and obesity (6 [20%] versus 80 [60%] in Manila, P <0.01), with lower mean BMI of 28.2 kg/m² (versus 31.8 kg/m² in Manila). Local Filipino patients had a numerically higher prevalence of hypertension compared to Manila patients (12 [40%] versus 29 [22%], respectively, P = 0.06). Local Filipino patients also had lower AST (39 versus 150 IU/L in the Manila study) and lower ALT (60 versus 192 IU/L in the Manila study) (Table 3).
Table 3: Characteristics of Filipino patients compared to the Manila study

| Variable                      | Ethnic group          |
|-------------------------------|-----------------------|
|                               | Manila study patients | Local Filipino patients | P’       |
| Total patients with NAFLD     | 134                   | 30                      |
| Female, no. (%)               | 95 (71)               | 15 (50)                 | 0.05     |
| Age, y, mean (SD)             | 42.2 (2.1)            | 51.1 (13.5)             |          |
| BMI, mean (SD)                | 31.8 (7.2)            | 28.2 (3.6)              |          |
| Comorbidities, no. (%)        |                       |                         |
| BMI >30 kg/m²                 | 80 (60)               | 6 (20)                  | <0.01    |
| Diabetes                      | 92 (69)               | 7 (23)                  | <0.01    |
| Hypertension                  | 29 (22)               | 12 (40)                 | 0.06     |
| Laboratory measures, mean (SD)|                       |                         |
| Albumin, g/L                  | 33.5 (6)              | 43.7 (3)                |          |
| AST, IU/L                     | 150 (19)              | 39 (26)                 |          |
| ALT, IU/L                     | 192 (17)              | 60 (36)                 |          |

Note: Boldface indicates statistically significant at P <0.05
* z-test for two proportions
NAFLD = Non-alcoholic fatty liver disease; AST = Aspartate aminotransferase; ALT = Alanine aminotransferase

**DISCUSSION**

Given the rising prevalence of NAFLD, an understanding of the relationship between ethnicity and NAFLD can optimize diagnosis and management in increasingly diverse populations. Our cross-sectional study of NAFLD patients found a significant over-representation of Filipino patients with NAFLD at a proportion that was 2-fold greater than the expected proportion based on local ethnic distributions. To our knowledge, Filipino patients have not been identified in the North American literature to be a high-risk group for NAFLD and have not previously been examined as an independent group in multi-ethnic NAFLD studies. This is most likely because Asian populations are often studied as a single homogeneous group. Many studies report Asian Americans as a single category without a breakdown into the differing Asian community subgroups, such as Filipino, Chinese, Japanese, Korean, and so on. Further compounding the difficulty of studying NAFLD, or any other disease process, in Asian groups is the fact that American studies rarely differentiate South Asians (ie, Indo-American) from East Asians (ie, Chinese/Japanese/Korean/Filipino Americans) despite these being heterogeneous groups. Due to these factors, the NAFLD experience of the Filipino community in North America has been unexplored, and our study is, to the best of our knowledge, the first to be reported.

Several factors can be considered in the higher prevalence of NAFLD in the Filipino population. The PNPLA3 gene, which regulates lipid metabolism, has been shown to have single-nucleotide polymorphisms that confer susceptibility to developing NAFLD and metabolic syndrome. The highest frequency of putative variants has been reported in Hispanic and East Asian populations (19,20). Filipino patients may be at risk genetically given the historical Spanish and East Asian admixture in the Philippines. The only published study by Baclig et al examined the PNPLA3 gene in Filipino patients; however, it was ultimately inconclusive due to the small sample size. Further research in larger populations is required to determine whether contemporary Filipino populations may also have a genetic susceptibility (21).

Further, it is well-established in the literature that NAFLD is associated with metabolic syndrome, hypertension, obesity, and diabetes (22). Studies show that Filipino populations in North
America have a higher prevalence of hypertension, diabetes, metabolic syndrome, and visceral adipose tissue, despite having similar or lower BMI to Caucasian counterparts (14,23,24). Similarly, studies in Filipino American populations have demonstrated a high incidence of dietary habits suboptimal for metabolic syndrome and limited physical activity, which are established extrinsic factors in NAFLD development (15,25). In areas of growing Filipino American populations, the role of initiatives to address metabolic disease has been explored and implemented with success (26–28). Similar health needs assessments on NAFLD prevalence, health awareness, and lifestyle risk factors should be considered in the local Filipino Canadian population, given our findings of higher NAFLD prevalence.

Interestingly, local Filipino patients had more similarities in NAFLD presentation to other local ethnic groups than Filipino patients in the Manila study (16). Local patients did not demonstrate a female predominance and were older with a mean age of 51 years, similar to a mean age of 53 years in a recent large US study (29). Local patients also had a higher prevalence of hypertension (40%) but less obesity (20%) and diabetes (23%) compared to Manila study patients. Comparatively, North American NAFLD patients had a similar prevalence of hypertension (36%–50%), obesity (36%–71%) and diabetes (13%–26%) in pooled estimates from a recent meta-analysis (7). Further, when comparing within our North American cohort, Filipino patients did not have significant differences in diabetes and hypertension compared to other ethnic groups. Overall, the clinicodemographic characteristics of local Filipino patients had more similarities to other North American patients than Filipino patients included in the Manila study. There may be several factors accounting for these observed differences. First, patient data from the Manila study was collected from 1999 to 2004, and the prevalence of NAFLD risk factors, such as metabolic disease, has increased dramatically in the Philippines. For example, from 1999 to 2016, the global Non-Communicable Disease Risk Collaboration estimates a rise in national obesity rates from 2.3% to 5.5% in men and 4.2% to 7.9% in women (30,31). Unfortunately, there is a lack of more recent comparison data of Filipino patients with NAFLD. Another consideration is the effect of the environmental influences of Western lifestyles, such as diet and activity level. As previous studies have suggested a higher risk of NAFLD in

Our study is inconclusive for whether Filipino patients present with lean NAFLD, which has been previously described in patients of Asian ethnicity. Only 20% of local Filipino patients with NAFLD were obese, though 60% were overweight (BMI greater than 25). Comparatively, in the Manila study, 60% of patients were obese, and 9% were overweight. It is important to note that BMI cut-off values for obesity differ based on ethnicity; whereby Asian patients are considered obese at a lower BMI, this has not been determined for the Filipino population. As such, both our study and the Manila study utilized Western cut-offs for obesity. Our data, when taken in conjunction with the Manila study, demonstrates that 20%–30% of NAFLD patients present with a BMI less than 25. Further study is required to clarify whether the proportion of NAFLD patients with normal BMI is secondary to population variation or if lean NAFLD is truly prominent in this population.

There did not appear to be significantly more advanced liver disease in Filipino patients in our NAFLD cohort compared to other ethnic groups. The mean NFS was lowest in Asian patients and highest in patients of Caucasian and Other ethnicities, but there were no statistical differences in NFS when comparing Filipino patients to either group. All NFS were less than –1.455, with a negative predictive value of 88%–93% for advanced fibrosis (17). As serum-based score systems can have varying sensitivity in different ethnic groups and the NFS incorporates BMI cut-offs validated for a North American population, more research is required to investigate the accuracy of serum scores in Filipino NAFLD patients (33). Nonetheless, in our study, TE was used as a more sensitive measure of advanced fibrosis. The resulting median LSM was similar in all ethnic groups and less than 8.0 kPa, corresponding to a 95% negative predictive value for fibrosis stage F3 or greater (34).

Limitations

There are several limitations to our study. As a single centre hepatology clinic based in a tertiary hospital, our study sample may not represent the greater population. As the clinic is dependent on referrals from family physicians, there may be a referral bias if Filipino patients are over-referred compared to other ethnicities. Further, to allow for the
most accurate comparison between NAFLD ethnicity and local population proportions, we utilized the Vancouver Metro census to match the clinic’s catchment area. Further, the census data was collected in 2016, which is temporally comparable to our data collection from 2015–2018; while it is possible that there was further influx of Filipino immigrants since the latest census, it likely does provide a close estimate for our purposes. There are also uncertainties in the measurement of NAFLD and advanced liver fibrosis that have yet to be established in Filipino patients, including BMI cut-off for obesity and the performance of non-invasive serum scores in a Filipino-specific ethnic group. As such, we utilized TE in addition to serum scores to provide a more accurate assessment of liver fibrosis. Finally, the small sample size of ethnic groups limited the generalizability of the results to broader Filipino populations and the statistical power of our analysis. Further study should include larger samples over a longer observation period.

CONCLUSIONS
In conclusion, we found that Filipino patients have a higher prevalence of NAFLD than would be expected based on their local ethnic distribution. There is a paucity of NAFLD studies in Filipino patients, despite an abundance of studies demonstrating risk factors for NAFLD, including higher prevalence of hypertension, metabolic syndrome, diabetes, obesity, and associated lifestyle factors. In our study, Filipino patients presented similarly to other North American patients and did not have more advanced liver fibrosis based on non-invasive testing. More studies are required on screening, diagnosis, and management of NAFLD, focusing on Filipino populations. From a public health perspective, the Filipino Canadian community may benefit from targeted education initiatives regarding fatty liver disease.

CONTRIBUTIONS: Conceptualization, EM Yoshida; Data Curation, SX Jiang, M Heer, R Trasolini, B Cox, C Galts, V Marquez; Data Analysis, SX Jiang, V Marquez; Writing – Original Draft, SX Jiang, R Trasolini, M Heer, B Cox, C Galts, V Marquez, EM Yoshida; Writing – Review & Editing, SX Jiang, R Trasolini, M Heer, B Cox, C Galts, V Marquez, EM Yoshida.

ETHICS APPROVAL: Approval was obtained for retrospective chart review from the Clinical Ethics Review Board of the University of British Columbia. This retrospective chart review study involving human participants was in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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