Validation of Ontario Marginalization Index generated from 3-digit postal code in patients with end-stage kidney disease

Qibo Wang[1], Noor El-Dassouki[1], Nathaniel Edwards[1], Philip Mutia[1], Roula Khairalla[1], Nawang Yanga[1], Mohammed Saqib[1], Areej Ali[1], Heather Ford[1], Adrian Dychiao[1], Istvan Mucsi[1]

1. University Health Network, Multi-Organ Transplant Program and Division of Nephrology, Toronto, Canada

INTRODUCTION

- Socioeconomic status (SES) is an important determinant of health in the Canadian population (1).
- For patients with end-stage kidney disease (ESKD), lower SES is associated with lower access to kidney transplant and worse transplant outcomes in the US and Europe (2-6).
- In Ontario, SES can be assessed using the Ontario Marginalization Index (OMI), which is a census- and geographically-based index that establishes four different measures of socio-economic marginalization and deprivation using postal codes (7).
- In research settings, only the first three digits of patient postal codes are collected due to patient privacy reason
    - This is because the first three digits of a postal code describes a larger geographical area (called a Census Tract) than that described by a full six-digit postal code, thus limiting the ability to identify an individual patient and maintaining their privacy
- Objective: To validate OMI generated with the first three digits of postal codes (OMI3), instead of six-digit postal codes, using data from the 2016 census by analyzing the association between OMI3 and patient-reported socioeconomic information.
    - If OMI3 is valid, we will be able to use this index to evaluate the association between SES and access to care and health outcomes in medical research while maintaining patient confidentiality.

STUDY DESIGN & METHODOLOGY

- Cross-sectional convenience sample of adults (≥ 18) with CKD referred for transplant assessment or undergoing dialysis across Toronto
- Patient-reported information was collected on a tablet-based electronic data capture system (DADOS, Techna Institute, Toronto)
- OMI3 was created as follows:
    1. Three-digit postal codes were linked with their corresponding Dissemination Area (DA) (small geographic unit with an average population of 400 – 700 people (7)) using the Statistics Canada Postal Code Conversion File
    2. OMI data was then linked with the DA identifier
    3. Because the area represented by a 3-digit postal code is larger than that represented by the DA, we calculated the population weighted average of the OMI factor scores for each 3-digit postal code in the Greater Toronto Area (where the majority of our sample resides) and then ranked these to generate new quintiles for OMI3
- OMI3 scores are presented in quintiles, where groups are ranked from the least marginalized to the most marginalized in the GTA
- OMI dimensions will be compared to patient-reported SES variables to determine the validity of using OMI3 as an indicator of SES
- Descriptive statistics are presented as mean (SD) or percentage; univariable associations between OMI variables and patient-reported SES variables were assessed using chi-square and Fischer exact tests, with all statistical analysis completed using STATA14

Variable Comparison

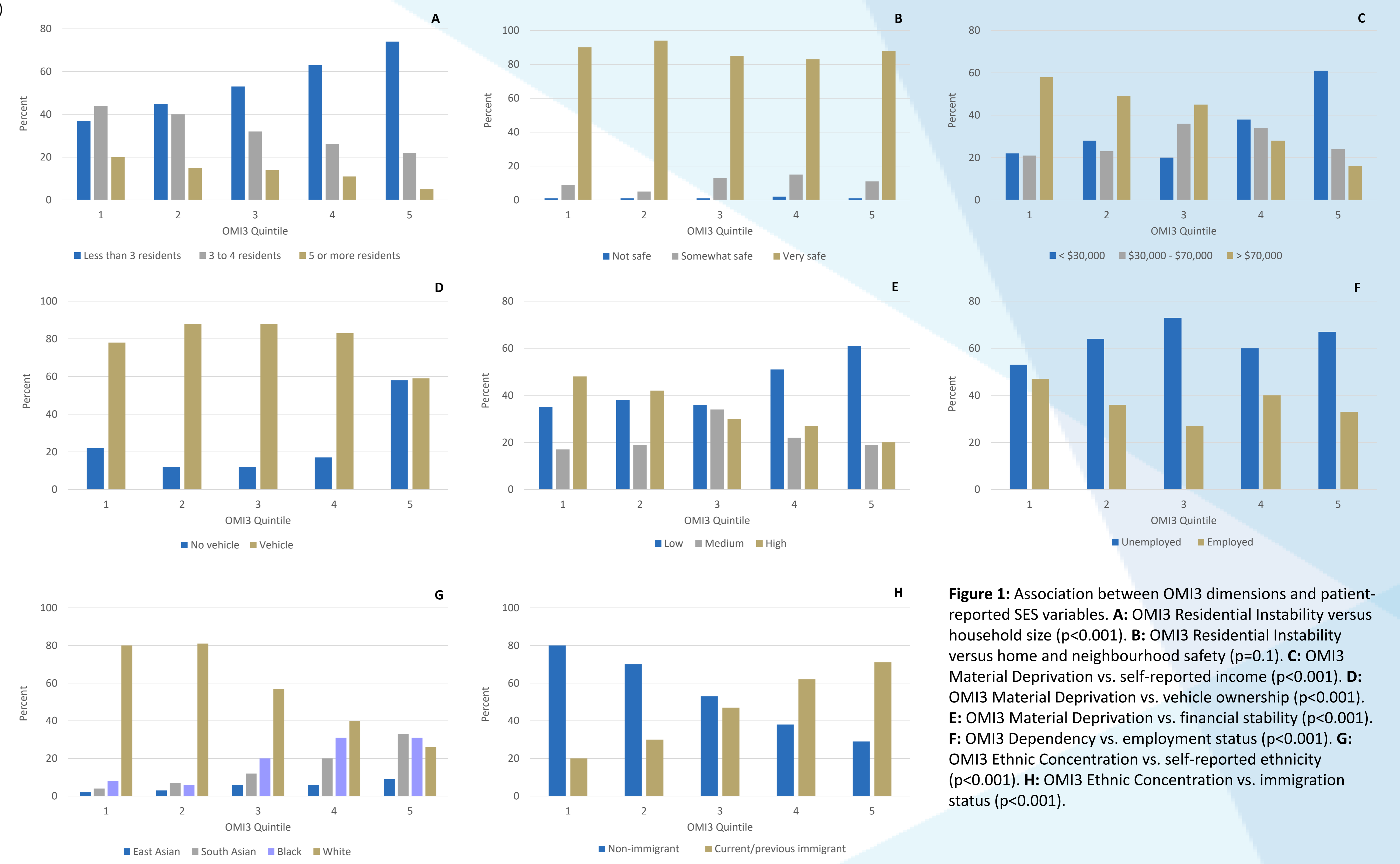| OMI Dimensions (7)	Patient-Reported SES Variable
Residential Instability: Area-level concentrations of people who experience high levels of family or housing instability	**Household size:** "How many people live permanently in your current household?" **Home and neighbourhood safety:** "Which of the following statements best describes in general how safe you feel in your home or neighborhood?"
Material Deprivation: Area-level indicator of inability of individuals and communities to access and attain basic needs	**Income:** "What was your total household income (from all sources) before taxes in the last calendar year?" **Vehicle ownership:** "Do you or does anyone in your household own a car/other vehicle?" **Financial stability:** "If your family lost your current income, how long could you continue to live in your current situation?" (0-2 months/low, 3-6 months/medium, 7-12 months/high)
Dependency: Area-level concentration of people who do not have income from employment	**Employment status:** "Which of the following best describes where your income comes from?"
Ethnic Concentration: Area-level concentration of people who are recent immigrants and/or who belong to visible minority groups	**Ethnicity:** "Which of the following best describes your racial or ethnic group?" **Immigration status:** : "Are you now or have you ever been a landed immigrant, refugee or been on a work/minister permit in Canada"

HYPOTHESIZED ASSOCIATIONS

- Patients in the highest OMI3 Residential Instability quintile will have larger household size and lower home and neighbourhood safety
- Patients in the highest OMI3 Material Deprivation quintile will have lower income and financial stability, and will not own a household vehicle
- Patients in the highest OMI3 Dependency quintile will be unemployed
- Patients in the highest OMI3 Ethnic Concentration quintile will belong to racialized ethnic groups and will be current/previous immigrants

RESULTS

Table 1: Participant demographic characteristics (n = 1163)

VARIABLE		TOTAL n(%)
Mean age (± SD)		56 (± 16)
Male		713 (61)
≥ 12 years of education		635 (58)
Ethnicity	White	530 (50)
	East Asian	60 (6)
	South Asian	194 (18)
	Black	237 (22)
	Other	41 (4)
Married/Common-Law		603 (54)
< 3 permanent household residents		620 (56)
High home and neighbourhood safety		998 (88)
Low financial stability		221 (47)
Income	< $30,000	282 (36)
	$30,000 - $70,000	233 (30)
	> $70,000	271 (35)
Unemployed		704 (64)
Current/previous immigrant		545 (53)
Household vehicle		868 (78)
RRT Modality	Dialysis	625 (54)
	Transplant	431 (38)
OMI3 Residential Instability	1 (Least unstable)	84 (8)
	2	221 (22)
	3	274 (26)
	4	342 (33)
	5 (Most unstable)	127 (12)
OMI3 Material Deprivation	1 (Least deprived)	38 (4)
	2	266 (25)
	3	389 (37)
	4	209 (20)
	5 (Most deprived)	146 (14)
OMI3 Dependency	1 (Least dependent)	80 (8)
	2	446 (42)
	3	416 (40)
	4	102 (10)
	5 (Most dependent)	4 (0)
OMI3 Ethnic Concentration	1 (Least concentrated)	45 (4)
	2	69 (7)
	3	105 (10)
	4	382 (36)
	5 (Most concentrated)	447 (43)

Figure 1: Association between OMI3 dimensions and patient-reported SES variables. **A:** OMI3 Residential Instability versus household size (p<0.001). **B:** OMI3 Residential Instability versus home and neighbourhood safety (p=0.1). **C:** OMI3 Material Deprivation vs. self-reported income (p<0.001). **D:** OMI3 Material Deprivation vs. vehicle ownership (p<0.001). **E:** OMI3 Material Deprivation vs. financial stability (p<0.001). **F:** OMI3 Dependency vs. employment status (p<0.001). **G:** OMI3 Ethnic Concentration vs. self-reported ethnicity (p<0.001). **H:** OMI3 Ethnic Concentration vs. immigration status (p<0.001).

DISCUSSION

- OMI3 Residential Instability scores were significantly associated with household size in the opposite direction than was hypothesized, and were not significantly associated with home and neighbourhood safety
- OMI3 Material Deprivation scores were significantly associated with income, financial stability, and household vehicle ownership as hypothesized
- OMI3 Dependency scores were significantly associated with employment status as hypothesized
- OMI3 Ethnic Concentration scores were significantly associated with patient-reported ethnicity and immigration status as hypothesized
- **We propose that OMI3 Material Deprivation, Dependency, and Ethnic Concentration scores are appropriate measures of patient SES and can be used to assess SES in studies enrolling patients with ESKD, and that OMI3 Residential Instability score requires further study before being used**
- Limitations
    - Relatively small convenience sample
    - OMI data is based on the 2016 census, whereas the self-reported patient data was collected up to Dec 2019, so some OMI data may not be up-to-date

REFERENCES

1. Mikkonen, J., Raphael, D. (2010). Social Determinants of Health: The Canadian Facts. Toronto: York University School of Health Policy and Management.
2. Axelrod, D.A., Dzebisashvili, N., Schnitzler, M.A., Salvalaggio, P.R., Segev, D.L., Gentry, S.E., Tuttle-Newhall, J., Lentine, K.L. (2010). The Interplay of Socioeconomic Status, Distance to Center, and Interdonor Service Area Travel on Kidney Transplant Access and Outcomes. *Clinical Journal of American Society of Nephrology*, 5(12).
3. Gore, J.L., Danovitch, G.M., Litwin, M.S., Pham, P.T., Singer, J.S. (2009). Disparities in the utilization of live donor renal transplantation. *American Journal of Transplantation*, 9(5).
4. Roodnat, J.I., Laging, M., Massey, E.K., Kho, M., Kal-van-Gestel, J.A., Ilzermans, J.N.M., van de Wetering, J., Weimar, W. (2012). Accumulation of Unfavourable Clinical and Socioeconomic Factors Precludes Living Donor Kidney Transplantation. *Transplantation*, 93(5).
5. Udayaraj, U., Ben-Shlomo, Y., Roderick, P., Casula, A., Dudley, C., Collett, D., Ansell, D., Tomson, C., Caskey, F. (2012). Social deprivation, ethnicity, and uptake of living donor kidney transplantation in the United Kingdom. *Transplantation*, 93(6).
6. Zhang, Y., Gerdtham, U.G., Rydell, H., Jarl, J. (2018). Socioeconomic inequalities in the kidney transplantation process: A registry-based study in Sweden. *Transplantation Direct*, 4(2).
7. Matheson, F.I., van Ingen, T. (2018). 2016 Ontario marginalization index: user guide. Toronto, ON: St. Michael's Hospital. Joint publication with Public Health Ontario.

CONTACT INFORMATION

Email: noor.el-dassouki@uhnresearch.ca

DISCLOSURES

The authors have no conflicts of interest to disclose.