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Characteristics and health behaviors of diabetic patients receiving influenza vaccination☆

Karly A. Achtymichuk[a,b], Jeffrey A. Johnson[a,b], Fatima Al Sayah[b], Dean T. Eurich[a,b,*]

[a] School of Public Health, University of Alberta, 3-300 Edmonton Clinic Health Academy, 11405-87 Ave, Edmonton, AB, Canada T6G 1C9
[b] ACHORD, 2-040 Li Ka Shing Centre for Health Research Innovation, University of Alberta, Edmonton, AB, Canada T6G 2E1

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ABSTRACT

Objective: Epidemiological research has posited a 'healthy user' bias in patients receiving influenza vaccination; thus we sought to evaluate potential healthy-user attributes and their associations with influenza vaccination.

Research design & methods: Between 2011 and 2013, adults with type 2 diabetes were enrolled in a prospective cohort in Alberta, Canada. Information collected included sociodemographics, diabetes-related data (e.g., duration, complications), health behaviors (e.g., smoking status), functional health status, and satisfaction with healthcare. Data were collected by a mailed, self-administered survey. Multivariable logistic regression analyses were used to identify potential healthy-user attributes independently associated with influenza vaccination.

Results: From a cohort of 2040 patients, 1287 (63%) reported receiving the influenza vaccine in the previous year. Average age of the cohort was 64 years (standard deviation 11) and 55% were male. In multivariable analysis, attributes independently associated with influenza vaccination included receiving preventive medications: aspirin (64% vs 44%; adjusted odds ratio, aOR 1.65, 95% CI 1.34–2.04); blood pressure medications (76% vs 56%; aOR 1.36, 95% CI 1.07–1.71); and cholesterol-lowering medications (74% vs 53%; aOR 1.50, 95% CI 1.19–1.89), as well as having a healthcare professional check feet for lesions (47% vs 31%; aOR 1.39, 95% CI 1.12–1.74). Additional covariates independently associated with influenza vaccination included: age over 65 years, respiratory disease, the number of additional comorbidities, and higher ratings of healthcare experience.

Conclusion: Vaccinated diabetic patients exhibit many postulated attributes of 'healthy users', which has implications for the interpretation of epidemiological studies of influenza vaccine effectiveness, as well as targeting future vaccination campaigns.

Influenza vaccination is undoubtedly one of the largest public health prevention programs around the world. Most guidelines recommend influenza vaccination for all patients aged $\geq$6 months unless contraindicated; however, certain high-risk groups are prioritized for vaccination, including those with diabetes [1,2]. Clinical practice guidelines for the management of type 2 diabetes recommend that all diabetes patients receive the annual influenza vaccine [3,4].

Although several observational studies have assessed influenza vaccine effectiveness in diabetes patients [5–8], the true effectiveness is still debated due to lack of high quality randomized controlled trials and concerns of bias in observational studies [9]. Of particular concern is a 'healthy user' bias, whereby patients who choose to be vaccinated are postulated to be healthier, presumably through engagement in more preventive and health-seeking behaviors (e.g., getting annual check-ups, following cancer-screening guidelines, adhering to prescribed medications) [10]. Because many observational studies of vaccine effectiveness are based on administrative claims data, such healthy-user attributes are rarely accounted for and can lead to severe bias

Abbreviations: aOR, adjusted odds ratio; ABCD, Alberta's Caring for Diabetes Project; MCS-12, Mental Component Summary of the Short-Form 12 Version 2 Survey; PCS-12, Physical Component Summary of the Short-Form 12 Version 2 Survey; SDSCA, Summary of Diabetes Self Care Activities; VIF, variance inflation factor.

☆ Work Performed at the University of Alberta.

* Corresponding author at: ACHORD, 2-040 Li Ka Shing Center for Health Research Innovation, University of Alberta, Edmonton, AB, Canada T6G 2E1. Tel.: +1 780 492 6333; fax: +1 780 492 7455.

E-mail addresses: karlya@ualberta.ca (K.A. Achtymichuk), jeff.johnson@ualberta.ca (J.A. Johnson), falsayah@ualberta.ca (F. Al Sayah), deurich@ualberta.ca (D.T. Eurich).

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[11–13]. Healthy user bias is not specific to influenza vaccination and has been used to explain the relationships detected in observational studies between hormonal therapy or vitamins and cardiovascular outcomes, statins and multiple outcomes including hip fracture, Alzheimer's disease, sepsis, and cancer [14].

To date few studies have specifically explored potential healthy-user attributes. This is due, in part, to reliance on administrative databases, which often lack important patient information characterizing attributes and healthy user behaviors. In the few non-administrative database studies conducted, higher functional status has been shown to be a major determinant of vaccine receipt and associated outcomes [11,13]. Given the importance of influenza vaccination in public health, and the potential impact of the healthy user bias in observational studies of preventive strategies and treatments, we sought to determine the differences in healthy-user attributes between patients who receive the influenza vaccine compared to patients who do not. To do so we used a large clinically-rich population-based cohort of patients with type 2 diabetes.

1. Research design and methods

The Alberta's Caring for Diabetes Project (ABCD) is an ongoing prospective population-based cohort of adults with type 2 diabetes in the province of Alberta, Canada [15,16]. Eligible patients included those over 18 years of age and who are able to communicate in English. Patients with known type 1 diabetes or gestational diabetes were excluded. Patients were recruited between December 2011 to December 2013 through multiple approaches including invitations through primary care networks, diabetes clinics, and community pharmacies as well as radio, print and television advertising. Eligible patients willing to participate received a self-administered survey via the mail. Follow-up reminders were issued approximately 4 weeks following initial contact to non-responders. The representativeness of the ABCD cohort has been previously assessed and shown to be a representative sample of Albertans and Canadians with diabetes [16]. The data for this analysis were limited to the baseline survey which, depending on the participant, could have been filled out between December 2011 and December 2013. One year of data (one survey) were used per participant. All participants provided written informed consent and the ABCD project was approved by the University of Alberta Research Ethics Board.

1.1. Outcomes

Our primary outcome of interest was whether or not the patient reported receipt of the influenza vaccine in the past twelve months. In Alberta, influenza vaccination is free of charge and is available through community vaccination campaign clinics, primary care centers, hospitals, as well as community pharmacies. Self-report of influenza vaccination has been described in previous studies as a valid method with high sensitivity and moderate specificity [17–20].

1.2. Measurements

Self-reported data covered a wide range of clinical, behavioral, psychosocial and process of care factors believed to be associated with influenza vaccine use and health outcomes in patients with diabetes. Specific data collected included, but was not limited to: sociodemographic variables consisting of age (greater or equal to 65 years vs less), sex, marital status (married vs not), educational level (high school or more vs less), ethnicity (Caucasian vs other) and annual household income (≥$80,000/year vs less).

Comorbidities included heart disease, cerebrovascular disease, respiratory disease, and cancer, as well as an overall count of other major comorbidities (range 0–10). Preventive medications often prescribed in diabetes patients and known to be associated with the healthy user were included: aspirin, blood pressure medications (e.g., ACE inhibitors), and cholesterol-lowering medications (e.g., statins). Duration of diabetes and insulin use were included as markers of disease severity. Information on the use of pneumococcal vaccine was collected but not included in our primary model as co-receipt with influenza vaccination was common (correlation coefficient = 0.54, $p < 0.001$); however, we did include it in sensitivity analyses.

Health status was measured by the Short Form "SF-12" version 2, which yields 2 summary scores: the PCS-12 (physical component summary) and MCS-12 (mental component summary). These were analyzed as continuous variables with higher scores indicating better physical and mental health status, respectively [21]. Self-care management was measured by the Summary of Diabetes Self Care Activities (SDSCA) [22]. The SDSCA domains of general diet, blood sugar testing, footcare and medication adherence were included as continuous scores from 0 to 7, representing the mean number of days per week that these self-care activities were followed. Other health behaviors assessed include: smoking (current or not), alcohol consumption [23] (yes or no), and meeting guidelines for physical activity (yes or no) which was measured by the Godin and Shephard Leisure-time physical activity questionnaire [24].

Clinical monitoring indicators including checks for A1C, cholesterol, blood pressure, and dilated eye exams, as well as healthcare professional activities including checking feet for lesions, testing urine for protein and measuring weight on a scale were also included.

Lastly, patients were asked to rate their healthcare experience over the past year on a scale from 0 to 10. This was analyzed as a continuous variable with higher scores indicating higher satisfaction with care [25,26].

1.3. Analysis

All analyses were done using logistic regression. In building our multivariable model, two different approaches were taken. In our primary analysis, we postulated that all clinical and behavioral factors as noted above should be related to the healthy user and influenza vaccine receipt. Thus, we organized the covariates into five major blocks to assess the impact of increasing clinical and behavioral data on predicting influenza vaccine receipt: (1) sociodemographics, (2) comorbidities & medications, (3) health status, (4) self-care behaviors, and (5) clinical monitoring. We then completed a series of multivariable logistic regression models to evaluate the association between available covariates and influenza vaccination. Specifically, we first calculated unadjusted estimates. Second, we conducted simple adjustments for sociodemographic variables. Third, we included comorbidities and medications that can typically be derived from most administrative datasets. Lastly we included more difficult-to-capture health status and measures of self-care behaviors and clinical monitoring. We report unadjusted and adjusted odds ratios (ORs) from our logistic regression models with their respective 95% confidence intervals (95% CI). We report the *c*-statistic for each block of covariates independently and the cumulative *c*-statistic for all blocks currently in the model. In our secondary analysis, we built a more parsimonious multivariable model, including only variables based on statistical significance ($p < 0.1$) in univariate analyses. In all models, multicollinearity was examined by calculating the variance inflation factor (VIF), where values more than 10 were interpreted as important multicollinearity; however, none were observed in our multivariable model. Statistical analysis was conducted with Stata version 12.1 (StataCorp LP, College Station, TX).