1   **Cohort Profile: Prospective Cohort to Study the COVID-19 Immune Response in**

2   **Retail Workers in Québec, Canada (CISACOV)**

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34 **ABSTRACT**

35 *Purpose:* Retail workers are an understudied occupational group that may have been at

36 increased risk of contracting SARS-CoV-2 during the COVID-19 pandemic. Therefore, we

37 set up a longitudinal cohort of participants working in this sector to better document the

38 incidence of SARS-CoV-2 infection and the immune response to infection and/or

39 vaccination in this group.

40 *Participants:* A total of 304 participants were recruited between April 20, 2021 and

41 October 22, 2021. They were invited to attend three visits (each separated by ~12 weeks)

42 during which they provided blood samples and information on participant characteristics,

43 COVID-19 symptoms, and vaccination. An extension phase of two additional visits was

44 carried out between March 15th, 2022 and October 3rd, 2022 to document the impact of

45 the Omicron variant among the 198 participants who were still eligible for recruitment.

46 Participants were aged 18 to 75 and worked in grocery stores, hardware stores, bars or

47 restaurants within the Québec City metropolitan area (Canada). *Findings to date:* This

48 article describes participants' demographic, socioeconomic, behavioral, clinical and

49 occupational characteristics, and their COVID-19 symptoms (where applicable). It also

50 describes SARS-CoV-2 vaccination status and any SARS-CoV-2 diagnostic test (i.e., PCR or

51 rapid antigen) performed from the beginning of the pandemic until the last visit.

52 *Future plans:* The incidence of SARS-CoV-2 infections will be assessed. The immune

53 response (innate and acquired) to SARS-CoV-2 infection or vaccination will be studied

54   using a variety of techniques, including reference and experimental enzyme-linked

55   immunosorbent assays, microneutralization assays with live viruses, experimental

56   pseudoneutralization with an angiotensin-converting enzyme 2-spike assay, peripheral

57   blood mononuclear cells and neutrophil stimulation, and a proliferation assay based on

58   carboxyfluorescein diacetate succinimidyl ester.

59   *Registration:* Not applicable.

60   *Strengths and limitations*

61   • This cohort offers a comprehensive dataset to study the immune response to

62   SARS-CoV-2 infection or vaccination (alone), or hybrid immunity, as participants

63   provided information on a wide range of demographic, socioeconomic,

64   behavioral, clinical, and occupational variables. However, the low proportion of

65   racial minorities (i.e., 3.0%) limits the use of this cohort to study racial

66   determinants of immunity to SARS-CoV-2.

67   • This cohort focuses on workers in the food and retail service sector, an

68   understudied population at high risk of occupational exposure to infectious

69   agents.

70   • This study covered seven pandemic waves and thus captured a large number of

71   confirmed infections from different variants.

72   • Sample collection was initiated immediately prior to COVID-19 vaccine availability

73   for this population and thus captured successive vaccination campaigns over 17

74   months.

75   •   In keeping with the study design, none of the participants had severe COVID-19

76   disease requiring hospitalization at baseline, and none of the COVID-19 illnesses

77   that occurred during the study required hospitalization; this cohort may not,

78   therefore, be used to study the immune response leading to severe health

79   outcomes, but is appropriate to study the immune response to mild SARS-CoV-2

80   infections.

81   •   Nearly 1300 blood samples were collected; furthermore, only 13 out of 304 (4.3%)

82   participants withdrew before attending all three initial visits, and 4 out of 198

83   (2.0%) participants who remained eligible in the extension phase withdrew before

84   attending the fifth visit. A series of at least 5 blood samples drawn over 48 weeks

85   is therefore available for most participants.

INTRODUCTION

During the SARS-CoV-2 pandemic, workers with client-facing duties were considered to be at greater risk of infection than those who worked remotely.[1-3] Although most studies have focused on healthcare workers (HCW),[4][5] many non-HCWs were also considered to be at risk due to their occupational exposure.[6][7]

Workers in the food and retail industry are an understudied occupational group that may have been at greater risk of contracting SARS-CoV-2. These workers often have below-average incomes, face precarious employment conditions and lack benefit packages to cover health-related absenteeism. At the beginning of the pandemic, these workers often lacked the training and the access to protective equipment used by HCWs to reduce exposure.[8] However, risk is likely to vary from one sector to another. For example, grocery stores were considered an essential service and therefore remained open throughout the pandemic, with public health measures (e.g., mask wearing) being enforced and generally well respected. In contrast, restaurants and bars were intermittently opened and closed by health authorities over the same period, and public health measures were more difficult to enforce due to the intrinsically social nature of these businesses and their main purpose — the consumption of food and drink — that precluded continuous mask wearing.

Compelling evidence now confirms that the risk of occupational exposure is high for these workers. In a serological survey conducted in New York City prior to the approval of the first COVID-19 vaccine, the seroprevalence of anti-spike antibodies was higher among

107   grocery store and restaurant workers than in most subgroups of HCWs.[1] In another

108   serosurvey conducted in Switzerland, kitchen staff and grocery store workers exhibited

109   an above-average seroprevalence compared to other essential workers.[9] In the

110   Netherlands, individuals working in the hospitality sector were more likely to have a

111   positive PCR test result than those working in non-close-contact occupations.[10] In Japan,

112   restaurants and bars were the second most common setting of SARS-CoV-2 outbreaks

113   after healthcare facilities.[7][11]

114   To date, no thorough investigation of SARS-CoV-2 exposure has been conducted

115   among Canadian workers in grocery stores, hardware stores, bars or restaurants.[12][13] Such

116   an investigation could help better prepare health authorities when implementing future

117   measures, including the designation of priority groups for vaccination, and mandatory

118   lockdowns in these sectors. Accordingly, we set up a longitudinal cohort that investigated

119   the incidence of COVID-19 and the humoral and cellular immunity (innate and acquired)

120   to SARS-CoV-2 in these workers. This article describes the experimental design of the

121   project and the cohort of participants.

COHORT DESCRIPTION

Participants and setting

Eligibility criteria included the following: (1) providing informed consent; (2) age ≥18 years; (3) working either on a full-time or part-time basis in a grocery store, hardware store, bar or restaurant located in the administrative regions of Capitale-Nationale and Chaudière-Appalaches that include and surround the area of Québec City, Canada; (4) having a public-facing role in daily work-related activities; (5) having worked ≥20 full days between February 1st, 2020 and the first visit; and (6) having no history of hospitalization due to COVID-19.

Participants were recruited using a variety of strategies: 1) an online recruitment campaign conducted by a student-run communication agency; 2) email invitations to members of partner union organizations - *Confédération des syndicats nationaux* (CSN) and to sectoral organizations of hardware store workers - *Association Québécoise de la quincaillerie et des matériaux de construction* (AQMAT); and 3) email information to all students and employees at *Université Laval* and the *Centre Hospitalier Universitaire de Québec* in order to publicize the study.

Design and procedures

The study was initially designed as a prospective cohort study with three sampling visits, each separated by 12±2 weeks, between April 20th, 2021 and October 3rd, 2022. In response to the emergence of Omicron, an extension of two additional visits was proposed to the participants who were still eligible for recruitment. An additional COVID-

143   19 visit (VCoV) was also planned shortly after the occurrence of any SARS-CoV-2 infection

144   during the study period (Figure 1).

145   At the first visit ("V1"), participants signed an informed consent form and were then

146   interviewed by trained nurses to obtain information on demographic, socioeconomic,

147   behavioral, clinical and occupational variables (Table 1). The questionnaires were adapted

148   from those suggested by our funding body, the COVID Immunity Task Force (CITF).[14] At or

149   after the third visit ("V3"), eligible participants received information about the extension

150   of the study and signed a new informed consent if they were interested in participating.

151   At the second ("V2"), third ("V3"), fourth ("V4") and fifth visits ("V5"), participants

152   completed an abridged version of the V1 questionnaire that focused the COVID-19

153   vaccines that they received and SARS-CoV-2 symptoms, diagnosis, exposure and

154   associated risk factors (Table 1). Blood was drawn to study humoral immunity (i.e., at V1

155   to V5) and cellular immunity (i.e., at V1, V3, and V5) to SARS-CoV-2. Additional PCR tests

156   were carried out at V4 and V5 to detect asymptomatic carriers.

157   The VCoV visits took place at a median time of 15 days (10 to 42 days) after the onset

158   of symptoms. Blood was drawn to study humoral and cellular immunity and a

159   questionnaire focusing exclusively on SARS-CoV-2 diagnosis and symptoms was

160   completed at that visit.

161   *Study exposures and follow-up*

162   The two main exposures of the study were SARS-CoV-2 infection, defined as a

163   positive test result for SARS-CoV-2 (PCR or antigen detection), and participants'

164   vaccination status. Participants were asked about possible or confirmed SARS-CoV-2

165   infection (i.e., symptoms, diagnostic test, test date and test result) and their SARS-CoV-2

166   vaccination history (i.e., number of doses, date of vaccination, type of vaccine) since the

167   beginning of the pandemic at V1, and since the last visit (at V2 to V5). Positive SARS-CoV-

168   2 test results were therefore captured from the beginning of the pandemic until the

169   earliest among the last visit, withdrawal from the study, or loss of eligibility.

170   *Study outcome*

171   The primary outcomes were vaccine- and infection-induced immunity. We also

172   explored the humoral immunity, using different techniques and antigens, and the cellular

173   immunity (innate and acquired).

174   *Confidentiality and data storage*

175   This study was approved by the « *Comité d'éthique de la recherche du CHU de Québec

176   – Université Laval* » (registration number 2021-5744). A unique, anonymized identifier

177   was assigned to each participant and used to store the data and the samples. The samples

178   will be stored for up to 10 years, and the data for at least 15 years.

179   *Patient and public involvement statement*

180   No public stakeholders were involved in establishing and designing this cohort.

181   *Participant characteristics*

182   Overall, 304 individuals were initially recruited to attend the three first visits from

183   April 20th, 2021 to May 9th, 2022. The cohort included 149 (49.0%) restaurant/bar

184   workers, 112 (36.8%) grocery store workers, and 43 (14.1%) hardware store workers.

185   With the emergence of Omicron, 198 participants who at the time of ethic approval were

186   still within the recruiting window, were included for two additional visits (12±4 weeks

187   apart) between March 15th, 2022 and October 3rd, 2022. Only 13 out of 304 (4.3%)

188   withdrew before V3, and only 4 more out of 198 (2.0%) withdrew at V5, resulting in a

189   series of at least 5 blood samples drawn over 48 weeks for most participants.

190   On average, participants were aged 41.3 years in the overall cohort (Table 2).

191   Specifically, restaurants/bar workers were on average 37.2 years old, grocery store

192   workers 44.2 and hardware store workers 48.2. Female participants represented 57.9%

193   of the cohort. Overall, 96.7% self-identified as White, 1.6% as Asian, 1.0% as Latino

194   American, and 0.7% as Black. The low proportion of racial minorities (i.e., 3.3%) is

195   consistent with the size of the visible minority population in the Québec City metropolitan

196   area (i.e., 4.9% according to census).[15] Levels of education varied: 39.4% reported having

197   a high school diploma or vocational certificate, 33.2% a higher education certificate and

198   22.7% at least a university degree. In total, 76.0% of participants resided in the Capitale-

199   Nationale administrative region, the remainder residing in the Chaudière-Appalaches

200   administrative region (Table 3). Most (i.e., 62.2%) lived alone or with one other person,

201   23.0% lived with children (<18 years), 15.5% with HCWs and 7.6% with teachers or

202   kindergarten workers. These distributions were similar within each occupational group.

203   According to body mass index (BMI), 41.1% of the participants had a healthy weight

204   (i.e., BMI=18.5 to 24.9 kg/m^2), 27.0% were overweight (BMI=25.0 to 29.9 kg/m^2) and

205   30.6% were obese (BMI ≥30 kg/m^2) (Table 4). Only 1.3% were considered underweight

206   (BMI <18.5 kg/m^2). Cigarette (i.e., tobacco) use was reported by 17.4% of the participants

207   and e-cigarette use by 7.9%. About half (i.e., 47.7%) of participants reported having at

208   least one comorbidity. Hardware store workers had more comorbidities, probably

209   because they were slightly older (on average). Overall, 17.1% reported usually receiving

210   an annual influenza vaccine (13.8% in the year prior to the first visit).

211   Approximately half (i.e., 53.6%) of the participants reported working on average

212   more than 30 hours per week (Table 5). Most (88.8%) had attended at least one gathering

213   of 10 or more persons during the study period, and 40.8% reported attending more than

214   10 such gatherings. The predominant mode of transportation was by car (88%), followed

215   by bus (12.8%) and walking (9.2%). Traveling outside the province of Québec was reported

216   by 47.0% of the participants, with 25.7% travelling within Canada, 14.8% to the United

217   States, and 27.6% elsewhere. The distribution of participants in each occupational group

218   was similar for the workplace region, mode of transportation and travelling, but differed

219   for the weekly hours worked and the number of gatherings attended.

220   Overall, 98.7% of the participants reported wearing a mask at work, indicating

221   excellent adherence to this measure (Table 6). Other measures, such as handwashing

222   (98.4%), distancing (70.1%) and the use of Plexiglas dividers (77.3%) were also frequent.

223   The use of gloves (6.9%) and face-shields (10.5%), which were not extensively promoted

224   by the regional public health authorities, were less frequent. Outside work, all

225   participants reported wearing a mask in public (100.0%); most avoided usual salutations

226   (85.2%), practiced social distancing (84.2%) and avoided contact with vulnerable persons

227   (83.6%) and crowded places (76.6%). Most participants reported washing their hands

228   when dirty (96.7%), after using the bathroom (97.7%), when arriving at (92.1%) and

229   leaving the workplace (71.7%), before eating (87.8%) and after handling trash (79.6%). In

230   general, adherence to these measures was consistently lower among restaurant and bar

231   workers, possibly because of the nature of their work or their younger age (on average).

232   **FINDINGS TO DATE**

233   *SARS-CoV-2 infection*

234   Overall, 168 positive tests were reported in 121 participants throughout the study

235   period (Table 7). Of these tests, 117 were the first to yield a positive result as reported by

236   the participants; 40 (performed by 37 participants) were additional tests with 32

237   considered follow-up tests (<90 days since previous test) and 8 detecting a second or third

238   infection (>90 days since previous test). The remaining 11 (including four first-ever

239   positives) were PCR tests performed as per protocol at V4 and V5 among asymptomatic

240   or pre-symptomatic individuals. In addition, 29 participants reported 31 suspected

241   COVID-19 infections based on their symptoms, although not confirmed by a PCR or

242   antigen detection test.

243   *SARS-CoV-2-related symptoms*

244   Among the 117 participants with a first confirmed SARS-CoV-2 infection, 94.9%

245   reported ≥1 symptom at the time of testing (Table 8). Each individual symptom was

246   experienced by ≥47.9% of participants, except for diarrhea (13.7%) and loss of smell or

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247   taste (22.2%), a pattern consistent with prior studies.[16-18] These distributions were similar

248   within each occupational group.

249   Vaccination for SARS-CoV-2

250   The participants were vaccinated according to local government recommendations

251   with the vaccines approved by Canadian health authorities. The COVID-19 vaccines

252   available were monovalent Comirnaty (Pfizer-BioNTech), Spikevax (Moderna) and

253   Vaxzevria (AstraZeneca), which each required two doses to complete the primary series.

254   Hardware store workers were the most highly vaccinated occupational group, 100% of

255   them having received two doses by February 2022 (Figure 2). By the end of the study (i.e.,

256   last visit between May 10th, 2022 and October 3rd, 2022), nearly 70% of all participants

257   had received at least one booster dose.

258   At the time of testing positive, 17.9% of the participants had received no vaccine

259   dose, 0.9% had received a single dose of vaccine, 38.4% had received two, 39.3% had

260   received three, and 3.4% had received four (Table 9). In participants who tested positive

261   and had received at least two vaccine doses, all infections occurred after the 4th wave,

262   when the Omicron variant was predominant.

263   *Blood sample bank to study infection-induced, vaccine-induced, and hybrid immunity*

264   Overall, 1299 blood samples were collected, including 304 (23.4%) at V1, 297 (22.9%)

265   at V2, 291 (22.4%) at V3, 198 (15.2%) at V4, 194 (15.0%) at V5, and 15 (1.2%) at additional

266   visits (i.e., VCoV). In total, 69.2% of the blood samples were drawn from vaccinated

267   participants with no known history of SARS-CoV-2 infection, 23.1% from vaccinated and

268   previously infected participants, 6.9% from unvaccinated participants with no known

269   history of SARS-CoV-2 infection, and 11 (0.8%) from previously infected and unvaccinated

270   participants (Table 10).

271   **STRENGTHS AND LIMITATIONS**

272   We set up a cohort of 304 participants to conduct a longitudinal study of COVID-19

273   immunity among food and retail workers who lived and worked within the greater

274   Québec City metropolitan region. The participants provided information on a wide range

275   of demographic, socioeconomic, behavioral, clinical and occupational variables. The study

276   covered seven waves of COVID-19 infection, including those dominated by the Alpha,

277   Delta, and Omicron variants, thus capturing a relatively large number of epidemiological

278   periods and infections. In addition, the blood samples were collected at each scheduled

279   visit regardless of participants' infection or vaccination history, thus enabling the study of

280   infection-induced, vaccine-induced and hybrid immunity in this extensively characterized

281   cohort. Moreover, few participants withdrew from the study before the end of the initial

282   (i.e., V1-V3) and extension phases (i.e., V4-V5), resulting in complete series of at least 5

283   samples for most participants.

284   A total of 117 first (ever) COVID-19 infections were reported, and most occurred

285   between December 5th, 2021 and October 3rd, 2022, consistent with the emergence of

286   the highly contagious Omicron variant. In the present study, vaccine coverage was high:

287   by the time Omicron had emerged, nearly 95% of the participants had already received

288   two vaccine doses (primary series). This high rate of vaccination may be because retail

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289   workers considered themselves at higher risk of SARS-CoV-2 exposure than the general

290   population and were thus more willing to get vaccinated and reduce their risk of infection.

291   Some limitations must be considered when interpreting our results. Per the study

292   design, none of the participants had previously experienced a severe COVID-19 illness

293   that required hospitalization. Therefore, the cohort may not be used to study the immune

294   response that leads to severe health outcomes, but is appropriate to study the immune

295   response to mild COVID-19 illness. Furthermore, our study was not designed to infer a

296   causal relationship between a worker's occupational sector and the risk of SARS-CoV-2

297   infection, such that confounders probably explain part of the differences among

298   occupational groups. For example, relative to hardware store workers, grocery store

299   workers were younger (i.e., mean age: 44.2 vs. 48.2 years), included more overweight or

300   obese participants (i.e., 72.3% vs. 46.5%), and lived in more crowded households (i.e.,

301   proportion with ≥3 residents: 49.1% vs. 25.6%), which may have predisposed them to

302   infection. Another limitation is that the cohort may have been subject to a sampling bias

303   as there may be less vaccine hesitancy among people willing to participate in a scientific

304   study. Hence, the study participants may not be representative of the overall population

305   of workers in these sectors. This is suggested by the 5% to 7% higher vaccination coverage

306   for the second dose as of fall 2021 compared to the general population of the province of

307   Québec.

308   The low proportion of racial minorities (i.e., 3.0%) also limits the use of this cohort to

309   study racial determinants of immunity to SARS-CoV-2. In addition, participant responses

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310　may have been affected by a memory bias, particularly for those whose last infection

311　occurred months before V1. Moreover, few samples were drawn from unvaccinated and

312　previously infected participants, so that the cohort may be of limited use to study

313　immunity induced by infection alone. The high vaccination coverage also made it

314　impossible to assess the impact of vaccination on the risk of infection, since, at any given

315　time, most participants had been vaccinated. Lastly, our study may have underestimated

316　the incidence of SARS-CoV-2 infection since most infections occurred during the Omicron

317　wave, when access to PCR-based screening was limited in Québec (and only less sensitive

318　antigen detection tests were available). The serology data of these samples will shed light

319　on this question.

320　**COLLABORATION**

321　More detailed, participant-level information is publicly available on an online platform

322　developed by Maelstrom Research.[19] Researchers with other enquiries or collaboration

323　proposals may contact Sylvie Trottier — the principal investigator in charge of setting up

324　the cohort — at sylvie.trottier@crchudequebec.ulaval.ca. Data on participants' immune

325　responses to SARS-CoV-2 infection and vaccination will be shared through peer-reviewed

326　publications.

330　**Competing interests statement:** Nothing to declare.

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420

421 **TABLES AND FIGURES**

422 **Table 1. Participant visits**

	Visit 1 N=304	Visit 2 N=297	Visit N=291	Visit 4 N=198	Visit 5 N=194	COVID-19 visit (VCoV) N=15
Retention	100%	98%	96%	100%	98%	-
Eligibility assessment	X			X		
Consent form	X			X		
Participant characteristics						
Demographic data	X					
Household data	X					
Clinical data	X					
Occupational data	X	X	X	X	X	X
Retrospective questionnaire form						
COVID-19 positive tests & symptoms	X	X	X	X	X	X
Vaccine status	X	X	X	X	X	X
Cross-section interventions						
Humoral immunity blood samples	X	X	X	X	X	X
Cellular immunity blood samples	X		X		X	X
COVID-19 PCR test at visit				X	X	

423

424 **Table 2. Detailed demographics of study participants at the first visit**

	Overall study population		Restaurant/bar workers		Grocery store workers		Hardware store workers	
	Total (N=304)	COVID-19[1] (N=117)	Total (N=149)	COVID-19[1] (N=62)	Total (N=112)	COVID-19[1] (N=42)	Total (N=43)	COVID-19[1] (N=13)
Age (years), Mean±SD	41.3 ± 15.9	39.6 ± 14.6	37.2 ± 14.8	36.2 ± 14.3	44.2 ± 15.3	42.4 ± 14.1	48.2 ± 17.3	46.5 ± 14.6
Age groups, N (%)								
18-59	257 (84.5%)	106 (90.6%)	135 (90.6%)	57 (91.9%)	93 (83.0%)	37 (88.1%)	29 (67.4%)	12 (92.3%)
60-75	47 (15.5%)	11 (9.4%)	14 (9.4%)	5 (8.1%)	19 (17.0%)	5 (11.9%)	14 (32.6%)	1 (7.7%)
Sex, N (%)								
Female	176 (57.9%)	72 (61.5%)	95 (63.8%)	39 (62.9%)	57 (50.9%)	25 (59.5%)	24 (55.8%)	8 (61.5%)
Male	128 (42.1%)	45 (38.5%)	54 (36.2%)	23 (37.1%)	55 (49.1%)	17 (40.5%)	19 (44.2%)	5 (38.5%)
Race/ethnicity,[2] N (%)								
White	294 (96.7%)	114 (97.4%)	142 (95.3%)	61 (98.4%)	109 (97.3%)	40 (95.2%)	43 (100.0%)	13 (100.0%)
Asian	5 (1.6%)	0 (0.0%)	4 (2.7%)	0 (0.0%)	1 (0.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Black	2 (0.7%)	2 (1.7%)	0 (0.0%)	0 (0.0%)	2 (1.8%)	2 (4.8%)	0 (0.0%)	0 (0.0%)
Latino American	3 (1.0%)	1 (0.9%)	3 (2.0%)	1 (1.6%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Educational attainment, N (%)								
Less than high school	14 (4.6%)	3 (2.6%)	4 (2.7%)	2 (3.2%)	9 (8.0%)	0 (0.0%)	1 (2.3%)	1 (7.7%)
High school	79 (26.0%)	27 (23.1%)	42 (28.2%)	14 (22.6%)	23 (20.5%)	7 (16.7%)	14 (32.6%)	6 (46.2%)
Professional certificate	41 (13.5%)	13 (11.1%)	19 (12.8%)	6 (9.7%)	16 (14.3%)	6 (14.3%)	6 (14.0%)	1 (7.7%)
CEGEP and college certificate	101 (33.2%)	45 (38.5%)	51 (34.2%)	26 (41.9%)	35 (31.3%)	14 (33.3%)	15 (34.9%)	5 (38.5%)
University baccalaureate	54 (17.8%)	22 (18.8%)	28 (18.8%)	12 (19.4%)	21 (18.8%)	10 (23.8%)	5 (11.6%)	0 (0.0%)
Graduate studies	15 (4.9%)	7 (6.0%)	5 (3.4%)	2 (3.2%)	8 (7.1%)	5 (11.9%)	2 (4.7%)	0 (0.0%)

425 Abbreviations: CEGEP = General and professional teaching college

426 Notes:

427 1. Subset of participants who contracted COVID-19 at least once during the study period.

428 2. Self-reported by study participants

Table 3. Household characteristics of the participants at the first visit

	Overall study population		Restaurant/bar workers		Grocery store workers		Hardware store workers	
	Total (N=304)	COVID-19[1] (N=117)	Total (N=149)	COVID-19[1] (N=62)	Total (N=112)	COVID-19[1] (N=42)	Total (N=43)	COVID-19[1] (N=13)
Region, N (%)								
Capitale-Nationale	231 (76,0%)	91 (77,8%)	112 (75,2%)	45 (72,6%)	86 (76,8%)	35 (83,3%)	33 (76,7%)	11 (84,6%)
Chaudière-Appalaches	73 (24,0%)	26 (22,2%)	37 (24,8%)	17 (27,4%)	26 (23,2%)	7 (16,7%)	10 (23,3%)	2 (15,4%)
Household size, N (%)								
1-2 residents	189 (62,2%)	76 (65,0%)	100 (67,1%)	48 (77,4%)	57 (50,9%)	19 (45,2%)	32 (74,4%)	9 (69,2%)
3-4 residents	93 (30,6%)	32 (27,4%)	36 (24,2%)	10 (16,1%)	48 (42,9%)	19 (45,2%)	9 (20,9%)	3 (23,1%)
≥5 residents	22 (7,2%)	9 (7,7%)	13 (8,7%)	4 (6,5%)	7 (6,3%)	4 (9,5%)	2 (4,7%)	1 (7,7%)
Co-residents, N (%)								
Underage (<18)	70 (23,0%)	29 (24,8%)	35 (23,5%)	12 (19,4%)	29 (25,9%)	14 (33,3%)	6 (14,0%)	3 (23,1%)
Healthcare worker	47 (15,5%)	17 (14,5%)	23 (15,4%)	9 (14,5%)	18 (16,1%)	5 (11,9%)	6 (14,0%)	3 (23,1%)
Kindergarden worker	10 (3,3%)	3 (2,6%)	5 (3,4%)	1 (1,6%)	5 (4,5%)	2 (4,8%)	0 (0,0%)	0 (0,0%)
Teacher	13 (4,3%)	7 (6,0%)	9 (6,0%)	4 (6,5%)	4 (3,6%)	3 (7,1%)	0 (0,0%)	0 (0,0%)
Household bedroom, N (%)								
0-2	158 (52,0%)	66 (56,4%)	90 (60,4%)	41 (66,1%)	49 (43,8%)	19 (45,2%)	19 (44,2%)	6 (46,2%)
≥3	146 (48,0%)	51 (43,6%)	59 (39,6%)	21 (33,9%)	63 (56,3%)	23 (54,8%)	24 (55,8%)	7 (53,8%)

Notes:

1. Subset of participants who contracted COVID-19 had least once during the study period.

Table 4. Clinical characteristics of study participants at the first visit

	Overall study population		Restaurant/bar workers		Grocery store workers		Hardware store workers	
	Total (N=304)	COVID-19[1] (N=117)	Total (N=149)	COVID-19[1] (N=62)	Total (N=112)	COVID-19[1] (N=42)	Total (N=43)	COVID-19[1] (N=13)
BMI scores, Mean±SD	27,3 ± 6,1	27,5 ± 6,4	27,0 ± 6,9	26,83 ± 6,7	28,1 ± 5,3	27,94 ± 5,2	26,3 ± 5,3	27,51 ± 6,6
BMI categories, N (%)								
<18.5 (underweight)	4 (1,3%)	1 (0,9%)	2 (1,3%)	1 (1,6%)	2 (1,8%)	0 (0,0%)	0 (0,0%)	0 (0,0%)
18.5-24.9 (healthy weight)	125 (41,1%)	49 (41,9%)	73 (49,0%)	30 (48,4%)	29 (25,9%)	13 (31,0%)	23 (53,5%)	6 (46,2%)
25.0-29.9 (overweight)	82 (27,0%)	23 (19,7%)	31 (20,8%)	10 (16,1%)	39 (34,8%)	9 (21,4%)	12 (27,9%)	4 (30,8%)
≥30 (obesity)	93 (30,6%)	44 (37,6%)	43 (28,9%)	21 (33,9%)	42 (37,5%)	20 (47,6%)	8 (18,6%)	3 (23,1%)
Smoking, N (%)								
Cigarette user	53 (17,4%)	22 (18,8%)	33 (22,1%)	14 (22,6%)	16 (14,3%)	6 (14,3%)	4 (9,3%)	2 (15,4%)
E-cigarette user	24 (7,9%)	8 (6,8%)	20 (13,4%)	6 (9,7%)	3 (2,7%)	2 (4,8%)	1 (2,3%)	0 (0,0%)
Comorbidities,[2] N (%)								
Hypertension	39 (12,8%)	11 (9,4%)	13 (8,7%)	4 (6,5%)	18 (16,1%)	6 (14,3%)	8 (18,6%)	1 (7,7%)
Chronic pulmonary disease	33 (10,9%)	17 (14,5%)	13 (8,7%)	6 (9,7%)	14 (12,5%)	10 (23,8%)	6 (14,0%)	1 (7,7%)
Diabetes mellitus	18 (5,9%)	5 (4,3%)	4 (2,7%)	1 (1,6%)	11 (9,8%)	3 (7,1%)	3 (7,0%)	1 (7,7%)
Hypothyroidism	16 (5,3%)	4 (3,4%)	6 (4,0%)	2 (3,2%)	6 (5,4%)	1 (2,4%)	5 (11,6%)	1 (7,7%)
Cancer	10 (3,3%)	3 (2,6%)	4 (2,7%)	1 (1,6%)	5 (4,5%)	2 (4,8%)	1 (2,3%)	0 (0,0%)
Cardiovascular disease	8 (2,6%)	2 (1,7%)	2 (1,3%)	0 (0,0%)	3 (2,7%)	1 (2,4%)	3 (7,0%)	1 (7,7%)
Immune deficiency	7 (2,3%)	5 (4,3%)	3 (2,0%)	3 (4,8%)	1 (0,9%)	0 (0,0%)	3 (7,0%)	2 (15,4%)
Chronic neurological disorder	6 (2,0%)	1 (0,9%)	2 (1,3%)	1 (1,6%)	3 (2,7%)	0 (0,0%)	1 (2,3%)	0 (0,0%)
Liver disease	2 (0,7%)	0 (0,0%)	0 (0,0%)	0 (0,0%)	1 (0,9%)	0 (0,0%)	1 (2,3%)	0 (0,0%)
Blood disorder	1 (0,3%)	1 (0,9%)	1 (0,7%)	1 (1,6%)	0 (0,0%)	0 (0,0%)	0 (0,0%)	0 (0,0%)
Obesity[3]	1 (0%)	0 (0%)	1 (1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Kidney disease	0 (0,0%)	0 (0,0%)	0 (0,0%)	0 (0,0%)	0 (0,0%)	0 (0,0%)	0 (0,0%)	0 (0,0%)
Influenza vaccination, N (%)								
Usually received	52 (17,1%)	21 (17,9%)	23 (15,4%)	12 (19,4%)	18 (16,1%)	7 (16,7%)	11 (25,6%)	2 (15,4%)
Received in the last year	42 (13,8%)	12 (10,3%)	17 (11,4%)	5 (8,1%)	15 (13,4%)	5 (11,9%)	10 (23,3%)	2 (15,4%)

Notes:

1. Subset of participants who contracted COVID-19 had least once during the study period.

437   2. Comorbidities related to an increased risk of hospitalisation at the first visit.

438   3. 30.6% of participants had a BMI in the range of obesity, but only one reported to be obese.

439 **Table 5. Occupational and behavioral characteristic of study participants**

	Overall study population		Restaurant/bar workers		Grocery store workers		Hardware store workers	
	Total (N=304)	COVID-19[1] (N=117)	Total (N=149)	COVID-19[1] (N=62)	Total (N=112)	COVID-19[1] (N=42)	Total (N=43)	COVID-19[1] (N=13)
Workplace region,[2] N (%)								
Capitale-Nationale	240 (78,9%)	96 (82,1%)	123 (82,6%)	49 (79,0%)	85 (75,9%)	36 (85,7%)	32 (74,4%)	11 (84,6%)
Chaudière-Appalaches	64 (21,1%)	19 (16,2%)	26 (17,4%)	12 (19,4%)	27 (24,1%)	6 (14,3%)	11 (25,6%)	1 (7,7%)
Weekly hours worked,[3] Mean±SD	27,9 ± 11,5	28,9 ± 11,4	24,7 ± 11,0	24,5 ± 11,0	32,6 ± 10,4	34,2 ± 9,8	26,6 ± 11,9	32,3 ± 10,4
Participants working								
Full time (≥30)	141 (46,4%)	64 (54,7%)	49 (32,9%)	23 (37,1%)	73 (65,2%)	32 (76,2%)	19 (44,2%)	9 (69,2%)
Part time (<30)	163 (53,6%)	53 (45,3%)	100 (67,1%)	39 (62,9%)	39 (34,8%)	10 (23,8%)	24 (55,8%)	4 (30,8%)
Gathering of 10+ persons,[3] Mean±SD	17,1 ± 27,5	22,5 ± 31,4	23,2 ± 33,9	31,5 ± 38,9	10,4 ± 15,8	13,1 ± 15,9	13,7 ± 22,1	9,9 ± 10,4
Per group, N (%)								
None	34 (11,2%)	6 (5,1%)	16 (10,7%)	2 (3,2%)	15 (13,4%)	4 (9,5%)	3 (7,0%)	0 (0,0%)
1 to 10 gatherings	146 (48,0%)	47 (40,2%)	57 (38,3%)	16 (25,8%)	62 (55,4%)	22 (52,4%)	27 (62,8%)	9 (69,2%)
11 to 50 gatherings	101 (33,2%)	51 (43,6%)	58 (38,9%)	33 (53,2%)	32 (28,6%)	14 (33,3%)	11 (25,6%)	4 (30,8%)
>50 gatherings	23 (7,6%)	13 (11,1%)	18 (12,1%)	11 (17,7%)	3 (2,7%)	2 (4,8%)	2 (4,7%)	0 (0,0%)
Transportation,[2] N (%)								
Car	266 (87,5%)	103 (88,0%)	127 (85,2%)	54 (87,1%)	98 (87,5%)	37 (88,1%)	41 (95,3%)	12 (92,3%)
Carpooling	2 (0,7%)	2 (1,7%)	1 (0,7%)	1 (1,6%)	1 (0,9%)	1 (2,4%)	0 (0,0%)	0 (0,0%)
Bus	39 (12,8%)	16 (13,7%)	23 (15,4%)	9 (14,5%)	10 (8,9%)	5 (11,9%)	6 (14,0%)	2 (15,4%)
Bicycle	13 (4,3%)	6 (5,1%)	7 (4,7%)	3 (4,8%)	4 (3,6%)	2 (4,8%)	2 (4,7%)	1 (7,7%)
Walking	28 (9,2%)	11 (9,4%)	13 (8,7%)	6 (9,7%)	14 (12,5%)	5 (11,9%)	1 (2,3%)	0 (0,0%)
Travel,[3] N (%)								
Any destination	143 (47,0%)	70 (59,8%)	79 (53,0%)	40 (64,5%)	48 (42,9%)	25 (59,5%)	16 (37,2%)	5 (38,5%)
In Canada	78 (25,7%)	39 (33,3%)	45 (30,2%)	24 (38,7%)	23 (20,5%)	13 (31,0%)	10 (23,3%)	2 (15,4%)
To USA	45 (14,8%)	20 (17,1%)	25 (16,8%)	11 (17,7%)	16 (14,3%)	8 (19,0%)	4 (9,3%)	1 (7,7%)
Other destination[4]	84 (27,6%)	45 (38,5%)	47 (31,5%)	25 (40,3%)	28 (25,0%)	16 (38,1%)	9 (20,9%)	4 (30,8%)

440 Notes:

441 1. Subset of participants who contracted COVID-19 had least once during the study period.

442   2. At the time of the first visit (i.e., week 0).

443   3. During the entire study period.

444   4. Includes travel to Cuba, Ireland, Great-Britain, Luxembourg, Dominican Republic, South Africa, Bahamas, Morocco, Guadeloupe,

445   Panama, Costa Rica, Greece.

446

447 **Table 6. Protective measures taken at work and elsewhere by study participants at first visit**

	Overall study population		Restaurant/bar workers		Grocery store workers		Hardware store workers	
	Total (N=304)	COVID-19[1] (N=117)	Total (N=149)	COVID-19[1] (N=62)	Total (N=112)	COVID-19[1] (N=42)	Total (N=43)	COVID-19[1] (N=13)
Protection measures at work,[2] N (%)								
Mask	300 (98,7%)	116 (99,1%)	147 (98,7%)	61 (98,4%)	111 (99,1%)	42 (100,0%)	41 (95,3%)	13 (100,0%)
Handwashing	299 (98,4%)	114 (97,4%)	145 (97,3%)	59 (95,2%)	111 (99,1%)	42 (100,0%)	43 (100,0%)	13 (100,0%)
Plexiglas	235 (77,3%)	88 (75,2%)	96 (64,4%)	39 (62,9%)	98 (87,5%)	37 (88,1%)	41 (95,3%)	12 (92,3%)
Social distancing	213 (70,1%)	86 (73,5%)	111 (74,5%)	48 (77,4%)	74 (66,1%)	29 (69,0%)	28 (65,1%)	9 (69,2%)
Protective glasses	77 (25,3%)	12 (10,3%)	30 (20,1%)	4 (6,5%)	35 (31,3%)	5 (11,9%)	12 (27,9%)	3 (23,1%)
Faceshield	32 (10,5%)	4 (3,4%)	16 (10,7%)	1 (1,6%)	13 (11,6%)	2 (4,8%)	3 (7,0%)	1 (7,7%)
Gloves	21 (6,9%)	3 (2,6%)	10 (6,7%)	0 (0,0%)	9 (8,0%)	3 (7,1%)	2 (4,7%)	0 (0,0%)
Face Cover	7 (2,3%)	1 (0,9%)	3 (2,0%)	0 (0,0%)	4 (3,6%)	1 (2,4%)	0 -	0 (0,0%)
Other[3]	135 (44,4%)	59 (50,4%)	85 (57,0%)	41 (66,1%)	43 (38,4%)	16 (38,1%)	7 (16,3%)	2 (15,4%)
Behavioral protection measures,[2] N (%)								
Mask wearing in public spaces	304 (100,0%)	117 (100,0%)	149 (100,0%)	62 (100,0%)	112 (100,0%)	42 (100,0%)	43 (100,0%)	12 (92,3%)
Avoid usual salutations	259 (85,2%)	99 (84,6%)	119 (79,9%)	48 (77,4%)	103 (92,0%)	39 (92,9%)	37 (86,0%)	12 (92,3%)
Social distancing	256 (84,2%)	93 (79,5%)	115 (77,2%)	41 (66,1%)	102 (91,1%)	40 (95,2%)	39 (90,7%)	12 (92,3%)
Avoid contacts with vulnerable persons	254 (83,6%)	93 (79,5%)	114 (76,5%)	42 (67,7%)	100 (89,3%)	38 (90,5%)	40 (93,0%)	13 (100,0%)
Avoid crowded places	233 (76,6%)	81 (69,2%)	102 (68,5%)	35 (56,5%)	94 (83,9%)	34 (81,0%)	37 (86,0%)	12 (92,3%)
Quarantine if exposed to COVID-19	126 (41,4%)	70 (59,8%)	65 (43,6%)	36 (58,1%)	46 (41,1%)	25 (59,5%)	15 (34,9%)	9 (69,2%)
Pre-emptive isolation	36 (11,8%)	23 (19,7%)	21 (14,1%)	13 (21,0%)	12 (10,7%)	9 (21,4%)	3 (7,0%)	1 (7,7%)
Handwashing habits,[2] N (%)								
After using the toilet	297 (97,7%)	115 (98,3%)	147 (98,7%)	60 (96,8%)	109 (97,3%)	42 (100,0%)	41 (95,3%)	13 (100,0%)
When dirty	294 (96,7%)	113 (96,6%)	140 (94,0%)	58 (93,5%)	112 (100,0%)	42 (100,0%)	42 (97,7%)	13 (100,0%)
When entering workspace	280 (92,1%)	106 (90,6%)	136 (91,3%)	55 (88,7%)	107 (95,5%)	37 (88,1%)	37 (86,0%)	13 (100,0%)
Before eating	267 (87,8%)	104 (88,9%)	124 (83,2%)	51 (82,3%)	105 (93,8%)	41 (97,6%)	38 (88,4%)	12 (92,3%)
Before & after handling food	246 (80,9%)	96 (82,1%)	127 (85,2%)	55 (88,7%)	93 (83,0%)	32 (76,2%)	26 (60,5%)	9 (69,2%)
After handling trash	242 (79,6%)	97 (82,9%)	119 (79,9%)	51 (82,3%)	95 (84,8%)	38 (90,5%)	28 (65,1%)	8 (61,5%)
When exiting workspace	218 (71,7%)	81 (69,2%)	104 (69,8%)	41 (66,1%)	87 (77,7%)	32 (76,2%)	27 (62,8%)	8 (61,5%)
Other[4]	50 (16,4%)	11 (9,4%)	29 (19,5%)	4 (6,5%)	12 (10,7%)	2 (4,8%)	9 (20,9%)	5 (38,5%)

448 Notes:

449 1. Subset of participants who contracted COVID-19 had least once during the study period

450   2. Includes customer registry, QR code, customer limit in store, thorough cleaning of workplace, worker temperature surveillance.

451   3. Includes after touching the cash register, handling money, in between clients.

452 **Table 7. Number of COVID-19 positive tests**

	Overall cohort	Bar/ Restaurant	Grocery store	Hardware store
Reported positive COVID-19 tests				
First occurrence	**117**	**62**	**42**	**13**
PCR	40	24	13	3
Antigen detection	77	38	29	10
Additional test[1]	**8**	**5**	**2**	**1**
PCR	1	1	0	0
Antigen detection	7	4	2	1
Positive PCR test for COVID-19 at V4 or V5	**11**	**6**	**5**	**0**
First occurrence	4	1	3	0
Additional test				
<90 days from previous test	4	3	1	0
≥90 days from previous test	3	2	1	0
Reported symptoms (no positive test)	**31**	**17**	**12**	**2**

453 Notes:

454   1. All 90 days or more since a previously positive test.

455

456 **Table 8. COVID-19 symptoms at the first COVID-19 positive test reported by the participant**

	Overall cohort (N=117)	Bar/ Restaurant (N=62)	Grocery store (N=42)	Hardware store (N=13)
Asymptomatic infection, N (%)	**6 (5,1%)**	**2 (3,2%)**	**4 (9,5%)**	**0 (0,0%)**
Symptomatic infection, N (%)	**111 (94,9%)**	**60 (96,8%)**	**38 (90,5%)**	**13 (100,0%)**
Runny nose or nasal congestion	76 (65,0%)	39 (62,9%)	26 (61,9%)	11 (84,6%)
Cough	74 (63,2%)	41 (66,1%)	25 (59,5%)	8 (61,5%)
Headache	71 (60,7%)	36 (58,1%)	26 (61,9%)	9 (69,2%)
Sore throat	70 (59,8%)	41 (66,1%)	23 (54,8%)	6 (46,2%)
Fever	68 (58,1%)	39 (62,9%)	19 (45,2%)	9 (69,2%)
Muscle pain	65 (55,6%)	35 (56,5%)	22 (52,4%)	8 (61,5%)
Shortness of breath	56 (47,9%)	27 (43,5%)	21 (50,0%)	8 (61,5%)
Loss of sense of smell or taste	26 (22,2%)	11 (17,7%)	10 (23,8%)	5 (38,5%)
Diarrhea	16 (13,7%)	7 (11,3%)	8 (19,0%)	1 (7,7%)

457

458 **Table 9. COVID-19 vaccination status at the first reported COVID-19 positive test**

	Overall cohort (N=117)	Bar/ Restaurant (N=62)	Grocery store (N=42)	Hardware store (N=13)
Vaccination status, N (%)				
No vaccine	21 (17.9%)	11 (17.7%)	10 (23.8%)	0 (0.0%)
One dose	1 (0.9%)	0 (0.0%)	1 (2.4%)	0 (0.0%)
Two doses	45 (38.5%)	24 (38.7%)	15 (35.7%)	6 (46.2%)
Three doses	46 (39.3%)	26 (41.9%)	14 (33.3%)	6 (46.2%)
Four doses	4 (3.4%)	1 (1.6%)	2 (4.8%)	1 (7.7%)

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460   **Table 10. Blood samples collected by vaccination status**

	Overall cohort Blood samples (N = 1299)	
	Infected	Not infected
No Vaccine, N (%)	**11 (0.8%)**	**89 (6.9%)**
Vaccinated, N (%)	**300 (23.1%)**	**899 (69.2%)**
1 dose	14 (1.1%)	61 (4.7%)
2 doses	145 (11.2%)	584 (45.0%)
3 doses	122 (9.4%)	231 (17.8%)
4 doses	20 (1.5%)	22 (1.7%)

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Figure 1. Timeline of the study illustrating the visits (colored dash lines) and the first occurrences of COVID-19-positive tests (grey bars)
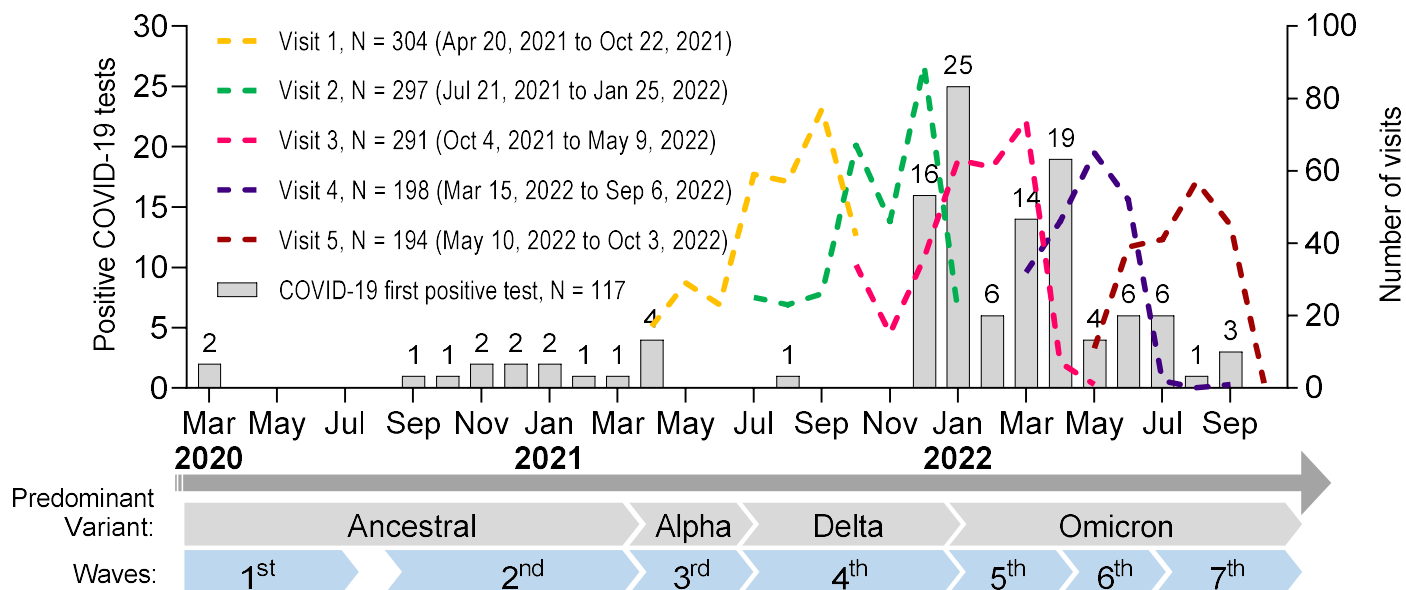
Figure 2. Evolution of the vaccination coverage (Comirnaty [Pfizer-BioNTech], SpikeVax [Moderna] or Vaxzevria [AstraZeneca] vaccine) during the study period (A) in the overall cohort stratified by the number of doses received, and (B) stratified by occupational group. The study data are compared to those of the Public Health Agency of Canada (Qc population) for the whole province.[20]