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Report on epidemiology and commonness  
between Finland and Netherlands

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## **EXECUTIVE SUMMARY**

This register study evaluates the change in the numbers of diagnoses related to post COVID-19 condition in Finland and the Netherlands. It compares the changes in numbers of diagnoses set for patients in healthcare units between the years 2019, 2020 and 2021. The aim is to provide data for the evaluation of the post Covid-19 condition burden of disease in Finland and the Netherlands. The study has received EU Horizon funding: Long Covid — HORIZON-HLTH-2021-DISEASE-04.

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# 1 ABSTRACT

## Background

In October 2021 the World Health Organization defined Post COVID-19 condition or Long Covid as the 'condition occurring in individuals with a **history of probable or confirmed SARS CoV-2 infection**, usually **3 months from the onset of COVID-19 with symptoms and that last for at least 2 months and cannot be explained by an alternative diagnosis**'. Multiple symptoms have been linked to post COVID-19 condition in numerous studies. According to estimates, 1 out of 10 (or even more) respondents who tested positive for Covid-19 exhibit symptoms for 12 weeks or longer. The comprehensive Finnish National Healthcare Registers allow for an estimation of the changes in numbers of post COVID-19 related diagnosis among the population. Similar observations can be made for the Netherlands based on the AHON-database. This data can provide additional insight into the estimated incidence of post COVID-19 condition.

## Objectives

In this register-based study, we aim to observe the **change in the number of diagnoses** possibly related to post COVID-19 condition during the years 2019, 2020 and 2021 in Finland comparing to the similar general practice-based register data from the Netherlands. This comparison will help to identify some possible general similarities or differences between the data of the two countries. Furthermore, it will set basis for further analyses on the linkage between acute COVID-19 and the incidence of symptoms related to post COVID-19 allowing for later analyses on the post COVID-19 condition burden of disease.

## Methods

Based on an observational cohort study performed in the Netherlands, persistent symptoms after COVID-19 were recognized and classified as 'core', 'acute' or 'other' symptoms. The ICPC-2 diagnostic codes used in the Netherlands were assigned corresponding ICD-10 codes used in Finland. For Finland data on the numbers of people assigned a certain diagnosis was derived by linkage and pseudonymization of data from the National Infectious Disease Register, the Care Register for Healthcare and the Primary Healthcare Visit Register. The Dutch data was based on the AHON-database which is an ongoing longitudinal database aiming to give insight into medical care provided in general practices in the North of the Netherlands. All data were derived separately for the years 2019, 2020 and 2021. Changes in numbers of set diagnoses were observed and compared.

## Conclusions

In general both in the Finnish and the Dutch data numbers of diagnosed core symptoms linked to post COVID-19 condition were increased when comparing 2021 registry data to 2019 registry data. In addition to being explained by the pandemic, changes in numbers of diagnosis can also be explained by changes in healthcare seeking behaviour and healthcare provision. Further analyses of the data is crucial to determine if the increases in numbers of post COVID-19 related diagnosis

concerned those having had prior acute SARS-CoV-2 infection.

## 2 INTRODUCTION

In October 2021 The World Health Organization defined Post COVID-19 condition or Long Covid as the 'condition occurring in individuals with a **history of probable or confirmed SARS CoV-2 infection**, usually **3 months from the onset of COVID-19 with symptoms and that last for at least 2 months and cannot be explained by an alternative diagnosis**' (1). According to estimates, 1 out of 10 (or even more) respondents who tested positive for Covid-19 exhibit symptoms for 12 weeks or longer (1).

In August 2022, the Lancet published the Dutch study based on data collected within Lifelines, a multidisciplinary, prospective, population-based, observational cohort. The study examined the health and health-related behaviours of people living in the north of the Netherlands. Longitudinal dynamics of 23 somatic symptoms surrounding COVID-19 diagnoses were assessed using 24 repeated measurements between March 31, 2020, and Aug 2, 2021. Participants with COVID-19 (a positive SARS-CoV-2 test or a physician's diagnosis of COVID-19) were matched by age, sex, and time to COVID-19-negative controls. The symptom severity was recorded before and after COVID-19 in participants with COVID-19 and compared to that of matched controls. Persistent symptoms in COVID-19-positive participants at 90-150 days after COVID-19 compared with before COVID-19 and with matched controls included chest pain, difficulties with breathing, pain when breathing, painful muscles, ageusia or anosmia, tingling extremities, lump in throat, feeling hot and cold alternately, heavy arms or legs, and general tiredness. In 12.7% of patients, these symptoms could be attributed to COVID-19. (2) Other common symptoms that have been reported in Long COVID include palpitations, abdominal pain, rash, headache, recurrent fever and forgetfulness as well as insomnia, depression and anxiety (3–5).

The WHO released emergency codes **U08**, **U09** and **U10** in November 2020 (6). The codes '**U08 Personal History of COVID-19**' and '**U09 Post COVID-19 condition**' have been used to describe post COVID-19 condition. **U09 is the more specific code for depicting post COVID-19 condition.** Post COVID-19 condition is a new entity and its ICD-10 codes came effective in Finland on the 1<sup>st</sup> of January 2021. Its use was not well-established before the official WHO definition on October 6<sup>th</sup> 2021. In the Netherlands, the ICPC-2 code R83.04 was used from May 2022 onwards. Most likely physicians in both countries coded the post COVID-19 patients by a diagnosis primarily describing their main prolonged symptom(s) following acute SARS-CoV-2 infection. In addition, physicians might have preferred using a diagnosis other than 'post COVID-19 condition' when they were somewhat uncertain of their patient's symptoms relation to COVID-19, even when at least temporal causality was probable. Thus, to estimate the incidence of post COVID-19 condition, other diagnoses representing symptoms possibly related to post COVID-19 should also be considered.

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## 3 AIM OF STUDY

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In this register-based study, we aim to observe the **change in the number of diagnoses** possibly related to post COVID-19 condition during the years 2019, 2020 and 2021 in Finland comparing to the similar general practice-based register data from the Netherlands. This comparison will help to identify some possible general similarities or differences between the data of the two countries. Furthermore, it will set basis for further analyses on the linkage between acute COVID-19 and the incidence of symptoms related to post COVID-19 condition allowing for later analyses on the post COVID-19 burden of disease.

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## 4 METHODS

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Based on the observational cohort study of the Dutch group (2), persistent symptoms after COVID-19 were recognized, please see Table 1. The Dutch data used ICPC-2 codes which were divided as representing 'core', 'acute' or 'other' symptoms related to post COVID-19 condition. In addition to the diagnoses selected based on the Dutch study, we also included the diagnostic codes for insomnia, depression and anxiety, as increases in these diagnoses have been indicated by other studies (4). For the Finnish data, we decided to use ICD-10 codes, as they are set by physicians and are thus more likely to be more accurate. They also represent the patients who have ended up consulting a physician (instead of a nurse) for their symptoms. The selection of the ICD-10 codes corresponding to the provided ICPC codes was made by an experienced general practitioner through a systematic review of the ICD-10 code manual for possible alternatives that are in practical application.

For the Finnish data we also sought to analyze the number of post Covid-19 diagnoses (ICD-10 codes U08 and U09).

The Finnish data was provided by the Finnish National Institute for Health and Welfare and is based on three different registers:

- The Finnish National Infectious Disease Register (NIDR)
  - o contains information on specific diagnosed infectious disease, including SARS-CoV-2 infection. All PCR confirmed SARS-CoV-2 infections are automatically reported to the register by laboratories.
- The Care Register for Healthcare (Hilmo)
  - o contains diagnoses set for in-hospital visits, special care outpatient visits and ambulatory surgery
- The Primary Healthcare Visit Register (Avohilmo).
  - o contains diagnoses set by public and private primary healthcare providers as well as home care.

Data linkage between registers is possible using the unique personal identity numbers assigned to each Finnish citizen immediately at birth or upon immigration. For this research, all data were pseudonymized (after register linkage and) before analyses.



Each time a patient in Finland has an official consultation (live or remote) with a physician, the consultation is registered in the electronic patient record system and an ICD-10 diagnostic code must be set. The applied diagnostic code is transferred to either the National Care Register for Healthcare or the Primary Healthcare Visit Register, if the healthcare provider is connected to the national registers. If a patient has two consultations with a physician for the same reason, the diagnosis is shown twice in the national registers. For this study we received data for both the number of times a specific diagnosis had been set and the number of individuals who had been registered with the certain diagnosis during the study-periods.

In the beginning of the year 2020, two large private primary healthcare providers joined the national registers leading to an increase in the numbers of many registered diagnoses. These healthcare providers are responsible for a major part of the occupational healthcare in Finland. To improve the comparability of the years 2020 and 2021 to the year 2019, we analyzed the data in both ways: first by excluding and then by including the diagnostic codes provided from occupational healthcare.

The Dutch data is based on routine primary care data in the Netherlands using the AHON-database. There are no national patient registries in the Netherlands. The AHON-database is an ongoing longitudinal database which aims to give insight into medical care provided in general practices in the North of the Netherlands, covering a catchment area of about 300.000 inhabitants. Starting in 1998, pseudonymized patient records have been added every three months to the AHON-database from a growing number of participating general practices. Patients are informed by their general practices via folders, posters and website texts, that they participate in the AHON-database. Individual patients can fill out an opt-out form for their data not to be recorded in the AHON-database. General Practitioners (GP) register all official consultations (live or remote) in their electronic patient record system using ICPC-2 diagnostic codes. These data are pseudonymized. For this study we extracted number of individuals who had been registered with certain ICPC-2 codes during the study-periods.

All data were derived separately for the years 2019, 2020 and 2021. The choice of investigated time periods was dictated by technical/practical aspects in deriving data from the Dutch registries that only allowed extracting data on entire calendar years.

Finland has a population of ca. 5,6 million; the Netherlands a population of c. 17,5 million.

The current register data does not indicate, whether the diagnoses were set to individuals with microbiologically confirmed SARS-CoV-2 infection or to individuals who had not been diagnosed with the virus. Neither does it show the time point of setting the diagnosis after a possible SARS-CoV-2 infection. However, we have already begun preliminary analyses that take these important aspects into account.

Table 1 Symptoms/diagnoses connected to post COVID-19 condition. C=core symptom, A= acute symptom, O= other symptom

SYMPTOM	TYPE OF SYMPTOM	ICPC-2	ICD-10	DEFINITION OF ICD-10 CODE
ageusia/anosmia	C	N16	R43	disturbance of taste and smell
difficulties with breathing	C	R02	R060	dyspnea
			R069	unspecified abnormalities of breathing
pain when breathing	C	R01	R071	chest pain on breathing
chest pain	C	K01	R072	precordial pain
			R073	other chest pain
			R074	chest pain, unspecified
			R091	pleuricy
			I409	acute myocarditis, unspecified
			I459	conduction disorder
			I499	cardiac arrhythmia
			R000	tachycardia, unspecified
			R002	palpitations
			R070	pain in throat
lump in throat	C	D21/R21	R070	pain in throat
			R13	dysphagia
			R13	dysphagia
heavy arms and/or legs	C	L09/14	M796	pain in limb, hand, foot, fingers and toes
			R298	other symptoms and signs involving the nervous and musculoskeletal systems
general tiredness	C	A04	R53	malaise and fatigue
			F480	neurasthenia
painful muscle	C	L18	M791	myalgia
			R26	abnormalities of gait and mobility
			R27	ataxia
tingling extremities	C	N05	R200	anesthesia of skin
			R202	paresthesia of skin
			R208	other disturbance of skin sensation
feeling hot/cold alternately	C	A02	R6888	other general symptoms and signs
fever	A	A03	R50	fever of other or unknown origin
wet cough	A	R05	R05	cough
			J40	bronchitis
			J42	unspecified chronic bronchitis
			J98	other respiratory disorders
dry cough	A	R05	R05	cough

headache	O	N01	R518	headache, other
			R5181	facial pain, unspecified
itchy eyes	O	F13	H10	Conjunctivitis
sore throat	A	R21	R070	pain in throat
			J312	chronic pharyngitis
runny nose	A	R07	J00	acute nasopharyngitis
			J311	chronic nasopharyngitis
			J310	chronic rhinitis
nausea	O	D09	R11	nausea and vomiting
sneezing	A	R07	R067	sneezing
back pain	O	L02/L03	M549	dorsalgia, unspecified
			M598	other dorsalgia
			M545	low back pain
			M546	pain in thoracic spine
stomach pain	A	D02	R104	other and unspecified abdominal pain
			R101	pain localized to upper abdomen
			R103	pain localized to lower abdomen
dizziness	O	N17	R42	dizziness of giddiness
			H811	benign paroxysmal vertigo
			H813	other peripheral vertigo
			H814	vertigo of central origin
			H819	unspecified disorder of vestibular function
diarrhea	A	D11	A09	infectious gastroenteritis and colitis
			A084	viral intestinal infection
			A083	other viral enteritis
			A085	other specified intestinal infections
			K529	noninfective gastroenteritis and colitis
			K591	functional diarrhea
insomnia/sleep disturbance	O	P06	F51	insomnia
			G471	hypersomnia
			G472	circadian rhythm sleep disorders
			G478	other sleep disorder
			G479	sleep disorder
depression	O	P76	F320	major depressive disorder, single episode, mild
			F321	major depressive disorder, single episode, moderate
			F322	major depressive disorder, single episode, severe
			M328	other depressive disorder
			F329	major depressive disorder, single episode, unspecified

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			F412	mixed anxiety and depressive disorder
Anxiety	O	P74	F411	generalized anxiety disorder
			F413	other mixed anxiety disorders
			F419	anxiety disorder

## 5 RESULTS

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The main results of the Finnish data are presented in Table 2. It shows all ICPC-2 codes used in the Netherlands and corresponding ICD-10 codes used in Finland that could be related to post COVID-19 condition, the absolute number of individuals who received the diagnosis during the years 2019, 2020 and 2021 as well as the percentage change in number of individuals with a certain diagnosis comparing year 2020 to year 2019 and year 2021 to 2019. Diagnoses set in occupational healthcare are excluded in Table 2, as they were not available in the 2019 register data.

Table 2 The change in the number of individuals assigned a certain diagnostic code when comparing year 2020 to 2019 year 2021 to 2019 and 2021 to 2020. Diagnoses registered in occupational healthcare are excluded. Core symptoms are highlighted in light green.

Symptom	type of symptom	ICPC-2	Corresponding ICD-10 codes	Number of individuals with diagnosis (1diagnosis/person/year)			% change in number of individuals with diagnoses		
				2019	2020	2021	2020 vs 2019	2021 vs 2019	2021 vs 2020
ageusia/anosmia	C	N16	R43	896	795	870	-11 %	-3 %	9 %
difficulties with breathing	C	R02	R060, R069	49534	50088	58021	1 %	17 %	16 %
pain when breathing	C	R01	R071	1582	1519	1667	-4 %	5 %	10 %
chest pain	C	K01	R072, R073, R074, R091, I409, I459, I499, R000, R002	96640	93836	113502	-3 %	17 %	21 %
lump in throat	C	D21/R21	R070, R13	21095	23362	26685	11 %	26 %	14 %
heavy arms and/or legs	C	L09/14	M796, R298	109193	115264	150350	6 %	38 %	30 %
general tiredness	C	A04	R53, F480	52971	54485	69622	3 %	31 %	28 %
painful muscle	C	L18	M791, R26, R27	27722	28417	33089	3 %	19 %	16 %
tingling extremities	C	N05	R200, R202, R208	9714	10108	12099	4 %	25 %	20 %
feeling hot/cold alternately	O	A02	R6888	3816	3459	4283	-9 %	12 %	24 %
fever	A	A03	R50	33664	29036	34670	-14 %	3 %	19 %
wet cough	A	R05	R05, J40, J42, J98	47892	38146	49276	-20 %	3 %	29 %
dry cough	A	R05	R05	44415	35271	46280	-21 %	4 %	31 %
headache	O	N01	R518, R5181	33458	30582	37347	-9 %	12 %	22 %
itchy eyes	O	F13	H10	60068	40342	48603	-33 %	-19 %	20 %
sore throat	A	R21	R070, J312	13455	15088	17162	12 %	28 %	14 %
runny nose	A	R07	J00, J311, J310	12974	13946	18645	7 %	44 %	34 %
nausea	O	D09	R11	15723	14378	17157	-9 %	9 %	19 %
sneezing	A	R07	R067	32	46	127	44 %	297 %	176 %
back pain	O	L02/L03	M549, M598, M545, M546	111896	113357	135368	1 %	21 %	19 %
stomach pain	A	D02	R104, R101, R103	148825	151757	181159	2 %	22 %	19 %
dizziness	O	N17	R42, H811, H813, H814, H819	54232	53002	58665	-2 %	8 %	11 %
diarrhoea	A	D11	A09, A084, A083, A085, K529, K591	49757	38158	42459	-23 %	-15 %	11 %
insomnia/sleep disturbance	O	P06	F51, G471, G472, G478, G479	33507	43868	56199	31 %	68 %	28 %
depression	O	P76	F320, F321, F322, F328, F329, F412	72168	81721	95462	13 %	32 %	17 %
anxiety	O	P74	F411, F413, F419	45416	54382	68563	20 %	51 %	26 %

There was an increase in the number of individuals diagnosed with almost all symptoms defined as core symptoms of post COVID-19 condition. Interestingly, the number of individuals diagnosed with 'ageusia/anosmia' decreased. The biggest changes in numbers of individuals with a certain diagnosis between years 2021 and 2019 are seen in insomnia (68% increase), anxiety (51%), runny

nose (44%), heavy arms and/or legs (38%) and general tiredness (31%).

In Table 3 we present the data for the years 2020 and 2021 including occupational healthcare data. In this table, the increase in post COVID-19 related symptoms between the years 2020-2021 was even larger than in Table 2, up to one third in breathing difficulties and up to 2/3 and more in symptoms like lump in throat, heavy legs and arms and painful muscles and up to 90% in tiredness. Increase of 35% applied also to ageusia/anosmia diagnoses when occupational healthcare was included.

*Table 3 The change in number of individuals assigned a certain diagnosis when comparing the year 2021 to 2020. Diagnoses registered in occupational healthcare are included in 2020 and 2021.*

Symptom	type of symptom	ICPC-2	Corresponding ICD-10 codes	Number of individuals with diagnosis (1/person/year) in 2019	Number of individuals with diagnosis (1/person/year) in 2020	Number of individuals with diagnosis (1/person/year) in 2021	%change in number of individuals with diagnosis 2021 vs. 2020
ageusia/anosmia	C	N16	R43	909	949	1226	29 %
difficulties with breathing	C	R02	R060, R069	50456	53752	68276	27 %
pain when breathing	C	R01	R071	1611	1707	2142	25 %
chest pain	C	K01	R072, R073, R074, R091, I409, I459, I499, R000, R002	97597	102704	142037	38 %
lump in throat	C	D21/R21	R070, R13	21335	27967	34673	24 %
heavy arms and/or legs	C	L09/14	M796, R298	111363	134174	208478	55 %
general tiredness	C	A04	R53, F480	54598	65824	103821	58 %
painful muscle	C	L18	M791, R26, R27	28246	33936	49214	45 %
tingling extremities	C	N05	R200, R202, R208	9793	11205	15456	38 %
feeling hot/cold alternately	C	A02	R6888	3824	3805	5007	32 %
fever	A	A03	R50	34004	32185	45788	42 %
wet cough	A	R05	R05, J40, J42, J98	48932	43357	63964	48 %
dry cough	A	R05	R05	45386	40149	60188	50 %
headache	O	N01	R518, R5181	33696	33435	45714	37 %
itchy eyes	O	F13	H10	61011	49965	72472	45 %
sore throat	A	R21	R070, J312	13623	19411	24401	26 %
runny nose	A	R07	J00, J311, J310	13167	16849	25791	53 %
nausea	O	D09	R11	15957	15840	21293	34 %
sneezing	A	R07	R067	32	56	139	148 %

back pain	O	L02/L03	M549, M598, M545, M546	115570	144599	217108	50 %
stomach pain	A	D02	R104, R101, R103	150270	165186	215112	30 %
dizziness	O	N17	R42, H811, H813, H814, H819	54846	57850	71677	24 %
diarrhoea	A	D11	A09, A084, A083, A085, K529, K591	50505	50147	74092	48 %
insomnia/sleep disturbance	O	P06	F51, G471, G472, G478, G479	35627	66444	115833	74 %
depression	O	P76	F320, F321, F322, F328, F329, F412	73996	96933	136503	41 %
Anxiety	O	P74	F411, F413, F419	46125	62427	91473	47 %

The data on the actual post COVID-19 diagnoses (U08 or U09) set in Finland is presented in Table 4. A significant number of individuals were diagnosed with post COVID-19 condition during 2021. By the Finnish register linkage of NIDR with ICD-10 codings, we observed that only 15% of the post COVID-19 diagnoses were set three months or later after a PCR confirmed SARS-CoV-2 acute infection as should be according to the WHO post COVID-19 definition. Thus, the usage of the ICD-10 codes U08 and U09 was not well-established. This is understandable as the official WHO definition of post COVID-19 condition was announced in October 2021, during the last quarter of the observation period.

Table 4 Number of post COVID-19 diagnoses (U08 and U09) during 2019, 2020 and 2021 (overall and by noting 1 diagnosis/person/year).

Year	Number of individuals with diagnosis U08		Number of individuals with diagnosis U09	
	occupational healthcare diagnoses excluded	occupational healthcare diagnoses included	ccupational healthcare diagnoses excluded	occupational healthcare diagnoses included
2019	15	15	0	0
2020	17	29	12	29
2021	1002	1589	1200	2148

If we only look at the 15 % of post COVID-19 diagnoses U08 (n=1589) and U09 (n=2148) set at least 3 months after the acute infection, the number of new post COVID-19 cases would be circa 560 in 2021 (10/100 000 population). The number of COVID-19 cases notified in NIDR between October 2020 and September 2021 was 134 391 (7), thus 4.2 / 1000 confirmed COVID-19 cases sought for doctor's help due to post COVID-19 condition in 2021.

The main results of the Dutch data are presented in Table 5. It shows all ICPC-2 codes used in the

Netherlands and corresponding ICD-10 codes used in Finland that could be related to post COVID-19, the absolute number of individuals who have received the diagnosis during the years 2019, 2020 and 2021 as well as the percentage change in number of individuals with a certain diagnosis comparing year 2020 to year 2019, year 2021 to 2019, and year 2021 to 2020.

*Table 5 The change in the number of individuals assigned a certain diagnostic code when comparing year 2020 to 2019 and year 2021 to 2019. Core symptoms are highlighted in light green.*

Symptom	type of symptom	ICPC-2	Corresponding ICD-10 codes	Number of individuals with diagnosis (1diagnosis/person/year)			% change in number of individuals with diagnoses		
				2019	2020	2021	2020 vs 2019	2021 vs 2019	2021 vs 2020
ageusia/anosmia	C	N16	R43	348	421	438	21 %	26 %	-2 %
difficulties with breathing	C	R02	R060, R069	13882	14677	15710	6 %	13 %	7 %
pain when breathing	C	R01	R071	312	482	355	54 %	14 %	26%
chest pain	C	K01	R072, R073, R074, R091, I409, I459, I499, R000, R002	3654	3341	4286	-9 %	17 %	28%
lump in throat	C	D21/R21	R070, R13	2134	2283	2617	7 %	23 %	15%
heavy arms and/or legs	C	L09/14	M796, R298	22056	22138	26301	0 %	19 %	17%
general tiredness	C	A04	R53, F480	46434	38049	43722	-18 %	-6 %	15%
painful muscle	C	L18	M791, R26, R27	10860	9597	11141	-12 %	3 %	16%
tingling extremities	C	N05	R200, R202, R208	2188	2231	2775	2 %	27 %	24%
feeling hot/cold alternately	C	A02	R6888	306	325	298	6 %	-3 %	-8%
fever	A	A03	R50	8156	10672	10508	31 %	29 %	-2%
Wet/dry cough	A	R05	R05, J40, J42, J98	41647	33840	30019	-19 %	-28 %	-11%
headache	O	N01	R518, R5181	12255	12695	14426	4 %	18 %	14%
itchy eyes	O	F13	H10	7302	6961	8304	-5 %	14 %	19%
sore throat	A	R21	R070, J312	10812	13073	12359	21 %	14 %	-5%
runny nose / sneezing	A	R07	J00, J311, J310, R067	2215	2421	2390	9 %	8 %	-1%
nausea	O	D09	R11	5337	5570	6037	4 %	13 %	8%
back pain	O	L02/L03	M549, M598, M545, M546	48446	44188	49098	-9 %	1 %	10%
stomach pain	A	D02	R104, R101, R103	16163	15778	17771	-2 %	10 %	13%
dizziness	O	N17	R42, H811, H813, H814, H819	12176	12734	14902	5 %	22 %	17%
diarrhoea	A	D11	A09, A084, A083, A085, K529, K591	12131	10461	11798	-14 %	-3 %	13%
insomnia/sleep disturbance	O	P06	F51, G471, G472, G478, G479	23694	24317	27794	3 %	17 %	14%
depression	O	P76	F320, F321, F322, F328, F329, F412	49121	47314	51727	-4 %	5 %	9%
anxiety	O	P74	F411, F413, F419	33287	33519	37087	1 %	11 %	11%



There was an increase in the number of individuals diagnosed with almost all symptoms defined as core symptoms of post COVID-19 condition, except for general tiredness that slightly decreased. The biggest changes in numbers of individuals with a certain diagnosis between years 2021 and 2019 are seen in the core symptoms tingling extremities (27% increase), ageusia/anosmia (26% increase), and lump in throat (23% increase). When comparing 2020 with 2019, there was a remarkable increase in the core symptoms pain when breathing which was reduced to a 14% increase when comparing 2021 to 2019.

The post COVID-19 condition ICPC-2 code was introduced in 2022 in the Netherlands, and thus it was not possible to extract the number of post COVID-19 cases. However, in the Lifelines study, the participants were asked whether they visited their GP. Of all post COVID-19 cases, 48% reported one or more appointments with their GP, compared to 33% of recovered COVID-19 cases.

## 6 DISCUSSION

We used registry data to compare the numbers of diagnoses related to post COVID-19 condition in Finland and the Netherlands. We focused on the core symptoms of post COVID-19 as defined in a Dutch population study, since these are the symptoms that are increased after COVID-19, while taking into account the symptom status of cases before infection, and of uninfected controls. This reduces the problem that we do not know whether symptoms after COVID-19 represent sequelae of the SARS-CoV-2 infection, effects of the pandemic itself, or other reasons.

Both in the Finnish and Dutch data, in general the core symptoms were increased when comparing 2021 registry data to 2019 registry data, the only exceptions being in Finland a 3% decrease in ageusia/anosmia, and in the Netherlands a 3% decrease in feeling hot/cold alternately and a 6% decrease in general tiredness. The largest differences between Finland and the Netherlands also occurred in these symptoms, with a 26% increase in ageusia/anosmia in the Netherlands), and a 31% increase in general tiredness in Finland. In contrast, the frequency of difficulties with breathing, chest pain, lump in throat and tingling extremities was remarkably similar in both countries, with differences of 0 to 4 percent points.

One important reason for the differences between countries is the use of different coding systems. Data on Finland used the ICD-10, while the data on the Netherlands were based on the ICPC-2. Although we tried to find matching codes, some of the matches might have been better than others, which might especially affect the more aspecific symptoms. For example, remarkably similar frequencies were found for tingling extremities (increases of 25% in Finland and 27% in the Netherlands) and chest pain (increased of 17% in both countries), while large differences were found for general tiredness and heavy arms and /or legs. This however does not explain the large difference in ageusia/anosmia for which there are clearly matching ICD-10 and ICPC-2 codes. While different

virus variants might be linked to different symptoms, the differences between countries in dominant virus variant seem to small to explain this difference.

Another explanation would be differences in health care seeking behaviour, related to specific symptoms. More than 3700 post COVID-19 specific codes were detected in health care, but only 15% were set to patients three months after a PCR confirmation of an acute SARS-CoV-2 infection. Extrapolating from these post COVID-19 condition specific codes, less than one percent of patients developed post COVID-19 condition and sought for doctor's help after COVID-19 in Finland in 2021. In the Netherlands, registry data are absent due to a lack of a timely post COVID-19 code, but the Lifelines study gives some indications about healthcare use. In this study, the frequency of post COVID-19 symptom occurrence was 12.7%. About half of these patients indicated on the Lifelines questionnaires to have visited their GP.

The following aspects should be considered before making conclusions on post COVID-19 condition incidence from diagnosis code-based figures.

The start of the pandemic in March 2020 caused many changes in the provision and usage of healthcare services. Recognizing and preventing SARS-CoV-2 infections as well as treating severe COVID-19 and other acute infection related conditions was prioritized. The treatment of many chronic conditions was postponed. People were actively in contact with healthcare providers for any symptom possibly related to COVID-19 in order to be tested and in order to receive sick leave and in some cases reimbursement.

Already during the first weeks of the pandemic, remote consultations (especially chat consultations) became increasingly popular. In Finland, such consultations were rapidly employed primarily by private healthcare providers. The private healthcare provides a large part of the occupational healthcare services in Finland. The diagnoses registered by two of these major private healthcare providers were connected to the Primary Healthcare Visit Register in the beginning of 2020, which automatically increases the numbers of many diagnoses in this register data. On the other hand, some healthcare providers have faced technical issues in transferring reliable diagnostic data to the Primary Healthcare Visit register.

It should be marked that the COVID-19 pandemic started in March 2020, so only three quarters of the data for that year represents the pandemic period. If a symptom following acute SARS-CoV-2 infection is considered representing post COVID-19 condition when persisting/occurring three months after the onset of the acute infection, only the diagnoses set at the earliest in June 2020 could officially represent post COVID-19 condition. On the other hand, a person might be diagnosed with a symptom less than three months after acute COVID-19 and have the symptom persisting for several months longer without the need to contact a healthcare provider again thus not showing in the healthcare registers.

The pandemic has also had an influence on people's behaviour. Some might have avoided contacting healthcare providers in fear of getting infected; some might have postponed dealing with

a symptom due to temporary unavailability of healthcare services. People suffering from mild prolonged symptoms after acute COVID-19 might not have contacted healthcare providers at all. On the other hand, people with many and/or severe prolonged symptoms after acute COVID-19 could have contacted a doctor several times for the same reason.

For Finland, the reliability of comparison between the years 2020 and 2021 is better, as there were more occupational healthcare providers generating diagnostic data to the national registers. Thus, Table 3 better reflects the use of healthcare services due to these symptoms (many employed individuals mainly use their occupational healthcare services for their health issues). However, for the Netherlands the comparison of 2021 to 2019 is more valid, especially since the incidence of COVID-19 at the start of the pandemic was relatively low in the catchment area of the AHON database. Therefore, the main comparisons were made based on the difference between 2021 and 2019.

To evaluate the magnitude and significance of an increase in the number of individuals with a certain symptom, it is important to look at the absolute number of individuals diagnosed with the symptom or condition. The greatest absolute increases in individuals with a certain diagnosis between years 2021 and 2019 is observed in both countries the following symptoms: heavy arms and/or legs, insomnia, depression and anxiety.

Thus, it would be crucial to analyze the data further: can a greater increase in the diagnoses related to post COVID-19 condition be observed in those diagnosed with acute COVID-19? For example 'back pain' is a diagnosis, the increase in the incidence of which can be due to the changes in lifestyle caused by the pandemic (people staying at home, working remotely, avoiding gyms etc), not by a SARS-CoV-2 infection. Additionally: at what point of time after an acute SARS-CoV-2 infection are the diagnoses set? And has the individual possibly had some of the diagnoses even before the pandemic and a possible SARS-CoV-2 infection, as is suggested by the Lifelines study? In addition, looking at the numbers by age group and sex could give additional insight to the post COVID-19 phenomenon. Observing the possible changes in diagnosing post COVID-19 condition after the WHO's official definition would also be of interest. We have already started a more thorough analysis of this data in Finland and plan to describe the findings in a separate research article.

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