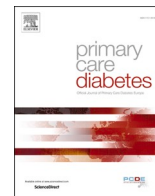




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COVID-19 pandemic impact on people with diabetes: results from a large representative sample of Italian older adults

Giacomo Pietro Vigezzi^{a,b}, Paola Bertuccio^a, Camilla Bonfadini Bossi^a, Andrea Amerio^{c,d}, Luca Cavalieri d'Oro^e, Giuseppe Derosa^{f,g}, Licia Iacoviello^{h,i}, David Stuckler^j, Alberto Zucchi^k, Alessandra Lugo^l, Silvano Gallus^l, Anna Odone^{a,*}, Lost in Lombardia Project Investigators

^a Department of Public Health, Experimental and Forensic Medicine, University of Pavia, Pavia, Italy

^b Collegio Ca' della Paglia, Fondazione Ghislieri, Pavia, Italy

^c Department of Neuroscience, Rehabilitation, Ophthalmology, Genetics, Maternal and Child Health (DINO GMI), Section of Psychiatry, University of Genoa, Genoa, Italy

^d IRCCS Ospedale Policlinico San Martino, Genoa, Italy

^e Epidemiology Unit, Brianza Health Protection Agency, Monza, Italy

^f Department of Internal Medicine and Therapeutics, University of Pavia, Pavia, Italy

^g Centre of Diabetes and Metabolic Diseases, University of Pavia and IRCCS Policlinico San Matteo Foundation, Pavia, Italy

^h Department of Medicine and Surgery, Research Center in Epidemiology and Preventive Medicine (EPIMED), University of Insubria, Varese, Italy

ⁱ Department of Epidemiology and Prevention, IRCCS Neuromed, Pozzilli, Italy

^j Department of Social and Political Sciences, Bocconi University, Milan, Italy

^k Epidemiology Unit, Bergamo Health Protection Agency, Bergamo, Italy

^l Department of Environmental Health Sciences, Istituto di Ricerche Farmacologiche Mario Negri IRCCS, Milan, Italy

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ABSTRACT

Aims: Restrictions imposed to prevent SARS-CoV-2 transmission should be weighed against consequences on vulnerable groups' health. Lifestyles and disease management of older people with diabetes might have been differentially impacted compared to non-chronic individuals.

Methods: A cross-sectional study (LOST in Lombardia) was conducted on a representative full sample of 4 400 older adults (17th-30th November 2020), collecting data on lifestyles, mental health and access to care before and during the pandemic.

Results: We compared 947 (51.9%) people with diabetes and 879 (48.1%) healthy subjects reporting no chronic conditions. People with diabetes reported more frequently increased physical activity (odds ratio, OR 2.65, 95% confidence intervals, CI 1.69-4.13), drinks/week reduction (OR 6.27, 95%CI 3.59-10.95), increased consumption of fruit (OR 2.06, 95%CI 1.62-2.63), vegetables (OR 1.41, 95%CI 1.10-1.82), fish (OR 2.51, 95%CI 1.74-3.64) and olive oil (OR 3.54, 95%CI 2.30-5.46). People with diabetes increased telephone contacts with general practitioners (OR 3.70, 95%CI 2.83-4.83), hospitalisations (OR 9.01, 95%CI 3.96-20.51), visits and surgeries cancellations (OR 3.37, 95%CI 2.58-4.42) and treatment interruptions (OR 1.95, 95%CI 1.33-2.86).

Conclusions: Pandemic adverse effects occurred but are heterogeneous in a population with chronic diseases, who seized the opportunity to improve health behaviours, despite health system difficulties guaranteeing routine care, within and beyond COVID-19.

1. Introduction

Coronavirus Disease 2019 (COVID-19) outbreak quickly became a pandemic [1]. Italy was the first COVID-19 epicentre in Europe, and Lombardy was the region with the highest number of cases, hospital admissions and deaths [2]. On the 9th of March 2020, Italy was also the

first Western country to impose a nationwide stay-at-home order to reduce viral spread and alleviate pressure on the healthcare system [3]. In compliance with these non-pharmaceutical interventions (NPIs) and those followed in the second half of 2020 (e.g., geographical restrictions, physical distancing, school and other services closures, hand hygiene and respiratory etiquette prescriptions) [4], radical changes occurred in

* Correspondence to: Department of Public Health, Experimental and Forensic Medicine, University of Pavia, via Forlanini, 2, Pavia, Italy.

E-mail address: anna.odone@unipv.it (A. Odone).

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Italians' daily life and behaviours, impacting social, working, and family habits, and access to daily-life services [5].

This situation was responsible for exacerbating pre-existing health, socioeconomic, and geographic inequalities, with greater consequences among vulnerable populations [6], whose susceptibility is likely to worsen health outcomes.

Among disadvantaged groups, individuals with a chronic disease, such as diabetes, and frail individuals, such as the elderly, were more exposed than other categories [7], and the two vulnerabilities generally add up [8]. Both lifestyles [9–11] and healthcare services [12] are critical to enhance the quality of patients' life. Health behaviours, mental health, primary and hospital care use are interrelated determinants and potential risk factors for older people's wellbeing, diabetes evolution and management.

Available data on the impact of NPIs on health are inconsistent and inconclusive: cross-sectional assessments generally suggest an overall detrimental role of the pandemic and restrictions on lifestyles, mental health, and addictions [13,14]. Our previous studies on a representative sample of Italian households [15] showed huge implications on mental health symptoms [16], smoking habits [17], addictive behaviours [18], and sexual activity [19].

Thus far, there are no unequivocal results regarding the impact on people with diabetes, representing a specific vulnerable group in terms of attention paid to health behaviours, disease follow-up and compliance with treatments. Since hyperglycemia was the second most common comorbidity for COVID-19, after hypertension, and its management deeply relies on lifestyles and routine care [20,21], assessing these aspects is crucial, especially with available evidence referring to non-representative hospital-recruited samples and forbidding results' generalisation [22–24].

Within the 'Lockdown and lifeSTyles in Lombardia' (LOST in Lombardia) study [25–28], we investigated COVID-19 impact on physical and mental health outcomes, behavioural risk factors and access to care among older people with diabetes, in comparison with older people not affected by any chronic disease.

2. Materials and methods

2.1. Study design, setting and study population

LOST in Lombardia is a telephone-based cross-sectional study conducted in collaboration with Doxa, the Italian branch of the Worldwide Independent Network/Gallup International Association. Survey participants were selected among the Doxa panel and randomly recruited from a list of approximately 30,000 households living in the Lombardy region, representative by province and municipality size. A quota method was used to enrol study participants to guarantee the sample's representativeness, using quotas for sex, age group, and municipality size. A total of 4400 adults aged 65 years or more was recruited from the 17th of November to the 30th of November 2020.

The study protocol obtained approval from the ethics committee of Fondazione IRCCS Istituto Neurologico Carlo Besta, Milan, Italy (file number 76, October 2020), and consent to participate was collected for all participants.

2.2. Questionnaire and variables of interest

Recruited subjects were interviewed using a telephone-based questionnaire about their lifestyles, health behaviours, mental distress, dietary habits, and access to healthcare services before and during the pandemic. The questionnaire included socioeconomic variables (age, sex, marital status, number of household members, educational level, employment, and self-reported economic status) and anthropometric data (height and weight before and after the pandemic). Subjects were asked whether they suffered from any common chronic disease (including diabetes, hypertension, other cardiovascular diseases, cancer,

osteoarthritis or arthritis, osteoporosis, chronic kidney disease, asthma, chronic bronchitis or emphysema), about the year of each diagnosis and diseases' evolution during the pandemic.

Concerning health behaviours, participants were asked about physical activity (hours/week), smoking (cigarettes/day) and alcohol consumption (drinks/week) at the time of the interview (November 2020) and one year before (November 2019). They were also asked about their smoking status and years from smoking cessation. A specific section was dedicated to nutrition and dietary habits, asking participants about the changes in 8 food items consumption (unchanged, reduced, or increased with reference to November 2019), including those typical of the Mediterranean diet (i.e., fruit and nuts, vegetables, legumes, cereals, fish, milk and dairy products, meat and olive oil) to monitor eating habits patterns.

Regarding mental distress, we evaluated sleep quality and quantity, depressive and anxiety symptoms, through validated scales, with reference to both before and during the pandemic. Sleep quality and quantity were assessed using the Pittsburgh Sleep Quality Index (PSQI) questionnaire [29]. For the sleep quality evaluation, PSQI item number 9 was used. Participants were asked to answer also to PSQI item number 4, estimating how many hours of sleep they get at night. The presence of depressive symptoms was established using the 2-item Patient Health Questionnaire (PHQ-2), based on the 9-item validated scale (PHQ-9) [30]. Anxiety symptoms were assessed using the 2-item Generalised Anxiety Disorder (GAD-2), a short version of the 7-item scale (GAD-7) [31]. Higher PHQ-2 and GAD-2 scores during the pandemic than in 2019 stated worsening depressive and anxiety symptoms, respectively.

Changes in access to care were investigated asking participants about primary and hospital care, examinations and diagnostic tests, medicine purchase, using categorical answers (i.e., unchanged, reduced, or increased), while care delays (visits, surgeries, or therapies) were assessed with binary questions (yes, no). Details on the questionnaire's items and categorisation used are provided in Appendix A.

Our exposure of interest was having diabetes vs not having any chronic disease. We considered as outcomes the changes in body mass index (BMI), physical activity, smoking habit, alcohol consumption and psychological measures, computed as the difference between the variables measured at the time of interview and a year before and categorised as unchanged, decreased or increased. Categorical variables about food consumption and healthcare services access were also investigated as outcomes.

2.3. Statistical analysis

We carried out the statistical analyses on a subgroup of 1826 older adults, of whom 947 (51.9 %) people with diabetes and 879 (48.1 %) subjects without any chronic condition. Descriptive analyses were reported as proportions or mean with standard deviation (SD), according to the exposure status. Group comparisons were performed using the chi-square test for categorical variables and t-test for the continuous ones.

We estimated odds ratios (ORs) and corresponding 95 % CIs for each outcome, using multinomial multivariable logistic regression models including diabetes vs no chronic diseases as independent variable. The models included educational level, marital and self-reported economic status as confounders on the basis of the existing literature. Moreover, a statistical weight has been used in the model to ensure the representativeness of the sample of Lombard older adults for age, sex, and municipality size.

Statistical analyses were carried out using Stata software version 16.0 (Stata Corporation, College Station, Texas, USA).

3. Results

Table 1 reports the baseline distribution of sociodemographic characteristics and outcomes of interest according to the exposure status.

Table 1
Baseline distribution of 947 exposed subjects (with diabetes) and 879 unexposed ones (no chronic conditions) according to selected characteristics and outcomes.

	Exposed (with diabetes) n (%)	Unexposed (no chronic conditions) n (%)	<i>p</i> -value ^a
Total	947 (51.9)	879 (48.1)	
Age [mean (SD)]	76.1 (6.5)	72.2 (6.8)	< 0.01*
Gender			0.95
Males	462 (48.8)	430 (48.9)	
Females	485 (51.2)	449 (51.1)	
Marital status			<0.01*
Married	690 (72.8)	629 (71.6)	
Divorced/separated	31 (3.3)	31 (3.5)	
Widowed	191 (20.2)	130 (14.8)	
Single	35 (3.7)	89 (10.1)	
Number of household members			<0.01*
1	210 (22.2)	180 (20.5)	
2–3	699 (73.8)	604 (68.7)	
4 or more	38 (4.0)	95 (10.8)	
Education level			<0.01*
None/primary school	199 (21.0)	109 (12.5)	
Secondary school	434 (45.8)	249 (28.3)	
High school	272 (28.7)	389 (44.3)	
University degrees	42 (4.5)	132 (14.9)	
Employment status			<0.01*
Employed	17 (1.8)	79 (8.9)	
Retired	878 (92.7)	714 (81.3)	
Unemployed	3 (0.3)	7 (0.8)	
Housewife	47 (5.0)	77 (8.8)	
Unfit for job	2 (0.2)	2 (0.2)	
Self-reported economic status			<0.01*
Highly above and above the mean	68 (7.2)	113 (12.8)	
On average	579 (61.1)	694 (79.0)	
Highly below and below the mean	300 (31.7)	72 (8.2)	
Municipality inhabitants			0.91
Up to 5000	209 (22.1)	186 (21.2)	
5000–20,000	364 (38.5)	336 (38.2)	
20,000–100,000	214 (22.5)	212 (24.1)	
More than 100,000	160 (16.9)	145 (16.5)	
Number of chronic diseases			<0.01*
0		879 (100.0)	
1	104 (10.9)		
2	501 (52.9)		
3 or more	342 (36.1)		
BMI categories			<0.01*
Below 18.5	5 (0.5)	34 (3.9)	
18.5–24.9	368 (38.9)	486 (55.3)	
25.0–29.9	480 (50.7)	315 (35.8)	
30 and above	94 (9.9)	44 (5.0)	
Smoking status			<0.01*
Never smoker	562 (59.4)	568 (64.6)	
Ex-smoker	287 (30.3)	164 (18.7)	
Current smoker	98 (10.3)	147 (16.7)	
Cigarettes/day			
1–5	19 (2.0)	37 (4.2)	
5–15	61 (6.4)	85 (9.7)	
15 or more	18 (1.9)	25 (2.8)	
Drinks/week			<0.01*
0	407 (43.0)	496 (56.4)	
1–4	208 (22.0)	215 (24.5)	
5–7	256 (27.0)	106 (12.0)	
8–14	57 (6.0)	50 (5.7)	
15 or more	19 (2.0)	12 (1.4)	
Physical activity hours/week			<0.01*
0	379 (40.0)	256 (29.1)	
1–3	394 (41.6)	291 (33.1)	
4–6	85 (9.0)	133 (15.1)	
7 or more	89 (9.4)	199 (22.7)	
Sleep hours/night			<0.01*

Table 1 (continued)

	Exposed (with diabetes) n (%)	Unexposed (no chronic conditions) n (%)	
	≤6	349 (36.9)	264 (30.0)
	> 6	598 (63.1)	615 (70.0)
Sleep quality			<0.01*
Very good	74 (7.8)	139 (15.8)	
Satisfying	602 (63.6)	693 (78.8)	
Poor	270 (28.5)	46 (5.2)	
Bad	1 (0.1)	1 (0.1)	
GAD-2			<0.01*
<2	739 (78.0)	825 (93.9)	
≥ 3	208 (22.0)	54 (6.1)	
PHQ-2			<0.01*
<2	760 (80.3)	851 (96.8)	
≥ 3	187 (19.7)	28 (3.2)	

^a : *p*-value from t-test for continuous variables and from chi-square test for categorical variables.

People with diabetes compared to healthy ones were older (mean age 76.1 years vs 72.2 years), had fewer household members and more lived alone, had lower educational and socioeconomic status, and included more retired subjects. Exposed subjects were more overweight and obese, less current smokers who smoked few cigarettes/day, more alcohol consumers who drank more drinks/week, did less physical activity. Concerning psychological wellbeing, people with diabetes slept few hours/night, reported a poorer sleep quality, more anxiety and depressive symptoms.

Results from adjusted and weighted logistic regression models are reported in [Table 2](#) for the behavioural and psychological outcomes, [Table 3](#) for the dietary habits and [Table 4](#) for access to healthcare services.

People with diabetes reported more frequently both a BMI increase (OR 1.69, 95 % CI 1.19–2.40) and decrease (OR 1.40, 95 % CI 1.05–1.86) than healthy subjects. Having diabetes was positively associated with an increased physical activity (OR 2.65, 95 % CI 1.69–4.13) and inversely associated with a reduced physical activity (OR 0.75, 95 % CI 0.60–0.94). People with diabetes also reported an OR of 6.27 (95 % CI 3.59–10.95) for drinks/week reduction compared to healthy individuals. No significant associations emerged neither for changes in smoking habits nor for sleep quantity, GAD-2 and PHQ-2 scores.

People with diabetes reported significant increases in the consumption of fruit and nuts (OR 2.06, 95 % CI 1.62–2.63), vegetables (OR 1.41, 95 % CI 1.10–1.82), fish (OR 2.51, 95 % CI 1.74–3.64) and olive oil (OR 3.54, 95 % CI 2.30–5.46), while decreases in the consumption of legumes and cereals intake (OR 2.21, 95 % CI 1.18–4.14 and OR 1.72, 95 % CI 1.01–2.91, respectively). No significant associations emerged for meat and meat products intake.

People with diabetes experienced more an increase of telephone contacts with GP (OR 3.70, 95 % CI 2.83–4.83), hospitalisations (OR 9.01, 95 % CI 3.96–20.51), diagnostic tests (OR 4.15, 95 % CI 2.62–6.56), self-pay specialistic visits (OR 2.93, 95 % CI 2.03–4.24) and medicine purchases with (OR 4.00, 95 % CI 2.52–6.35) and without a medical prescription (OR 2.37, 95 % CI 1.68–3.33). Having diabetes was positively associated with scheduled visits or surgeries cancelled or postponed both by the provider’s (OR 2.47, 95 % CI 1.96–3.12) and patient’s decision (OR 3.37, 95 % CI 2.58–4.42) and ongoing treatments interruption (OR 1.95, 95 % CI 1.33–2.86).

4. Discussion

Findings from our large representative sample of older adults support our hypothesis that COVID-19 lockdown and pandemic impacted differentially wellbeing of older people with diabetes compared to healthy older people. People with diabetes reported more frequently an improvement of selected lifestyles than healthy individuals, thus

Table 2

Odds ratios (ORs) and corresponding 95 % confidence intervals (CIs) from multinomial multivariable logistic regression models for the association between exposure and health behavioural and psychological outcomes.

Outcomes	Exposed (with diabetes) n. (%) ^a	Unexposed (no chronic conditions) n. (%) ^a	OR ^b	95 % CI ^b	p-value
BMI change					
Unchanged	611 (64.7)	710 (79.8)	1.00		
Decreased	102 (10.8)	70 (7.9)	1.69	1.19–2.40	< 0.01*
Increased	231 (24.5)	111 (12.3)	1.40	1.05–1.86	0.02*
Physical activity (hours/week) change					
Unchanged	555 (58.8)	559 (62.8)	1.00		
Decreased	212 (22.4)	299 (33.6)	0.75	0.60–0.94	0.01*
Increased	177 (18.8)	32 (3.6)	2.65	1.69–4.13	< 0.01*
Cigarettes/day change					
Unchanged	909 (96.3)	869 (97.6)	1.00		
Decreased	30 (3.2)	11 (1.3)	1.27	0.66–2.45	0.48
Increased	5 (0.5)	10 (1.1)	0.51	0.16–1.64	0.26
Drinks/week change					
Unchanged	750 (79.4)	861 (96.7)	1.00		
Decreased	173 (18.4)	16 (1.8)	6.27	3.59–10.95	< 0.01*
Increased	21 (2.2)	13 (1.5)	1.31	0.64–2.70	0.46
Sleep hours/night change					
Unchanged	764 (80.9)	788 (88.5)	1.00		
Decreased	132 (14.0)	72 (8.1)	1.38	0.99–1.91	0.06
Increased	48 (5.1)	30 (3.4)	1.26	0.79–2.01	0.33
GAD-2 change					
Unchanged	531 (56.3)	537 (60.4)	1.00		
Decreased	65 (6.9)	48 (5.3)	1.09	0.70–1.70	0.70
Increased	348 (36.8)	306 (34.3)	1.11	0.90–1.37	0.35
PHQ-2 change					
Unchanged	628 (66.5)	619 (69.5)	1.00		
Decreased	83 (8.8)	46 (5.1)	1.23	0.82–1.85	0.31
Increased	233 (24.7)	226 (25.4)	1.09	0.87–1.38	0.46

^a : weighted for representativeness by age, sex and residence municipality size

^b : ORs and 95 % CIs were estimated using multinomial multivariable logistic regression models after adjustment for educational level (none/primary school, secondary school, high school, university degree), marital status (married, divorced/separated, widowed, single) and self-reported economic status (above the Italian mean, on average, below the Italian mean) and weighted for representativeness by age, sex and residence municipality size

endorsing their specific status of risk factors-aware patients [9]. Stronger associations emerged for improvements in physical activity, alcohol consumption and dietary habits, while diseases management and access to care were reported to suffer greatly.

The distribution of the most well-known sociodemographic and lifestyle risk factors among people with diabetes is in line with the available literature, since type 2 diabetes mellitus incidence rises with age [11] and is positively associated with high BMI and obesity [9], lower educational levels [32] and lower self-reported socioeconomic status [33]. These latter act as risk factors both for the disease and worsened health outcomes, probably due to the lack of awareness and possibility of adopting proper lifestyle habits over time. Loneliness is also more common among people with diabetes [34], even though age might play a role. Loneliness increases vulnerability in older people who neglect healthy behaviours [10], impacting psychological wellbeing. Anxiety [35] and depressive symptoms [10] usually scales scored higher values for people with diabetes, as we observed. The lower cigarettes consumption in people with diabetes may be a consequence of the diagnosis of diabetes and the consequent behavioural therapy set by the GP that discourages tobacco consumption, as confirmed by the higher rate of former smokers [36]. In contrast, the excess in alcohol

Table 3

Odds ratios (ORs) and corresponding 95 % confidence intervals (CIs) from multinomial multivariable logistic regression models for the association between exposure and dietary outcomes.

Outcomes	Exposed (with diabetes) ^a n. (%)	Unexposed (no chronic conditions) ^a n. (%)	OR ^b	95 % CI ^b	p-value
Fruit and nuts consumption change					
Unchanged	580 (61.5)	721 (81.0)	1.00		
Decreased	15 (1.6)	11 (1.2)	1.99	0.83–4.76	0.12
Increased	349 (36.9)	159 (17.8)	2.06	1.62–2.63	< 0.01*
Vegetables consumption change					
Unchanged	651 (68.9)	730 (81.9)	1.00		
Decreased	10 (1.1)	11 (1.3)	1.03	0.37–2.87	0.95
Increased	283 (30.0)	149 (16.8)	1.41	1.10–1.82	< 0.01*
Legumes consumption change					
Unchanged	772 (81.8)	806 (90.6)	1.00		
Decreased	55 (5.8)	12 (1.4)	2.21	1.18–4.14	0.01*
Increased	117 (12.4)	72 (8.0)	1.31	0.93–1.84	0.13
Cereals consumption change					
Unchanged	798 (84.5)	827 (92.9)	1.00		
Decreased	63 (6.6)	17 (1.9)	1.72	1.01–2.91	0.04*
Increased	84 (8.9)	46 (5.2)	1.09	0.72–1.67	0.68
Fish consumption change					
Unchanged	707 (74.9)	806 (90.5)	1.00		
Decreased	31 (3.3)	29 (3.3)	1.10	0.64–1.90	0.74
Increased	206 (21.8)	55 (6.2)	2.51	1.74–3.64	< 0.01*
Milk and dairy products consumption change					
Unchanged	739 (78.3)	839 (94.2)	1.00		
Decreased	18 (1.9)	21 (2.4)	3.87	2.45–6.11	< 0.01*
Increased	187 (19.8)	30 (3.4)	1.11	0.56–2.20	0.77
Meat and meat products consumption change					
Unchanged	784 (83.0)	808 (91.0)	1.00		
Decreased	81 (8.6)	47 (5.1)	1.52	1.03–2.24	0.04*
Increased	79 (8.4)	34 (3.9)	1.84	1.18–2.88	< 0.01*
Olive oil consumption change					
Unchanged	738 (78.2)	851 (95.6)	1.00		
Decreased	4 (0.4)	4 (0.4)	0.93	0.25–3.36	0.91
Increased	202 (21.4)	35 (4.0)	3.54	2.30–5.46	< 0.01*

^a : weighted for representativeness by age, sex and residence municipality size

^b : ORs and 95 % CIs were estimated using multinomial multivariable logistic regression models after adjustment for educational level (none/primary school, secondary school, high school, university degree), marital status (married, divorced/separated, widowed, single) and self-reported economic status (above the Italian mean, on average, below the Italian mean) and weighted for representativeness by age, sex and residence municipality size

consumption is a warning alarm, even more since alcohol has no nutritional value. They also engaged in nearly half as much physical activity as those not affected by chronic diseases, consistently with disease pathogenesis [10], although inactivity is a primary risk factor for disease onset and progression.

Consistently with general population, during pandemic BMI increased [27,37], physical activity decreased [27,38] as sleep hours per night and sleep quality [39]. Psychiatric scales reported a worsening in depressive and anxiety symptoms [16]. Voluptuous habits displayed a

Table 4

Odds ratios (ORs) and corresponding 95 % confidence intervals (CIs) from multinomial multivariable logistic regression models for the association between exposure and healthcare services access outcomes.

Outcomes	Exposed (with diabetes) n. (%) ^a	Unexposed (no chronic conditions) n. (%) ^a	OR ^b	95 % CI ^b	p-value
Telephone contacts with GP					
Unchanged	535 (56.7)	735 (82.5)	1.00		
Decreased	55 (5.8)	58 (6.5)	1.26	0.82–1.93	0.30
Increased	354 (37.5)	98 (11.0)	3.70	2.83–4.83	< 0.01*
GP visits					
Unchanged	582 (61.7)	754 (84.7)	1.00		
Decreased	211 (22.3)	122 (13.7)	2.34	1.78–3.06	< 0.01*
Increased	151 (16.0)	14 (1.6)	6.14	3.27–11.52	< 0.01*
ED access					
Unchanged	737 (78.0)	831 (93.3)	1.00		
Decreased	82 (8.6)	50 (5.7)	1.64	1.09–2.47	0.02*
Increased	126 (13.4)	9 (1.0)	7.01	3.40–14.46	< 0.01*
Hospitalisations					
Unchanged	759 (80.4)	836 (93.9)	1.00		
Decreased	60 (6.3)	47 (5.3)	1.28	0.84–1.96	0.25
Increased	125 (13.3)	7 (0.8)	9.01	3.96–20.51	< 0.01*
Outpatient visits					
Unchanged	693 (73.4)	803 (90.2)	1.00		
Decreased	120 (12.7)	73 (8.2)	1.91	1.37–2.68	< 0.01*
Increased	132 (13.9)	14 (1.6)	5.14	2.81–9.42	< 0.01*
Diagnostic tests					
Unchanged	723 (76.6)	802 (90.1)	1.00		
Decreased	65 (6.9)	62 (7.0)	1.15	0.77–1.70	0.50
Increased	156 (16.5)	26 (2.9)	4.15	2.62–6.56	< 0.01*
Self-pay specialist visits					
Unchanged	729 (77.2)	793 (89.0)	1.00		
Decreased	48 (5.1)	49 (5.5)	1.03	0.67–1.61	0.88
Increased	167 (17.7)	49 (5.5)	2.93	2.03–4.24	< 0.01*
Medicine purchases with medical prescription					
Unchanged	760 (80.5)	833 (93.6)	1.00		
Decreased	24 (2.5)	28 (3.2)	0.77	0.42–1.41	0.39
Increased	161 (17.0)	28 (3.2)	4.00	2.52–6.35	< 0.01*
Medicine purchases without medical prescription					
Unchanged	742 (78.5)	815 (91.6)	1.00		
Decreased	16 (1.7)	19 (2.1)	0.72	0.33–1.60	0.42
Increased	187 (19.8)	56 (6.3)	2.37	1.68–3.33	< 0.01*
Scheduled visits or surgeries cancelled or					

Table 4 (continued)

Outcomes	Exposed (with diabetes) n. (%) ^a	Unexposed (no chronic conditions) n. (%) ^a	OR ^b	95 % CI ^b	p-value
postponed by provider's decision					
No	605 (64.1)	698 (78.4)	1.00		
Yes	339 (35.9)	192 (21.6)	2.47	1.96–3.12	< 0.01*
Scheduled visits or surgeries canceled or postponed by patient's decision					
No	692 (73.3)	782 (87.9)	1.00		
Yes	252 (26.7)	108 (12.1)	3.37	2.58–4.42	< 0.01*
Treatments interrupted					
No	854 (90.5)	835 (93.8)	1.00		
Yes	90 (9.5)	55 (6.2)	1.95	1.33–2.86	< 0.01*

^a : weighted for representativeness by age, sex and residence municipality size
^b : ORs and 95 % CIs were estimated using multinomial multivariable logistic regression models after adjustment for educational level (none/primary school, secondary school, high school, university degree), marital status (married, divorced/separated, widowed, single) and self-reported economic status (above the Italian mean, on average, below the Italian mean) and weighted for representativeness by age, sex and residence municipality size

non-significant reduction both in cigarettes/day and drinks/week (not among healthy individuals), as proved by previous inconsistent evidence [17,40]. All these risk factors should be considered to investigate how vulnerable subjects have dealt with the pandemic.

However, adjusting for the most frequently reported potential confounders (i.e., educational level, marital and self-reported economic status) and weighting our estimates to ensure representativeness, the comparison with healthy subjects pointed out the specific resilience of people with diabetes in response to the pandemic.

First, our results on increasing exercise among people with diabetes in a higher proportion than healthy individuals are consistent with previous findings [23,41]. A possible explanation is that individuals with diabetes, aware of their vulnerability, likely try to protect themselves [42]. Nonetheless, as diabetes first-line non-pharmacological treatment, physical activity levels remained suboptimal [43] with inconsistent evidence [44], indicating a greater need to investigate this aspect. We observed unstable BMI trends among people with diabetes, who experienced both weight loss and gain [11]. Reduced alcohol consumption is in line with other analyses [23] and could be explained with an effort towards better nutrition. In accordance with existing literature [22], results for psychiatric symptoms were inconclusive.

Second, significant improvements emerged about nutrition and food item intake, in line with previous findings [45,46]. These patterns may have also been influenced by spending more time at home than subjects without diabetes, trying to avoid contagion [9].

Finally, our findings on access to care support the hypothesis of discontinuities and disease management issues in routine care of non-communicable diseases, particularly at a primary-care level, during the first pandemic phase [47]. On the one hand, subjects with diabetes generally experienced more psychiatric symptoms, impacting health-care needs and seeking. Moreover, increases in GP telephone contacts [48] and cancellations or postponements of scheduled visits and surgeries by patient decision might be determined by increased anxiety because of fear of infection. On the other hand, due to lifestyle changes

and the sudden unavailability of healthcare providers, they might have suffered from health problems due to avoidant behaviours, poor adherence to therapies and poor ability to care adequately. The increase in hospitalisations, diagnostic tests, examinations with specialist prescriptions, as well as the expenditure for medicines, and the treatments interruptions suggest relevant clinical implications in the monitoring and integrated care of non-communicable diseases. Due to both constrained healthcare provision and delayed healthcare seeking behaviours, the COVID-19 pandemic impact on routine diabetes care suggested reduced access to critical health services for patients unable to continue their routine management. Our findings corroborate the first-phase downscaling that health system and primary care services, in particular, went through [48]. This determined detrimental health consequences for chronic diseases burden [12] with a subsequent increased incidence of complications and the observed increase in care-seeking by people with diabetes. Outpatient clinic closures, decreased inpatient capacity, staff and medicine shortages, delayed care-seeking, limited self-care practices and transport difficulties might have contributed to diabetes management challenges [49].

This study needs to be interpreted in light of several strengths and limitations.

To our knowledge, the LOST in Lombardia project is the first multidisciplinary study conducted on a large representative sample exploring the effects of the pandemic on behavioural risk factors, physical and mental health outcomes and access to care in a 10-million inhabitants' region at the heart of the COVID-19 outbreak in Europe. These characteristics (i.e., the numerousness of the interviewed subjects and their representativeness of the general population) allow us to propose a fair generalisation of the observed results to other high/middle-income countries. This is the first analysis from a representative sample assessing pandemic consequences among people with diabetes in terms of health-related determinants. The adopted study design acknowledged simulating a pre-post analysis, exploiting the first-wave nationwide lockdown as a quasi-natural experiment. Potential selection bias was overcome using computer-assisted telephone interviewing (CATI), the most suitable survey method for subjects aged 65 and over, since an online panel would present limited coverage in such an elderly population. On the contrary, a computer-assisted personal interviewing (CAPI) was not advisable during the pandemic. The use of validated evidence-based scales and answers in the adopted questionnaire ensured a rigorous assessment of the collected variables.

Concerning limitations, the cross-sectional nature of our data does not allow us to infer robust causality. Nevertheless, nexuses direction is supported by social and biological plausibility and by comparing pre-pandemic status with the answers referring to 2019. Other limitations include the possible information bias due to self-reported responses and diagnosis, and a potential recall bias since participants were asked to report their status before the pandemic at the time of the interview. Furthermore, access to care was evaluated through not validated answers. Finally, about the population sample, nursing home and long-term care residents were not included, and the comparison between subjects with diabetes, including those with other comorbidities, and healthy subjects might have overestimated the observed changes.

Our analysis suggests that, while people with diabetes have implemented good behavioural strategies, particularly in terms of diet and lifestyles, they are less adept at managing their health, indicating a lack of treatment compliance and issues in healthcare provision during the pandemic. As a specific vulnerable group targeted by health promotion and prevention interventions [50], they demonstrated a surprising resilience. The main lesson is that people with diabetes are less stable but not systematically prone to worsen lifestyles when external conditions theoretically complicate their efforts: they can also seize the opportunity to maintain and even improve their health [23].

Nonetheless, health and social care responses should be tailored to meet chronic patients' needs while minimising long-term health care costs and inequities incurred as a result of the pandemic's unknown

duration. To begin, early epidemiological screening campaigns to identify those at higher risk should be timely promoted. The results of these analyses should be used to inform prevention strategies that provide accurate information on how to best deal with the pandemic's consequences in terms of healthy habits, psychological support, and medical assistance.

Since we noticed a specific problem with healthcare, we could foster healthcare coordination by encouraging more primary care and on-the-ground services. This should include targeted messages about disease management, ongoing support via telephone, telemedicine, or even home visits, ensuring access to insulin, other medicines and supplies [51], and, most importantly, planning for the future, as health systems must prioritise essential services in order to maintain continuity of service delivery [52]. Promoting more healthcare digitalisation could be a game-changer in this area [53], next to monitoring real-time essential services coverage levels strictly. Moreover, given the increased susceptibility of these individuals, mental health issues should be closely monitored [54], and this factor should be considered in future public health strategies, including those requiring large-scale lockdowns, quarantines or social isolation.

5. Conclusion

To the best of our knowledge, our work stands out from other surveys published with less rigorous sampling methods because of the sizeable, representative and adjusted estimates, which allow us to propose generalisations on pandemic consequences for people with diabetes in order to impact public health and decision-makers policies favourably. We observed the resilience of people with diabetes, their commitment to improving lifestyles and difficulties in disease management.

More research is needed to confirm and expand our findings so that we can better understand how to protect older individuals, people with diabetes and other chronic disease patients in the event of other emergencies. New longitudinal studies should be conducted to assess the long-term implications and potentialities of preventive interventions at the population level. A global interdisciplinary approach involving public health, epidemiology, primary and hospital care, and social sciences is needed to evaluate programmes' effectiveness on chronic patients' wellbeing enrolling population-based cohorts to be followed over time, within and beyond COVID-19.

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Statements and declarations

Ethics approval and consent to participate and for publication

Ethics approval and consent to participate and publication for this non-interventional study was obtained from the Ethics committee of Fondazione IRCCS Istituto Neurologico Carlo Besta, Milan, Italy; file number 76, October 2020. The authors declare that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2000.

CRedit authorship contribution statement

GPV and AO, together with SG and AL, conceptualised and designed the study. GPV, together with AO, AL, PB and CBB, contributed to the implementation of the research and the analysis of the results. GPV, together with CBB, PB and AO, wrote the first draft of the manuscript. All authors provided important contributions for the interpretation of findings and contributed to the final version of the manuscript. All authors carefully revised the final version of the manuscript. All authors read and approved the last version of the manuscript.

Competing interests

Each author declares that he or she has no commercial associations (e.g., consultancies, stock ownership, equity interest, patent/licensing arrangement) that might pose a conflict of interest in connection with the submitted article.

Data availability

The datasets supporting the conclusions of this study are available from the corresponding author upon request.

References

- [1] W. Coronavirus, 2021. Dashboard | WHO Coronavirus (COVID-19) Dashboard With Vaccination Data, in, 2021.
- [2] A. Odone, D. Delmonte, T. Scognamiglio, C. Signorelli, COVID-19 deaths in Lombardy, Italy: data in context, *Lancet Public Health* 5 (2020), e310.
- [3] C. Signorelli, T. Scognamiglio, A. Odone, COVID-19 in Italy: impact of containment measures and prevalence estimates of infection in the general population, *Acta Bio Med.: Atenei Parm.* 91 (2020) 175.
- [4] I. Ayouni, J. Maatoug, W. Dhouib, N. Zammit, S.B. Fredj, R. Ghammam, H. Ghanem, Effective public health measures to mitigate the spread of COVID-19: a systematic review, *BMC Public Health* 21 (2021) 1015.
- [5] L.M. Philpot, P. Ramar, D.L. Roellinger, B.A. Barry, P. Sharma, J.O. Ebbert, Changes in social relationships during an initial “stay-at-home” phase of the COVID-19 pandemic: a longitudinal survey study in the US, *Soc. Sci. Med.* 274 (2021), 113779.
- [6] C. Bamba, R. Riordan, J. Ford, F. Matthews, The COVID-19 pandemic and health inequalities, *J. Epidemiol. Community Health* 74 (2020) 964–968.
- [7] A. Abdi, M. Jalilian, P.A. Sarbarzeh, Z. Vlaisavljevic, Diabetes and COVID-19: A systematic review on the current evidences, *Diabetes Res. Clin. Pr.* 166 (2020), 108347.
- [8] S. Wild, G. Roglic, A. Green, R. Sicree, H. King, Global prevalence of diabetes: estimates for the year 2000 and projections for 2030, *Diabetes Care* 27 (2004) 1047–1053.
- [9] E. Lambrinou, T.B. Hansen, J.W. Beulens, Lifestyle factors, self-management and patient empowerment in diabetes care, *Eur. J. Prev. Cardiol.* 26 (2019) 55–63.
- [10] H. Kolb, S. Martin, Environmental/lifestyle factors in the pathogenesis and prevention of type 2 diabetes, *BMC Med.* 15 (2017) 131.
- [11] Y. Zheng, S.H. Ley, F.B. Hu, Global aetiology and epidemiology of type 2 diabetes mellitus and its complications, *Nat. Rev. Endocrinol.* 14 (2018) 88–98.
- [12] D. Beran, S. Aebischer Perone, M. Castellsague Perolini, F. Chappuis, P. Chopard, D.M. Haller, F. Jacqueroiz Bausch, H. Maisonneuve, N. Perone, G. Gastaldi, Beyond the virus: ensuring continuity of care for people with diabetes during COVID-19, *Prim. Care Diabetes* 15 (2021) 16–17.
- [13] A. Catucci, U. Scognamiglio, L. Rossi, Lifestyle changes related to eating habits, physical activity, and weight status during COVID-19 quarantine in Italy and some European Countries, *Front. Nutr.* 8 (2021), 718877.
- [14] A. Fiorillo, G. Sampogna, V. Giallonardo, V. Del Vecchio, M. Luciano, U. Albert, C. Carmassi, G. Carrà, F. Cirulli, B. Dell’Osso, M.G. Nanni, M. Pompili, G. Sani, A. Tortorella, U. Volpe, Effects of the lockdown on the mental health of the general population during the COVID-19 pandemic in Italy: Results from the COMET collaborative network, *Eur. Psychiatry* 63 (2020), e87.
- [15] A. Odone, A. Lugo, A. Amerio, E. Borroni, C. Bosetti, G. Carreras, L. Cavaliere d’Oro, P. Colombo, T. Fanucchi, S. Ghislandi, G. Gorini, L. Iacoviello, R. Pacifici, C. Santucci, G. Serafini, C. Signorelli, C. Stival, D. Stuckler, C.A. Tersalvi, S. Gallus, COVID-19 lockdown impact on lifestyle habits of Italian adults, *Acta Biomed.* 91 (2020) 87–89.
- [16] A. Amerio, A. Lugo, C. Stival, T. Fanucchi, G. Gorini, R. Pacifici, A. Odone, G. Serafini, S. Gallus, COVID-19 lockdown impact on mental health in a large representative sample of Italian adults, *J. Affect Disord.* 292 (2021) 398–404.
- [17] G. Carreras, A. Lugo, C. Stival, A. Amerio, A. Odone, R. Pacifici, S. Gallus, G. Gorini, Impact of COVID-19 lockdown on smoking consumption in a large representative sample of Italian adults, *Tob. Control* (2021).
- [18] A. Lugo, C. Stival, L. Paroni, A. Amerio, G. Carreras, G. Gorini, L. Mastrobattista, A. Minutillo, C. Mortali, A. Odone, R. Pacifici, B. Tinghino, S. Gallus, The impact of COVID-19 lockdown on gambling habit: a cross-sectional study from Italy, *J. Behav. Addict.* 10 (2021) 711–721.
- [19] A. Amerio, A. Lugo, C. Bosetti, T. Fanucchi, G. Gorini, R. Pacifici, A. Odone, S. Gallus, Italians Do It ... Less. COVID-19 lockdown impact on sexual activity: evidence from a large representative sample of Italian adults, *J. Epidemiol.* 31 (2021) 648–652.
- [20] F. Farahani, F. Mirzaei, I. Khodadadi, E. Abbasi-Oshaghi, Importance of hyperglycemia in preoperative, intraoperative and postoperative periods in COVID-19 patients, *Int. J. Surg.* 83 (2020) 1–2.
- [21] F. Mirzaei, I. Khodadadi, S.A. Vafaei, E. Abbasi-Oshaghi, H. Tayebinia, F. Farahani, Importance of hyperglycemia in COVID-19 intensive-care patients: mechanism and treatment strategy, *Prim. Care Diabetes* 15 (2021) 409–416.
- [22] J.W. Sacre, E. Holmes-Truscott, A. Salim, K.J. Anstey, G.R. Drummond, R. R. Huxley, D.J. Magliano, P. van Wijngaarden, P.Z. Zimmet, J. Speight, J.E. Shaw, Impact of the COVID-19 pandemic and lockdown restrictions on psychosocial and behavioural outcomes among Australian adults with type 2 diabetes: findings from the PREDICT cohort study, *Diabet. Med.* 38 (2021), e14611.
- [23] B. Hansel, L. Potier, S. Chalopin, E. Larger, J.F. Gautier, F. Delestre, V. Masdoua, B. Visseaux, J.C. Lucet, S. Kerneis, Y. Abouleka, J.F. Thebaut, J.P. Riveline, D. Kadouch, R. Roussel, The COVID-19 lockdown as an opportunity to change lifestyle and body weight in people with overweight/obesity and diabetes: results from the national French COVIDIAB cohort, *Nutr. Metab. Cardiovasc Dis.* 31 (2021) 2605–2611.
- [24] Y. Tanji, S. Sawada, T. Watanabe, T. Mita, Y. Kobayashi, T. Murakami, H. Metoki, H. Akai, Impact of COVID-19 pandemic on glycemic control among outpatients with type 2 diabetes in Japan: a hospital-based survey from a country without lockdown, *Diabetes Res. Clin. Pr.* 176 (2021), 108840.
- [25] Y. Wang, A. Lugo, A. Amerio, L.C. d’Oro, L. Iacoviello, A. Odone, A. Zucchi, S. Gallus, D. Stuckler, The impact of COVID-19 lockdown announcements on mental health: quasi-natural experiment in Lombardy, Italy, *Eur. J. Public Health* (2022).
- [26] M. Bonaccio, F. Gianfagna, C. Stival, A. Amerio, C. Bosetti, L. Cavaliere d’Oro, A. Odone, D. Stuckler, A. Zucchi, S. Gallus, L. Iacoviello, Changes in a Mediterranean lifestyle during the COVID-19 pandemic among elderly Italians: an analysis of gender and socioeconomic inequalities in the “LOST in Lombardia” study, *Int. J. Food Sci. Nutr.* (2022) 1–10.
- [27] C. Stival, A. Lugo, C. Bosetti, A. Amerio, G. Serafini, L. Cavaliere d’Oro, A. Odone, D. Stuckler, L. Iacoviello, M. Bonaccio, P.A. van den Brandt, A. Zucchi, S. Gallus, COVID-19 confinement impact on weight gain and physical activity in the older adult population: data from the LOST in Lombardia study, *Clin. Nutr. ESPEN* 48 (2022) 329–335.
- [28] C.M. Jarach, A. Lugo, C. Stival, C. Bosetti, A. Amerio, L. Cavaliere d’Oro, L. Iacoviello, A. Odone, D. Stuckler, A. Zucchi, P. van den Brandt, W. Garavello, C. R. Cederoth, W. Schlee, S. Gallus, The impact of COVID-19 confinement on tinnitus and hearing loss in older adults: data from the LOST in Lombardia study, *Front. Neurol.* 13 (2022), 838291.
- [29] D.J. Buysse, C.F. Reynolds 3rd, T.H. Monk, S.R. Berman, D.J. Kupfer, The pittsburgh sleep quality index: a new instrument for psychiatric practice and research, *Psychiatry Res.* 28 (1989) 193–213.
- [30] K. Kroenke, R.L. Spitzer, J.B. Williams, The patient health questionnaire-2: validity of a two-item depression screener, *Med. Care* 41 (2003) 1284–1292.
- [31] A. Sapra, P. Bhandari, S. Sharma, T. Chanpura, L. Lopp, Using generalized anxiety disorder-2 (GAD-2) and GAD-7 in a primary care setting, *Cureus* 12 (2020), e8224.
- [32] J. Mathisen, A.K.G. Jensen, I. Andersen, G.S. Andersen, U.A. Hvidtfeldt, N.H. Rod, Education and incident type 2 diabetes: quantifying the impact of differential exposure and susceptibility to being overweight or obese, *Diabetologia* 63 (2020) 1764–1774.
- [33] E. Agardh, P. Allebeck, J. Hallqvist, T. Moradi, A. Sidorchuk, Type 2 diabetes incidence and socio-economic position: a systematic review and meta-analysis, *Int. J. Epidemiol.* 40 (2011) 804–818.
- [34] R.A. Hackett, J.L. Hudson, J. Chilcot, Loneliness and type 2 diabetes incidence: findings from the english longitudinal study of ageing, *Diabetologia* 63 (2020) 2329–2338.
- [35] A. Bickett, H. Tapp, Anxiety and diabetes: innovative approaches to management in primary care, *Exp. Biol. Med.* 241 (2016) 1724–1731.
- [36] J. Maddatu, E. Anderson-Baucum, C. Evans-Molina, Smoking and the risk of type 2 diabetes, *Transl. Res* 184 (2017) 101–107.
- [37] D.R. Bakaloudi, R. Barazzoni, S.C. Bischoff, J. Breda, K. Wickramasinghe, M. Chourdakis, Impact of the first COVID-19 lockdown on body weight: a combined systematic review and a meta-analysis, *Clin. Nutr.* (2021).
- [38] W.I.J. de Boer, J.O. Mierau, J. Schoemaker, L. Viluma, R.H. Koning, The impact of the Covid-19 crisis on socioeconomic differences in physical activity behavior: evidence from the lifelines COVID-19 cohort study, *Prev. Med.* 153 (2021), 106823.
- [39] C. Franceschini, A. Musetti, C. Zenesini, L. Palagini, S. Scarpelli, M.C. Quattropiani, V. Lenzo, M.F. Freda, D. Lemmo, E. Vegni, L. Borghi, E. Saita, R. Cattivelli, L. De Gennaro, G. Plazzi, D. Riemann, G. Castelnuovo, Poor sleep quality and its consequences on mental health during the COVID-19 lockdown in Italy, *Front. Psychol.* 11 (2020), 574475.
- [40] R.A. Schmidt, R. Genois, J. Jin, D. Vigo, J. Rehm, B. Rush, The early impact of COVID-19 on the incidence, prevalence, and severity of alcohol use and other drugs: a systematic review, *Drug Alcohol Depend.* 228 (2021), 109065.
- [41] M.R. Patel, G. Zhang, C. Leung, P.X.K. Song, M. Heisler, H.M. Choe, R. Mehdipanah, X. Shi, K. Resnicow, G. Rajaei, J.D. Piette, Impacts of the COVID-19 pandemic on unmet social needs, self-care, and outcomes among people with diabetes and poor glycemic control, *Prim. Care Diabetes* 16 (2022) 57–64.

- [42] A.D.A. 5, Lifestyle management: standards of medical care in diabetes-2019, *Diabetes Care* 42 (2019). S46-s60.
- [43] P.C. Dempsey, C.E. Matthews, S.G. Dashti, A.R. Doherty, A. Bergouignan, E.H. van Roekel, D.W. Dunstan, N.J. Wareham, T.E. Yates, K. Wijndaele, B.M. Lynch, Sedentary behavior and chronic disease: mechanisms and future directions, *J. Phys. Act Health* 17 (2020) 52–61.
- [44] M.B. Ruiz-Roso, C. Knott-Torcal, D.C. Matilla-Escalante, A. Garcimartín, M. A. Sampedro-Núñez, A. Dávalos, M. Marazuela, COVID-19 lockdown and changes of the dietary pattern and physical activity habits in a cohort of patients with type 2 diabetes mellitus, *Nutrients* 12 (2020).
- [45] P.G. Della Valle, G. Mosconi, D. Nucci, G.P. Vigezzi, L. Gentile, V. Gianfredi, M. Bonaccio, F. Gianfagna, C. Signorelli, L. Iacoviello, A. Odone, Adherence to the Mediterranean Diet during the COVID-19 national lockdowns: a systematic review of observational studies, *Acta Biomed.* 92 (2021), e2021440.
- [46] E.S. Mitchell, Q. Yang, H. Behr, L. Deluca, P. Schaffer, Adherence to healthy food choices during the COVID-19 pandemic in a U.S. population attempting to lose weight, *Nutr. Metab. Cardiovasc Dis.* 31 (2021) 2165–2172.
- [47] B. Michalowsky, W. Hoffmann, J. Bohlken, K. Kostev, Effect of the COVID-19 lockdown on disease recognition and utilisation of healthcare services in the older population in Germany: a cross-sectional study, *Age Ageing* 50 (2021) 317–325.
- [48] S. Seidu, C. Hambling, P. Holmes, K. Fernando, N.S. Campbell, S. Davies, K. Khunti, The impact of the COVID pandemic on primary care diabetes services in the UK: a cross-sectional national survey of views of health professionals delivering diabetes care, *Prim. Care Diabetes* (2022).
- [49] M. Mohseni, S. Ahmadi, S. Azami-Aghdash, H. Mousavi Isfahani, A. Moosavi, M. Fardid, M. Etemadi, F. Ghazanfari, Challenges of routine diabetes care during COVID-19 era: A systematic search and narrative review, *Prim. Care Diabetes* 15 (2021) 918–922.
- [50] G. Dallagiaco, A. Allora, S. Salvati, G. Cocciolo, M. Capraro, A. Lamberti, S. Senatore, L. Gentile, V. Gianfredi, A. Laurenzi, C. Molinari, A. Caretto, M. Faccini, C. Signorelli, M. Scavini, A. Odone, Type 1 diabetes patients' practice, knowledge and attitudes towards influenza immunization, *Vaccines* (2021).
- [51] J. Kang, Y. Chen, Y. Zhao, C. Zhang, Effect of remote management on comprehensive management of diabetes mellitus during the COVID-19 epidemic, *Prim. Care Diabetes* 15 (2021) 417–423.
- [52] WHO, 2020. Maintaining essential health services: operational guidance for the COVID-19 context: interim guidance, 1 June 2020, in, *World Health Organization*, 2020.
- [53] A. Odone, S. Buttigieg, W. Ricciardi, N. Azzopardi-Muscat, A. Staines, Public health digitalization in Europe, *Eur. J. Public Health* 29 (2019) 28–35.
- [54] A. Amerio, A. Odone, L. Marzano, A. Costanza, A. Aguglia, G. Serafini, C. Signorelli, S.N. Ghaemi, M. Amore, Covid-19: the last call for telepsychiatry, *Acta Biomed.* 91 (2020) (ahead of print).