

Nutritional problems of patients with COVID-19 receiving dietetic treatment in primary care

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Abstract

Background: The nutritional problems of patients who are hospitalised for COVID-19 are becoming increasingly clear. However, a large group of patients have never been hospitalised and also appear to experience persistent nutritional problems. The present study describes the nutritional status, risk of sarcopaenia and nutrition-related complaints of patients recovering from COVID-19 receiving dietetic treatment in primary care.

Methods: In this retrospective observational study, data were collected during dietetic treatment by a primary care dietitian between April and December 2020. Both patients who had and had not been admitted to the hospital were included at their first visit to a primary care dietitian. Data on nutritional status, risk of sarcopaenia and nutrition-related complaints were collected longitudinally.

Results: Data from 246 patients with COVID-19 were collected. Mean \pm SD age was 57 ± 16 years and 61% of the patient population was female. At first consultation, two thirds of patients were classified as overweight or obese (body mass index $>25 \text{ kg m}^{-2}$). The majority had experienced unintentional weight loss because of COVID-19. Additionally, 55% of hospitalised and 34% of non-hospitalised patients had a high risk of sarcopaenia. Most commonly reported nutrition-related complaints were decreased appetite, shortness of breath, changed or loss of taste and feeling of being full. Nutrition-related complaints decreased after the first consultation, but remained present over time.

Conclusions: In conclusion, weight changes, risk of sarcopaenia and nutrition-related complaints were prevalent in patients with COVID-19, treated by a primary care dietitian. Nutrition-related complaints improved over time, but remained prevalent until several months after infection.

KEYWORDS

COVID-19, dietitian, nutrition-related complaints, nutritional status, primary care, sarcopaenia

Key points

- Weight changes, risk of sarcopaenia and nutrition-related complaints were prevalent in patients with COVID-19 treated by a primary care dietitian.
- Most commonly reported nutrition-related complaints were decreased appetite, shortness of breath, changed or loss of taste and feeling of being full.

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- Nutrition-related complaints improved over time, but remained prevalent until several months after infection.
- The risk of a poor nutritional status and high risk of sarcopaenia should be considered, especially in combination with persistent nutrition-related complaints as a result of COVID-19.

INTRODUCTION

The recent worldwide COVID-19 pandemic as a result of the Coronavirus SARS-CoV-2 has caused major challenges for healthcare professionals all over the world.^{1,2} Symptoms of COVID-19 vary amongst individuals and may range from asymptomatic to severe respiratory failure requiring admission to hospital or even admission to an intensive care unit (ICU).³⁻⁶ After the acute phase, many people experience persistent symptoms until a few weeks to several months after infection.⁷⁻⁹ In addition to general COVID-19 symptoms, such as fever, fatigue, cough, dyspnoea and nutrition-related complaints, are common in patients recovering from COVID-19.^{8,10,11} Nutrition-related complaints include loss of taste and smell, loss of appetite, nausea, vomiting or diarrhea, which may lead to reduced food intake and/or decreased nutrient absorption.^{12,13} As a consequence, nutritional requirements are often not met, which can result in unintentional weight loss and loss of muscle mass and strength. Additionally, physical inactivity as a result of COVID-19 is a risk factor for loss of muscle mass and strength.¹⁴ Weight loss and loss of muscle mass and strength are common in patients with COVID-19, both in the acute phase and up to several months after infection.¹⁵ Previous studies have shown that COVID-19 is associated with a poor nutritional status, which may result in a high risk of malnutrition^{11,16-18} and sarcopaenia.^{11,19-21}

Most nutrition studies have focused on hospitalised patients with severe COVID-19. The recently published prospective COVOED study investigated the nutritional status, risk of sarcopaenia and nutrition-related complaints of hospitalised patients with COVID-19.¹¹ Almost all patients had one or more nutrition-related complaints. The most predominant complaints were decreased appetite, feeling of being full, shortness of breath, changed taste and loss of taste. These nutrition-related complaints persisted 3–5 months after discharge.¹¹

Only limited literature has been identified on nutritional problems of patients recovering from COVID-19 in primary care. A recent review advises to pay attention to prolonged nutritional problems in patients based at home.²² Therefore, this retrospective part of the COVOED study describes the nutritional status, risk of sarcopaenia and nutrition-related complaints of patients with COVID-19 treated by a primary care dietitian in 2020. Additionally, it describes the duration of treatment and method of performing the dietetic consultation of primary care dietitians treating COVID-19 patients.

METHODS

Study design and population

The present study is part of the larger COVOED study, an observational cohort study. We retrospectively collected data from adult patients who received dietetic care for COVID-19 by a primary care dietitian between 27 April and 31 December 2020. Dietetic practices in The Netherlands were approached via email or via the Dutch Dietetic Association, and invited to participate in the study. Patients, in turn, were invited by their treating dietitians and a written informed consent was signed by all participating patients. Patients included in the study were likely to have had the Wuhan-variant of the Coronavirus SARS-CoV-2. Both patients admitted to the hospital and patients never admitted to the hospital were included. Dietitian-reported data were retrieved from the electronic patient files and transferred to Castor Electronic Capture (version: Castor EDC 2020.2, Amsterdam, The Netherlands), a web-based electronic platform.

Patients were entered into the study at their first visit to a primary care dietitian. Data were categorised for each time point, that is at first consultation (study entry), after 1 month, as well as 2, 3 and 4–6 months.

Patient characteristics

The following general items were collected to describe the patient population: age, gender, and hospital admission (yes/no). For patients who had been admitted to the hospital for COVID-19, data on previous length of hospital stay (LOS), hospital ward and ICU stay, and any support therapy received (i.e., oxygen mask, ventilatory support, tube feeding) were recorded. ICU patients were defined as having been admitted to the ICU at any point in time during hospitalisation. Hospital ward patients were defined as having been hospitalised, but not admitted to ICU. Additionally, data on consistency of oral nutrition and use of oral nutrition supplements were collected.

Nutritional status

The nutritional status of the patients was assessed by body mass index (BMI) and weight changes before the first consultation with the primary care dietitian. Body weight and height were used to calculate BMI (weight/

height²). BMI was categorised as described by the World Health Organization (WHO)²³: underweight BMI 18.5 kg m⁻², normal weight 18.5–25 kg m⁻², overweight BMI 25–30 kg m⁻², obesity BMI 30–40 kg m⁻² and morbid obesity > 40 kg m⁻². Dietitians were asked to measure body composition with bioelectric impedance analysis.

The risk of sarcopaenia was assessed with the SARC-F questionnaire.^{24,25} The SARC-F consists of five items: strength, assistance in walking, rise from a chair, climbing stairs and falls. A total score of 4 or more indicates an increased risk of sarcopaenia.

Nutrition-related complaints

The following nutrition-related complaints were collected during the dietetic consultations: decreased appetite (anorexia), shortness of breath, nausea, feeling of being full, changed taste, loss of taste (ageusia), difficulty chewing or swallowing and pain in the mouth. Four nutrition-related complaints were added halfway during data collection because these complaints were commonly, but not systematically, reported in the electronic patient files of the primary care dietitians: fatigue, muscle weakness, loss of smell (anosmia) and changed smell. For appetite, a visual analogue scale (1–100) was used.²⁶ Additionally, dietitians were asked to use the Bristol Stool Chart to assess stool frequency and consistency.²⁷

Dietetic treatment

The following items were collected to describe the dietetic treatment in primary care: referring physician, method of performing dietetic consultation, number of consultations, number of hours reimbursed by the health insurance, duration of dietetic treatment and reason for ending dietetic treatment. Additionally, the involvement of a physiotherapist at any point in time during the dietetic treatment was recorded. The method of performing the dietetic consultation was categorised into three categories: completely remotely (by telephone or video call), completely face-to-face (at practice site or via home visit) or blended.

Statistical analysis

Descriptive analyses were performed to describe the patient population using proportions, mean \pm SD, and medians with interquartile ranges (IQR), as well as to analyse the nutritional status, risk of sarcopaenia and nutrition-related complaints. Different patient characteristics and nutritional status between hospitalised and non-hospitalised patients were quantified by means of independent samples *t* tests and chi-squared tests. All

data were analysed using SPSS, version 25 (IBM Corp.) *p* < 0.05 was considered statistically significant.

RESULTS

Patient characteristics

In total, 246 patients were included in the study (Table 1). Mean \pm SD age was 57 \pm 16 years and 61% of the patient population was female. Forty-three per cent of the patient population had been hospitalised for COVID-19, of which 51% of the patients had been admitted to the ICU. Hospitalised patients were significantly older (64 \pm 13 years) compared to non-hospitalised patients (52 \pm 16 years). The hospitalised group consisted of more men (58%), whereas the non-hospitalised group consisted of significantly more women (76%). Additional data on hospital admitted patients is provided in the Supporting information (Table 1).

Nutritional status

Data on the nutritional status of included patients with COVID-19 at the first dietetic consultation by a primary care dietitian is described in Table 1. Mean \pm SD BMI was 28.3 \pm 5.9 kg m⁻² and 67% of the patient population was classified as being overweight or obese (BMI >25 kg m⁻²). No significant differences in BMI were found between hospitalised and non-hospitalised patients. The majority of the patients had experienced weight loss when comparing current weight with regular weight; 26% had lost 5–10 kg and 12% had lost more than 10 kg. More than one-third of the patients had experienced weight (re-)gain in the month before the first consultation with the primary care dietitian. However, 24% of hospitalised patients and 12% of non-hospitalised patients had experienced weight loss of 5%–10% in the month before the first consultation. Data on body composition are not shown as a result of numerous missing data.

In Table 2, the risk of sarcopaenia assessed by the SARC-F questionnaire at the first dietetic consultation is shown: 44% of the patients were at high risk of sarcopaenia. Hospitalised patients were more frequently at high risk of sarcopaenia compared to non-hospitalised patients (55% vs. 34%). Patients with a high risk of sarcopaenia were significantly older (60 \pm 15 years) than patients with no risk of sarcopaenia (52 \pm 14 years).

Nutrition-related complaints

Only a minority of patients (17%) did not report any nutrition-related complaint at the first dietetic

TABLE 1 General characteristics and nutritional status of patients with COVID-19 at first dietetic consultation by a primary care dietitian

	Total group (<i>n</i> = 246)	Hospitalised (<i>n</i> = 100) ^a	Non-hospitalised (<i>n</i> = 133) ^a
Gender, <i>n</i> (%)			
Men	97 (39)	58 (58)	32 (24)
Women	149 (61)	42 (42)	101 (76)
Age (mean ± SD)	<i>n</i> = 244 ^a 57.2 ± 15.9	<i>n</i> = 99 ^a 64.3 ± 12.8	<i>n</i> = 132 ^a 52.3 ± 15.7
BMI (mean ± SD)	<i>n</i> = 235 ^a 28.3 ± 5.9	<i>n</i> = 98 ^a 28.3 ± 5.2	<i>n</i> = 126 ^a 28.2 ± 6.4
< 18.5 kg m ⁻²	4 (2)	1 (1)	3 (2)
18.5–25 kg m ⁻²	74 (31)	27 (28)	45 (36)
25–30 kg m ⁻²	72 (31)	37 (38)	31 (25)
30–40 kg m ⁻²	79 (33)	31 (31)	44 (35)
> 40 kg m ⁻²	6 (3)	2 (2)	3 (2)
Weight change over the month before first consultation with primary care dietitian, <i>n</i> (%)	^a <i>n</i> = 176	^a <i>n</i> = 75	^a <i>n</i> = 94
Weight gain more than +5 kg	14 (8)	7 (9)	6 (6)
Weight gain +1 to +5 kg	48 (27)	25 (33)	21 (22)
Stable weight: -1 to +1 kg	45 (26)	8 (11)	35 (37)
-1 to -5 kg	36 (20)	15 (20)	21 (22)
-5 to -10 kg	21 (12)	12 (16)	8 (9)
More than -10 kg	12 (7)	8 (11)	3 (3)
Weight loss over the month before first consultation with primary care dietitian, <i>n</i> (%)	<i>n</i> = 176 ^a	<i>n</i> = 75 ^a	<i>n</i> = 94 ^a
< 5%	140 (80)	53 (71)	82 (87)
5%–10%	30 (17)	18 (24)	11 (12)
> 10%	6 (3)	4 (5)	1 (1)
Weight change compared to regular weight, <i>n</i> (%)	<i>n</i> = 209 ^a	<i>n</i> = 88 ^a	<i>n</i> = 118 ^a
Weight gain more than 5 kg	19 (9)	4 (5)	14 (12)
Weight gain 1–5 kg	13 (6)	6 (7)	7 (6)
Stable weight: -1 to +1 kg	41 (20)	9 (10)	32 (27)
-1 to -5 kg	57 (27)	24 (27)	32 (27)
-5 to -10 kg	54 (26)	28 (32)	26 (22)
More than -10 kg	25 (12)	17 (19)	7 (6)
Weight loss compared to regular weight, <i>n</i> (%)	<i>n</i> = 209 ^a 128 (61)	<i>n</i> = 88 ^a 41 (47)	<i>n</i> = 118 ^a 84 (71)
< 5%	59 (28)	30 (24)	29 (25)
5%–10%	22 (11)	17 (19)	5 (4)
> 10%			

^aData were not fully available for all patients: the *n* within the table depicts the number of patients with available data.

Abbreviation: BMI, body mass index.

consultation. Fifty-nine per cent of patients reported more than one nutrition-related complaints. Figure 1 shows the nutrition-related complaints reported at the first consultation. The five most frequently reported complaints for both hospitalised and non-hospitalised patients were: a decreased appetite (58%), shortness of breath (56%), changed taste (53%), loss of taste (51%) and feeling of being full (45%). Almost one in three patients experienced nausea and non-hospitalised

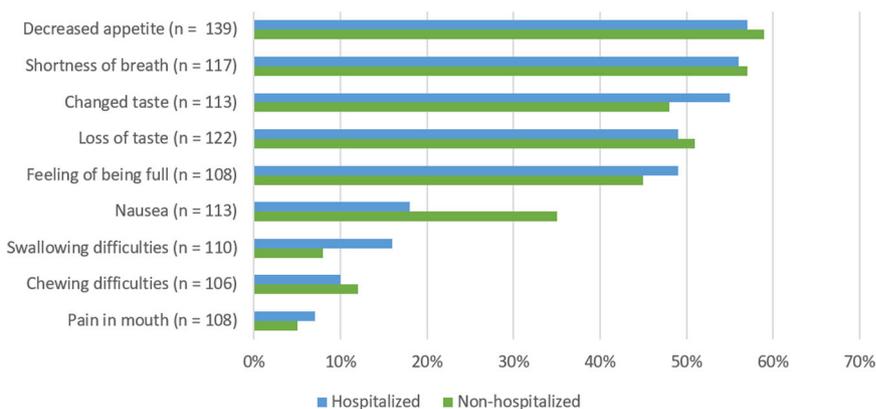
patients experienced nausea more often than hospitalised patients (25% vs. 18%).

Of the four additionally nutrition-related complaints, fatigue was most common; 84 out of 85 patients (99%) reported fatigue at the first consultation. Muscle weakness was reported by 56 out of 64 patients (88%). Seventeen out of 54 patients (31%) reported a loss of smell and 13 out of 48 patients (27%) reported a changed smell. The nutrition-related complaints reported at

TABLE 2 SARC-F in patients with COVID-19 at first dietetic consultation by a primary care dietitian

Question	Total group (n = 88)	Hospitalised (n = 44)	Non-hospitalised (n = 44)
Strength: How much difficulty do you have in lifting and carrying 10 lb/ 5 kg?, n (%)			
None	25 (28)	8 (18)	17 (39)
Some	43 (49)	24 (55)	19 (43)
A lot or unable	20 (23)	12 (27)	8 (18)
Assistance in walking: How much difficulty do you have walking across a room?, n (%)			
None	46 (52)	20 (46)	26 (59)
Some	36 (41)	19 (43)	17 (39)
A lot, use of aids or unable	6 (7)	5 (11)	1 (2)
Rise from a chair: How much difficulty do you have transferring from a chair or bed?, n (%)			
None	45 (51)	16 (36)	29 (66)
Some	38 (43)	26 (59)	12 (27)
A lot or unable without help	6 (6)	2 (5)	3 (7)
Climb stairs: How much difficulty do you have climbing a flight of 10 stairs?, n (%)			
None	14 (16)	4 (9)	10 (23)
Some	50 (57)	25 (57)	25 (57)
A lot or unable	24 (27)	15 (34)	9 (20)
Falls: How many times have you fallen in the past year?, n (%)			
None	77 (88)	35 (80)	42 (96)
1–3 falls	11 (12)	9 (20)	2 (5)
≥ 4 falls	0	0	0
Total score (mean ± SD)	3.3 ± 2.4	3.9 ± 2.3	2.7 ± 2.3
≥ 4 points, n (%)	39 (44)	24 (55)	15 (34)

FIGURE 1 Nutrition-related complaints of patients with COVID-19 at the first dietetic consultation by a primary care dietitian



different points in time (i.e., at first consultation, after 1 month, as well as 2, 3, 4–6 months) are shown in the Supporting information (Table 2).

After 1 month, 18% of hospitalised patients and 45% of non-hospitalised patients did not report any nutrition-

related complaints; this increased to 42% and 46% for hospitalised and non-hospitalised patients, respectively, at 4–6 months of follow-up (Figure 2). Nevertheless, after 4–6 months 37% of hospitalised patients and 36% of non-hospitalised patients still reported more than one

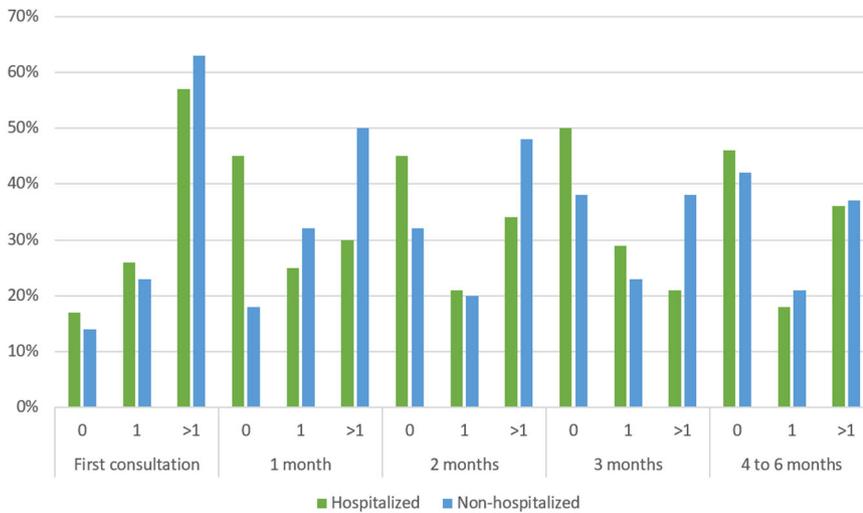


FIGURE 2 The number of nutrition-related complaints reported by patients with COVID-19 at different points in time

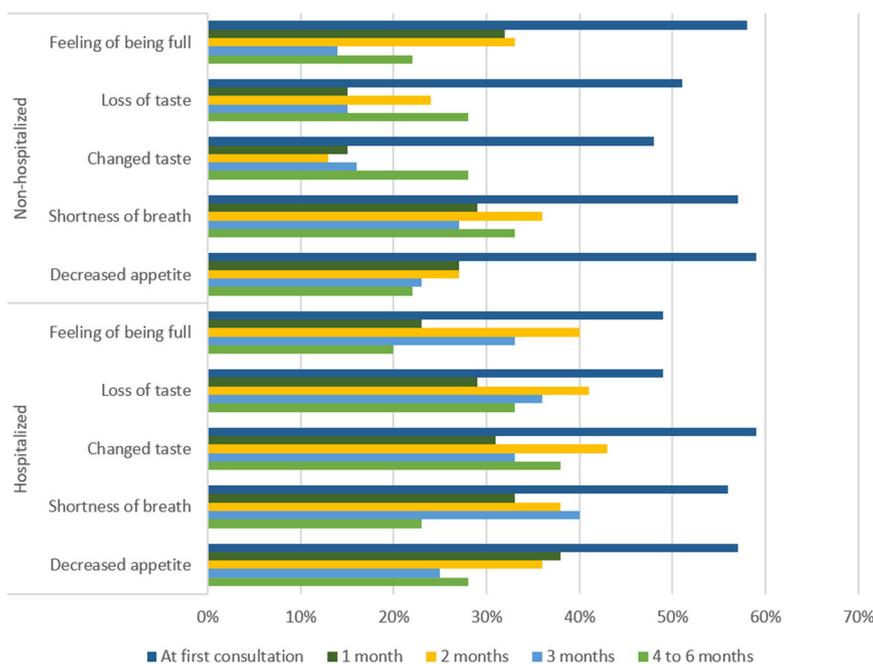


FIGURE 3 Nutrition-related complaints of patients with COVID-19 at different points in time

nutrition-related complaint. The development of the five most common nutrition-related complaints in time is shown in Figure 3. Not all participants were measured on each time point, which hindered performing longitudinal analyses. The number of patients reporting nutrition-related complaints decreased after the first consultation, but nutrition-related complaints remained present. In the months after the first consultation, many patients still reported nutrition-related complaints. For example, shortness of breath was experienced by 38% of the patients after 1 month, by 33% after 3 months and by 30% after 4–6 months. After 4–6 months, the most frequently reported nutrition-related complaints were changed taste (32%), loss of taste (30%) and shortness of breath (30%). The mean visual analogue score for appetite was and remained low (< 70%), especially at

the first dietetic consultation by a primary care dietitian. Data on stool frequency and consistency were not shown as a result of numerous missing data.

Dietetic consultation

Data on the dietetic consultations are shown in Table 3. Most patients (61%) were referred by the general practitioner. The median number of dietetic consultations was 5.0 (IQR = 3.0–7.0) and the median number of hours submitted to the health insurance company for reimbursement was 3.3 (IQR = 2.5–4.0); no differences were observed between hospitalised and non-hospitalised patients. More than one-third of the patients received six to eight consultations by a primary care dietitian in the first

TABLE 3 Dietetic consultation by primary care dietitians

	Total group (<i>n</i> = 246)	Hospitalised (<i>n</i> = 100)	Non-hospitalised (<i>n</i> = 133)
Referring physician, <i>n</i> (%)	<i>n</i> = 241 ^a	<i>n</i> = 98 ^a 39 (40)	^a = 131
Hospital dietitian	41 (17)	44 (45)	2 (2)
General practitioner	146 (61)	7 (7)	96 (73)
Physiotherapist	40 (17)	3 (3)	30 (23)
Direct access	11 (5)	5 (5)	7 (5)
Transfer from hospital without transfer dietitian	8 (3)	4 (4)	2 (2)
Transfer from a dietitian from a nursing home or rehabilitation ward	4 (2)		0
Number of consultations (median, IQR)	^a <i>n</i> = 166 5.0 (3.0–7.0)	^a <i>n</i> = 62 5.0 (4.0–7.3)	^a <i>n</i> = 98 5.0 (3.0–7.0)
1	10 (6)	3 (5)	7 (7)
2–3	34 (20)	8 (13)	25 (25)
4–5	51 (31)	21 (34)	28 (28)
6–8	58 (35)	23 (37)	33 (34)
≥ 9	13 (8)	7 (11)	5 (5)
Number of hours submitted to the health insurance company (median, IQR)	<i>n</i> = 161 ^a 3.3 (2.5–4.0)	<i>n</i> = 67 ^a 3.3 (2.5–4.0)	<i>n</i> = 88 ^a 3.0 (2.5–4.0)
≤ 3 h	78 (48)	32 (48)	46 (52)
3–7 h	78 (48)	32 (48)	40 (46)
≥ 7 h	5 (4)	3 (4)	2 (2)
Method of performing the dietetic consultation, <i>n</i> (%)	^a <i>n</i> = 159	^a <i>n</i> = 65	^a <i>n</i> = 93
Completely remote	42 (26)	27 (42)	15 (16)
Completely face-to-face	79 (50)	23 (35)	56 (60)
Blended care	38 (24)	15 (23)	22 (24)
Reason for closing dietetic treatment, <i>n</i> (%)	<i>n</i> = 155 ^a 116 (75)	<i>n</i> = 61	<i>n</i> = 89 ^a 67 (76)
Treatment goals were achieved	35 (22)	^a 44 (72)	18 (20)
Treatment is closed at request of the patient	3 (2)	17 (28)	3 (3)
The patient died	1 (1)	0	1 (1)
The patient was discharged from the care of the institution		0	

^aData were not fully available for all patients: the *n* within the table depicts the number of patients with available data.

Abbreviation: IQR, interquartile range.

4–6 months. Fifty percent of the patients were treated completely face-to-face, both at the practice site or via a home visit; non-hospitalised patients were treated completely face-to-face more frequently than hospitalised patients (60% vs. 35%, respectively). Hospitalised patients were treated completely remote more often (42% vs. 16%). In 80% of the patients, a physiotherapist was involved during treatment by a primary care dietitian. In 13% of the patients, the consistency of the meals needed to be adjusted. Oral nutritional supplements were prescribed in 49% of the patients at any time during the dietetic treatment, and tube feeding was not prescribed at all. The treatment goals were achieved in 75% of the patients at the end of the dietetic treatment.

DISCUSSION

The present study demonstrates that patients with COVID-19 receiving dietetic treatment in primary care experience a large number of nutrition-related complaints until several months after infection. Nutrition-related complaints improved over time, but remained highly prevalent, both in hospitalised and non-hospitalised patients. At first consultation with the primary care dietitian, the majority of the patients had experienced weight loss, although some had started re-gaining weight. Still, the majority of the patient population (67%) was classified as being overweight or obese and 44% of the patients were at high risk of sarcopaemia.

Two out of three patients were older than 50 years of age and hospitalised patients were significantly older compared to non-hospitalised patients. These findings are in line with previous studies that found that older adults are more susceptible to severe COVID-19 and more likely to be hospitalised. This can be explained by the fact that older adults more frequently present multiple comorbidities and have a weaker immune function.^{28–30} The present study also found that hospitalised patients were more frequently overweight or obese. This finding is in line with previous studies that found that a higher BMI may lead to more severe disease symptoms which may require hospital admission more often.^{12,17,30,31}

The majority of the patients had experienced weight loss when comparing the current weight with regular weight. However, more than a one-third of the patients had experienced weight (re-)gain in the month before the first consultation. It is likely that patients had lost weight during acute infection and (re-)gained weight again in the recovery phase. The prospective part of COVOED study, which monitored patients during hospitalisation and after discharge, also showed (re-)gain of weight after discharge.¹¹

Previous studies have shown a high risk of malnutrition in patients with COVID-19, especially in hospitalised patients.^{16–18} Based on the data collected in the present study we were unable to determine how many patients were malnourished because the required data to assess malnutrition according to the GLIM criteria³² were not systematically recorded. However, weight loss and risk of sarcopaenia (two phenotypic criteria) were frequently observed, as well as nutrition-impacting symptoms (e.g., loss of taste or smell and poor appetite; two aetiologic criteria). Thus, we assume that a fair amount of patients may have met the malnutrition criteria, even in this group of patients that was mostly obese and not hospitalised.

Previous studies have shown that COVID-19 is associated with a high risk of sarcopaenia as a result of skeletal muscle-related symptoms, such as loss of muscle mass and strength.^{11,14,19–21} The present study found that 55% of the hospitalised patients were at high risk of sarcopaenia at first consultation. Patients who were never hospitalised were less likely to have a high risk of sarcopaenia, but still more than one-third were at high risk. The results of the prospective COVOED study showed that, among hospitalised patients only, 73% of the patients had a high risk of sarcopaenia during hospital admission and 56% of the patients still had a high risk of sarcopaenia in the first dietetic consultation after discharge.¹¹ Based on the results of this study and previous studies, treatment by a physiotherapist and dietitian should be considered, especially in patients with a high risk of sarcopaenia.^{33,34} Additional measurements of strength and body composition are necessary to establish the diagnosis of sarcopaenia.³⁴

The results of the present study showed that patients with COVID-19 receiving dietetic treatment in primary care experience a wide range of nutrition-related

complaints during recovery, both in patients admitted to the hospital and in patients never admitted to the hospital. The number of patients reporting one or more nutrition-related complaints decreased more rapidly in non-hospitalised patients compared to hospitalised patients. However, after 4–6 months of follow-up, this number was almost the same with 58% of hospitalised and 54% of non-hospitalised patients still reporting nutrition-related complaints. It should be noted that this may be because patients with multiple complaints were still receiving dietetic treatment after months and were therefore included in the follow-up analyses.

Even after several months many patients still reported nutrition-related complaints such as a changed taste, loss of taste, shortness of breath and decreased appetite. This supports data from other studies showing that many complaints remain for long periods after infection with COVID-19. A study by Blomberg *et al.*⁸ conducted in 247 home-isolated and 65 hospitalised patients, showed that 61% of all patients had persistent symptoms at 6 months of follow-up. Most reported persistent symptoms were fatigue and disturbed smell and/or taste. All nutrition-related complaints presented in the present study are likely to influence the nutritional intake of patients. In general, disease can result in multiple nutrition-related complaints such as loss of appetite which may lead to reduced food intake and/or decreased nutrient absorption.¹²

The findings of the present study should be interpreted in light of the limits of the study design. First, a retrospective study design was used, resulting in missing data. Second, it was not possible to collect the same data at the same time points for each patient. Therefore, data were accumulated per time point to make it possible to show follow-up data on the nutrition-related complaints. It should be noted that each time point involved different patients, which hindered performing longitudinal analysis. Unfortunately, we were not able to accumulate follow-up data on risk of sarcopaenia because of numerous missing data. Additionally, we had to rely on the SARC-F screening tool to obtain an indication of sarcopaenia risk. Future projects need to determine the amount and loss of muscle mass and strength in patients with COVID-19. Another consideration is that we had difficulties interpreting weight changes over time, as referral diagnosis (“patient wants to gain weight” vs. “patient wants to lose weight”) was not recorded. Patient characteristics of included patients are comparable to COVID-19 populations described by others for age, gender and BMI,^{12,17,22} and therefore we assume that the study is representative for the patient population in 2020, which was most likely to have had the Wuhan-variant of the Coronavirus SARS-CoV-2. Different variants may cause different symptoms.

An important strength of the present study is that the data provides insight into the nutritional status, risk of sarcopaenia and nutrition-related complaints of patients

with COVID-19 visiting a primary care dietitian. We included both patients admitted to the hospital and patients never admitted to the hospital. To date, most nutrition studies have focused on hospitalised patients with severe COVID-19 and only a small number of studies was performed in non-hospitalised patients. When comparing the results of the present study with the results of the prospective COVOED study,¹¹ performed in hospitalised patients only, the most striking revelation is that nutrition-related complaints over time are independent of hospitalisation and continue to last over many months after infection. The present study supports results from previous studies and also contains new COVID-19-related information important for dietetic care. Because COVID-19 is a relatively new disease and the long-term consequences are still unclear, many more studies are needed. International dietary management guidelines were established soon after the COVID-19 outbreak, but most of these were written before the true severity and duration of nutrition-related complaints were known. The results of the present study contribute to further improvements of the care offered by primary care dietitians.

CONCLUSIONS

In conclusion, the majority of patients with COVID-19 had experienced unintentional weight loss due to COVID-19, yet more than one third had experienced weight (re-)gain in the month before the first consultation with a primary care dietitian. Additionally, 29% of hospitalised patients and 13% of non-hospitalised patients had experienced more than 5% weight loss in the month before the first consultation. More than one-half of hospitalised and more than one-third of non-hospitalised patients had a high risk of sarcopaenia. Nutrition-related complaints were highly prevalent in patients with COVID-19 visiting a primary care dietitian, both in patients admitted to the hospital and in patients never admitted to the hospital. Of these complaints, decreased appetite, shortness of breath, changed or loss of taste and feeling of being full were most reported. Nutrition-related symptoms improved over time, but remained highly prevalent until several months after infection.

The risk of a poor nutritional status and high risk of sarcopaenia should be considered, especially in combination with persistent nutrition-related complaints as a result of COVID-19. Measurement of strength and body composition is therefore an essential part of the diagnosis and evaluation by a primary care dietitian.

AUTHOR CONTRIBUTIONS

Hinke M. Kruizenga, Nicolette J. Wierdsma and Peter J. M. Weijts designed the research. Anne I. Slotegraaf, Hinke M. Kruizenga and Nicolette J. Wierdsma

conducted the research. Anne I. Slotegraaf analysed data. Hinke M. Kruizenga and Marian A. E. de van der Schueren contributed to the analyses and interpretation of the data. All authors critically reviewed the manuscript and approved the final version of the manuscript submitted for publication.

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CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest.

ETHICAL STATEMENT

The study protocol was reviewed by the medical ethics review board of VU University Medical Center (IRB00002991), who decided that the Medical Research Involving Human Subjects Act (WMO) did not apply for this study. A general informed consent was provided by the patients to use medical data for research purposes.

TRANSPARENCY STATEMENT

The authors affirm that this manuscript is at honest, accurate and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

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PEER REVIEW

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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