Changing characteristics of post-COVID-19 syndrome: Cross-sectional findings from 458 consultations using the Stanford Hall remote rehabilitation assessment tool

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Received 5 September 2022
Accepted 17 December 2022

To cite: Houston A, Tovey C, Rogers-Smith K, *et al*. *BMJ Mil Health* Epub ahead of print: [*please include* Day Month Year]. doi:10.1136/military-2022-002248

ABSTRACT

Background In the UK, there have been multiple waves of COVID-19, with a five-tier alert system created to describe the transmission rate and appropriate restrictions. While acute mortality decreased, there continued to be a significant morbidity, with individuals suffering from persistent, life-restricting symptoms for months to years afterwards. A remote rehabilitation tool was created at the Defence Medical Rehabilitation Centre (DMRC) Stanford Hall to assess post-COVID-19 symptoms and their impact on the UK military.

This study aims to understand changes in post-COVID-19 syndrome between wave 1 and wave 2, identify interactions between alert level and symptoms and investigate any predictive nature of acute symptoms for postacute symptomology in a young, physically active population.

Methods Cross-sectional study of 458 consecutive remote rehabilitation assessments performed at DMRC Stanford Hall between 2 April 2020 and 29 July 2021. Consultations were coded, anonymised, and statistical analysis was performed to determine associations between acute and postacute symptoms, and between symptoms, alert levels and waves.

Results 435 assessments were eligible; 174 in wave 1 and 261 in wave 2. Post-COVID-19 syndrome prevalence reduced from 43% to 2% between the waves. Acutely, widespread pain was more prevalent in wave 2 ($p<0.001$). Postacutely, there was increased anxiety ($p=0.10$) in wave 1 and increased sleep disturbance ($p<0.001$), memory/concentration issues ($p<0.001$) and shortness of breath/cough ($p=0.017$) in wave 2. Increasing alert level was associated with increased postacute symptom prevalence ($p=0.046$), with sleep disturbance increasing at higher alert level ($p=0.016$). Acute symptoms, including fatigue, sleep disturbance and myalgia, were associated with multiple postacute symptoms.

Conclusions This study reports the overall prevalence and symptom burden in the UK military in the first two waves of COVID-19. By reporting differences in COVID-19 in different waves and alert level, this study highlights the importance of careful assessment and contextual understanding of acute and postacute illnesses for individual management plans.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Post-COVID-19 syndrome affects significant numbers of individuals, with 2.2 million people in the UK suffering from life-altering symptoms following acute COVID-19, impacting on life, function and occupation.

WHAT THIS STUDY ADDS

⇒ The study reports differences between wave 1 and wave 2 in military personnel, showing associations between raised COVID-19 alert levels and incidence of symptoms, especially neuropsychiatric.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Given the interwave differences, a thorough clinical assessment, including time and context of acute illness, should be undertaken to ensure individualised patient management.

⇒ The presence of certain acute symptoms may predict the development of postacute symptoms, thereby allowing targeted, proactive clinical interventions.

INTRODUCTION

Despite rigorous and restrictive public health measures, SARS-CoV-2 and resulting clinical entity, COVID-19, continued to spread through the UK. Due to regular viral mutation, at least three distinct waves of the disease were identified between March 2020 and December 2021 in England (figure 1),[1] with a five-tier alert system developed in May 2020, updated in August 2022, to communicate 'the current risk at a UK-wide level' (box 1).[2]

The clinical management of acute COVID-19 has improved, with reduced mortality compared with previous coronavirus epidemics[3]; however, subsequent post-COVID-19 morbidity has a significant and lasting impact on society. Individuals can have life-restricting symptoms following their acute illness, impacting on their activities of daily living (ADLs), quality of life and ability to work, with 2.2 million people in the UK reporting ongoing symptoms.[4–6]

With physical, cognitive and mental health symptoms, it has been named 'post-COVID-19

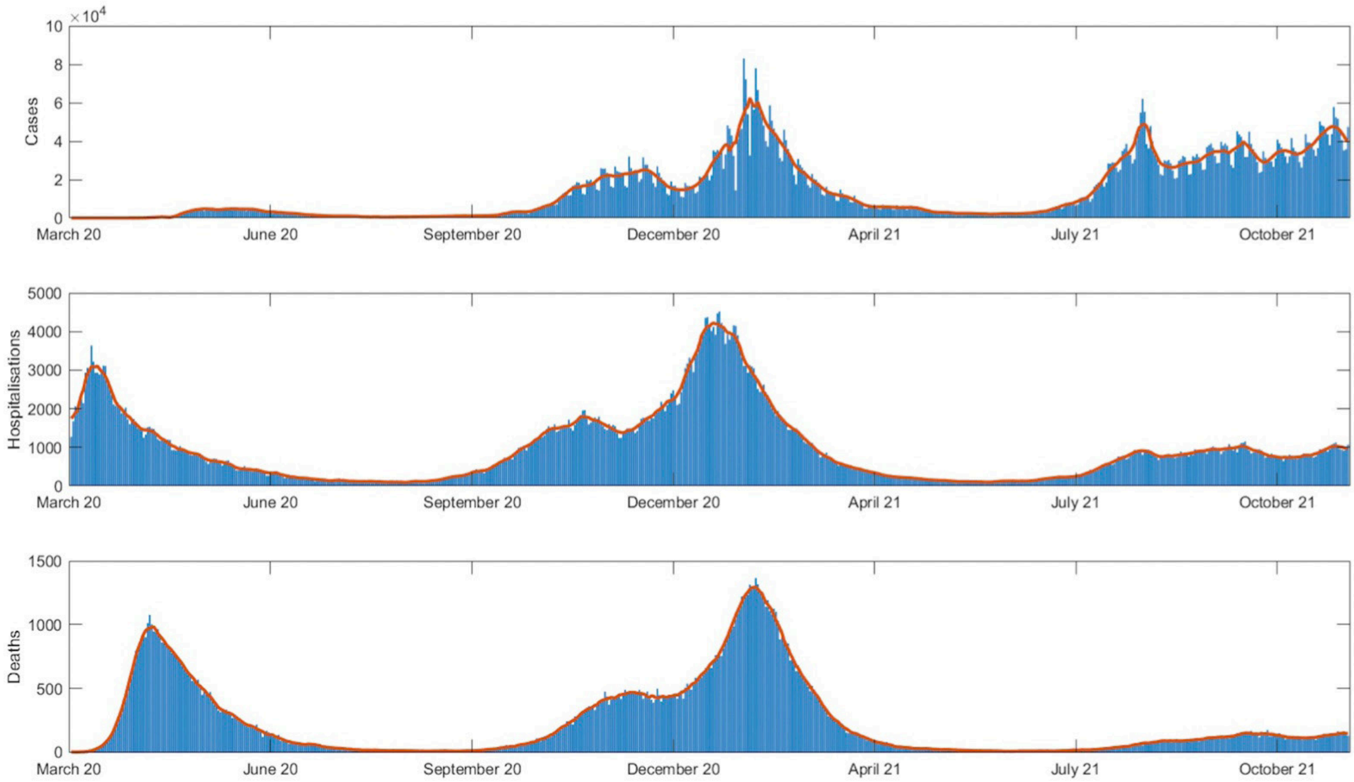

Figure 1 Rolling 7-day average of cases, hospitalisations and deaths in England since 1 March 2020. Adapted from Gov.UK[31]

syndrome' when lasting 12 or more weeks.[6] Up to 203 symptoms or physiological alterations have been reported in working-age individuals in discrete symptom clusters.[5–8] There is also an overlap between individuals suffering from post-COVID-19 syndrome and other conditions, such as postintensive care syndrome.[9] There is no current consensus on the diagnostic criteria or optimal management of post-COVID-19 syndrome, with many studies using differing criteria across heterogeneous study populations. However, there is agreement that multidisciplinary team (MDT) rehabilitation should be a cornerstone of ongoing care after exclusion of potential medical sequelae.[6]

Box 1 COVID-19 alert levels and dates in England, March 2020 to July 2021

Level 5: COVID-19 in general circulation; transmission is high and/or exponentially rising; a material risk of healthcare services being overwhelmed.
Dates: 4 January 2021 to 24 February 2021.
Level 4: COVID-19 in general circulation; transmission is high and/or exponentially rising.
Dates: 26 March 2020 to 18 June 2020; 21 September 2020 to 3 January 2021; 25 February 2021 to 9 May 2021.
Level 3: COVID-19 is in general circulation.
Dates: 19 June 2020 to 20 September 2020; 10 May 2021 to 12 December 2021.
Level 2: COVID-19 is present in the UK; number of cases and transmission is low.
Dates: Before 25 March 2020.
Level 1: COVID-19 is not known to be present in the UK.
Dates: N/A.

Key to understanding and managing post-COVID-19 syndrome is the identification of symptoms and recognition of their impact. In April 2020, an MDT working group at the Defence Medical Rehabilitation Centre (DMRC) Stanford Hall developed a remote rehabilitation assessment tool, the first such tool in clinical use in the UK.[10 11] It was modelled on the likely sequelae, assessing the functional impact of acute and postacute symptoms.[3] Similar to other rehabilitation assessment tools now widely used in the UK, it offers timely, accessible and effective assessments and facilitated appropriate therapeutic interventions.[12 13]

Using 15 months of experience from a tertiary rehabilitation centre, the aim of this study is to articulate the symptom burden of post-COVID-19 syndrome, characterise differences between the UK's first and second waves of COVID-19, and COVID-19 alert level as a proxy measure of societal factors, and identify any predictive factors of post-COVID-19 syndrome.

METHOD

Study design

Cross-sectional observational study of consecutive patients referred to DMRC Stanford Hall from the UK Defence Primary Healthcare (DPHC). Referrals were made from UK Armed Forces general practitioners who provided initial management. Patients requiring rehabilitation input were referred following an acute illness characterised by fever, persistent cough or anosmia with ongoing impairment or limitation on ADLs or occupation lasting beyond 4 weeks in accordance with the Defence medical policy. The presence or absence of symptoms and their impact were assessed by a physician working through the assessment proforma with the patient.[11]

As this is a service evaluation of existing clinical practice, in line with Ministry of Defence policy, approval was sought from the local audit lead and Caldicott Guardian at DMRC Stanford Hall, with ethical approval not required.

Eligibility criteria

Four hundred and fifty-eight consecutive patients were assessed using a video teleconsultation (VTC, Attend Anywhere, Australia) between 2 April 2020 and 29 July 2021 and were considered for inclusion. VTCs were performed by a consultant physician following patient referral from DPHC with life-impacting post-COVID-19 symptoms. Further detail on the referral pathway can be found here.[11] All rehabilitation VTC consultations on the Defence Medical Information Capability Programme (DMICP) electronic health record during the study period were coded, with anonymised data extracted and analysed. Patients were excluded if key data were unavailable.

Patient dichotomisation

Acute phase symptoms were dichotomised using date of the positive test, and postacute symptoms using the VTC date. Dichotomisation was also performed according to COVID-19 wave and UK alert level at the date of the patient's positive test result. Based on national case numbers, wave 1 was considered to have occurred from the commencement of the pandemic, up to, and including the 19 July 2020, when 'wild-type' was the dominant variant. Dates after that were considered part of wave 2 (up to 29 July 2021), at which time 'Alpha' was the dominant variant.

Outcome measures

This study aims to investigate the associations between acute and postacute symptoms, waves and symptoms, and alert levels and symptoms.

Primary outcomes are all the symptoms listed in the proforma, both acute phase and postacute phase.[11] All acute symptoms were selected for analysis given the multisystem nature of post-COVID-19 syndrome. Secondary outcomes were the time to consultation, and timing of acute illness and VTC assessment, and therefore the wave and alert level.

Statistical analysis

X^2 tests were applied to identify associations between all acute and postacute symptoms, plus symptom prevalence and wave or alert level. For continuous variables, normality was assessed using a Shapiro-Wilk test and inspection of the frequency histogram distributions and Q-Q plots. For normally distributed data, independent t-tests were applied where wave was the independent variable and one-way analyses of variance (ANOVAs) were applied where the independent variable was alert level. Where results were not normally distributed, Mann-Whitney U tests were applied to tests where wave was the independent variable and Kruskal-Wallis one-way ANOVAs were applied where the independent variable was alert level. Post hoc analyses were carried out using Dunn's tests, and Bonferroni corrections were applied to adjust the significance value, accounting for multiple comparisons. An alpha threshold of 0.05 was used to indicate significance. All statistical analyses were performed using SPSS V.27 (IBM).

RESULTS

Four hundred and thirty-five assessments met the eligibility criteria (table 1). Twenty-three were excluded due to incomplete proforma (n=19), missing positive test date (n=3) and DMICP alert declining consent to access records (n=1).

Table 1 Differences in referral speeds between waves and alert levels

Group	Referral speed (weeks) Median (IQR)	Statistic	P value
Wave 1	18 (10–29)	Z=−4.026	<0.001*
Wave 2	14 (10–18)		
Alert level 2	22 (13–33)*†‡§	H=36.996	<0.001*
Alert level 3	12 (9–18)*¶		
Alert level 4	15 (10–20)*¶		
Alert level 5	14 (11–17)*¶		

*P<0.01.
†Significantly different from alert level 3.
‡Significantly different from alert level 4.
§Significantly different from alert level 5.
¶Significantly different from alert level 2.

There were 174 patients in wave 1 and 261 in wave 2 when dichotomised according to their date of positive test, divided into 82 in wave 1 and 353 in wave 2 according to date of VTC. UK alert level 2/3/4/5 groups were n=96, 32, 233 and 74, respectively, when dichotomised by date of positive test, and n=0, 147, 222 and 66, respectively, by date of VTC.

During the study period, the overall rates of COVID-19 positivity in the Armed Forces increased, and relative numbers of post-COVID-19 syndrome decreased. There were 406 positive cases in wave 1 (testing restrictions applied), 174 of whom were referred for rehabilitation assessment (43%), and an additional 11 484 positive cases in wave 2, with 261 referred for rehabilitation assessment (2%).[14 15]

Time to referral

Patients in wave 1 were reviewed 4 weeks later than those in the second wave (p<0.001, table 1). Significant differences were also observed according to the alert level, with those who contracted COVID-19 in alert levels 3, 4 and 5 assessed significantly sooner after their positive test (between 7 and 10 weeks earlier, p<0.001) compared with individuals in alert level 2 (table 1).

Associations between acute and postacute symptoms

Significant associations were observed between acute and postacute symptoms (table 2). Fever, a cough and a sore throat during the acute stage of illness were not significantly associated with any postacute symptom (p>0.05).

Fatigue

Patients reporting acute fatigue showed a greater prevalence of postacute anxiety (38% vs 23%), fatigue (73% vs 60%), headaches (25% vs 10%) and sleep disturbance (37% vs 25%), compared with those who did not.

Shortness of breath

Patients reporting acute shortness of breath (SoB) showed a greater prevalence of postacute anxiety (36% vs 25%), but lower prevalence of memory and/or concentration issues (38% vs 49%), compared with those who did not.

Table 2 Associations between acute and postacute symptoms

	Postacute symptoms								
	ADL limitations	Anxiety	Low mood	Fatigue	Headache	Pain	SoB and/or cough	Memory and/or concentration issues	Sleep issues
Acute symptoms									
Fever	0.119 (0.73)	0.058 (0.81)	0.109 (0.741)	0.116 (0.733)	1.924 (0.165)	0.013 (0.908)	0.487 (0.485)	0.131 (0.717)	0.186 (0.667)
Cough	0.274 (0.6)	1.478 (0.224)	0.915 (0.339)	0.365 (0.546)	0.047 (0.827)	0.119 (0.731)	0.344 (0.557)	0.114 (0.736)	0.133 (0.715)
Sore throat	1.634 (0.201)	2.634 (0.105)	1.336 (0.248)	1.873 (0.171)	0.036 (0.849)	0.142 (0.706)	2.865 (0.091)	0.002 (0.964)	3.032 (0.082)
Runny nose	0.364 (0.546)	0.168 (0.682)	2.264 (0.132)	2.844 (0.092)	0.428 (0.513)	1.296 (0.255)	0.634 (0.426)	1.169 (0.28)	0.004 (0.947)
Loss of smell/taste	1.706 (0.191)	1.833 (0.176)	3.015 (0.083)	0.093 (0.761)	0.813 (0.367)	0.066 (0.797)	0.616 (0.432)	0.359 (0.549)	4.964 (0.026)*
Myalgia	0.236 (0.627)	7.537 (0.006)*	2.317 (0.128)	3.648 (0.056)	0 (0.989)	2.885 (0.089)	3.639 (0.056)	3.988 (0.046)*	4.274 (0.039)*
Arthralgia	2.553 (0.11)	8.828 (0.003)**	0.87 (0.351)	3.354 (0.067)	3.513 (0.061)	3.469 (0.063)	1.18 (0.277)	0.952 (0.329)	0.885 (0.347)
Fatigue	0.854 (0.355)	9.544 (0.002)**	0.148 (0.701)	7.835 (0.005)*	12.721 (<0.001)**	3.304 (0.069)	2.401 (0.121)	2.426 (0.119)	6.617 (0.010)*
SoB	4.044 (0.044)	5.224 (0.022)*	0.609 (0.435)	0.092 (0.761)	1.699 (0.192)	0.024 (0.877)	2.371 (0.124)	4.266 (0.039)*	0.127 (0.721)
Widespread pain	2.424 (0.119)	0.418 (0.518)	0.035 (0.852)	0.006 (0.94)	6.147 (0.013)	0.903 (0.342)	0.637 (0.425)	6.059 (0.014)*	11.962 (0.001)**
Local pain	0.346 (0.556)	3.663 (0.056)	1.633 (0.201)	0.656 (0.418)	1.852 (0.174)	6.108 (0.013)*	0.79 (0.374)	1.769 (0.184)	0.418 (0.518)
Headache	1.867 (0.172)	0.822 (0.365)	1.235 (0.266)	0.02 (0.887)	2.746 (0.097)	1.292 (0.256)	4.102 (0.043)*	2.117 (0.146)	0.131 (0.718)
Hospitalisation	13.032 (<0.001)**	1.777 (0.183)	8.565 (0.003)**	0.568 (0.451)	0.395 (0.529)	0.786 (0.375)	2.519 (0.112)	5.759 (0.016)*	0.432 (0.511)

X^2 test showing significant difference: *p<0.05; **p<0.005.
ADL, activities of daily living; SoB, shortness of breath.

Myalgia

Patients who reported acute myalgia showed greater prevalence of postacute anxiety (38% vs 25%), memory and/or concentration issues (45% vs 36%) and sleep disturbance (37% vs 27%), compared with those who did not.

Headache

Patients reporting acute headaches showed a reduced prevalence of postacute SoB and/or a cough postacutely (56% vs 69%) than those who did not.

Pain

Patients reporting acute widespread pain showed a greater prevalence of postacute memory and/or concentration issues (50% vs 38%) and sleep disturbance (44% vs 27%), compared with those who did not. Patients reporting acute localised pain showed a greater prevalence of postacute pain than those who did not (44% vs 28%).

Hospitalisation

Hospitalisation, as a marker of acute COVID-19 severity, significantly increased the likelihood of postacute ADL limitations (21% vs 8%), but reduced the likelihood of low mood (27% vs 34%) and memory and/or concentration issues (32% vs 45%), compared with community-managed patients.

Associations between waves and symptoms

Patients in wave 1 and wave 2 reported 4.98±2.99 and 5.24±2.21 acute symptoms, respectively (p=0.299). Postacutely, patients in the second wave reported significantly more symptoms than patients in wave 1 (3.52±2.25 vs 2.87±1.66, p=0.013).

Acute symptoms

Widespread pain was the only acute symptom significantly more prevalent in wave 2 compared with wave 1 (14% vs 44%, p<0.001).

Postacute symptoms

Patients in the first wave demonstrated a greater prevalence of ADL limitations (20% vs 9%, p=0.012) and anxiety (44% vs 30%, p=0.10), compared with those in the second wave. During the second wave, individuals were more likely to experience SoB and/or a cough (55% vs 71%, p=0.017), memory and/or concentration issues (17% vs 47%, p<0.001) and sleep disturbance (11% vs 38%, p<0.001) than the first wave (table 3).

Associations between alert levels and symptoms

Acute symptoms

Acutely, widespread pain and a runny nose were the only symptoms significantly more prevalent in the higher alert levels (p<0.001 and p=0.009, respectively).

Postacute symptoms

A significant effect of alert level on symptoms reporting was found postacutely (p=0.046).

Post hoc analysis revealed symptom prevalence was significantly greater in alert level 5 compared with alert level 3 (4.0±2.28 vs 3.24±2.09, p=0.028), but not significantly different from alert level 4 (4.0±2.28 vs 3.33±2.17, p=1.00) (table 4). No significant difference was found between alert levels 3 and 4 (p=0.058). Increasing alert levels were also seen

Table 3 Associations between waves and symptoms

Symptom	Overall (%)	Wave 1 (%)	Wave 2 (%)	X^2	P value
Acute stage					
Fever	76	76	78	0.146	0.703
SoB	71	72	70	0.256	0.613
Fatigue	66	69	65	0.884	0.347
Cough	65	67	64	0.22	0.639
Myalgia	57	57	57	0.013	0.91
Loss of smell/taste	38	33	41	2.45	0.117
Arthralgia	35	31	35	1.05	0.305
Widespread pain	32	14	44	43.4	<0.001**
Sore throat	31	29	30	0.06	0.806
Runny nose	15	10	15	1.86	0.173
Headache	14	16	14	0.341	0.559
Local pain	12	11	13	0.311	0.577
Hospitalisation	25	24	25	0.022	0.882
Postacute stage					
Fatigue	68	68	68	0.088	0.766
SoB and/or cough	68	55	71	5.69	0.017*
Memory and/or concentration issues	42	17	47	23.3	<0.001**
Low mood	37	37	37	0.002	0.966
Sleep issues	33	11	38	19.2	<0.001**
Anxiety	32	44	30	6.69	0.010*
Pain	30	22	31	2.01	0.157
Headache	20	13	21	2.32	0.128
ADL limitations	11	20	9	6.26	0.012*

Significant difference: *p<0.05; **p<0.005.
ADL, activities of daily living; SoB, shortness of breath.

to be associated with increased levels of postacute sleep disturbance (p=0.016).

Assessment outcomes

Following their assessment, a similar proportion of patients in wave 1 and wave 2 were offered an open appointment (2% vs 3%), a telephone follow-up (16% vs 14%), discharged from rehabilitation services (18% vs 17%) and invited for inpatient rehabilitation at DMRC Stanford Hall (65% vs 60%). Far fewer were offered remote rehabilitation (22% vs 8%), with an increase in referrals back to primary care (4% vs 8%) and to the Defence COVID-19 Recovery Service (DCRS) (7% vs 37%).

DISCUSSION

This study reports the changing impact of post-COVID-19 syndrome in a physically active population, describing a significant reduction in prevalence, as well as interwave symptom changes, potential impact of societal factors and some indications of the predictive nature of acute pathology. The symptoms described in this study are in line with other working-age and active population and cohort studies.[5 16–18]

Post-COVID-19 syndrome prevalence

Despite the increase in referrals and symptom burden in this population between wave 1 and wave 2, there was a substantial decrease in prevalence of post-COVID-19 syndrome (43% vs 2%), although the prevalence is likely to be artificially high in the first wave due to widespread testing restrictions. This study cannot fully determine the reasons behind this; however, potential explanations include better awareness of the condition[6] and self-management resources,[19] and the changing nature of COVID-19 variants.[20 21]

Table 4 Associations between alert levels and symptoms

Symptom	Overall (%)	Level 2 (%)	Level 3 (%)	Level 4 (%)	Level 5 (%)	X^2	P value
Acute stage							
Fever	76	76	78	76	81	0.824	0.844
SoB	71	75	63	70	74	2.32	0.509
Fatigue	66	65	72	68	62	1.52	0.678
Cough	65	71	53	66	63	3.57	0.312
Myalgia	57	54	66	59	51	2.94	0.4
Loss of smell/taste	38	33	44	39	36	1.73	0.631
Arthralgia	35	34	26	33	38	1.71	0.634
Widespread pain	32	17	19	33	55	30.5	<0.001**
Sore throat	31	33	26	27	33	1.74	0.628
Runny nose	15	8	6	12	25	11.6	0.009*
Headache	14	14	13	16	10	2.27	0.519
Local pain	12	11	6	12	14	1.27	0.735
Hospitalisation	25	22	19	24	34	4.39	0.222
Postacute stage							
Fatigue	68	0	41	35	33	1.581	0.454
SoB and/or cough	68	0	25	28	45	0.364	0.834
Memory and/or concentration issues	42	0	71	62	82	1.091	0.58
Low mood	37	0	37	30	30	0.569	0.752
Sleep issues	33	0	35	43	54	8.235	0.016*
Anxiety	32	0	7	13	13	1.818	0.403
Pain	30	0	18	21	21	3.697	0.157
Headache	20	0	68	69	67	1.061	0.588
ADL limitations	11	0	78	75	76	0.398	0.82

Significant difference: *p<0.05; **p<0.005.
ADL, activities of daily living; SoB, shortness of breath.

Vaccinations have been seen to reduce post-COVID-19 syndrome.[22] Excluding those who required it for operational purpose, the majority of Armed Forces personnel received their vaccination during phase II of the national vaccination programme, from April 2021 onwards.[23] All individuals in this study contracted COVID-19 prior to this date; therefore, there is likely to have been minimal vaccination effect in this study.

Associations between acute illness and postacute symptoms

For the first time in a UK military population, this study has identified associations between postacute symptoms and acute illness. Previous work has suggested that the acute severity or symptom burden was predictive of post-COVID sequelae.[24] This was not our prior experience,[11] nor in other populations[13]; however, this study does reveal that acute hospitalisation was predictive of developing multiple postacute symptoms including ADL limitations ($p<0.001$), low mood ($p=0.003$) and memory/concentration issues ($p=0.016$).

When comparing the acute and postacute management between waves, there was far greater community management during wave 2, demonstrated by reduced hospitalised admissions (24% vs 52%) and increased referrals back to primary care (8% vs 4%). This is likely the result of improved clinical experience, skills and knowledge, combined with reducing variant severity, enabling primary care to have greater confidence managing patients infected with SARS-CoV-2 in the acute/postacute phase of illness.[25 26] The increase in time to VTC assessment in wave 1 is likely reflective of the time required to establish the clinical service.

As seen in other work, understanding the relationship between acute and prolonged illness can aid diagnosis and management.[24] In this study, specific acute symptoms were seen to be associated with multiple postacute symptoms. These included acute fatigue with postacute headache ($p<0.001$), anxiety ($p=0.002$), fatigue ($p=0.005$) and sleep disturbance ($p=0.010$); and acute myalgia with postacute anxiety ($p=0.006$), sleep disturbance ($p=0.039$) and memory/concentration issues ($p=0.046$). Associations were also observed between acute widespread pain with postacute sleep disturbance ($p=0.001$) and memory/concentration issues ($p=0.014$); acute SoB with postacute anxiety ($p=0.022$) and memory/concentration ($p=0.039$); acute arthralgia with postacute anxiety ($p=0.003$); acute localised pain with postacute generalised pain ($p=0.013$); and acute headache with postacute SoB/cough ($p=0.043$). The predictive nature of the three cardinal acute symptoms of COVID-19 (fever, cough, loss of taste/smell)[6] is minimal in this study, with only acute loss of taste/smell showing statistical significance for individuals developing postacute sleep disturbance ($p=0.026$). Although the prognostic value of markers of acute illness was not investigated experimentally, these findings provide a promising direction for future work, allowing proactive clinical management of specific symptoms/clusters, similar to those used by other study groups.[13]

Associations between waves and symptoms

The predominant acute symptoms remained the same between the waves (fever, cough, fatigue, SoB and myalgia), with only widespread pain demonstrating a significant difference between them (increased in wave 2, $p<0.001$).

There were some postacute variance between wave 1 and wave 2, with increased anxiety ($p=0.010$) and ADL limitation ($p=0.012$) in wave 1, and sleep disturbance ($p<0.001$), memory/concentration issues ($p<0.001$) and SoB/cough ($p=0.017$) in wave 2.

While this study is unable to fully confirm the relationships between variant and postacute symptomology, it is likely that the change in the dominant SARS-CoV-2 variant between waves, wild type to Alpha, with subsequent change in clinical presentation, may have contributed to these differences.[20 21]

Association between alert levels and symptoms

Acutely, there was a linear correlation with increasing widespread pain ($p<0.001$) and runny nose ($p=0.009$), the clinical significance of which is uncertain. However, postacutely, alert levels had a significant effect on symptoms ($p=0.046$), with increased symptom prevalence at alert level 5 ($p=0.028$) and increased levels of postacute sleep disturbance at higher alert levels ($p=0.016$) (table 4). There were also non-statistically significant increased anxiety and cognitive symptoms (memory and concentration disturbance) at higher alert levels.

Other studies in both military[7] and civilian[13] populations report worsening mental health individuals following COVID-19 compared with pre-COVID-19 rates, but for the first time, these findings suggest that increases in mental health symptoms, cognitive symptoms and sleep disturbance could be linked to external environmental factors, with restrictive public health measures such as lockdowns, and corresponding media reporting, potentially increasing the individual ‘perceived threat’ and worsening post-COVID-19 symptomology.

Assessment outcomes

Similar proportions of individuals were invited for residential post-COVID-19 rehabilitation, offered telephone follow-up or an open appointment and discharged across each wave. In wave 2, fewer patients were offered remote rehabilitation, with a greater proportion re-referred to primary care and to the bespoke DCRS, reflecting the move back to face-to-face clinical services. Overall, 61% of individuals were offered rehabilitation, which is lower than the 80% of individuals from a study in the Netherlands over a similar period (March 2020 to June 2021); however, their study population was post-hospital discharge with a median age of 60.[27]

The increase in DCRS referrals is understandable as, although this cross-cadre collaborative clinical and occupational assessment service to ensure safe return to duty was established with the Defence and NHS partners in a matter of months,[28] it became fully active and ready for referrals by the second wave. This was not the entirety of DCRS referrals, as the majority were direct referrals.

Strength and limitations

Having a unified assessment, referral and electronic health record across the Defence, with a known denominator, gives a clear representation of the prevalence and impact of post-COVID-19 syndrome in this population. Selection bias remains, given the admission health standards of the Armed Forces, with pre-existing cardiorespiratory fitness likely to be protective for individuals,[29] and therefore not all findings can be fully generalised. Also, given the active nature of military occupation, relatively minor limitations might be more limiting for an individual than for those in sedentary employment.

A particular strength of this study is the sample size (n=435), and ability to compare the second wave directly to the first wave using the same target population, assessment tool, clinical team and methodological approach, with the limitation of no genomic testing to correlate changes to variants. For the first time in this population, this study has been able to offer some limited predictive value in the development of post-COVID-19 symptomology. The value of these predictions will be explored further during the longitudinal M-COVID cohort study (1061/MODREC/20).[30]

Finally, this review used the same coding methodology as the first, with a symptom assumed to not be present if the relevant tick box was incomplete. This approach may result in an underestimate of the prevalence of that symptom. When multiple data points (>25%) or dates of acute illness/VTC were missing, the assessment was withdrawn from the analysis (n=22), with one assessment withdrawn due to lack of consent for electronic medical records to be used for research purposes (as recorded on DMICP). A substantial limitation is that no demographic data were recorded during the data collection; however, other studies performed in UK military personnel with post-COVID-19 limitations have, and can give an indication of the studied demographic.[7 11]

CONCLUSIONS

This study reports the symptom burden in over 400 young, working, active individuals, describing an overall reduction in the prevalence of post-COVID-19 syndrome within the UK Armed Forces, while demonstrating increased management in primary care during acute and postacute phases of COVID-19.

Differences in the acute and postacute symptoms between waves of infection were reported, with the effect of society on the symptomology of post-COVID-19 syndrome, highlighting the importance of individually tailored rehabilitation care for patients based on a careful assessment and contextual understanding of their acute and postacute illnesses.

Contributors OOS and RBD conceived the study idea. OOS and AH refined the study design and analysis plan. SB, MC, MG, JN, RP, PT and AH performed the VTC consultations. CT, KRS and KT performed the data collection. AH performed the analysis, including all statistical tests. OOS, AH and PL drafted the manuscript with help from RBD. All authors agreed to the final version, with OOS acting as the guarantor for this study.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient consent for publication Not applicable.

Ethics approval No formal ethical approval was required as a service evaluation of existing clinical practice in line with MoD policy. Approval was gained from the local audit lead and Caldicott Guardian.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement All data relevant to the study are included in the article. All data used in the analysis of this study are included in the manuscript. The data sets relate to serving members of the UK Ministry of Defence and therefore are sensitive. Reasonable data requests should be directed to the corresponding author and permissions can be sought if appropriate.

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