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Geriatric rehabilitation for patients with advanced chronic obstructive pulmonary disease: A naturalistic prospective cohort study on feasibility and course of health status

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Abstract

In view of the worldwide aging population, disease-specific geriatric rehabilitation (GR) programs are needed. Therefore, we developed and implemented a postacute GR program for patients with advanced chronic obstructive pulmonary disease (COPD) (the GR-COPD program). The aim of this study is to investigate the feasibility of the GR-COPD program and to present clinical data on patient characteristics and course of functional capacity and health status. This is a naturalistic prospective cohort study of patients with advanced COPD. A total of 61 patients entered the GR-COPD program and were eligible to participate in this study. All patients suffered from advanced COPD, and comorbidities were frequent. On admission, functional capacity and health status were severely limited but showed significant and clinically relevant improvement during the GR-COPD program. Patients with advanced COPD admitted to hospital for an acute exacerbation suffer from severely impaired functional capacity and poor health status. Development and implementation of a postacute GR program for these patients are feasible and likely to offer substantial improvements. Further research is essential and should focus on designing a controlled intervention trial to investigate the efficacy of the program.

Keywords

Geriatric rehabilitation, advanced COPD, skilled nursing facility, palliative care, pulmonary rehabilitation

Introduction

Geriatric rehabilitation (GR) has emerged as a promising field of interest, showing that it has the potential to improve outcome measurements related to morbidity and mortality in elderly people.[1] GR is usually organized as a form of integrated care and does not differ from rehabilitation medicine in its multidisciplinary, patient-centred approach. However, geriatric patients differ in many ways from younger patients who need rehabilitation. Besides having multimorbidity, their disabilities are usually multicausal. Pre-existent functional limitations are caused not only by comorbidity conditions but also by physiological conditions, such as sarcopenia.[2] Furthermore, patients admitted for GR often suffer from concurrent diseases and complications interfering with the rehabilitation treatment. In this sense, GR operates at the crossroads of geriatric medicine and rehabilitation medicine.[2] Considering the worldwide aging population, there

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is a growing need for programs designed for geriatric patients. However, the development, implementation and evaluation of disease-specific GR programs (other than orthopaedic and general) are lacking.[1]

One field in which development of disease-specific GR programs can be meaningful is progressive organ failure, such as chronic obstructive pulmonary disease (COPD). Prevalence of COPD is rising worldwide and disease severity is strongly related to age.[3] Patients with advanced COPD suffer from a high symptom burden, deteriorating functional capacity and declining quality of life; moreover, their prognosis is poor, especially after hospital admission for an acute exacerbation.[4–6]

Pulmonary rehabilitation (PR) emerged as a recommended standard of care for patients with symptomatic COPD[7] and is effective in advanced and both stable and postacute COPD in reducing the risk of readmission and mortality and improving health-related quality of life (HRQoL) and exercise capacity.[7,8] Poor health status and prognosis in patients with advanced COPD also call for implementation of palliative care methods. Palliative care should start early in the disease trajectory (when patients become symptomatic) and should be combined with active treatment and life-prolonging care.[9]

In clinical practice, however, availability of PR programs is limited and patients with advanced COPD are often excluded from these programs because of their limited training capacity and frequent concurrent diseases and complications due to comorbidity, all interfering with the rehabilitation program. Furthermore, although the palliative care needs of patients advanced COPD are increasingly being recognized, palliative care is still scarcely received by patients with advanced COPD.[10] A disease-specific GR program that is more adjusted to the needs and possibilities of this group of patients could be an interesting option. Besides offering an adjusted, low-intensity program, GR in the Netherlands is coordinated by an elderly care physician who is specialized in rehabilitation of frail, often elderly, patients with complex disabilities and multimorbidity.[11] The importance of medical practitioners as an essential part of GR and their findings about causes, comorbidity and prognosis being incorporated into the rehabilitation plan, was recently stated.[12] Furthermore, integration of rehabilitation medicine and palliative care is common practice in GR, and patients with advanced COPD might benefit from this integrated approach.[13]

Considering these facts, our group developed and implemented a postacute GR program for patients with advanced COPD (the GR-COPD program).[14] Aim of the present study is to investigate feasibility of the program and to present clinical data on patient characteristics and courses of functional capacity and health status.

Methods

Design

This is a naturalistic prospective cohort study of patients with advanced COPD admitted to a postacute GR program in a skilled nursing facility (SNF). Baseline data (T0) were collected within 3 days after admission to the SNF. Patient and disease characteristics, functional capacity, nutritional status, psychosocial functioning and health status were registered. At discharge from the SNF (T1), functional capacity, nutritional status and health status were measured again. Data were collected from May 2009 until January 2011.

Setting and study population

Patients with severe (Global Initiative for Chronic Obstructive Lung Disease (GOLD)[15] stage 3) to very severe (GOLD stage 4) COPD admitted to the hospital for an acute exacerbation were selected for the GR-COPD program by a pulmonologist. Indication for the GR-COPD program was considered appropriate when patients suffered from high symptom burden and/or a substantial decline in functional capacity without sufficient recovery during hospital stay. Furthermore, a multidisciplinary approach was required to achieve improvement in functional capacity and health status instead of physical therapy alone and patients had to be motivated. Patients who lacked motivation, or patients with prominent psychiatric or cognitive dysfunction interfering with rehabilitation, were excluded from the program. All patients admitted to the GR-COPD program were eligible to participate in this study. Data were collected from the patient's file by the patient's physician and transferred to an anonymous data file using Statistical Package for the Social Sciences (SPSS) software (SPSS 20; SPSS, Chicago, Illinois, USA).

The GR-COPD program

In the Netherlands, GR is organized as a form of integrated and transmural care and is provided at SNFs,

usually situated in nursing homes.[16] SNFs offer post-acute restorative treatment with a multidisciplinary patient-centred approach in a therapeutic living environment.[16] During the study period, GR was funded by the government's Exceptional Medical Expenses Act (AWBZ), which offers a weekly average of 18–22 h of nursing care and 4 h of individual therapy. The SNF at which the current study was conducted has a multidisciplinary team that offers pulmonary, orthopaedic, neurological and general GR. This SNF is situated at a separate ward of the nursing home and has a capacity of 60 beds with a mean length of admission (LOA) of 39 days. On average, 350 patients are admitted for GR each year. The GR-COPD program was developed in 2009 by the multidisciplinary team of the SNF in close collaboration with the pulmonologist and physiotherapist from the pulmonary department of the local hospital. Development of the program was based on national and international guidelines on PR and palliative care.[9,17] The multidisciplinary team of the SNF consists of an elderly care physician,[11] a skilled nurse, a physiotherapist, a psychologist, an occupational therapist, a speech and language pathologist, a dietician and a social worker. During development and implementation, each member of the team received specific training on PR techniques within their own field of interest. A detailed description of the program has recently been published.[14] The GR-COPD program contains several modules concerning different aspects of rehabilitation and palliative care: optimizing pulmonary medication use and inhalation techniques, support smoking cessation, adequate symptom control, physiotherapy (endurance and strength training, inspiratory muscle training, relaxation techniques, breathing regulation skills and mucus evacuation techniques), occupational therapy, analysis of nutritional status and dietary supplementation, analysis of speech, breathing and swallowing techniques, psychosocial intervention (mostly aimed at depression, anxiety or adverse coping strategies), education focusing on self-management strategies, peer support contact and advance care planning. Goal setting is tailored to the individual patient and the program is weekly evaluated and adjusted (as needed) by the multidisciplinary team and the pulmonologist who makes monthly visits to all patients. All patients follow a standardized 6-week program and assignment to therapies is stringent. The program contains a minimum of six 40-min physiotherapy sessions per week, usually three endurance and three strength training sessions. Group sessions are combined with individual training. Furthermore, training of breathing, huffing and relaxation techniques are offered once a week. Occupational therapy is given once or twice a week in 30- to 45-min sessions and analysis and evaluation of nutritional status is done by the dietician every week. Patients participate in weekly group sessions, which are supervised by the psychologist, and are aimed at education of patients and relatives on self-management strategies and peer support contact.

Measurements and instruments

The following patient and disease characteristics were registered: age, sex, marital status, disease severity (GOLD stage, forced expiratory volume in 1 s as percentage of predicted (FEV_1%pred)), long-term oxygen therapy (LTOT) (yes/no), smoking status (smoker/nonsmoker), LOA during hospital stay and LOA during rehabilitation. Comorbidity was assessed using the modified Cumulative Illness Rating Scale (CIRS)[18]. The CIRS consists of 13 items (organ or disease systems) with a severity scale ranging from 0 to 4 for each item. Total score is the sum of all items (range 0–56), with scores >10 indicating severe impairment.

Nutritional status was measured by the body mass index (BMI) and the fat-free mass index (FFMI). The BMI was calculated as weight/height^2 (in kilogram per square metre) and was categorized in two groups: underweight (<21 kg/m^2) and not underweight ($\geq$21 kg/m^2).[19] The FFMI was measured during hospital stay using bioelectrical impedance analysis. Depletion was considered when the FFMI was $\leq$16 kg/m^2 in men and $\leq$15 kg/m^2 in women.[19]

Functional capacity

The modified 20-point Barthel index (BI) measures activities of daily living and is a valid, reliable and widely used instrument to assess improvement during rehabilitation programs.[20] The total score ranges from 0 to 20, with 20 representing complete functional independence. The minimal clinically important difference (MCID) for the BI is not well established for COPD patients. In stroke patients, the MCID of the BI is +1.85.[21]

The 6-min walk test (6MWT) is a practical, easy to perform and widely used instrument to measure exercise capacity in COPD patients. The MCID for the 6MWT in patients with severe COPD is +26 ($\pm$2) m.[22]

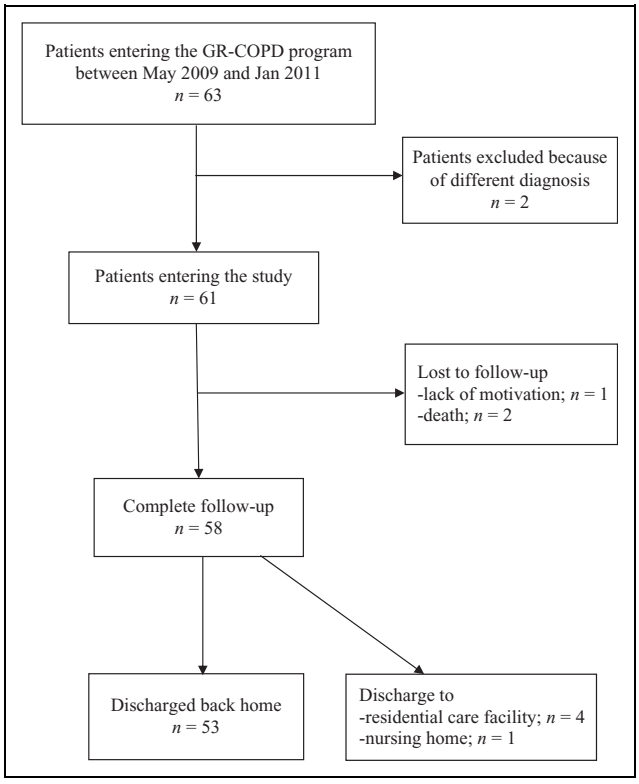

Figure 1. Flow chart of patients.

Peripheral muscle strength was measured as handgrip force (HF) using a hand dynamometer. Total scores (right hand + left hand) are given in kilogram force, and normative data are age and sex dependent.[23]

Psychosocial functioning

The Hospital Anxiety and Depression Scale (HADS) is a valid and reliable screening instrument for symptoms of anxiety and depression. It has two 7-item subscales, one for anxiety and the other for depression. A score of 8 points or higher on either subscale indicates a higher risk for the presence of a clinically relevant anxiety disorder or depression.[24]

Health status

Health status was measured using the Clinical COPD Questionnaire (CCQ).[25] The CCQ is a validated and reliable 10-item, self-administered questionnaire. Items are scored on a Likert scale ranging from 0 to 6. The final score is the sum of all items divided by 10; higher scores indicate a worse health status. The CCQ consists of the subdomain symptom, functional state and mental state, and scores for these three domains can be calculated separately. The MCID of the CCQ total score is -0.4.[26]

Statistical analysis

All data were processed using the SPSS (SPSS 20.0; SPSS). Descriptive analyses were used for general baseline patient characteristics, disease characteristics and data from measurements on admission. Categorical variables are described as frequencies, while continuous variables are tested for normality and are presented as mean and SD or median and interquartile range (IQR) in case of skewed data. Continuous variables were compared between T0 and T1 using a paired samples *t*-test or Mann–Whitney test, as appropriate. We defined statistical significance at $p \leq 0.05$ (two-sided level of significance).

Results

General patient characteristics

Of the 63 consecutive patients who entered the program during the period from May 2009 until January 2011, 2 were excluded from this study because of a different diagnosis (1 due to asthma and 1 due to small airway disease). One patient dropped out due to lack of motivation and was discharged back home. Two patients died during the program; in both patients it was concluded that rehabilitation was no longer feasible. For these patients, end-of-life care communication and advance care planning (e.g. do not attempt cardiopulmonary resuscitation, no more admissions to the hospital) had been performed and death was expected. Overall, 91% ($n = 53$) of the patients were discharged back home after a median LOA of 35 days (IQR 21–61). Four patients were discharged to a residential care facility and one patient was discharged to a nursing home (Figure 1).

Table 1 presents the patient and disease characteristics on admission to the GR-COPD program (T0). All patients had advanced COPD (GOLD stage 3 ($n = 29$) or GOLD stage 4 ($n = 32$)), with a mean FEV_1%pred of 32.9 (10.8). Of these, 17 (28%) patients were on LTOT. Comorbidity was prevalent, as 41% of the patients had a CIRS score ≥ 10, indicating severe impairment due to comorbidity. Organ and disease systems (except respiratory) showing the highest mean scores were cardiac (0.97, 35% ≥ 2), musculoskeletal and integumentary (0.85, 33% ≥ 2) and endocrine–metabolic (0.75, 31% ≥ 2).

Table 1. Patient and disease characteristics on admission (baseline/T0) to the GR-COPD program.[a]

Number of patients	61
Age in years (SD)	68.9 (9.9)
Sex: woman, *n* (%)	30 (49)
Living alone, *n* (%)	28 (46)
LOA-H in days (IQR)	8 (7–11)
LOA-SNF in days (IQR)	35 (21–61)
GOLD 3, *n* (%)	29 (48)
GOLD 4, *n* (%)	32 (52)
FEV_1%pred (SD)	32.9 (10.8)
LTOT, *n* (%)	17 (28)
Comorbidity, CIRS (total score) (SD)	9.6 (4.3)
Smoker, *n* (%)	10 (16.5)

[a]Categorical variables are described as frequencies, while continuous variables are tested for normality and are presented as mean and SD or median and IQR in case of skewed data. GR-COPD: geriatric rehabilitation program for patients with advanced chronic obstructive pulmonary disease; LOA-H: length of admission during hospital stay; LOA-SNF: length of admission during rehabilitation; IQR: interquartile range; GOLD: Global Initiative for Chronic Obstructive Lung Disease; FEV_1%pred: forced expiratory volume in 1 s as percentage of predicted; LTOT: long-term oxygen therapy; CIRS: Cumulative Illness Rating Scale.

Measurements on admission

Table 2 presents the outcomes of all measurements on admission (T0) to and discharge from the GR-COPD program. Functional capacity was impaired, as on admission both the BI and the 6MWT showed care dependency and limited exercise capacity. Peripheral muscle strength showed that 25 patients (41%) had an HF below the normative value. Although the mean BMI was within normal range, 20 patients (33%) had a BMI < 21 kg/m^2, indicating underweight. Depletion of the FFMI was present in 44% ($n = 27$) of all patients. HADS scores showed that 47% of the patients had a higher risk (score of $\geq$8) for anxiety and 43% for depression. The mean CCQ score was 3.5 ($\pm$0.9), indicating severely limited health status.

Course of functional capacity during the GR-COPD program

There was a significant and clinically relevant improvement of functional capacity during the GR-COPD program (Table 2, Figure 2). The median BI improved from 17 (IQR 15–18) to 20 (IQR 17–20), and the mean 6MWT from 208 m ($\pm$119) to 274 m ($\pm$122) at discharge. In 41 patients, the BI improved 2 or more points (>MCID); in 2 patients, the BI on discharge was lower than on admission; and in 9 patients, the BI did not change during the program. In 71.7% of the patients, the 6MWT improved $\geq$26 m (>MCID). In two patients, the 6MWT did not change; and in six patients, the 6MWT decreased. The nutritional status measured by the mean BMI showed no significant improvement. However, the number of patients with underweight (BMI < 21 kg/m^2) decreased from 20 to 12 ($p = 0.007$). Improvement in health status was also significant and clinically relevant: the mean score of the CCQ improved from 3.5 ($\pm$0.9) on admission to 2.2 ($\pm$1.0) at discharge.

Discussion

Main findings

The main finding of this study is that, in patients with advanced COPD, who suffered a recent exacerbation, comorbidity is frequent, functional capacity is impaired and health status is severely limited. Furthermore, nutritional status is often impaired and many patients are at risk for an anxiety or depressive disorder. Nevertheless, during the GR-COPD program, functional capacity and health status showed substantial and clinically relevant improvement. This implies that, although these patients are severely limited in training capacity, a postacute GR program is feasible and is likely to offer substantial benefits.

Strength and limitations

To the best of our knowledge, this is the first study focusing on feasibility, patient characteristics and course of functional capacity in patients with advanced COPD admitted to a postacute GR program. The current study was not designed as an intervention trial but as a naturalistic prospective cohort study. Therefore, a control group was not part of this study and the current study can also be seen as a pilot study. Further research is essential and should focus on designing a controlled intervention trial to investigate the efficacy of the program. Other limitations are possible population bias due to criteria used to select patients for the program and the fact that we were unable to collect information on patients who were selected for the program but refused to participate. Since these latter patients were discharged back home from the hospital, health status and functional capacity of our population are probably worse than that of the initial population who was indicated for the program in the hospital. This could bias the generalizability of our results. We used the BI to measure

Table 2. Outcomes of measurements on admission (T0) to and discharge from (T1) the GR-COPD program.

Measurement	T0	T1	*p*
Functional capacity			
BI (IQR)	17 (15–18)	20 (17–20)	<0.001[b]
6MWT (m) (SD)	208 (119)	274 (122)	<0.001[a]
HF (kgf) (SD)	52.0 (17.0)	55.6 (17.5)	<0.001[a]
HF < norm value, *n* (%)	25 (41)	18 (30)	0.024[c]
Nutritional status			
BMI (kg/m^2) (SD)	23.3 (4.7)	23.8 (4.0)	0.051[a]
BMI < 21 kg/m^2, *n* (%)	20 (33)	12 (20)	0.007[c]
FFMI (kg/m^2) (SD)	15.8 (2.3)	–	–
Psychosocial functioning			
HADS_Anxiety	7.5 (4.2)	–	–
HADS_Depression	7.4 (4.6)	–	–
Health status			
CCQ (SD)	3.5 (0.9)	2.2 (1.0)	<0.001[a]

Categorical variables are described as frequencies, while continuous variables are tested for normality and are presented as mean and SD or median and IQR. Continuous variables were compared between T0 and T1 using a paired samples *t*-test[a] or Mann–Whitney test[b], as appropriate. Categorical variables were compared between T0 and T1 using χ^2 tests[c]. GR-COPD: geriatric rehabilitation program for patients with advanced chronic obstructive pulmonary disease; BI: Barthel index; 6MWT: 6-min walk test; HF: handgrip force; BMI: body mass index; FFMI: fat-free mass index; HADS: Hospital Anxiety and Depression Scale; CCQ: Clinical COPD Questionnaire.

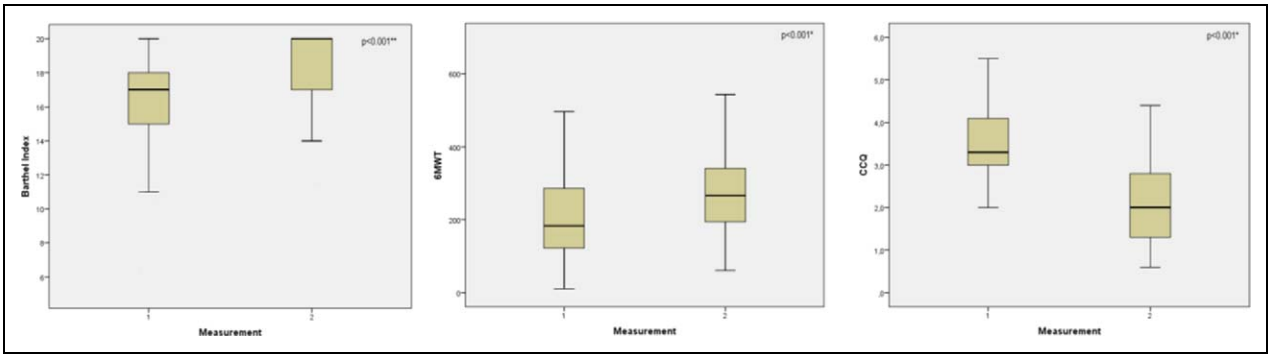

Figure 2. Course of functional capacity and health status from admission (T0) to discharge (T1).

functional capacity. However, the BI might not be the most suitable instrument to measure functional capacity and impairment in patients with COPD due to the ceiling effect and insensitivity to change at the upper level of the scale.[27] Nevertheless, the BI is a widely used instrument and recent literature shows that it can be used in patients with COPD.[28] Our results also show the ceiling effect of the BI, but improvement was still clinically relevant.

Few data are available on GR programs specifically designed for patients with advanced COPD. A recent systematic review on the efficacy of GR failed to identify one disease-specific program for geriatric patients who has been well evaluated, other than orthopaedic and general GR.[1] Studies on the effect of PR in elderly patients with COPD are scarce but show positive outcomes of PR programs for relatively older COPD patients.[29,30] However, compared with our population, these studies included only stable COPD patients with less severe airflow obstruction and functional impairment. Furthermore, excluded from these latter studies were patients with comorbid diseases that are likely to limit exercise capacity. Studies on the effect of postacute PR programs in elderly COPD patients are also scarce. Puhan et al.[8] performed a systematic review to assess the effect of PR on future hospital admissions, mortality, HRQoL and exercise capacity, in patients with COPD after a recent exacerbation. The authors concluded that postacute PR is a highly effective and safe intervention to reduce hospital admissions and mortality and to improve HRQoL. Of the nine studies that met

their eligibility criteria, five investigated the effect of an inpatient PR program that followed immediately after hospital admission.[31–35] Of these studies, one was conducted at an intensive care unit[31] and one study included patients with less severe airflow limitation compared with our population.[32] Three small studies reported positive effects on exercise capacity,[33] health-care utilization[34] and HRQoL,[35] of a postacute PR program in populations who were more similar to ours with regard to age, lung function and exercise capacity. However, in those studies comorbidity was not always measured,[35] or patients with significant comorbidities were excluded from the PR program.[33] Although there are differences between our population and the populations described in studies on the effect of (postacute) PR program, these data are in line with our results, indicating that postacute rehabilitation in patients with advanced COPD is feasible, safe and can probably offer substantial benefits.

A notable finding of the present study is that the mean age of the patients who entered the GR-COPD program was 68.9 years, which is relatively young considering that this is a GR program. However, indication for the GR-COPD program was based on disease severity and the presence of impaired functional capacity and health status with insufficient recovery during hospital stay. Age was not an inclusion or exclusion criterion. This suggests that, in patients with COPD, advanced disease with limited functional capacity and health status can be present at a relatively young age. Nevertheless, 54% of the patients were aged $\geq$70 years and almost 20% of our population were aged $\geq$80 years.

Implications for future research

Although our results suggest that the GR-COPD program is effective in this specific group of patients, our study design did not include a control group and a randomized controlled trial is compulsory to confirm these findings. As literature on this topic is scarce, further research is essential. Studies should focus on defining appropriate outcome measurements to identity which patient outcomes can be achieved and sustained and identify patient characteristics that can predict which patients with advanced COPD are most likely to benefit from an postacute GR program.

Conclusions

Patients with advanced COPD admitted to hospital for an acute exacerbation suffer from frequent comorbidities, severely impaired functional capacity and poor health status. Development and implementation of a postacute GR program for this group of patients are feasible and can probably offer substantial improvements.

Authors' note

EFvDvI designed the study, processed and analyzed the collected data and wrote the manuscript. WPA participated in the design of the study, reviewed the manuscript and assisted with the statistical analysis. MS, KHGS and NHC reviewed the manuscript. All authors have given final approval of the version to be published.

Conflict of interest

The authors declared no conflicts of interest.

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