# Caffeine: a cup of care? An exploration of the relation between caffeine consumption and behavioral symptoms in persons with dementia

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# REDUCING BEHAVIORAL SYMPTOMS IN OLDER PATIENTS WITH DEMENTIA BY REGULATING CAFFEINE CONSUMPTION: TWO SINGLE-SUBJECT TRIALS

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## ABSTRACT

### *Background*

Caffeine is a stimulant with strong individualized effects in adults. In elderly patients with dementia there is a group relation between caffeine and apathy, aberrant motor behavior and sleeping difficulties. A single-subject trial was designed to examine the individual effects of caffeine on behavioral symptoms in older adults with dementia.

### *Method*

Two blinded crossover single-subject trials were conducted in a dementia special care unit. During a 4-week period, caffeine consumption was partly regulated by using caffeinated (C) and decaffeinated (D) coffee pads, in a predetermined order (C-D-D-C). Behavioral symptoms were measured with the NPI-NH and CMAI, and caffeine consumption was measured using questionnaires.

### *Results*

In participant A the specific behavioral symptoms decreased in the 'decaf weeks' and increased slightly when caffeinated coffee was reintroduced (NPI-NH item agitation/aggression scores on weeks 1-4: 12, 3, 1 and 4, respectively). The same pattern emerged in the total CMAI score, the CMAI physically aggressive cluster scores, the CMAI non-aggressive behavior cluster scores, the total NPI-NH score and the NPI-NH psychomotor behavior cluster score. In contrast, in participant B no relation was found between caffeine consumption and behavioral symptoms.

### *Conclusion*

Behavioral symptoms in elderly patients with dementia are complex and require detailed analysis. In some patients, behavioral symptoms can be reduced by a relatively simple regulation of caffeine consumption. A personalized treatment approach is necessary, especially if relatively simple interventions can improve the burden for patients and caregivers.

## INTRODUCTION

Behavioral and psychological symptoms are common in older patients with dementia and place a considerable burden on formal and informal caregivers.(1, 2) The etiology of behavioral symptoms is complex and probably multifactorial. Although many interventions have been well investigated, tailoring these results for the individual patient remains a challenge. Therefore, an individualized approach is necessary.(3)

Caffeine is a commonly consumed stimulant and normal use is known to increase alertness and reduce fatigue. (4) If used in high amounts, caffeine can increase or induce anxiety, restlessness, insomnia and psychomotor agitation.(4, 5) However, the stimulating effects of caffeine show a large individual variation and most people tend to control the caffeine consumption themselves to avoid adverse effects. (4, 5)

The effect of caffeine on behavioral symptoms in older patients with dementia is not extensively investigated. A small pilot study in older patients with dementia showed that caffeine consumption was associated with apathy, aberrant motor behavior and sleeping difficulties.(6) However, individual variation in the effects of caffeine on behavior impedes translating these results to clinical practice. Therefore, to further examine and quantify the individual effects of caffeine on behavioral symptoms, two single-subject trials were performed with two older adults with dementia.

## METHODS

In elderly care, a randomized trial presents substantial methodological barriers, e.g. likely loss to follow-up and the risk of bias by multimorbidity. (7) The single-subject trial is also a randomized blinded study, but conducted with one single patient. It is seen as the ultimate proof for the individual patient,(8) especially if the intervention has shown variation in efficacy between patients,(7) as is the case when considering the effects of caffeine.

In an earlier study , the caffeine consumption and behavior of 29 residents of a dementia special care unit was registered.(6) Of these residents, eligibility for the present single-subject trial included both a high intake of caffeine and severe behavioral symptoms. Four residents met these criteria. Those with active psychiatric (co-)morbidity(n=1) and those in whom informed proxy consent was not achievable(n=1) were excluded. This left two residents. As both were legally incapable to give consent, informed proxy consent was obtained. The local ethics committee was also informed. Withdrawal was possible at any time at the request of the legal representative or staff as they saw fit, without any consequences.

The caffeine consumption was regulated during a 4-week period by serving caffeinated (C) or decaffeinated (D) coffee in a predetermined order per week (i.e. C-D-D-C) to allow for a washout period. The residents and staff were unaware of the predetermined order, and also blinded for

the intervention using unrecognizable coffee pods in unmarked tins. A questionnaire was used to record the number of cups of coffee and of tea consumed during the day. The consumption of these beverages was neither limited nor stimulated by the staff.

Behavioral symptoms were scored using the Neuro Psychiatric Inventory-Nursing Home edition (NPI-NH) (9, 10) and the Cohen Mansfield Agitation Inventory (CMAI).(11, 12) The NPI-NH assesses 12 neuropsychiatric symptoms. The frequency and severity are rated and are multiplied to create a symptom score (range 1-12). The total score is the sum of all 12 symptoms (range 12-144). The NPI identifies three clusters of symptoms: psychosis, psychomotor behavior, and affect. (13) The CMAI assesses 29 agitated behaviors in patients with dementia. All items are scored on a 7-point scale (range 29-203). The CMAI focuses on three clusters of symptoms: physically aggressive, physically nonaggressive and verbally agitated behavior.(14) Both rating scales are validated for use in Dutch nursing homes (14) and, in the present study, were scored weekly by a nurse.

## RESULTS

### Participant A

The first participant is an 85-year-old woman, diagnosed with Alzheimer's disease. In the nursing home she continuously paces through the unit. There is a general restlessness and, occasionally, sadness but no other signs of depression are apparent. If she does not feel in control, she becomes angry and hits the nurses or residents. A detailed multidisciplinary analysis was conducted following national guidelines. (15) As no physical cause was found, environmental and psychological interventions were set in place. Additionally, in the presence of physical aggression endangering herself or others, a small dose of lorazepam was given. A single-subject trial was initiated to examine whether this patient's high level of caffeine consumption influenced her general restlessness, agitation and aggression.

During the 4-week observation period, 3212 mg of caffeine was consumed: 67% from coffee. During the 'decaf weeks' (weeks 2 and 3), 19% of the total amount of caffeine was consumed. There was no medication or comorbidity present which could interfere with caffeine metabolism. The reduction in caffeine consumption coincided with a reduction of NPI-NH item agitation/aggression (scores for weeks 1 to 4 were: 12, 3, 1 and 4, respectively) (Table 1). After the reintroduction of caffeine, there was a slight increase in these behavioral symptoms. The same pattern was seen in the total CMAI score, the CMAI item general restlessness, the CMAI physically aggressive and non-aggressive cluster scores, the total NPI-NH score and the NPI-NH psychomotor behavior cluster score. The decrease of the total NPI-NH score was almost entirely attributable to the items agitation/aggression, irritability and aberrant motor behavior. The changes seen in the total CMAI score were due to several items, including general restlessness and aggressive behavior (Table 1).

**Table 1:** Results of the trial: participant A

| | Week 1 (C) [a] | Week 2 (D) [a] | Week 3 (D) [a] | Week 4 (C) [a] |
|---|---|---|---|---|
| Caffeine (total mg)[b] | 1420 | 303 | 309 | 1180 |
| CMAI (total) | 60 | 51 | 44 | 51 |
| *CMAI item scores*[c] | | | | |
| Pacing | 6 | 6 | 5 | 6 |
| Inappropriate robing/disrobing | 5 | 5 | 5 | 5 |
| Cursing or verbal aggression | 5 | 3 | 1 | 3 |
| Hitting | 4 | 2 | 1 | 1 |
| Grabbing | 4 | 2 | 1 | 1 |
| Pushing | 1 | 1 | 1 | 2 |
| Get to different place | 3 | 1 | 4 | 1 |
| Hoarding things | 6 | 5 | 5 | 6 |
| General restlessness | 6 | 6 | 1 | 6 |
| *CMAI cluster scores* | | | | |
| Physically aggressive behavior | 18 | 12 | 8 | 11 |
| Physically non-aggressive behavior | 28 | 25 | 22 | 26 |
| Verbally agitated behavior | 4 | 4 | 4 | 4 |
| NPI-NH (total) | 49 | 25 | 1 | 8 |
| *NPI-NH item scores*[d] | | | | |
| Agitation/aggression | 12 | 3 | 1 | 4 |
| Depressed mood | 9 | 0 | 0 | 0 |
| Irritability | 12 | 8 | 0 | 0 |
| Aberrant motor behavior | 12 | 12 | 0 | 4 |
| Might time behavior | 4 | 2 | 0 | 0 |
| *NPI-NH cluster scores* | | | | |
| Psychosis | 0 | 0 | 0 | 0 |
| Psychomotor behavior | 24 | 11 | 1 | 4 |
| Affect | 9 | 0 | 0 | 0 |

[a] C: caffeinated coffee; D: decaffeinated coffee

[b] cup of tea 30 mg; cup of coffee 70 mg; cup of decaffeinated coffee 3 mg

[c] all other CMAI items (spitting, constant request for attention, repetitious sentences/ questions, kicking, throwing things, making strange noises, screaming, biting, scratching, intentional falling, complaining, negativism, eating inappropriate substances, hurting oneself or others, handling things inappropriately, hiding things, tearing things, performing repetitious mannerisms, verbal sexual advances and physical sexual advances) had a continuous score of 1 during the study

[d] all other NPI-NH items (delusions, hallucinations, anxiety, euphoria, apathy, disinhibition and eating change) had a continuous score of 0 during the study

CMAI: Cohen Mansfield Agitation Inventory

NPI-NH: Neuro Psychiatric Inventory-Nursing Home edition

### Participant B

Participant B, a 91-year-old woman, was diagnosed 6 years earlier with mixed type dementia. After admission, she kept to herself. If someone entered her room she became angry and aggressive, often pushing people out of the room. Her family perceived her behavior as being 'her nature'. Following the national guidelines,(15) an extensive multidisciplinary evaluation of her behavior was made, resulting in environmental and psychological interventions. No psychotropic medication was prescribed. A single-subject trial was initiated to investigate whether her high level of caffeine consumption influenced her anger and aggression. However, during the 4-week observation period no relationship was found between total caffeine consumption.

## DISCUSSION

Two single-subject trials were performed to explore whether specific behavioral symptoms could be reduced by regulating caffeine consumption in older patients with dementia with high caffeine intake and behavioral symptoms.

In participant A, the behavioral symptoms decreased in the 'decaf weeks' and increased slightly when regular coffee was reintroduced. In participant B, no relationship was found between caffeine consumption and behavioral symptoms.

This is the first report of single-subject trials to investigate the effects of caffeine on the management of behavioral symptoms in older patients with dementia. To evaluate the clinical value of the results, the limitations and strengths of the study need to be addressed. In these trials, the CMAI ratings pertain only to the week prior to the administration of the CMAI, instead of the usual 2-week period. However, because of the frequent nature of the behavioral symptoms, it is unlikely that our results were adversely affected. On the other hand, this study has several strengths. First, both the NPI-NH and the CMAI were scored by a single caregiver who knew the participant well; this is known to increase the validity of the ratings.(13) Second, although this was a real-life situation, no other interventions took place during the trial period (e.g. pharmacotherapy), which serves to increase the internal validity.

In general, the single-subject trial is uniquely suited for individualized research: it is a fast and flexible method to evaluate treatment effects, especially in complex situations. Moreover, the double-blinded crossover design creates a perfectly matched control. However, it is less suited for generalization to all patients with dementia and behavioral symptoms. This makes the single-subject trial the ideal design to determine individual effects of caffeine on specific behavioral symptoms.

Caffeine can have a positive or negative effect, depending on the amount consumed and the individual sensitivity. The single-subject trials presented here reveal the differences between the individuals.

Several reviews have shown that individuals generally regulate their caffeine consumption to maximize the beneficial effects and decrease negative effects.(4, 5) However, patients who are dependent on others, such as patients with dementia, are unable to regulate this and are, therefore, more likely to experience negative effects.

In conclusion, behavioral symptoms seem to be influenced by caffeine consumption in some older patients with dementia. In accordance with the effects of caffeine in adults, there seems to be a strong individual effect and tolerance to caffeine in older patients. These two single-subject trials support the need for detailed analysis of behavioral symptoms in dementia and also show the need for individually-based management of behavioral symptoms.

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