Walking and night-time restlessness in mild-to-moderate dementia: a randomized controlled trial

SIR—Sleep disturbance, particularly night-time restlessness, is frequently present in older people with dementia [1, 2], forms a major burden to caregivers and is one of the primary reasons for nursing home placement [3, 4]. Interventions aimed at reducing night-time disturbances are therefore clinically highly relevant [3].

Sleep disturbances in dementia may be caused by a reduction of Zeitgebers (i.e. external cues that synchronize internal systems to the 24 h light/dark cycle), such as physical activity [1, 2, 5]. Indeed, in ambulatory nursing-home residents with dementia, a lower level of daily physical activity is associated with more sleep disturbances [6]. A recent review showed that daily physical activity in moderate-to-severe dementia leads to more efficient sleep [7]. However, these interventions were multi-dimensional (including bright light and improved sleep hygiene) precluding knowledge of which type of stimulation is (most) effective [7]. In the present study, a type of physical activity appropriate for older nursing-home residents with dementia, i.e. walking [8], was offered daily, to determine the effects on sleep disturbance, e.g. night-time restlessness, in persons with mild-to-moderate dementia.

Methods

Participants

Nineteen nursing homes participated in the study. Potential participants were selected by medical staff and criteria included: (i) age >70 years old; (ii) dementia diagnosis; (iii) mild-to-moderate cognitive impairment, i.e. a Mini-Mental State Examination (MMSE) [9] score of >10; (iv) being able to walk with or without a walking aid. Dementia subtype, categories of co-morbid disease and the use of psychotropic medication were extracted from the medical status. This study was approved by the local medical ethical committee. Study goal and procedure were explained to selected participants and their relevant relatives. Oral (participants) and written (relatives) consent was obtained.

Procedure

Participants were randomly assigned to either the experimental or the control group. In the experimental group, participants walked for 30 min at a self-selected speed, accompanied by a student. Moments of rest, if necessary, were allowed (addition to the 30 min). Walks were on nursing-home wards and in public places inside the nursing home. The control group received a social visit by a student, which also took place inside the nursing home; therefore, light exposure for both groups was comparable. Interventions were applied five times a week for 6 weeks. Time of day of the intervention was variable, according to patients’ and students’ schedules. Missed interventions were subsequently caught up with in the weekend. In case a participant missed more than two times during any week, interventions were added in the remaining weeks to ensure that each subject’s total intervention dose included 30 sessions.

Materials

Sleep disturbance was assessed by an Actiwatch (Cambridge Neurotechnology Ltd, Cambridge, UK), which is a small activity monitor worn on the dominant wrist: the week before the intervention started (T1), the week directly after the last intervention session (T2) and again 6 weeks after (T3). An estimated night period of 9:30 p.m. to 8:00 a.m., based on the observed bed and get up times of older persons with dementia living in multiple Dutch nursing homes [10], was used to determine actigraphy variables [11]. Night-time restlessness is determined by the mean activity during nightly hours based on 6 min bins. Sleep efficiency is determined by dividing the amount of sleep as calculated by an algorithm by the time spent in bed. The number of wake bouts involves the actual number of episodes of wakefulness during the night period. Daytime activity presents the mean activity during daily hours based on 6 min bins. Interdaily stability serves as a measure of the degree of resemblance across activity patterns of individual days. Higher values indicate a more stable rhythm across days. Intradaily variability represents fragmentation of periods of rest and activity. Lower values indicate normal sleep–wake patterns.

Statistical analysis

A sample size calculation [12] was performed: an effect of moderate magnitude (0.5) was aimed to detect as significant [13]. Setting the level of significance at 0.05, the power (1–beta) at 0.80, and the within subject correlation at 0.75, the required total number of participants was 63. Differences between groups were analysed employing independent-samples t-tests, χ² tests or Mann–Whitney U tests. The actigraphy variables were analysed by means of a linear mixed model, which was used over the three assessments (T1, T2 and T3) accounting for the correlation between repeated measures on the same patient and...
allowing patients to have unequal numbers of assessments. When significant time * group interactions were detected, post hoc interaction contrasts, i.e. T1–T2, indicative of treatment effects, and T2–T3, indicative of long-term treatment effects, were determined [14]. To examine whether the persons with the most disturbed rest–activity rhythm, or those most sedentary showed an improved rest–activity rhythm, we performed additional analyses by dividing the groups based on the interdaily stability and their level of daytime activity at baseline (T1), respectively, by means of the split-half method.

**Results**

Seventy-nine participants completed T2 (Figure 1); 7 did not want to continue the allocated condition, but analyses were on an intention-to-treat basis [15]. Mean age and MMSE score of participants were 84.3 (range 75–95 years) and 19.4 (range 11–28), respectively. Most participants were women (79.7%). Dementia diagnoses included Alzheimer’s disease (AD) (n = 25), vascular disease (VaD) (n = 7), AD/VaD (n = 9), frontotemporal dementia (n = 1) and dementia not otherwise specified (n = 37). There were no differences in age t(77) = −1.59, P = 0.117, MMSE score t(77) = −1.30, P = 0.199], gender distribution [χ²(1) = 0.53, P = 0.465] and distribution of dementia subtypes (χ² = −0.30, P = 0.767) between groups. Most prevalent type of co-morbidities included hypertension (n = 28), cataract operation (n = 23), tumours (n = 16), diabetes mellitus (n = 15) and arthritis (n = 14). None of the specific co-morbidity categories or types of psychotropic medication showed a significant difference in prevalence between groups (data not shown), nor did total number of illnesses (χ² = −1.34, P = 0.182).

Actiwatches were worn for several days (M = 5.96, SD = 1.12, range 4–9 days). For means and standard deviations of the actigraphy variables, see Table 1. None of the actigraphy variables revealed a significant time * group interaction effect [night-time restlessness: F(2,77.2) = 0.16,
Research letters

Table 1. Means and standard deviations of the actigraphy variables

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P = 0.830; sleep efficiency: $F(2,75.4) = 1.26$, $P = 0.290$; number of wake bouts: $F(2,75.6) = 1.61$, $P = 0.207$; daytime activity: $F(2,75.5) = 1.07$, $P = 0.349$; interdaily stability: $F(2,75.0) = 0.31$, $P = 0.736$; intradaily variability: $F(2,75.40) = 0.16$, $P = 0.849$]. Additional analysis showed that persons with the most disturbed rest–activity rhythm (interdaily stability < 0.74) at baseline also did not show significant time * group interaction effects on any of the actigraphy variables ($0.200 < P < 0.790$), nor did persons that were most sedentary (daytime activity < 4.425) at baseline ($0.432 < P < 0.939$).

Discussion

The current walking programme did not show a beneficial effect on night-time restlessness or other actigraphy parameters in older nursing-home residents with mild-to-moderate dementia. There are several possible explanations for these results. First, the sleep disturbances of the participants may not have been that impaired to begin with. Although our additional analyses including only those with more disturbed sleep also did not reveal beneficial effects of the intervention, the sleep disturbances were not comparable to those of persons in a more advanced stage of dementia [1]; interdaily stability = 0.71 versus interdaily stability = 0.49 and intradaily variability = 0.75 versus intradaily variability = 0.85. In other studies including older persons with more advanced dementia, a multi-sensory intervention improved sleep indeed only in those persons with more severe sleep disturbances [16, 17]. Secondly, although one can assume that a physical activity intervention may be more beneficial to those most sedentary, this was not revealed in our additional analyses. It may have been the case, however, that participants compensated for their extra activity by being more sedentary during the rest of the day [18]. Thirdly, participants showed a high prevalence of cardiovascular co-morbidity, i.e. 89% revealed conditions such as hypertension or mild heart failure. Cardiovascular conditions may result in a reduced cardiac output [19, 20], which may lead to reduced cerebral perfusion [21] instead of increased frontal cerebral perfusion normally seen after exercise [22]. Frontal cortico-subcortical connections [23, 24] play a role in sleep processes and disruptions of connections have indeed been associated with sleep disturbances [25]. Fourthly, although the duration of the walking programme was chosen to minimize study drop-outs, this may not have been the most optimal duration. Since a large proportion of participants revealed cardiovascular co-morbidity, a walking programme of longer duration may benefit the cardiovascular system [26] and may then improve sleep disturbance. Lastly, the timing of the physical activity was variable and some studies argue that physical activity is performed best 5–6 h before going to bed [27] or any time in the afternoon [28].

There were limitations to the current study. First, actual bed and get up times of participants were unknown, but based on the observations from a similar group of persons. Secondly, there is uncertainty concerning the intensity (e.g. %VO$_{2max}$) and the exact duration (minutes) of the intervention. In addition, we do not have information on the remaining physical activities participants may have been involved in.

The current study focused on an appropriate type of physical activity, i.e. self-paced walking, but results failed to indicate that the intervention benefitted sleep in this group of older nursing-home residents with mild-to-moderate dementia. It is of crucial importance to determine in future studies which specific participant or programme characteristics play a role in a potential beneficial influence of a physical activity intervention on night-time restlessness.

Key points

- Sleep disturbance, e.g. night-time restlessness, is common in dementia.
- Multi-dimensional interventions, including physical activity, improve sleep disturbances in advanced dementia.
- The present RCT did not show a positive effect of physical activity on sleep disturbances in mild-to-moderate dementia.
- Specific characteristics of either the participants or the intervention may explain the present findings.
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Conflicts of interest

None declared.

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References