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Fearfulness in aviary housed laying hens – Effects of management and potential confounding effects of the Novel Object test

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A B S T R A C T

Few studies have assessed fearfulness and how it relates to feather condition and management strategies in end-of-lay hens housed in commercial aviaries. As aviary housing for laying hens grows with the phasing out of cages, there is a need to ensure the currently used methods of assessing on-farm flock fearfulness are robust and to avoid confounding effects. The aim of this study was to investigate the relationship between daily management routines and plumage condition and the fearfulness of aviary housed laying hens as assessed by the Novel Object (NO) test. In addition, the study aimed at investigating potential confounding effects when performing the NO test in commercial flocks. Forty-five indoor multitiered aviary-system flocks of laying hens from across Norway were visited at the end of lay (range: 70–76 wk of age). The flocks consisted of either Lohmann LSL ($n = 30$) or Dekalb White ($n = 15$) non-beak-trimmed hens. During the visits, flock fearfulness was assessed using the NO test with 4 different objects, plumage condition was assessed using the NorWel method, and information on how the daily inspections were performed (duration and by how many different people) was collected. More hens tended to approach the NO with less damage to the breast feathers and more damage to the tail feathers in the Lohmann flocks but not in the Dekalb flocks ($0.05 < P < 0.07$). There was no effect of the number of people involved in the daily inspections of the hens ($P = 0.56$) or the amount of time spent inside the hen house per day ($P = 0.80$) on the number of hens approaching the NO. There was also no effect of in which corridor the NO test was carried out (wall vs inner corridors; $P = 0.27$). But there was an effect of the type of objects ($P < 0.0001$). More hens approached the "virus" NO compared to the three other objects used. The results support previous works showing a relationship between fearfulness and feather pecking and highlight the need for caution regarding hybrid differences. The results also suggest that, when performing the NO test in commercial aviaries, corridor does not have a confounding effect on this test while the type of novel object can be a confounder.

1. Introduction

During recent years, consumer awareness of laying hen welfare has increased worldwide, particularly in Europe and North America. An example of this is the European Citizens' Initiative "End the Cage Age" (Compassion in World Farming International, 2022). This campaign launched in 2018 and resulted in almost 1.4 million signatures and a commitment by the European Commission to revise the current EU legislation and phase out the use of cages for farmed animals across Europe by 2027. Similarly, McDonald has decided to phase out eggs from caged hens in North America before 2025 (McDonald's, 2015). As the worldwide consumption of eggs is not expected to decrease, phasing out cage systems for layers will result in an increased number of laying hens housed in alternative systems (also named non-cage or floor-housing systems), i.e. organic, free range or aviary systems. It is well-known that different production systems affect the welfare of laying hens differently (Freire and Cowling, 2013; Lay et al., 2010). For example, mortality is usually lower in caged hens compared to layers housed in alternative systems, whereas the behavioural needs are better accommodated for in layers housed in alternative systems compared to caged hens (Rodenburg et al., 2008, 2005). With an increase in aviary housing for laying hens, there is a growing demand for practical on-farm welfare assessment tools, that can be performed quickly and non-invasively (Vasdal et al., 2022).

One significant welfare problem in laying hens is fearfulness. Fearfulness is the predisposition of an individual to be easily frightened (Boissy, 1995). Exaggerated or inappropriate fear responses can increase the risk of injuries and mortality and reduce productivity. High fear

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levels have been associated with low body weight, low egg weight, low feed intake and high mortality (de Haas et al., 2013). One major factor in the fearfulness of laying hens is their relationship with the farmer. A previous study has shown that increased time with the caretaker can reduce the proportion of birds that move away from an approaching human (Barnett et al., 1992). Other studies suggest the number of persons performing daily inspections can affect the incidence of feather pecking behaviour, which has also been associated with fearfulness in laying hens (de Haas et al., 2014a; Decina et al., 2018; Green et al., 2000; Jones et al., 1995; Rodenburg et al., 2004). While fear can be assessed using both behavioural and physiological indicators, behavioural measures are preferred in on-farm settings as they are non-invasive and are often quick to perform. The Novel Object (NO) test is a commonly used test to measure fear as the behavioural responses of approach and avoidance when animals are exposed to novelty (Forkman et al., 2007). A hen will approach a novel stimulus until its motivation to avoid it is larger or equal to its motivation to approach it. A hen with high fearfulness will, therefore, keep a greater distance from the novel stimulus when given a choice compared to a hen with a lower level of fearfulness (Miller, 1959, 1944). This test is particularly useful in on-farm settings as it requires no catching or handling of the hens, the hens can be tested in their familiar home environment and in groups. Indeed, the NO test in included in the Welfare Quality® Assessment protocol for poultry (Welfare Quality, 2009).

Nevertheless, on-farm studies assessing fear of commercially housed laying hens are few and there is, therefore, a need for knowledge on how management routines such as the amount of time spent in the hen house and the number of people performing daily inspections can affect flock fearfulness in this setting. It is also important to assess the welfare of hens at end-of-lay ages to verify that all the measures undertaken during the rearing and production periods have long lasting effects and that the hens have a good welfare status all the way until the end of production. Furthermore, with an increase in housing of laying hens in aviary systems and the increase in the need for on-farm assessment protocols, it is important to investigate whether some aspects of the design of fear tests such as the NO test can be confounders and cloud the results of this test. For example, thigmotaxis (the tendency to remain close to vertical surfaces) is a sign of anxiety (Simon et al., 1994) and could result in different approach responses to the NO in aviary corridors along the walls versus the corridors along the centre of the house. Likewise, different novel objects used may excite different responses, even if they are of similar size, shape, or colour. These details are important for the refinement of the NO test.

The aim of this study was, therefore, to investigate the associations between certain management routines, and the fearfulness of aviary housed laying hens as assessed by the Novel Object test. In addition, the study aimed at assessing the relationship between fearfulness and plumage condition and investigate selected potential confounding effects when performing the NO test in commercial aviary flocks. We predicted that flock fearfulness would decrease with increasing time spent in the hen house per day and with increasing number of different people involved in the daily inspections of the hens. Furthermore, we expected that flock fearfulness would be positively correlated with plumage damage and that the results of the NO test would be affected by the placement of the novel objects in the hen house. This study was part of a larger project aiming at investigating the welfare of Norwegian laying hens at the end of the production period.

2. Materials and Methods

2.1. Animals and housing

This study was conducted between May 2020 and June 2021 and included 45 indoor multi-tiered aviary-system flocks of laying hens from across Norway. The flocks consisted of either Lohmann LSL (n = 30) or Dekalb White (n = 15) non beak-trimmed hens. The most common flock size was 7500, with only 4 flocks having more than 8000 hens and only 2 locks having less than 7000 hens (range 5300 - 19,000 hens; mean = 7921). The flocks were randomly selected from lists provided by the egg packing plants, and participation in the study was optional. The hens were housed under a 14-hour light/ 10-hour dark schedule and had access to feed and water via a chain dispersal system and drinking nipples respectively. The flocks were managed according to standardized practices with regards to feed, water, ventilation, litter and lighting (KSL, 2020). The pullets arrived at the farms at approximately 16 weeks of age and were kept until 78 weeks when they were depopulated following standard commercial practices for Norway. All farms had similar layout, with 3 tiers above the floor, feed, and water lines on tiers 1 and 2, nest boxes on tier 2, and perches on tier 3. The houses were about 12 m wide, with wood shavings litter covering a floor area ranging from 385 m^2 to 1000 m^2 that extended around and under the tiered aviary structures.

2.2. Farm visits and data collection

The flocks (1 flock/farm) were visited once near the end of the production period, between 70 and 76 weeks of age. During the visit, the plumage condition of the hens was recorded and a Novel Object test was performed. In addition, the farmers were questioned on the amount of time they spend inside the hen house (minutes per day) and on how many different people are involved in the daily inspections of the hens. Common activities performed by the farmers inside the hen house are inspections of the birds, removal of dead birds, collection of floor eggs and delivery of environmental enrichment material (e.g., oyster shell and gravel). All farm visits were conducted at approximately 09:00 h, during the light hours of the light cycle. Normal routines of the system (e.g., feeder chains, light intensity) were not altered during the assessment. Only one flock was visited per day.

2.2.1. Plumage condition

Feather loss was assessed individually in 50 hens per flock using the NorWel method (Vasdal et al., 2022). All researchers had previous experience and training in this method. The assessment was done by observing the birds without handling to minimize stress and disturbance of the flock. Choice of hen was based on the following principle: one hen was pseudo-randomly chosen and the hen second closest to the original hen was visually scored. Only hens that had all assessed body parts visible to the observer were scored. The observer walked calmly along the corridors and scored hens from all parts of the house (floor, slats, ramps, perches, etc.). Scores were awarded using a 3-point scale (0–2) for each of the following body parts: head, back/wings, breast, and tail. A score 0 was given when there was no feather loss at that body part. Score 1 was given when feathers were missing from an area < 5 cm in diameter in the body part. If the featherless area was > 5 cm in diameter, that body part was given a score of 2. The condition of the tail feathers was not assessed in the first 3 flocks visited and, therefore, these data are only available from 42 flocks.

2.2.2. Novel object test

Fearfulness was assessed by a novel object (NO) test, as described in the Welfare Quality® Assessment protocol for poultry (Welfare Quality, 2009) and previous protocols conducted on loose housed hens (Brantsæter et al., 2017; de Haas et al., 2014b). To generate a representative average for the flock, the NO test was performed in four locations in the hen house. The tests were thus carried out in all corridors, and at different distances to the door while the researcher performed the assessment of plumage condition. At each location, one of four NOs were randomly selected (Katteleker, Biltema, Norway; Fig. 1). As the flock size and house design across the farms visited were quite uniform, the placement of the NOs across the flocks was also comparable. The four NOs used were called mouse, virus, ball, and dumbbell. All objects were of similar size, i.e. measured approximately 5–8 cm at their largest

Fig. 1. The objects used the novel object test. From left to right: mouse, virus, ball and dumbbell (Katteleker, Biltema, Norway).

dimension, and colour, i.e. bright and light shades of green and yellow. The ball and the dumbbell had jingling bells inside and would, therefore, emit noise if moved. The mouse and virus were silent. It was expected that unexpected noise from the NOs if/when touched by the hens could also affect the response of the hens to the NO. During the test, the NO was placed on the litter in the corridor and the researcher stepped slowly backwards 10 steps. After placement, every 10 s, the researcher counted the number of hens within bird length (approx. 25 cm) of the NO. The test lasted a total of two minutes.

2.3. Ethical statement

Because the study did not involve any animal handling, experimental manipulations, or invasive procedures, it was exempt from approval of animal use by the Norwegian Food Safety Authority (Norwegian Regulations on Use of Animals in Research, 2015).

2.4. Statistical analyses

Statistical analyses were performed using the software SAS 9.4. The scores for feather loss in each of the four body parts (i.e. head, back/wings, breast, and tail) were averaged per flock. In addition, a total body score for feather loss was calculated as the sum of the four body parts assessed with a possible score between 0 and 8. The relationship between the number of hens approaching the NO and the feather loss scores were assessed using Pearson correlations by hybrid. Likewise, the relationship between the results of the number of birds approaching the NO and the amount of time the farmer spends in the hen house per day was assessed using Pearson correlation by hybrid. The results are presented as Pearson correlation coefficient and associated p values ($\alpha = 0.05$). The effect of the amount of different people performing daily inspections of the flock on the results of the NO were analysed using the mixed procedure with the number of people, the hybrid of the flock and their interaction as fixed factors and farmer as a random factor.

For the analyses of the results from the NO test, the location of the test (i.e. in a wall corridor or in an inner corridor), and the type of NO used (i.e. virus, ball, mouse or dumbbell) were noted in addition to the number of hens approaching the NO. The effect of the test location and the type of NO were analysed using the mixed procedure with hybrid and their interaction with hybrid as fixed factors and the farmer as a random factor. *Post-hoc* analyses were performed with the Tukey test (Tukey's HSD test).

3. Results

Table 1 shows the results from the correlation analysis between the results per hybrid of the NO test and the plumage damage scores and time spent in the hen room per day. For the Dekalb birds, there were no significant correlations between the NO test and the plumage condition in any of the body parts assessed. However, for the Lohmann birds, the number of hens approaching the NO correlated negatively to the condition of the breast feathers, showing that there was a strong tendency for more hens to approach the NO when they had less plumage damage in this body part ($P = 0.054$). Interestingly, the Lohmann birds also presented a tendency towards a positive correlation with the condition of the tail feathers, with more birds tending to approach the NO when this body part was more damaged ($P = 0.06$). There was no observed correlation between the results from the NO test and the reported total amount of time spent in the hen house per day for either of the hybrids (Table 1).

There was no relationship between the hybrid ($F_{1,39} = 1.19$; $P = 0.28$), the number of people involved in the daily inspections of the hens ($F_{2,39} = 0.59$; $P = 0.56$) or their interaction ($F_{2,39} = 0.62$; $P = 0.54$)

Table 2
The number of hens (LS Means ± SE; lower and upper confident intervals) approaching the novel objects during the Novel Object test across hybrids and number of people involved in the daily inspections of the hens.

Number of people	Hybrid	LS Means	SE	Lower CI	Upper CI
1	**Dekalb**	19.13	11.13	-3.38	41.63
	Lohmann	14.30	7.04	0.07	28.53
2	**Dekalb**	29.86	5.24	19.25	40.47
	Lohmann	16.25	3.61	8.95	23.55
3	**Dekalb**	18.56	7.87	2.65	34.47
	Lohmann	17.54	6.42	4.55	30.53

Table 1
Descriptive statistics and Pearson Correlation results for the relationship between the number of hens approaching the novel object and the plumage damage score and total time spent inside the hen house per day. Data presented per hybrid.

	Descriptive statistics					Pearson Correlation		
Variable	Unit	Mean	Std Dev	Minimum	Maximum	Coefficient	P-Value	N*
	Dekalb White							
FL full body	Sum of body scores	0.79	0.84	0.12	3.28	-0.35	0.20	15
FL head	Flock average score 0–2	0.15	0.19	0	0.68	-0.11	0.69	15
FL back/wings	Flock average score 0–2	0.34	0.38	0	1.46	-0.34	0.22	15
FL breast	Flock average score 0–2	0.16	0.25	0	0.76	-0.35	0.20	15
FL tail	Flock average score 0–2	0.15	0.22	0	0.84	-0.23	0.43	14
Time in the hen room	Min/day	58.33	37.11	25	180	-0.21	0.45	15
Variable	**Unit**	**Mean**	**Std Dev**	**Minimum**	**Maximum**	**Coefficient**	**P-Value**	**N***
	Lohmann LSL							
FL full body	Sum of body scores	2.30	1.54	0.2	6.19	-0.14	0.47	30
FL head	Flock average score 0–2	0.47	0.40	0	1.38	-0.19	0.32	30
FL back/wings	Flock average score 0–2	0.71	0.51	0.02	1.71	-0.21	0.26	30
FL breast	Flock average score 0–2	0.63	0.48	0	1.70	-0.36	0.054	30
FL tail	Flock average score 0–2	0.52	0.51	0	1.48	0.36	0.06	28
Time in the hen room	Min/day	57.17	42.66	15	240	0.21	0.27	30

Total number of flocks visited: 45. FL: Feather loss. *number of available data points on the average number of hens approaching the NO (Table 2). There was also no effect of the location of the NO (wall or inner corridor transect) on the number or hens approaching it during the NO test ($F_{1130} = 1.24$; $P = 0.27$). There was also no effect of the interaction between hybrid and the type of object used ($F_{3126} = 2.10$; $P = 0.10$). Across both hybrids, however, the type of the object used did affect the response during the NO test ($F_{3126} = 13.10$; $P < 0.0001$, Table 3), with significantly more hens approaching the 'virus' object compared to all other novel objects. There were no differences between the other objects ($P > 0.05$).

4. Discussion

The aim of this study was to investigate the associations between the time spent in the hen house per day and the number of people involved in the daily inspections, and the fearfulness of aviary housed laying hens as assessed by the Novel Object test. In addition, the study aimed at assessing the relationship between fearfulness and plumage condition and investigate some potential confounding effects when performing the NO test in commercial aviary flocks. The hens assessed in the present study were approximately 70–76 weeks of age and, therefore, approaching the end of the production period. Plumage damage has been shown to increase with age (Drake et al., 2010; Hinrichsen et al., 2016; Nicol et al., 2006). This may be due to wear of the plumage against elements of the environment such as netting and feeder lines, accumulation of plumage damage or an escalation of feather pecking behaviour. However, feather pecking has been confirmed as the major source of plumage damage (Bilčík and Keeling, 1999). In addition, the body parts most affected by feather loss in the present study were the back/wings and breasts. These body parts, as well as the vent area, are known to be the targets of damaging feather pecking. In comparison, damage to the feathers of the head and neck is usually related to abrasion or aggression pecking due to limited resources (Bilčík and Keeling, 1999; Heerkens et al., 2015). Interestingly, the results showed that flock fearfulness was somewhat correlated to plumage condition in the Lohmann LSL hens, but not in the Dekalb white hens. Indeed, the Lohmann hens received higher plumage damage scores than the Dekalb hens in all body parts, supporting the hypothesis that the higher level of feather pecking lead to respective changes in their fear levels (and vice-versa) and, in turn, in their response to the novel objects. Furthermore, strain differences in both behavioural and physiological responses to fear and stress have been demonstrated, particularly between white and brown laying hen strains (de Haas et al., 2013; Fraisse and Cockrem, 2006, Nelson et al., 2020). It is likely, therefore, that the two strains studied here, despite both being white strains, also respond to feather pecking stress differently. It is also possible that near significant results were detected in the Lohmann birds but not in the Dekalb birds due to the difference in sample sizes (i.e. 30 Lohmann flocks vs 15 Dekalb flocks). Further studies with larger sample sizes would be needed to ascertain this.

The observed correlation between fearfulness and feather pecking damage in the present study supports earlier reports of associations between flock fearfulness and feather pecking, both in the rearing period and in the laying period (de Haas et al., 2014a; Jones et al., 1995; Rodenburg et al., 2004). Indeed, a study comparing laying hens selected for low mortality due to feather pecking and cannibalism to hens from a control line found that control hens displayed higher levels of fearfulness (Nordquist et al., 2011). This indicates that reduced fearfulness was co-selected during the selection for low mortality due to feather pecking. Interestingly, when selected directly for feather pecking behaviour, higher levels of fearfulness were observed in hens from high feather pecking lines, compared to control and low feather pecking lines (van der Eijk et al., 2018). However, within the high feather pecking line, it was observed that it is the feather peckers, i.e. the individuals that perform feather pecking, that are less fearful compared to the victims or neutral individuals (van der Eijk et al., 2018). This might explain the somewhat surprising finding of a tendency for more Lohmann hens to approach the NO when the flock presented higher damage to the tail feathers. It is possible that the Lohmann hens which approached the NOs were the hens that were the less fearful feather peckers and not the more fearful victims of feather pecking.

One potential shortcoming of the plumage scoring method used in the present study, the NorWel method (Vasdal et al., 2022), was the sample size per flock. This method, developed by Norwegian egg producers and advisors, records feather loss on the head, back, breast and tail of 50 hens per flock, regardless of the total size of the flock. A larger sample size provides a more reliable estimate of prevalence when there is a large variation between birds in a flock (Bright et al., 2006). However, this method is very practical to perform, can be completed in approximately 20 min, and does not require catching and handling the hens, something which reduced the stress for the birds and does not impose sampling bias (Kjaer et al., 2011; Marchewka et al., 2013). In addition, the flock sizes in the present study were largely very uniform, with only 6 out of the 45 flocks having less than 7000 or more than 8000 hens. Nevertheless, despite the relatively high number of flocks investigated in the present study (i.e. 15 Dekalb flocks and 30 Lohmann LSL flocks), the also high standard deviation in plumage scores suggests that a larger sample size, both in number of flocks and number of hens assessed per flock, might be advantageous. It is also important to note that it is not possible to separate cause and effect in this study. It is not possible for us to say whether feather pecking was induced by fear or whether fear was induced by feather pecking. It is likely that both have feedback effects on each other.

Regarding the management routines assessed, we found no relationship between the amount of time spent in the hen house or the number of different people involved in the daily inspections and flock fearfulness. This was surprising, as several different management strategies have been found to affect flock fearfulness. Some examples are the use of dark brooders (Riber and Guzman, 2016), provision of litter and environmental enrichment (Brantsæter et al., 2017), and exposure to high sound levels (Campo et al., 2005). Even air quality management can have indirect effects. When air quality is poor, caretakers may reduce the amount of time they spend inside the laying hen house, which may decrease the quality of their inspections. As a result, health and welfare issues may go unnoticed for an extended period. Reduced contact with caretakers is known to increase fearfulness of the flock (Barnett et al., 1992). Furthermore, inspection of the flock by only one or two persons has been shown to increase the risk of feather pecking (Decina et al., 2018; Green et al., 2000). Thus, inspections performed by multiple members of staff have been recommended as a method to reduce fearfulness in flocks of laying hens (DEFRA, 2018). Not only the number of stockpersons involved in the daily routines, but also their attitude and behaviour, are correlated to the welfare of the laying hens. A study of non-cage systems in Austria showed that when stockpersons agree that contact with the hens is important for the welfare of the laying hens, more hens could be touched in a touch test and had a lower avoidance distance, indicating reduced fearfulness (Waiblinger et al., 2018). Furthermore, plumage damage and mortality were found to correlate positively with a negative general attitude of the stockpersons (Waiblinger et al., 2018).

One possible explanation for the lack of a relationship between the daily routines assessed in the present study and the fearfulness of the

Table 3
The number of hens (LS Means ± SE; lower and upper confident intervals) approaching each of the novel objects during the Novel Object test.

Novel Object	LS Means	SE	Lower CI	Upper CI
Ball	13.41a	3.09	7.27	19.54
Mouse	20.44a	3.09	14.31	26.58
Dumbbell	18.10a	3.09	11.96	24.24
Virus	31.83b	3.09	25.69	37.97

[a,b]Different letters indicate significant differences between novel objects ($P < 0.05$).

flocks could be a general lack of variability in the data. Out of the 45 flocks visited, only 7 (Dekalb = 2 and Lohmann = 5) were inspected by only one person. Twenty-eight flocks were inspected by two people and 10 flocks were inspected by three people. Furthermore, the farmers reported an inspection time of more than 60 min per day in only 9 of the 45 flocks visited, and only 3 of these farmers spent more than 90 min per day with their hens. Likewise, an inspection time of less than 30 min per day was only reported in 5 flocks. It is possible, therefore, that correlations between these daily routines and flock fearfulness would be detected where a greater variety of differences in daily routines was present. In Norway, the maximum laying hen flock size is 7500, unless a farmer is given a special dispensation from the authorities to have a larger flock. This rule is in place in order to promote the distribution of farms across the country and hinder the development of monopolies. A consequence of this, however, is that most egg producers in Norway must have a secondary employment to supplement their income. This cuts into the time available to perform lengthy inspections and spend time inside the hen house.

The results from the present study also showed no effects of the location of the NO test, i.e., if the test was performed on a wall corridor or in an inner corridor of the house, on the recorded number of hens approaching the NO. This can be useful information when assessing the fearfulness of commercially housed laying hens. Generally, the test should be repeated in several locations inside the house in order to ensure a representative sample. However, if there are physical or time constraints when performing this test on commercial flocks, it is advantageous to know that there should not be a confounding effect regarding which corridor is used for the test. Indeed, efficient, accurate and repeatable on-farm assessment tools are increasingly demanded in order to demonstrate that animal welfare requirements are being met, with multiple assessment protocols being currently available (Vasdal et al., 2022).

Finally, and rather interestingly, there was a strong effect of the type of NO on the response of the hens during the NO test. In the current study, the hens where less fearful and/or more attracted to the virus object in comparison to all the other objects used. The reasons for this can only be speculative, as all the objects were of approximately the same size and colour pallet. However, it is an important confirmation that the object used can indeed affect the results of the NO test and therefore this should be carefully considered when planning a NO test. The best practice is, of course, to use the same exact object in all instances within a study.

In conclusion, the present results add support to the previous studies showing a correlation between fearfulness and feather pecking in laying hens. In addition, the results point to differences between hybrids, both of white strains. This highlights the need for caution when generalising results across hybrids and when tailoring hybrid-specific management. While a relationship between the daily management routines assessed here and flock fearfulness could not be confirmed, the present study supplies evidence for the refinement of the Novel Object test in commercial aviaries by suggesting that corridor should not have a confounding effect on this test. The type of novel object, however, can be a confounder. Therefore, the performance of this test should be carefully considered during the design stage of any study.

CRediT authorship contribution statement

Fernanda Tahamtani: acquisition of data, data analysis and interpretation, article drafting and critical revision of the article. Kathe Kittelsen: Study conception and design, acquisition of data, critical revision of the article. Guro Vasdal: Study conception and design, acquisition of data, critical revision of the article.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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