



Published in final edited form as:

Educ Gerontol. 2023 ; 49(8): 673–686. doi:10.1080/03601277.2022.2148445.

Does self-directed learning address gaps in nursing student knowledge of Alzheimer’s disease?

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Abstract

In the past two decades, deaths from stroke, heart disease and HIV decreased, whereas reported deaths from age-related Alzheimer’s disease (AD) have increased. Future nurses will be caring for the rapidly escalating number of older adults facing increased AD risk, yet nursing students’ knowledge has been shown to be limited regarding the age-related disease of Alzheimer’s (and the most common dementia type) (Aljezawi et al., 2022; Mattos et al., 2015). In this pilot study, a quasi-experimental approach was used to examine undergraduate baccalaureate nursing students’ basic knowledge about AD among two cohorts ($N = 146$). Testing occurred following an assigned self-directed learning activity as a means of providing the most current information regarding dementia. Pearson correlation and t-tests were applied in comparing student results in pre- and posttest surveys and investigating possible correlations between sociodemographic variables. Students in the 2020 group scored lower on ten of the thirty test items than the earlier 2018 cohort, suggesting that the method of self-directed learning, despite offering the most recent information, may be inadequate. To prepare nursing students to care for the increasing numbers of older adults at risk for Alzheimer’s disease, curricula that are inclusive of the most recent advances in science surrounding dementia-related illnesses, and supplemented by faculty lectures, is recommended. This requires faculty themselves to be knowledgeable of the most recent advances in dementia risk, prevention, detection and management.

Alzheimer’s disease ranks sixth in the top ten causes of death in the United States, and over 6 million Americans are known to be living with this illness. That number has been projected to increase to 13 million by 2050 (Alzheimer’s Association, 2021). However, experts believe that only half are currently diagnosed, and these projections are expected to increase further as a result of isolation from the Covid19 pandemic (Lazzari & Rabottini, 2021). Although there is currently no cure for Alzheimer’s disease (AD), there are a number of modifiable risk factors that can assist persons to decrease their risk for Alzheimer’s disease and other dementias (Livingston et al., 2017). An upstream approach

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Disclosure statement

No potential conflict of interest was reported by the author(s).

to lessening AD incidence is to ensure that nursing students are adequately prepared to educate their patients and clients regarding health-promoting behaviors that may delay onset or progression of AD. It is also essential for all students to be updated regarding the latest advances in the science of AD, which is often available online before the most current information is represented in textbooks. The purpose of this pilot study was to test the effectiveness of an online self-directed learning activity, measured by pre-post tests for increasing nursing students' basic knowledge regarding the most common type of dementia; Alzheimer's.

Literature review

A search was conducted within the Cumulative Index of Nursing and Allied Health (CINAHL) and PubMed to evaluate published work regarding nursing students' basic knowledge of AD. The terms *Alzheimer's disease*, *dementia*, *nursing student knowledge*, and *United States/U.S./USA* were applied to academic journals, peer reviewed, and written within the last 5 years (2016–2021). Only 27 abstracts emerged, and of those, 14 were related to nursing student knowledge regarding Alzheimer's disease (AD) or other dementias. Eight were conducted outside the United States (Saudi Arabia, China, Iraq, Japan, Jordan, Kuwait, Nigeria, and Uganda.) We note a thorough 2018 systematic literature review, which investigated dementia attitudes and knowledge conducted by investigators based in Cyprus (Evripidou et al., 2019). In addition, several articles using Carpenter's et al. (2009) well-known Alzheimer's disease knowledge scale (ADKS) were available but fell outside the current literature date range. Finally, although there were multiple studies conducted in other countries, there were limited research articles within the United States that focused on the curriculum of nursing student's knowledge of AD, which are discussed here ($n = 5$).

Kimzey et al. (2016, 2019) conducted two different studies utilizing a convergent mixed method design and a quasi-experimental approach, respectively. In the first study of three different learning groups (online module, AD clinical experience, and no dementia-specific instruction), they investigated students' attitudes and knowledge about AD through pre-posttests. Measures included the Dementia Attitudes Scale (DAS) and Carpenter's et al. (2009) Alzheimer's Disease Knowledge Scale (ADKS). They found that dementia knowledge increased regardless of the type of educational approach. However, the AD clinical experience group showed the most improvement in scores over time ($M = 106.42$ and $M = 118.56$).

In their second study, (Kimzey et al., 2019) evaluated the effects of a virtual dementia experience on nursing student knowledge, attitudes, and empathy for people with dementia, and self-confidence of dementia care. The intervention group participated in an eight-minute virtual dementia experience simulation, which included alteration of senses during everyday tasks through a patented device. Measures included the Dementia Knowledge Assessment Tool Version 2 (DKAT2), a 21-item instrument evaluating knowledge of dementia and dementia care, in which higher scores indicate greater knowledge, the Interpersonal Reactivity Index (IRI) which examined empathy as the reactions of one individual to the observed experiences of another, and the Confidence in Dementia Scale (CODE)

a nine -item self-report questionnaire measuring in working with persons living with dementia (PLWD) that can be scored from 9 to 45 (Kimzey et al., 2016, 2019). Kimzey and colleagues (2019) found that dementia knowledge increased across both groups, but significant improvements were found in the students' attitudes and empathy scores in the group using the virtual simulation.

Adewuyi et al. (2018) investigated undergraduate nursing programs integrated learning regarding dementia using a sequential explanatory mixed method study. A Dementia Care Content in Entry-Level Undergraduate Nursing Curricula (DCCNC) instrument was developed and administered. The participant sample of $n = 111$ for the quantitative phase, and $n = 8$ for a subset who participated in the qualitative phase, were interviewed regarding delivery of dementia care content. Most ($n = 99$; 71.2%) of the prelicensure students received didactic instruction regarding patients with dementia, with six (4.3%) receiving instruction via YouTube videos or podcasts. Utilization of effective communication to meet cognitive and emotion needs of people living with dementia (PLWD) was the most reported area of competency ($n = 76$, 54.7%). The least commonly reported competencies were promoting a positive environment for PLWD ($n = 53$, 38.1%) and awareness of stigma ($n = 1$, 0.7%). In the qualitative phase of the study, clarification of geriatric syndromes such as dementia versus delirium was frequently requested (Adewuyi et al., 2018).

Mastel-Smith et al. (2019) studied the effect of a Dementia Care Bootcamp, combined with a clinical experience in improving nursing students' dementia knowledge, attitudes, empathy, and self-confidence in caring for PLWD. Results in this quasi-experimental study were compared with students who participated only in bootcamp activities, which included case studies, quizzes, videos, and hearing from caregivers about their experiences (Mastel-Smith et al., 2019). Four instruments used were the Dementia Knowledge Assessment (DKA), Dementia Attitudes Scale (DAS), the Interpersonal Reactivity Index (IRI) and the Confidence in Dementia Scale (Mastel-Smith et al., 2019). Although scores increased in regards to dementia knowledge, attitudes, and self-confidence (not empathy) after the bootcamp, no significant differences were found between the clinical and non-clinical experience groups. The authors suggested that one day of a dementia-specific clinical experience is insufficient. Of interest is that confidence significantly improved between baseline and six months.

Meyer et al. (2020) explored healthcare students' abilities to deliver person-centered care to PLWD after participating in a dementia simulation program. Three main themes emerged from the research to illustrate the effectiveness of transformative learning theory applied to students' experiences. Students were surprised by the difficulty they experienced in completing the simulation tasks, and applied this to PLWD (Theme 1). Students gained skills in personalizing and amending care plans for PLWD (Theme 2). Simulation was useful as a means of applying new knowledge to improve the lives of individuals living with common comorbidities (Theme 3) (Meyer et al., 2020).

In summary, this literature review targeting student knowledge regarding dementia included two quantitative, one qualitative, and two mixed methods studies. The teams of Kimzey, Adewuyi, and Mastel-Smith identified that clinically based simulation was the most

effective means of increasing learning outcomes. They also reported that preparing nurses at the undergraduate level should include journaling and simulation to inspire empathy and achieve positive or improved attitudes when working with PLWD and families. Both Kimzey and colleagues and Mastel-Smith et al. (2019) found that students gained competency in caring for PLWD as they gained more experience. Both Kimzey et al. (2016, 2019) and Adewuyi et al. (2018) noted that the curricula for the nursing program is heavy-laden, and that nursing student knowledge regarding the spectrum of dementia would benefit from research. They noted the importance of revising curricula to ensure inclusion that all aspects of Alzheimer's Disease and Related Dementias (ADRD) are included.

These findings identified the gap that current nursing curricula may not be sufficient to address the constantly emerging information regarding dementia. Therefore, we developed this pilot study to test the effectiveness of online modules, which might provide access to the most recent science regarding AD risk, prevention, detection, and treatment. We also wanted to know if self-directed learning would be effective in increasing dementia knowledge.

Limitations of the literature review included that studies were limited to the U.S., and in some cases, sample sizes were modest. Although there were statistically significant improvements in nursing students' confidence, competency, and attitudes, all authors called for more research. This is congruent with our earlier study of 102 baccalaureate students in Florida, the state with the second highest percentage of older adults (Wiese & Williams, 2018). Students demonstrated significant knowledge gaps, with as many as 71% answering incorrectly on multiple items in both basic and advanced knowledge measures. More investigation regarding the effectiveness of self-directed online learning is needed, considering its increased use during the recent Covid-19 pandemic and associated quarantine. This query is especially important when applied to teaching student nurses about a disease in which the science is continually changing.

Theoretical framework

In recognition that higher education students are adult learners, it is important to establish a theoretical framework that recognized the significance of adult learning. One characteristic of adult learners is that they are self-directed and their learning is enhanced when their experience is recognized and utilized in the learning process (Knowles, 1980). We aimed to use principles that view the adult learner as self-directed because it shifts the focus away from the instructor as the source for generating knowledge, and instead positions the instructor as a facilitator and collaborator of knowledge development (Tough, 1979). This in turn can guide the learner and help co-create an environment for self-directed learning (Merriam, 2001; Tough, 1979). The theory of adult learning, also known as Andragogy, was developed by Malcolm Knowles in 1968. Knowles defines self-directed learning as 'a process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying resources for learning, choosing and implementing appropriate learning strategies and evaluating learning outcomes' (Knowles, 1975, p.18). This theory grounded the instructional design through principles of a) allowing the student to take ownership of their learning needs and b) transition from being externally to internally driven to attain new knowledge and

consequently apply that knowledge. Although we fell short of assessing readiness in this pilot study, self-directed learning could be an effective means for nursing students to enhance their learning regarding ADRD, and translate that learning to effective care of older adults.

Instructional design

Providing effective care through caring science principles is the foundation on which all learning activities are structured at the C.E. Lynn College of Nursing. For example, Watson's Human Caring theory (Watson, 2007) served as the framework for designing this project. Watson's theory is composed of four main concepts; the transpersonal caring relationship, caring moment/caring occasion, caring-healing consciousness and caritas processes (Watson, 2007). Within the Theory of Human Caring, Watson asserts that the caritas processes are the core of nursing, and provide guidance for nursing actions. Applied to the disease of dementia, it is important to be grounded in a caring process that guides that relationship between caregiver and the individual with dementia. Using the caritas process directs students to determine problems in a holistic manner, including how to respond and adapt beyond the physical needs to address the patient's communication, emotional, and family needs. As a result, this theory can aid students in their ability to provide quality care that promotes a caring-healing process for individuals and caregivers struggling with dementia (Watson, 2022).

Course objectives

The C.E. Lynn College of Nursing has 12 program outcomes that are available on the College's website (2022). Each of these are addressed in the BSN Population Health course objectives. The objectives are designed to increase each student's ability to develop the 6C's of Caring (Roach, 2002). The 6Cs are competence, compassion, confidence, commitment, comportsment, and conscience. Competence is the Course Outcome most relevant to this pilot study regarding nursing student knowledge of Alzheimer's disease. The particular course objectives, associated AACN Essential (2008, 2021), and Level of Learning (Bloom, 1956) are offered in Table 1. The teaching/learning was the same for each objective (video lecture and optional reading), and tested through formative evaluation. This was an informal discussion during class at mid-term re ADRD knowledge gained and understanding. To assess self-monitoring, control, and desire for learning, the faculty inquired what activities the students were completing, including the optional reading resources available through the online website, as well as progress of and perceptions about the online self-learning activity. Faculty monitored completion of the required class assignment (Module 1) by the due date, and followed up with students lagging behind. The summative evaluation was based on the post-BKAD score and Course Exam (inclusion of ten questions addressing knowledge regarding Alzheimer's disease). This educational offering was also guided by the American Association of Colleges of Nursing (AACN) Domain 1; Knowledge for Nursing Practice, and the Core Competency 2.8c; Educate individuals and families regarding selfcare for health promotion, illness prevention, and illness management.

Method

A quasi-experimental study was conducted among 44 undergraduate nursing students, and results were compared to an earlier cohort of 102 students for a total $N= 146$. Descriptive frequencies of scores per item were compared. Independent t-test was used to analyze total scores between the 2018 and 2020 cohorts, and pre-posttest total scores using paired samples t-test of the 2020 cohort was employed.

In the earlier study, tests were given following traditional teaching regarding ADRD, which was included in the population health unit on care of older adults. The textbook for the earlier cohort did not have content specifically discussing dementia (a consequent edition now includes three pages discussing ADRD). In this current cohort, students were also asked to complete a minimum of four modules to achieve four hours of e-learning accessed through the National Institute of Aging (NIA) website (National Institutes of Aging, 2020), as a means of accessing updated information regarding dementia. Twenty-five modules in total were available for learning, which ranged from an overview of mild cognitive impairment, to dementia diagnosis and management. Caregiver support was also included, such as addressing behaviors in dementia. We note that in both the textbook and online venue, content regarding prevention of decrease in dementia risk was absent.

The instructor emphasized repeatedly in both verbal and written form, even beyond the consent process, that participation was voluntary. All students in either the traditional baccalaureate of science (BSN) 2018, or the accelerated (previous B.S. degree) cohort voluntarily agreed to participate, except one student from the 2022 group, who proceeded with the routine class assignments. For purposes of this study, self-directed learning was defined as a learning method in which the student manages their own learning activities, supported by the teacher's directions and resources.

The Basic Knowledge of Alzheimer's disease (BKAD) survey (Wiese et al., 2017, 2020) was administered via online access to Qualtrics before and after the self-directed intervention. The t-test and BKAD item and total score analyses were conducted in answering the research question 'Is self-directed learning regarding dementia effective in increasing nursing student basic knowledge?' The study was approved by the university Institutional Review Board (#719852-12). The method of instruction in 2018 was a live classroom supported by the textbook power points available in the online management system (hybrid). The method of instruction in 2020 was initially started with a live classroom, but converted to a live remote online format, with additional self-directed learning to a National Institute of Aging website. This change in instructional format was necessary, due to the Covid-19 pandemic-related quarantine.

Setting and sample

The nursing student body at a Florida public university from which the study participants were drawn are racially and ethnically diverse: African Americans comprise 40%, Hispanics 13%, 5% Haitian Creole, 4% Asian, and 38% non-Hispanic White. At the time this study was conducted, the students learned about Alzheimer's disease and other dementias in their first medical surgical nursing course and chronic aging clinical experience. Due to the high

percentage of older adults in the south Florida community, students often cared for older adults who were at risk for or were experiencing the illness of dementia.

Statistical analysis

Sample size for the independent and paired samples t-tests were calculated using a two-tailed, medium effect size (0.50), alpha of 0.05, and 80% power, resulting in a sample size of 34 required participants. Therefore, for both cohorts, the number of participants (2018 $n = 34$, and 2020 $n = 44$) was sufficient.

Measures

The socio-demographic survey included questions regarding age, race, ethnicity, total years as a nursing student, and total years in college. Each student was asked the number of times a formal lecture in nursing school regarding Alzheimer's disease or a related dementia was received. Being an informal or formal caregiver for someone with Alzheimer's disease with the categories was also assessed. Students were asked to indicate if their home outside of school was located in an urban or rural setting.

In addition to the socio-demographic survey, a basic measure of Alzheimer's disease (BKAD) survey (Wiese et al., 2017, 2020) was administered. The 30-item BKAD addresses subjects' knowledge of early detection and screening, and includes true/false questions regarding recent AD-associated health topics (e.g., diabetes and head injury). These items are not addressed in the well-known Alzheimer's disease knowledge scale (ADKS; Carpenter et al., 2009). The BKAD also includes a novel item regarding cognitive screening that is now a required component of the Patient Protection and Affordable Care Act (2010) mandated annual wellness visit, which is free of charge to patients. The total score possible is 30, with higher scores indicating greater knowledge. The BKAD survey previously demonstrated good internal consistency (Cronbach's $\alpha = .82$) after several phases of testing with 753 participants in five different rural areas (Wiese et al., 2020).

Educational intervention

Students in both cohorts completed the required work in the module, delivered through the online management course. The baseline content was the same for both the live and online lectures, which concentrated primarily on the incidence, physiology, recognizing the symptoms of dementia, and caregiver strain. In the live class, the instructor also discussed risk factors, warning signs/symptoms of Alzheimer's disease, potential prevention strategies, and importance of early detection and treatment.

Students in the second (2020) cohort were randomized by SPSS assignment into the control or intervention group. Specifically, the intervention group completed the 'Alzheimer's Disease and Related Dementia Mini-course' available through the NIA website link to the Alzheimer's Disease Research Center of the University of Washington (2021). Students were directed to complete four video lectures addressing ADRD pathology basics, symptoms, detection, and management. They were also encouraged to investigate the NIA website further, as numerous learning resources are available there, including communicating with older adults and best caregiving practices. Proof of completion of the

modules was verified by uploading a statement of completion, following the honor system in place at the University. The BKAD was then administered post-intervention to assess potential gains in knowledge. All 2020 cohort students completed both the pre-posttest surveys.

Results

Descriptive statistical analysis of the sociodemographics was completed prior to examining potential Pearson or chi-square correlations between independent variables (age, years of education, race, caregiver status, and ethnicity) and the dependent variable (level of BKAD knowledge). Independent samples t-test comparison of the total score was conducted between the 2018 one-time survey and the 2020 pretest survey (prior to the educational intervention). Pre-posttest paired samples scores in the 2020 quasi-experimental sample were then compared. We also analyzed the differences in frequency of correct responses between the 2018 and 2020 cohorts, and between the pre-post testing of the 2020 cohort (See Table 2). We also examined differences between the 2018 one-time score, and the 2020 post-intervention score, by considering potential differences related to teaching method, instructor expertise, historical (time) effect, or some unknown factor.

Sociodemographics

Sociodemographic characteristics between the 2018 and 2020 cohort were not significantly different. Similar to our student population, both cohorts demonstrated diversity in age and country of origin (see Table 2). Sixty-one percent were non-Hispanic White, 13% African-American, 5% Afro Caribbean, 5% Hispanic American, 5% Asian American, and 11% 'Other,' which included 2 from India (South Asia), 1 from the Philippines, and 1 from Iran. Two thirds ($n = 30$) of the students were native Floridians, while nine were from other US states. In addition to their student roles, students also worked as resident and medical assistants, pharmaceutical technicians, first responders, certified nursing assistants, food/beverage servicers, and caregivers of older adults (three, of which two were PLWD.) Nine were married, 33 were single, one widowed, and one separated/divorced.

2018 independent sample BKAD knowledge scores

The 2018 cohort identified the correct (true) response to 'Staying physically active might help to decrease the chances of getting AD' 81% of the time, whereas in 2020, 94% of the baseline (pretest) group answered correctly. For the item 'Nothing can be done to reduce the risk of getting AD,' in 2018, 75% of students answered correctly (false), as compared to 95% of the 2020 cohort answering correctly. Surprisingly, for the item 'Persons with AD experience less pain than other people,' the 2020 cohort answered *incorrectly* more often by 8% than the current group. For the test item 'Medicine is available that may keep AD from becoming worse,' there was an even greater (13%) decrease in correct responses from 2018 to 2020 (See the items marked with a blue triangle in Table 2).

2020 cohort pre-post BKAD knowledge scores

Overall, 2020 BKAD pretest total scores ($M = 23.7$, $SD = 4.6$) were lower than the BKAD posttest scores ($M = 27.4$, $SD = 3.4$). The paired samples t-test finding for this intervention

was significant: $t(43) = 2.28, p = .03$, with a Cohen's d medium effect size of -27.7 . No significant Pearson's r or chi-square correlations were found between BKAD knowledge scores and sociodemographic characteristics. Students in the posttest 2020 group scored 90 or higher on 14 items (35%), and 80–89% on an additional 13 items. Gaps in knowledge among the 2020 group that remained after the self-directed intervention were notable in regards to two items. These items were 1) recognizing head injury as a potential risk factor, in which 76% answered correctly, and 2) 'Medicine is available that may keep AD from becoming worse' (67% answered correctly). This latter finding was concerning, as it suggests that students may not be carefully reading the item, critically appraising the question, or receiving accurate information. It is well-known that there is no cure for AD (another item on the survey), but there are treatments that can be of benefit in managing dementia-associated behaviors, especially if initiated earlier in the disease process (Livingston et al., 2017).

Comparisons in baseline knowledge between the 2018 and 2020 cohorts

The 2020 pretest results were compared with those from the similar, but non-interventional study conducted in 2018, in which dementia knowledge was tested after students in the Population Health course completed the usual hybrid (live and online) course module regarding care of older adults. There was no significant difference between the 2018 and 2020 (pretest) cohort: $t(31) = 1.5, p = .079$ ($M = 26.8, SD = 3.5$, and $M = 27.3, SD = 2.9$). Overall, total correct responses stayed nearly the same or increased slightly in 19 of the 30 items between the 2018 and 2020 baseline surveys. The strongest gaps in the 2020 cohort's pretest knowledge, as indicated by scores below 80%, concerned one item regarding risk: 'Persons with a history of diabetes or high blood pressure are at greater risk of AD' (with 72% answering correctly), and two regarding symptomatic behaviors: 'Trouble managing bills may be a sign of AD' (79%), and 'Persons with AD always go through a violent stage' (77%) (Table 2).

Comparison between 2018 cohort one-time survey and 2020 posttest

Students in the 2020 posttest cohort actually scored lower in 10 items than the 2018 group, after completing the usual online module and the self-directed learning intervention (See items highlighted in red in Table 3).

Discussion

In this pilot study, the literature review revealed that although numerous gaps in nursing student knowledge about ADRD exist, the use of simulation to supplement didactic content was the most effective means of educating nursing students in dementia care. Reflective journaling was shown to enhance learning. A foundational level of ADRD-related knowledge is needed prior to conducting simulations, but the state of the science is emerging more rapidly than textbooks can reflect. Therefore, we tested a self-directed learning module that connected students with updated web resources. However, the 2020 students showed lower scores in 10 items than the 2018 cohort, even after completing the dementia-focused online module. Gaps in knowledge related to medication treatment, signs, and potential risk

factors remained. This is concerning, in light of our increasing older adult population with ADRD that will be cared for by future nurses.

Of potential importance to our results comparing the 2018 and 2020 cohorts was that the first cohort was taught through a hybrid (in person and online) content delivery program. Furthermore, the instructor was an ANCC board-certified gerontological nurse, and community-based nurse researcher focused on increasing early detection of Alzheimer's disease and related dementias. She shared stories and nursing situations from her practice to enhance instruction. In the 2020 cohort, the instructor also shared stories and nursing situations from her practice, and all students were from the accelerated track. The faculty member was a Doctor of Nursing Practice (DNP), and board-certified Family Nurse Practitioner. The lecture content itself was the same for both cohorts, and did not change over the two-year period, except for the added self-directed learning intervention in the 2020 group. Secondly, media attention to ADRD, and the numbers of 'baby boomers' reaching age 65, are steadily increasing, which may be indirectly contributing to student baseline knowledge regarding dementia; due to a phenomenon referred to as history effect in research (American Psychological Association, 2020). For example, the history effect in this study could cause the correct response to nearly double between the 2018 and 2020 baseline response to the item 'For persons over 65, having your memory tested should be part of your regular checkup,' suggesting that students are hearing the message that early detection is important. However, this does not explain why scores in five of the ten items actually decreased significantly ($p < .05$) in both cohorts' original scores. These items were: The sooner you get help for AD, the more you may slow it down; Wearing a heavy coat when it is hot outside may be a sign of AD; Medicine is available that may keep AD from becoming worse; Losing your keys from time to time is normal; Persons with AD experience less pain than other people. We were unable to clearly surmise reasons for these results, which contributed to the following implications.

Implications for research, teaching, and practice

In addition to comparing and contrasting dementia-related curricula and type of instruction, it would be helpful to explore students' additional experiences or resources that impacted learning. Queries such as informal caregiving, story-telling, personal searches for information, and other sources of learning regarding ADRD might shed light on the variations in ADRD knowledge. Furthermore, partnering with students to both identify preferred teaching strategies, and test novel educational approaches, to increase learning would provide benefit. Designing interactive approaches to dementia-specific student learning that will engage students, while streamlining curricula and providing current information, is needed. Repeating this pilot study in different settings and cultures would help to identify community-specific gaps in knowledge.

Regarding implications for teaching, we did not assess student readiness for self-directed learning, nor were faculty educated specifically regarding self-directed learning principles or strategies. These gaps in preparation, related to the unexpected quarantine, were foundational cracks leading to failure in learning. Students were trusted to read the NIA module (there was no verification of completion). It would be helpful in the future to ask

for a descriptive evaluation of learning. For example, the students could be asked to upload a one paragraph summary of their learning as a written assignment. The prompt would be to identify three specific items from the module regarding dementia prevention that they felt were particularly important for them to a) teach patients, b) teach their family, and c) behaviors they could adopt to decrease their own risk. Each point would require a quoted citation referenced by the page number or paragraph from the assigned module to demonstrate their specific engagement with the content.

These findings add weight to the need to provide a consistent and accurate means of educating and updating students regarding the basics of Alzheimer's disease. New information is emerging routinely regarding contributors to cognitive decline, and the impacts of dementia, which have been heightened by increased isolation related to Covid-19 mandatory quarantines (Lazzari & Rabottini, 2021; Rainero et al., 2021). Nurses also need to be provided updated training and education regarding ADRD. These healthcare providers of older adults also need to be self-aware of false perceptions regarding persons with dementia, such as the belief that persons with dementia don't experience pain or distress the same way as persons without cognitive decline. False perceptions preventing accurate interventions could potentially cause harm to the person or family.

Another important consideration is the potential benefit of instruction that includes instructor stories and experiences, and instructor training in the specific content area. The teacher for the 2018 cohort was a researcher and instrument designer in the field of education/early detection of Alzheimer's disease and related dementias. This is unlikely to be the norm in a population health class. Content needs to be designed and taught using a regularly updated curriculum that includes more stories from practice as a valuable means of relating to enhance learning.

Regarding practice, nurses are in a unique position to encourage their patients and communities regarding health behaviors that can promote brain health. In the past, it was believed that nothing could be done to diminish the threat or progression of disease. We now know that there are at least 12 health-promoting behaviors that could potentially decrease 40% of global dementia incidence (Livingston et al., 2017, 2017). These behaviors include more effective management of hypertension, obesity, diabetes, depression, and smoking cessation. They also include increasing levels of physical activity, social engagement, and hearing ability. Most recently, three new modifiable risk factors were added: traumatic head injury, air pollution, and excessive alcohol consumption (Livingston et al., 2017.) Furthermore, it is recognized that ADRD is a life course disease: childhood trauma, including loss of a parent and/or physical and mental neglect Donley et al. (2018), low socioeconomic status, (Deckers et al., 2019) and low early-life school performance (Dekhtyar et al., 2016) are associated with a greater risk of dementia later in life. As these potentially modifiable risk factors are person-centric, holistic approaches are critical to the success of lowering ADRD incidence (Griffiths et al., 2015).

Effective nursing care is grounded in holistic approaches, and nurses are perfectly positioned to provide person-centered education and interventions for increasing healthy lifestyles. Nurses can also be the catalyst for making change through educating themselves and the

communities they serve, beginning with children in schools regarding dementia risk factors. Nurses can serve on boards to effect policy changes, such as mandating helmet rules in contact sports, insurance support to provide hearing aids when needed, and environmental policies to increase green spaces for walking, and control of carbon-producing emissions.

Limitations

First, we did not fully engage the principles of self-directed learning, which includes the conceptualization, design, implementation and evaluation of learning guided by learners (Tekkol & Demirel, 2018). Secondly, the content that was available at the time through the NIA website (National Institutes of Aging, 2020) did not address ADRD prevention, risk, and benefits of early detection. These are concepts that are targeted in the BKAD measure. In contrast, the instructor who taught the 2018 content did include those in the live lecture, as she had designed the BKAD, which likely contributed to a biased result. Third, the basic levels of Bloom's taxonomy (Remembering, Understanding, and 'Applying') may have been the only objectives that actualized through the limited activities of the online learning format. It would have been helpful to add either an in-person or online simulation to achieve higher learning through 'Analyzing,' 'Evaluating' and 'Creating' (Adams, 2015; Bloom, 1956).

As in any convenience sample study, this work is limited in scope and generalizability. These pilot study findings would be greatly enhanced by randomization and wider testing among other schools of nursing. It would be helpful to know for example, if nursing student knowledge regarding ADRD varied between geographical and cultural settings, including rural (i.e., Montana, Appalachia, and New Mexico) and urban (i.e. Miami, San Francisco, and Chicago) settings.

Another limitation is that although the BKAD has an advantage over the often used ADKS for measuring dementia knowledge in that it addresses more of these modifiable risk factors, it heavily emphasizes only one type of dementia (Alzheimer's), Updated scales that also address professionals' knowledge of two other common types of dementia that present differently (Lewy body and vascular) are needed.

There are various nursing-specific resources for assessing dementia risk, and managing dementia syndromes, such as Hartford Institute's 'ConsultGeri.org,' and 'Nurses Improving Health Care for Elders' (NICHE) by Boltz et al. (2008), and Mezey et al. (2004). Nursing could benefit further from creating their own web portal that connects continually evolving dementia discoveries with a holistic care plan of nursing assessments and interventions. In summary, for a disease that impacts not only the health of the person affected, but also the caregivers, community, and nation, it is essential that nurses are armed with the most recent information and resources for diminishing the threat of dementia, which begins with the state of the science education of our nursing students.

Conclusion

Preparing nursing students to care for the increasing number of older adults at risk for, or experiencing ADRD should involve an annual review of the science by gerontology-

trained faculty. Consequent updating of curriculum as needed should include the most recent advances regarding prevention, risk, detection, treatment, and management. Didactic teaching by faculty knowledgeable in the latest advances related to ADRD, combined with nursing stories from practice, should be continuously incorporated. Prior to implementing self-directed learning strategies, both faculty and student readiness should be assessed and addressed. Self-directed learning, although potentially beneficial, should be supplemented with interactive and holistic teaching strategies, including simulation, particularly regarding actions involving care of others. We also recommend that teaching and learning activities involving care of older adults should be built on a caring science theoretical framework. All students and nurses must continue to actualize their potential in promoting healthy behaviors and brain health among older adults who face increased risk of ADRD.

Funding

Funding received from the National Institute on Aging, # K01AG064047

References

- Adams NE (2015). Bloom's taxonomy of cognitive learning objectives. *Journal of the Medical Library Association: JMLA*, 103(3), 152. 10.3163/1536-5050.103.3.010 [PubMed: 26213509]
- Adeuyi M, Kimble LP, Dormire SL, & Sudia T. (2018). Dementia care content in prelicensure nursing curricula: A pilot mixed-methods study. *The Journal of Nursing Education*, 57(2), 88–95. 10.3928/01484834-20180123-05 [PubMed: 29384569]
- Aljezawi ME, Al Qadire M, Suliman M, Al Omari O, & Khalaf A. (2022). Undergraduate nursing students' knowledge of and attitudes toward people with Alzheimer's disease. *BMC Geriatrics*, 22(1), 1–9. 10.1186/s12877-022-03389-6 [PubMed: 34979941]
- Alzheimer's Association. (2021). Alzheimer's disease facts and figures. <https://www.alz.org/alzheimers-dementia/facts-figures>
- Alzheimer's Disease Research Center, University of Washington. (2021). Mini-course of Alzheimer's disease and related dementias. <https://depts.washington.edu/mbwc/adrc/page/ADRD-mini-course>
- American Academy of Nursing (AACN). (2008). *The Essentials: Core Competencies for Professional Nursing*. <https://www.aacnnursing.org/Portals/42/AcademicNursing/pdf/Essentials-2008.pdf>
- American Academy of Nursing (AACN). 2021 *The Essentials: Core Competencies for Professional Nursing* <https://www.aacnnursing.org/Portals/42/AcademicNursing/pdf/Essentials-2021.pdf>
- American Psychological Association. (2020). Definition of history effect. *Dictionary of Psychology*. <https://dictionary.apa.org/history-effect>
- Bloom BS (1956). *Taxonomy of educational objectives: The classification of educational goals*. Longmans, Green.
- Boltz M, Capezuti E, Bowar-Ferres S, Norman R, Secic M, Kim H, Fairchild S, Mezey M, & Fulmer T. (2008). Changes in the geriatric care environment associated with NICHE (Nurses Improving Care for Health System Elders). *Geriatric nursing*, 29(3), 176–185. 10.1016/j.gerinurse.2008.02.002 [PubMed: 18555159]
- Carpenter B, Balsis S, & Otilingam PH, & Gatz M. (2009). The Alzheimer's disease knowledge scale: Development and psychometric properties. *The Gerontologist*, 49(2), 236–247. 10.1093/geront/gnp023 [PubMed: 19363018]
- Carper B. (1978). Fundamental patterns of knowing in nursing. *Advances in Nursing Science*, 1(1), 13–23. 10.1097/00012272-197810000-00004
- Christine E. Lynn College of Nursing. (2022). C.E. Lynn college of nursing curriculum model. <https://nursing.fau.edu/academics/curriculum-model.php>

- Deckers K, Cadar D, van Boxtel MP, Verhey FR, Steptoe A, & Köhler S. (2019). Modifiable risk factors explain socioeconomic inequalities in dementia risk: Evidence from a population-based prospective cohort study. *Journal of Alzheimer's Disease*, 71(2), 549–557. 10.3233/JAD-190541
- Dekhthar S, Wang HX, Fratiglioni L, & Herlitz A. (2016). Childhood school performance, education and occupational complexity: A life-course study of dementia in the kungsholmen project. *International Journal of Epidemiology*, 45(4), 1207–1215. 10.1093/ije/dyw008 [PubMed: 26968481]
- Donley GA, Lönnroos E, Tuomainen TP, & Kauhanen J. (2018). Association of childhood stress with late-life dementia and Alzheimer's disease: The KIID study. *European Journal of Public Health*, 28(6), 1069–1073. 10.1093/eurpub/cky134 [PubMed: 30020441]
- Evrpidou M, Charalambous A, Middleton N, & Papastavrou E. (2019). Nurses' knowledge and attitudes about dementia care: Systematic literature review. *Perspectives in Psychiatric Care*, 55(1), 48–60. 10.1111/ppc.12291 [PubMed: 29766513]
- Griffiths P, Bridges J, Sheldon H, & Thompson R. (2015). The role of the dementia specialist nurse in acute care: A scoping review. *Journal of Clinical Nursing*, 24(9–10), 1394–1405. 10.1111/jocn.12717 [PubMed: 25469780]
- Kimzey M, Mastel-Smith B, & Alfred D. (2016). The impact of educational experiences on nursing students' knowledge and attitudes toward people with Alzheimer's disease: A mixed method study. *Nurse Education Today*, 46, 57–63. 10.1016/j.nedt.2016.08.031 [PubMed: 27598794]
- Kimzey M, Mastel-Smith B, & Seale A. (2019). Effects of dementia-specific education for nursing students. *Nurse educator*, 44(6), 338–341. 10.1097/NNE.0000000000000623 [PubMed: 30557205]
- Knowles M. (1975). *Self-directed learning: A guide for learners and teachers*. Association Press.
- Knowles M. (1980). *The modern practice of adult education. From pedagogy to andragogy* (2nd ed.). Follett Publishing Company.
- Lazzari C, & Rabottini M. (2021). COVID-19, loneliness, social isolation and risk of dementia in older people: A systematic review and meta-analysis of the relevant literature. *International Journal of Psychiatry in Clinical Practice*, 26(2), 1–12. Advance online publication. 10.1080/13651501.2021.1959616
- Livingston G, Huntley J, Sommerlad A, Ames D, Ballard C, Banerjee S, Brayne C, Burns A, Cohen-Mansfield J, Cooper C, Costafreda SG, Dias A, Fox N, Gitlin LN, Howard R, Kales HC, Kivimäki M, Larson EB, Ogunniyi A, & Mukadam N. (2017). Dementia prevention, intervention, and care: 2020 report of the lancet commission. *The Lancet*, 396(10248), 413–446. 10.1016/S0140-6736(20)30367-6
- Livingston G, Sommerlad A, Orgeta V, Costafreda SG, Huntley J, Ames D, Ballard C, Banerjee S, Burns A, Cohen-Mansfield J, Cooper C, Fox N, Gitlin LN, Howard R, Kales HC, Larson EB, Ritchie K, Rockwood K, Sampson EL, & Mukadam N. (2017). Dementia prevention, intervention, and care. *The Lancet*, 390(10113), 2673–2734. 10.1016/S0140-6736(17)31363-6 .
- Mastel-Smith B, Kimzey M, & He Z. (2019). Dementia care education for nursing students. *The Journal of Nursing Education*, 58(3), 136–143. 10.3928/01484834-20190221-03 [PubMed: 30835800]
- Mattos MK, Jiang Y, Seaman JB, Nilsen ML, Chasens ER, & Novosel LM (2015). Baccalaureate nursing students' knowledge of and attitudes toward older adults. *Journal of Gerontological Nursing*, 41(7), 46–56. 10.3928/00989134-20150429-01
- Merriam SB (2001). Andragogy and self-directed learning: Pillars of adult learning theory. *New Directions for Adult and Continuing Education*, 2001(89), 3–14. 10.1002/ace.3
- Meyer K, James D, Amezaga B, & White C. (2020). Simulation learning to train healthcare students in person-centered dementia care. *Gerontology & Geriatrics Education*, 43(2), 1–16. 10.1080/02701960.2020.1838503
- Mezey M, Kobayashi M, Grossman S, Firpo A, Fulmer T, & Mitty E. (2004). Nurses improving care to health system elders (NICHE): Implementation of best practice models. *The Journal of Nursing Administration*, 34(10), 451–457. 10.1097/00005110-200410000-00005 [PubMed: 15577667]
- National Institutes of Aging. (2020). Alzheimer's dementia resources for professionals. <https://www.nia.nih.gov/health/alzheimers-dementia-resources-for-professionals>
- Patient Protection and Affordable Care Act, 42 U.S.C. § 18001. (2010).

- Rainero I, Bruni AC, Marra C, Cagnin A, Bonanni L, Cupidi C, Laganà V, Rubino E, Vacca A, DiLorenzo R, Provero P, Isella V, Vanacore N, Agosta F, Appollonio I, Caffarra P, Bussè C, Sambati R, Quaranta D, & SINDem COVID-19 Study Group. (2021). The Impact of COVID-19 quarantine on patients with dementia and family caregivers: A nation-wide survey. *Frontiers in aging neuroscience*, 12, 625781. 10.3389/fnagi.2020.625781
- Roach MS (2002). *Caring, the human mode of being: A blueprint for the health professions* (2nd rev.Ed). CHA Press.
- Tekkol A, & Demirel M. (2018). An investigation of self-directed learning skills of undergraduate students. *Frontiers in Psychology*, 9, 2324. 10.3389/fpsyg.2018.02324 [PubMed: 30532727]
- Tough A. (1979). *The adult's learning projects*. Ontario Institute for Students in Education.
- Watson J. (2007). Watson's theory of human caring and subjective living experiences: Carative factors/ caritas processes as a disciplinary guide to the professional nursing practice. *Texto & Contexto Enfermagem*, 16(1), 129–135. 10.1590/S0104-07072007000100016
- Watson J. (2022). 10 caritas processes. Retrieved March 18, 2022 from <https://www.watsoncaringscience.org/jean-bio/caring-science-theory/10-caritas-processes/>
- Wiese LK, & Williams CL (2018). Nursing students' knowledge about Alzheimer's disease. *Journal of Nursing Education and Practice*, 8(11), 83. 10.5430/jnep.v8n11p83
- Wiese LK, Williams CL, Tappen RM, & Newman D. (2020). An updated measure for investigating basic knowledge of Alzheimer's disease in underserved rural settings. *Aging & Mental Health*, 24(8), 1348–1355. PMID: 30869990 PMID: PMC8474126. 10.1080/13607863.2019.1584880 [PubMed: 30869990]
- Wiese LK, Williams CL, Tappen R, Newman D, & Rosselli M. (2017). Assessment of basic knowledge about Alzheimer's disease among older rural residents: A pilot test of a new measure. *Journal of Nursing Measurement*, 25 (3), 519–548. (PMID: 29268833). 10.1891/1061-3749.25.3.519 [PubMed: 29268833]

Table 1.

C.E. Lynn College of Nursing Objectives and AACN Essentials (2008, 2021), congruence to attain the course outcome ‘becoming competent’.

| Course Objective | AACN Essential ^a | Bloom’s Taxonomy ^b |
|--|-----------------------------|---|
| 1.Using a holistic approach, assess protective and predictive factors, which influence the health of individuals, families, communities, and populations. | I, II, V | Remembering Understanding |
| 2.Explore . . . health promotion, disease and injury prevention, through the lens of caring science. | V, VII | Applying Understanding |
| 3.Use evidence-based clinical prevention practices and Ways of Knowing (Carper, 1978) to guide nursing responses to health teaching, health counseling, screening, outreach, referral. | III, VII | Applying Analyzing |
| 4.Adapt the nursing process to provide nursing care in the community to vulnerable or at-risk individuals. | II, V, IX | Evaluating Creating Analyzing Evaluating Creating |

The above Objectives are associated with the C.E. Lynn College of Nursing P rogram Outcomes 1–12, available at the College of Nursing Website.

^aAmerican Academy of Nursing (AACN) (2008, 2021). *The Essentials: Core Competencies for Professional Nursing*. <https://www.aacnnursing.org/Portals/42/AcademicNursing/pdf/Essentials-202>.

^bAdams (2015). Bloom’s Taxonomy of Cognitive Learning Objectives. *Journal of the Medical Library Association: JMLA*, 103(3), 152. [10.3163/1536-5050.103.3.010](https://doi.org/10.3163/1536-5050.103.3.010)

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Table 2.

Student Sociodemographics; Categorical Variables.

| Variable | 2018 Cohort <i>n</i> = 102 | | 2020 Cohort <i>n</i> = 44 | |
|--|----------------------------------|-----------|---------------------------------|---------|
| | <i>f</i> | % | <i>f</i> | % |
| Male at birth | 12 | 12 | 8 | 18 |
| Female at birth | 90 | 90 | 36 | 82 |
| See a Provider | | | | |
| Yes | 18 | 18 | 10 | 23 |
| No | 84 | 84 | 34 | 77 |
| Caregiver | | | | |
| Yes | 4 | 4 | 3 | 07 |
| No | 98 | 98 | 41 | 93 |
| Ethnicity | | | | |
| Non-Hispanic White | 64 | 64 | 27 | 61 |
| African American | 12 | 12 | 6 | 13 |
| Afro Caribbean | 4 | 4 | 2 | 5 |
| Hispanic American | 10 | 10 | 2 | 5 |
| Asian American | 8 | 8 | 2 | 5 |
| Other | 4 | 4 | 5 | 11 |
| Marital Status | | | | |
| Single | 84 | 84 | 33 | 75 |
| Widowed | 16 | 16 | 1 | 2 |
| Married | 1 | 1 | 9 | 2 |
| Separated/Divorced | 1 | 1 | 1 | 2 |
| <i>Student Age and Years of Education (Continuous Variables)</i> | | | | |
| 2018 | <i>M</i> | <i>SD</i> | Minimum | Maximum |
| Age | 26 | 5.03 | 19 | 40 |
| Education | 19 | 4.91 | 14 | 24 |
| 2020 | | | | |
| Age | 34 | 5.67 | 20 | 47 |
| Education | 18 | 2.88 | 14 | 22 |

Table 3.

BKAD responses 2018 Cohort+ and pre-post education intervention 2020 cohort.

| | 2018 Cohort Correct* | 2020 Pre-test Correct Incorrect | | 2020 Post-test Correct Incorrect | |
|--|----------------------------|--|-------|---|-------|
| 1. The chance of getting AD is greater if a parent had it | 96 | 100 | 0 | 100 | 0 |
| 2. Persons with AD could remember things if they just tried harder * | 94 | 97.67 | 2.33 | 100 | 0 |
| 3. The sooner you get help for AD, the more you may slow it down. ▲ | 92 | 90.48 | 9.52 | 81.82 | 18.18 |
| 4. Stopping social activities could be a sign of AD | 86 | 81.82 | 18.18 | 88.24 | 11.76 |
| 5. Wearing a heavy coat when it is hot outside may be a sign of AD ▲ | 93 | 83.72 | 16.28 | 84.85 | 15.15 |
| 6. There may be a link between serious head injury and getting AD | 73 | 81.4 | 18.6 | 75.76 | 11.76 |
| 7. Forgetting words for familiar objects, even after a few minutes, may be a sign of AD | 90 | 88.37 | 11.63 | 88.24 | 11.76 |
| 8. Staying mentally active decreases the chances of AD | 88 | 81.4 | 18.6 | 88.24 | 11.76 |
| 9. AD is a normal part of growing older * | 98 | 90.7 | 9.3 | 94.12 | 5.18 |
| 10. Persons with Ad have less pain than other people * | 92 | 95.35 | 4.65 | 100 | 0 |
| 11. Being with others may keep your memory sharp | 86 | 88.37 | 11.63 | 82.35 | 17.65 |
| 12. There is a cure for AD * | 94 | 95.35 | 4.65 | 100 | 0 |
| 13. Keeping written lists as reminders are helpful in early AD stages | 98 | 97.67 | 2.33 | 96.97 | 3.03 |
| 14. Medicine is available that may keep AD from becoming worse ▲ | 81 | 86.36 | 13.64 | 67.65 | 32.35 |
| 15. Nothing can be done to reduce AD risk * | 75 | 86.05 | 13.95 | 94.12 | 5.88 |
| 16. Trouble managing bills may be a sign of AD | 84 | 79.07 | 20.93 | 85.29 | 14.71 |
| 17. Persons with a history of diabetes or high blood pressure are at greater risk of AD | 75 | 72.09 | 27.91 | 87.50 | 12.50 |
| 18. Healthy eating may decrease your AD risk | 88 | 88.37 | 11.63 | 94.12 | 5.88 |
| 19. Forgetting many appointments may be a sign of AD | 87 | 88.24 | 11.76 | 88.24 | 11.76 |
| 20. Persons with AD have less stress than other people * | 98 | 86.05 | 13.95 | 100 | 0 |
| 21. Losing your keys from time to time is normal ▲ | 90 ▲ | 97.67 | 2.33 | 85.29 | 14.71 |
| 22. Persons with AD experience less pain than other people *▲ | 92 | 81.4 ▲ | 18.6 | 85.29 | 14.71 |
| 23. Persons with AD will always recognize their close friends or family * | 96 | 97.67 | 2.33 | 100 | 0 |
| 24. Staying physically active might help to decrease the chances of getting AD | 81 | 90.7 | 9.3 | 94.12 | 5.88 |
| 25. Having difficulty remembering the rules of a game that you have played many times before may be a sign of AD | 86 | 88.37 | 11.63 | 88.24 | 11.76 |
| 26. People with AD always go through a violent stage * | 77 | 76.74 | 23.26 | 91.18 | 8.82 |
| 27. Constant lack of sleep may increase AD risk | 84 | 81.4 | 18.6 | 91.18 | 8.82 |
| 28. Asking someone the same question over and over again may be a sign of AD | 90 | 95.35 | 4.65 | 88.24 | 11.76 |
| 29. Trouble counting change may be a sign of AD | 95 | 90.7 | 9.3 | 100 | 0 |
| 30. For persons over 65, having your memory tested should be part of your regular checkup | 48 | 93.02 | 6.98 | 100 | 0 |

†. independent sample (one test only).

* = False is the correct answer.

▲ = Significant difference ($p < .05$) in 2018 test and 2020 cohort posttest responses.

1. items highlighted in Red indicate decreases in knowledge between 2018 (live) and 2020 (online course platform) didactic instruction.
2. Items in **Bold** indicate *decreases* in knowledge after a self-directed learning, web-based intervention (2020 pre-post intervention cohort).
3. Items both **Bolded** and Red indicate decreases in both circumstances (between 2018 and 2020, and after the self-directed learning intervention,) indicating knowledge deficits across all cohorts and assessments.

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