

Education of Nursing Students on Heat-Related Illness First Aid

by

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Background/Significance

Heat related illnesses (HRI's) are a cluster of medical conditions including heat stroke, heat exhaustion, rhabdomyolysis, heat syncope, heat cramps, and heat rash (The Center for Disease Control and Prevention, 2022). These occur when an individual is unable to maintain homeostasis and one's body temperature continues to rise above 100 degrees Fahrenheit. HRI's can be a medical emergency, leading to serious and potentially irreversible bodily injury if not treated rapidly. It is estimated that there are over 1,300 preventable deaths each year from HRIs (Environmental Protection Agency, 2022). However, this estimation is likely to be underreported due to the complex nature of HRIs. With hotter temperatures, deaths are higher in the summer months and are likely to increase alongside rising global temperatures (Environmental Protection Agency, 2022).

The summer months are ideal for crop growth and harvesting. Each year, over three million migrant and seasonal farmworkers – most of which are Latino - work under direct sunlight. Hot temperatures alongside inadequate hydration and limited workplace education on HRI prevention place migrant farmworkers at one of the highest at-risk populations for HRIs (Environmental Protection Agency, 2022). From 2000-2010, agricultural workers are thirty-five times more likely to die as a result of HRIs, and even more so male Latinos (Gubernot et al., 2015). Agricultural workers in 2021 made on average just over \$14 an hour in the United States despite the national average hourly wage being \$31.95 in May 2022 (Bureau of Labor Statistics, 2022). Lower wages and lower socioeconomic status put this population at risk for decreased healthcare access, contributing to increased morbidity and mortality (McMaughan et al., 2020). Compared to other groups, Hispanic persons living in the United States have some of the lowest insurance rates. Nineteen percent of the population is uninsured while six percent of non-

Hispanic whites are not (U.S. Department of Health and Human Services, 2021). Lower insurance coverage on average may result in higher upfront medical costs.

Historically in the United States, safety regulations for farmworkers are slow to emerge. Despite the large labor force, limited protections have left this population vulnerable to harm and exploitation. Occupational Safety and Health Administration (OSHA) has only recently begun to enforce HRI protection for the agriculture industry (OSHA, 2022), and only a handful of states have regulations aimed at limiting adverse heat events. However, none are states with the highest heat indexes (OSHA, 2022). While OSHA has limited regulations protecting farmworkers from heat illnesses, they provide a list of recommendations for employers to follow. This includes but is not limited to wearing protective clothing, drinking 16oz of water each hour, and recognizing HRI symptoms early. Each employee is also entitled to OSHA worker rights and protections consisting of the ability to speak up about safety hazards without fear of punishment, requesting an inspection, and reporting injuries (OSHA, 2022).

Beyond work and safety regulations, farmworkers who need emergency response teams are likely to experience increased wait times. This is due to increased distance from medical services. In a rural setting, the median response time for emergency medical services (EMS) is double compared to urban settings. Ten percent of response times reached nearly thirty minutes for EMS (Mell et al., 2017). Increased response times are associated with more adverse health outcomes, particularly in trauma patients.

With the focus on preventative care and education, the nursing profession has the ability to contribute greatly to limiting HRI's in farmworkers. To our knowledge, there are currently no other studies involving nursing students in improving farmworkers proficiency in HRI first aid. HRI's are also not a component of environmental health, mass casualty education, or public

health/population health in the AACN curriculum guidelines (American Association of Colleges of Nursing, 2022). With over 3.8 million registered nurses and 250,000 nursing students in the United States (American Association of Colleges of Nursing, 2019), it is imperative to use this untapped resource to educate and spread awareness on the importance of HRI prevention to those at risk.

Literature Review/Synthesis

Key search terms included "HRI" "Nursing Student" "Education" "Migrant Farmworkers" with Boolean phrases of "AND" and "OR". Based on these articles there is ample evidence linking HRI's to migrant farmworkers, and results are grouped as Prevalence of HRI's, HRI interventions, Nursing Student focus on HRI's prevention, train the trainer model in HRI's, and student healthcare education on HRI's and climate change.

Prevalence of HRI's

In the US Between 2017 and 2018, there were over 30,000 reports of HRI's through the National EMS Information System, most of which occurred during the summer and in the south Atlantic region. Over seventy percent of these reports resulted in treatment and transport via EMS (Yeargin et al., 2020). Each US state scored "above average" or "much above average" for summer 2022 temperatures, indicative of a nationwide risk for HRI's (National Centers for Environmental Information, 2022).

In Florida, studies conducted with citrus harvesters found they often have symptoms related to HRI's but are heavily underreported (Morera et al., 2020). Several farmworkers even believed this was just a part of the job, and they were the ones at fault for getting ill. Workers are sometimes paid based on the volume of their harvest, encouraging them to continue to work in

the heat and take fewer breaks. Focus groups provided insight on how farmworkers perceive HRI's, how they handle them, and what they believe they need in order to be successful in their jobs. These workers were familiar with HRI preventative measures but struggled with maintaining these practices (Morera et al., 2020). Another study conducted in Florida investigated the kidney function of over a hundred and fifty workers before and after their shift. Half of the participants were dehydrated prior to beginning their shift, and over eighty percent were dehydrated after. The possibility of Acute Kidney Injury was 47% higher for every 5 degree increase in temperature. Dehydration is a common affliction for farmworkers and will likely continue to negatively impact kidney health without further intervention (Mix et al., 2018).

An Eastern North Carolina (NC) study explored commonalities between farmworkers on hydration and perception of industry protection. Some of these results included a long distance between water and work locations, lack of industry standards to protect workers, as well as limited workplace education (Mizelle et al., 2022). In determining the prevalence of HRIs in NC farmworkers, it was found that 67% of those in the study reported working outside in very hot weather conditions. Over half of these individuals experienced at least one HRI symptom (Arcury et al., 2015).

A 2018 investigation in a Georgia farm found the average liquid consumption for employees was just over 70 oz per day, when the hourly recommended consumption is 16-32 oz. Over 60% of the sample experienced one or more heat related symptoms (Smith et al., 2021). A survey conducted of over 100 Georgia farmworkers found that overall, farmworkers were not concerned or worried about HRI's. These individuals tended to be H-2A workers and women (Luque et al., 2020).

HRI Intervention

The HEAT tool, an intervention intended to decrease prevalence of HRI's, was implemented in the Northwest region of the US. HEAT stands for Heat Education and Awareness Tool and provides training for agricultural employees as well as an app for employers. The focus of the application was to combine weather forecasts with agricultural safety recommendations. While the implementation of the tool was not located within the US region experiencing the highest rates of HRI's, this was the first study to investigate the use of a multi-level HRI intervention (Krenz et al., 2021). Washington State farmworkers participated in a summer educational course using a similar HEAT tool and found significant improvement in understanding of HRIs and how to prevent them (Marquez et al., 2022). A Heat Safety Tool app developed by OSHA works to inform crew leaders on weather data, heat indexes, and weather advisories (Luque, et al., 2020). Even with numerous efforts to improve understanding and prevention of HRIs, due to its complex nature it is difficult to determine the direct effects it will have on HRI deaths and hospitalizations.

In a 2018 study composed of over eighteen thousand participants, a community health worker led educational intervention was used to improve knowledge on HRIs. This resulted in a thirty eight percent decrease in hospital visits related to HRIs (Junaid et al., 2022). Topics included were risk factors, HRI symptoms, prevention and early recognition, diet, and what to do in case of a HRI emergency. Community health nurses played a role in ensuring interventions were culturally appropriate (Junaid et al., 2022). Despite the understanding that HRIs are a major contributor to poorer health outcomes in farmworkers, policies and regulations are limited in protecting this population. Today, studies are beginning to use a variety of educational tools geared towards improving awareness of HRIs. HEAT is a promising instrument intended to prevent adverse effects of prolonged heat exposure.

Nursing Student Focus on HRI Prevention

To our knowledge, studies of undergraduate nursing students' education on heat related illnesses in migrant farmworkers lacked depth and specificity. AgriSafe is an organization intended to educate both health care professionals and farmworkers but does not involve students. For five hundred dollars and twenty hours, the course titled "AgriSafe Nurse Scholar Program" includes prevention, identification, and assessment of agricultural workers' diseases and exposures (Mandarino, 2022).

Nursing students have yet to be the focus of improving health outcomes for migrant farmworkers. A study conducted on migrant farmworkers between 2016 and 2019 involved resident physicians and medical student volunteers who conducted medical visits and acted as interpreters. The farmworkers were able to attend clinics to receive healthcare, and researchers gathered data on most common chief complaint and treatment (Hirschl et al., 2021). Student Action with Farmworkers (SAF) is a program that works to improve outcomes for farmworkers in the Carolinas. The organization has partnered with universities including Wake Forest School of Medicine to investigate the health and safety of NC farmworkers under the age of 18. SAF has five different programs aimed towards education, awareness, and safety of agricultural workers (Arnold et al., 2019). However, once again, the involvement of nursing students is minimal.

Train the Trainer Model in HRI's

There is limited literature to our knowledge using train-the-trainer interventions with HRIs in farmworkers. The train-the-trainer model entails a team that undergoes training to become an expert in a subject. The trainers then relay said information to a larger population (Yarber, et al., 2015). This model has been successfully implemented in other research on farmworkers within a wide variety of local and larger populations. For example, Spanish

speaking farmworkers located in Miami, Florida were found to have higher rates of breast cancer. Using this model, the population was successful in reducing knowledge gaps and tailoring the education to the specific needs of the population (Rodriguez et al., 2020). Nurses are particularly important with this model because they are likely to contact many patients. A nurse's role in healthcare includes prevention and education, both of which tie heavily into this framework.

Student Healthcare Education on HRI's and climate change

With the close association between HRIs and rising temperatures, climate change education is necessary for the healthcare profession. A global study investigated the inclusion of climate change curriculum in over 2500 medical schools in 112 countries. Only 15% of the schools investigated contained climate change within the curriculum (Omnia et al., 2020). It is our understanding that current research on HRIs lacks involvement with nursing students yet has potential to limit adverse health outcomes of HRIs in vulnerable populations.

Research Questions/Aims

By training registered nurse (RN) and advanced practice registered nurse (APRN) students, the purpose of this quantitative research study was to increase RN and APRN student knowledge of HRI first aid, with the intention to reduce HRI morbidity and mortality. The research question was: How will student clinician knowledge of HRI first-aid be affected following an intervention incorporated into the Farmworker Family Health Program (FWFHP) held in Georgia during summer 2022?. We hypothesize that student knowledge on HRI first aid will increase significantly from pre- to post-test.

Methodology

Data for this cross-sectional, train-the-trainer educational intervention study was collected in the summer of 2022. 30 RN students and 25 APRN students were enrolled in the FWFHP in rural southwest Georgia. All the students were asked to participate and all agreed. Inclusion criteria are RN and APRN students enrolled in the 2022 summer FWFHP program. Exclusion criteria is any student that is not enrolled in the 2022 summer FWFHP program. This research was deemed no more than minimal risk, and therefore exempt from university IRB review. This study was approved by the university Institutional Review Board.

Before the summer program, all students completed a pretest to determine baseline understanding of HRIs and HRI first aid. The asynchronous, online presentation was then viewed by the students. All students attended every day of farmworker health program, providing clinical care to farmworkers and their family members at farmworker camps and homes. All RN and APRN students then completed the post-test, collected anonymously using REDCap. The pre- and post-test contained 13 multiple-choice questions, and 2 select-all-that-apply questions. Nursing students' course grades were not affected by participating in the study.

The intervention included an hour presentation and a toolkit for each student. The presentation included HRI pathophysiology, signs and symptoms, first aid and explanation of items in the toolkit. Toolkits contained educational HRI handouts, including from the National Institute for Occupational Safety and Health (NIOSH), that students were able to disperse up to 300 farmworkers during the 2-week program at the Ellenton Farmworker Clinic. This clinic provides healthcare to farm workers who have over 50% of their annual household income from agriculture.

Data Analysis

Data was placed into SPSS (v28). Students' scores were analyzed using paired samples t-tests. Impact was measured by gathering pre- and post-test scores to determine understanding and knowledge retention from the training course.

Results

Demographics

Specific demographic data was not collected for this cross-sectional interventional study.

Descriptive Statistics

Among 30 RN and 25 APRN students, there was a statistically significant increase in HRI and HRI first aid knowledge scores from pre- to post-test. The average score for pre-licensure students was 61% increasing to 93% for post-test. There was a significant increase in scores from pre-test ($M = 9.17$, $SD = 1.59$) to post-test ($M = 13.91$, $SD = 1.78$), $t(29) = 13.922$, $p < 0.05$ (two tailed). The mean increase was 4.74 [95% CI= 4.05, 5.44]. The eta squared statistic (0.7696) indicated a large effect size. The average score for post-licensure students was 69.1% increasing to 96% for post-test. There was a significant increase in scores from pre-test ($M = 10.36$, $SD = 1.29$) to post-test ($M = 14.4$, $SD = 0.7$), $t(24) = 14.17$, $p < 0.01$ (two tailed). The mean increase in scores was 4.04 [95% CI = 3.85, 5.16]. The eta squared statistic (0.807) indicated a large effect size.

During the initial score prior to intervention, Pre- and Post- licensure both scored less than 50% on questions 3, 6, 10, 13, 14, and 15. The questions covered topics including when emergency service should be called following a worsening of heat exhaustion symptoms, what effects of HRI's can lead to acute kidney injury, how to direct an agricultural worker who is feeling dizzy and wants to take a water break, whether you should wait to cool an agricultural

worker experiencing a heat stroke, how to cool them properly, and areas to apply cool towels or ice packs on their body. Post-test results for each of the highly missed questions were between averages of 80% and 100%. This means there was an increase in scores after the intervention from 30-50% for each question.

Pre- licensure students answered pre-test questions 2, 8, 9, and 11 with at least 90% accuracy. Post-licensure students answered pre-test questions 1, 2, 7, 9, 11, and 12 with at least 90% accuracy. This matches 3 questions pre-licensure students answered with high accuracy as well. Therefore, both pre- and post-licensure students had knowledge of whether an individual can experience a heat stroke if they are sweating, not telling an agricultural worker who feels dizzy to push through it for several hours, and making sure that someone stays with an agricultural worker experiencing a heat stroke.

Pre-licensure students answered post-test questions 1, 3, 10, and 15 with less than 90% accuracy. Post-licensure students answered only question 1 with less than 90% accuracy. However, no question had an average of less than 80% for both groups of students. In post-licensure students, 2 question averages decreased from pre- to post- test. Question 1 decreased from 90% to 80%, and question 7 decreased from 100% to 96%. This did not occur at all with pre-licensure students.

Discussion

Current research indicates high risk for HRI's in migrant farmworkers. With over a thousand known and preventable deaths caused by HRI's (Environmental Protection Agency, 2022), it is evident that changes in policies, procedures, and additional education are necessary to mitigate this risk. Including nursing students to aid in education is a great way to supplement the

national and state level regulation updates. These students provide needed information regarding the health and safety of farmworkers, learn to establish rapport with the community, and improve upon skills necessary for their career.

This study focuses on students' baseline knowledge of HRI's and how much information is retained throughout the program. Both Pre- and Post-licensure students improved drastically, indicating the content within the interventions was relevant and increased knowledge. While we intended for knowledge scores to increase, we were surprised that pre- and post- licensure students scored similarly. Both groups were knowledgeable in over 60% of the content prior to the intervention. This indicates a baseline understanding of hyperthermia, emergency management, and prevention.

Within the newest version of the Future of Nursing report (National Academies of Sciences, Engineering, and Medicine, 2021), Social Determinants of Health (SDOH) is a heavy focus in the Nursing Curriculum. This includes economic stability, social and community context, neighborhood and environment, health care, and education. The World Health Organization defines SDOH as "the conditions in which people are born, grow, live, work, and age, and the wider set of forces and systems shaping the conditions of life" (World Health Organization, 2022). SDOH can be applied to target the potential causes of HRI's with migrant farmworkers, as well as focus on improving outcomes.

Emergency and Disaster Nursing is also a component in the Nursing Curriculum, emphasizing the four stages: mitigation, preparedness, response and recovery (National Academies of Sciences, Engineering, and Medicine, 2021). With rises in temperatures, preparedness for disasters is necessary. Concepts related to HRI's are within the essentials of

nursing and curriculum, but HRI's in particular need to be included due to its preventable nature, high prevalence in the US, and need for additional workplace education.

A 2019 study determined that nursing students understood the importance of action and creating sustainable solutions for global warming and believed that nurses are in the position to influence and educate the community around them (McDermott-Levy et al., 2019). With the understanding of importance, the Ecological Planetary Health Model was developed to integrate climate change into nursing student education. The model provides a broader perspective on the integration of global warming knowledge. This will aid in preparing nursing students to face the consequences of climate change on the community (McDermott-Levy et al., 2019).

This study's limitations include no demographic data collected on the students and no data gathered on the tools students utilized most frequently to disseminate HRI knowledge. The sample was relatively small, and not diverse. Although no demographic data was collected, the program matches the demographics of the nation which includes white females. The study's strengths include the ability to be easily replicated. This study was short, cost effective, and can be applied to a wider population. The presentation portion of the study was both short and engaging. The KISS rule, keep it short and simple, was implemented. Recommendations for future replications include determining how much the dissemination of this knowledge to farmworkers improved their own understanding of HRI's.

Conclusion

HRIs are a complex issue that Latino farmworkers are particularly at risk for due to working in high outdoor temperatures, limited workplace education, and distance from emergency response teams. The United States heavily relies on agriculture to support the

economy and the food supply chain, which cannot be sustained without healthy workers. The future of global warming and climate change will likely exacerbate the current injury and death rate for migrant farmworkers if no intervention takes place. Done effectively, this intervention may contribute to limiting preventable deaths and disease. Results of this study should empower future nurses and providers to prevent and treat HRI in the farmworker population.

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