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## Evaluation of Remote-Based Learning of a Nutrition Program for Adolescents with Autism Spectrum Disorder: A COVID-19 Pilot Study

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EVALUATION OF REMOTE-BASED LEARNING OF A NUTRITION PROGRAM FOR  
ADOLESCENTS WITH AUTISM SPECTRUM DISORDER: A COVID-19 PILOT STUDY

by

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A thesis submitted in partial fulfillment of the requirements

for the Honors in the Major Program in Health Sciences

in the College of Health Professions and Sciences

and in the Burnett Honors College

at the University of Central Florida

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## ABSTRACT

**Introduction:** Adolescents with Autism Spectrum Disorder (ASD) demonstrate poor health-related behaviors, such as nutrition, compared to their typically developed counterparts. With the occurrence of the COVID-19 pandemic and mandatory stay-at-home orders, such health-related behaviors may be complicated and there is a need to focus on feasibility and acceptability of in-person and remote-based nutrition programs.

**Methods:** Eleven high school students with ASD were recruited to participate in a modified nutrition program utilizing Zoom software during COVID-19. The duration was once a week for four weeks, and concepts reviewed included shopping for healthy food on a budget, introducing non-perishable but nutritious food items, and food preparation safety measures.

**Results:** Ninety-seven percent of participants attended the remote-based nutrition program, while 87% attended the in-person nutrition program. While in-person demonstrated benefits including face-to-face interaction and hands-on cooking, the remote-based component demonstrated a high degree of feasibility and acceptability. Half of the students felt their health-related behaviors were negatively impacted by COVID-19 but reported that the implementation of the remote-based nutrition program positively impacted their nutrition choices.

**Conclusion:** The enforcement of health-related behaviors in adolescents with ASD is significant especially during disaster-related situations. Future research should focus on efficacy and intertwining methods of in-person and remote-based learning of a nutrition or other health-related behavioral interventions in this population.

*Keywords:* Autism Spectrum Disorder (ASD), nutrition, remote learning, COVID-19

## **DEDICATIONS**

This study is especially dedicated to the participants involved. I will never forget the level of intellect and the active participation you demonstrated, but more importantly, the exuberant personalities you continued to portray during this program, despite the challenges that COVID-19 presented. You may never know it, and we may never cross paths again in life, but you are the reason why I am pursuing a career in health promotion in underserved populations. I was so inspired by you, and I can only hope this project will pave the way for more future interventions that will positively impact many other people with Autism Spectrum Disorder (ASD) in the same way that it helped you.

To the participants' families, and the community partners who were involved: If it was not for your dedication in putting forth the effort to participate in this study during COVID-19, then important gaps in literature concerning the health of adolescents ASD may not have been addressed. This study would not have been possible without your support, and wherever you are now, I hope that you continue to build upon the growth that the participants had during this study.

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## INTRODUCTION

Autism spectrum disorder (ASD) is a neurodevelopmental disorder that is classified as impairments in communication and behavior (National Institute of Mental Health, 2020). Compared to their typical developing (TD) counterparts, individuals with ASD are more likely to engage in restricted and repetitive behaviors, such as maintaining a strict routine or repeating words or phrases (Lloyd, Bremer, & Crozier, 2016). The condition is four times more common in boys than in girls and is typically diagnosed during childhood. It has become more prominent in society today due to raised awareness and more specific diagnostic criteria. Currently, 1 in 54 children are diagnosed with ASD, in contrast to the 1 in 150 children who were diagnosed in 1992. (Baio et al., 2018; Centers for Disease Control and Prevention, 2020). Given the substantial increase in the rate of diagnosis, there is growing interest in developing evidence-based treatments to enhance quality of life and overall health in this population.

Research has highlighted that individuals with ASD demonstrate poor health-related behaviors, such as unhealthy eating patterns, due to their behavioral and social difficulties. Compared to TD individuals, those with ASD are more likely to suffer from chronic diseases such as obesity, cardiovascular disease, and metabolic syndrome due to poor nutrition and physical inactivity commonly found in this population (Dreyer Gillette et al., 2015; Flygare Wallén, Ljunggren, Carlsson, Pettersson, & Wändell, 2018; McCoy & Morgan, 2020; Must et al., 2017; Rimmer, Yamaki, Lowry, Wang, & Vogel, 2010; Tybor et al., 2019). Individuals with ASD demonstrate more nutritional deficiencies due to increased food selectivity and anxiety with trying new foods, and they tend to prefer calorically dense foods with little nutritional value (Gephart & Loman, 2013; Hyman et al., 2012; Liu et al., 2016; Ranjan & Nasser, 2015; Zimmer et al., 2012). It has also been found that they spend less time participating in physical activity (PA) and are more



sedentary due to increased anxiety towards changes in routine and the inability to efficiently interact with others (H. Stanish et al., 2015; H. I. Stanish et al., 2017). Due to these limitations, early interventions for nutrition and PA education in ASD individuals are crucial to promoting health-related behaviors and decreasing the likelihood of developing physical issues that can further complicate their lifestyle and needs.

A handful of studies have examined the feasibility and efficacy of health promotion programs for individuals with intellectual-developmental disabilities (IDD), grouping ASD with other conditions such as Down Syndrome and cerebral palsy (An, DuBose, Decker, & Hatala, 2019; M. E. Kemeny, Arnold, & Marge, 2011; Mische Lawson, Hiskey, & Theleman, 2018); however, only a few of these studies have focused exclusively on individuals with ASD (Garcia et al., 2020; Kim & Kang, 2020; L. C. Mechling, Ayres, Foster, & Bryant, 2013). While all of these studies have indicated positive changes in nutrition and/or PA in these individuals, such as improvements in body mass index (BMI), increased fruit and vegetables intake, and more time spent participating in PA, these studies lacked follow-up assessments to determine whether the newly-acquired skills were maintained over time (M. E. Kemeny, Arnold, & Marge, 2011; Kim & Kang, 2020). Another issue that these studies present is the majority of health promotion programs were developed exclusively for younger children or included a wide age range of individuals (Hinckson, Dickinson, Water, Sands, & Penman, 2013; Hubbard et al., 2014; E. A. Kemeny, R., 2012; Mische Lawson, Hiskey, & Theleman, 2018; Yilmaz, Katip, Counselor, & Çelebi, 2014). This is particularly concerning for older adolescents with ASD, who are transitioning into adulthood and becoming more independent, as they have limited opportunities to practice healthy lifestyle habits. Given the importance of promoting health behaviors in individuals aged 15-18

years old, it is clear that the lack of health promotion programs for this population is a critical gap in the research (An et al., 2019; Kim & Kang, 2020).

Remote-based instruction has been implemented as an evidenced-based treatment for individuals with ASD (Sam, Cox, Savage, Waters, & Odom, 2020). It has been utilized in the forms of virtual reality, multimedia, augmentative and alternative communication, iPads, and other specialized software programs in teaching other life skills such as social and behavioral competency (Cheng & Ye, 2010; Juban, Kodak, Cariveau, & Campbell, 2017; Lee et al., 2015; Panerai, Catania, Rundo, & Ferri, 2018), ATM usage (Kang & Chang, 2019), elementary education such as mathematics (Bryant et al., 2015), vocabulary acquisition (Coleman, Cherry, Moore, Park, & Cihak, 2015) and reading (Travers et al., 2011; Williams, Wright, Callaghan, & Coughlan, 2002), and schedule planning (Bross, Huffman, Watson, Wills, & Mason; Elicin & Tunalı, 2016), with some of these studies comparing remote-based instruction to in-person instruction face-to-face. Previous studies have incorporated the use of remote-based instruction to encourage health promotion in individuals with ASD or IDD in learning food-related skills, such as shopping at a grocery store (Hansen & Morgan, 2008; L. Mechling & Gast, 2003; L. Mechling, Gast, & Langone, 2002), ordering at a fast-food restaurant (L. C. Mechling & Cronin, 2006), and cooking recipes (Kim & Kang, 2020). While it was demonstrated that remote-based instruction showed improvements in the retention skills of the individuals with IDD, the remote-based simulation was sometimes not applicable to a more generalized community setting (L. Mechling, Gast, & Langone, 2002; L. C. Mechling, Ayres, Foster, & Bryant, 2013; L. C. Mechling & Cronin, 2006). Many of these studies also lacked a control group, were single-subject designs, and did not compare remote-based instruction to in-person instruction. Therefore, little is known regarding adolescents' preferences for remote-based vs. in-person methods or differences in learning

effectiveness between either of the two delivery platforms (Bross, Huffman, Watson, Wills, & Mason).

There is also limited research regarding the impact of disaster-related situations and events on individuals with IDD and specifically ASD (Courtenay & Perera, 2020; L. Stough, 2010; L. M. Stough, Ducey, & Kang, 2017). This issue presented itself after the novel coronavirus (COVID-19) was deemed as a pandemic outbreak on March 11, 2020, resulting in many governments enforcing their citizens to stay at home and isolate due to the uncertainty of its spread. While staying at home was considered the best way to prevent more cases of COVID-19, it served as a challenge for individuals with ASD and their caregivers because of the many physical, emotional, and social needs that people with ASD require in order to function daily. No studies to date have specifically examined the impact of COVID-19 on this population but rather have speculated its potential consequences (Cassidy et al., 2020; Colizzi et al., 2020; Courtenay & Perera, 2020; degli Espinosa, Metko, Raimondi, Impenna, & Scognamiglio, 2020; Simmons, 2020). For all individuals, including individuals with ASD, this disruption in normal routine and transition from structured to less-structured days, could pose negative consequences for their nutrition, PA, stress levels, and sleep (Brazendale et al., 2017; Brazendale et al., 2020). The requirement to self-quarantine could discourage them from adopting any positive health-related behaviors because of their rigid mannerisms and difficulties in adapting to a new routine. While some studies have documented perspectives on incorporating a healthier lifestyle, particularly with PA, in individuals with ASD during COVID-19 (Esentürk, 2020), there are no studies that have examined nutrition habits in adolescents with ASD during COVID-19 or any other disaster.

# **LITERATURE REVIEW**

## **Health-related behaviors in individuals with ASD**

Along with the social and behavioral difficulties that are associated with ASD, poor nutrition and physical inactivity are also prevalent in this demographic. Because of their behavioral rigidity, individuals with ASD tend to be highly selective with the foods they choose to eat (Tanoue, Takamasu, & Matsui, 2016), demonstrating more food neophobia and refusal than TD individuals (Bandini et al., 2010; Martins, Young, & Robson, 2008; Schreck, Williams, & Smith, 2004). This selectivity can cause them to suffer from deficiencies in vital micronutrients such as vitamins B6, B12, D, and E, folate, zinc, iron, calcium, and magnesium because of their preferences to choose calorically dense foods containing little to no nutritional value (Gephart & Loman, 2013; Hyman et al., 2012; Liu et al., 2016; Ranjan & Nasser, 2015; Zimmer et al., 2012). It has also been found that individuals with ASD engage in less PA than their TD peers (H. Stanish et al., 2015; H. I. Stanish et al., 2017) and are more likely to become obese and develop subsequent chronic diseases such as heart disease, cancer, and diabetes mellitus (Dreyer Gillette et al., 2015; McCoy & Morgan, 2020; Rimmer et al., 2010). In fact, it is estimated that 23-24% of children and adolescents with ASD are obese, compared to 15% of their TD peers (Must et al., 2017; Tybor et al., 2019). Therefore, early interventions for nutrition and PA education in ASD individuals are crucial to promoting health-related behaviors and decreasing the likelihood of developing physical issues that can further complicate their lifestyle and needs.

## **Health promotion programs in individuals with ASD**

A handful of studies have examined the feasibility and efficacy of health promotion programs for individuals with ASD. Collectively, the majority of these programs have focused on

PA rather than nutrition, and few have focused exclusively on individuals with ASD. Garcia et al. (2020) was one of the first studies to concentrate on promoting PA in individuals with ASD by examining the effects of an 8-week judo intervention on PA and sedentary behavior in children with ASD using ActiGraph GT9X accelerometers. It was reported that the percentage of time spent in sedentary behavior during an average day had declined from 50% to 42%, although these findings were not statistically significant (Garcia et al., 2020). Spratt et al. (2019) reported qualitative results from a female individual with ASD who participated in a wellness program intended for transitional youth with ASD called “Piece It Together” (PIT). While the participant provided positive reviews about how the intervention helped her achieve personal goals, no other documentation about the program was recorded (Spratt et al., 2019). In a study by An et al. (2019), a health behavioral model called “I Can Do It!” (ICDI) was utilized on fourteen adolescents ranging from 12-15 years old with IDD. This mentor-mentee program resulted in adolescents consuming more water, eating more fruits & vegetables daily, and partaking in larger amounts of PA over time, indicating that health-related behaviors in those with IDD can be positively influenced by others when intervention is given (An et al., 2019). Lawson et al. (2018) performed the ICDI intervention with a larger sample of 21 individuals with ages ranging from 4-23 years, and found that approximately 80% met PA goals, and 67% met their nutrition goals after the program, with significant changes in BMI observed (Mische Lawson et al., 2018). In Kemeny et al. (2012), a similar approach to the ICDI model called “I Can Do It, You Can Do It!” was tested on a larger group of individuals with IDD, including some with ASD, and it was documented that not only did the mentees improve in PA levels, physical fitness, fruit & vegetable consumption, and BMI, but also reported satisfaction with the program, claiming they felt healthier and stronger to accomplish daily tasks (E. A. Kemeny, R., 2012). However, none of these studies conducted

any follow-up assessments to determine whether the newly acquired positive attitudes were maintained over time (M. E. Kemeny et al., 2011).

Similar to TD youth, research shows that older adolescents with ASD tend to have poorer health habits compared to younger children; however, health promotion programs that focus exclusively on older adolescents with ASD are scarce. Interestingly, the majority of health promotion programs for youth with ASD have focused on young children or consisted of a wide age range of youth and young adults (Hinckson et al., 2013) (Hubbard et al., 2014; E. A. Kemeny, R., 2012; M. E. Kemeny et al., 2011; Mische Lawson et al., 2018; Yilmaz et al., 2014). This is particularly concerning for older adolescents with ASD, who are transitioning from a high school setting, and may have limited opportunities to practice healthy lifestyle habits. Given the importance of promoting health behaviors in adolescents with ASD, it is clear that the lack of health promotion programs for this population is a critical gap in the research (An et al., 2019; Kim & Kang, 2020)

### **In-person versus remote-based learning in individuals with ASD**

Remote-based instruction has been used to encourage health promotion in individuals with ASD or IDD, and is actually identified as an evidence-based treatment for individuals with ASD (Sam et al., 2020). Remote-based delivery has been utilized in the forms of virtual reality, multimedia, augmentative and alternative communication, iPads and other specialized software programs in teaching different life skills to these individuals. Skills demonstrated in previous studies include social and behavioral competency (Cheng & Ye, 2010; Juban, Kodak, Cariveau, & Campbell, 2017; Lee et al., 2015; Panerai, Catania, Rundo, & Ferri, 2018), ATM usage (Kang & Chang, 2019), elementary education such as mathematics (Bryant et al., 2015), vocabulary acquisition (Coleman, Cherry, Moore, Park, & Cihak, 2015), and reading (Travers et al., 2011;

Williams, Wright, Callaghan, & Coughlan, 2002), and schedule planning (Bross, Huffman, Watson, Wills, & Mason; Eliçin & Tunalı, 2016), with some of these studies comparing remote-based instruction to in-person instruction. Previous studies have documented using remote-based instruction to assist those with IDD in learning food-related skills, such as shopping at a grocery store (Hansen & Morgan, 2008; L. Mechling & Gast, 2003; L. Mechling et al., 2002) and ordering at a fast-food restaurant (L. C. Mechling & Cronin, 2006). In Mechling et al. (2013), four individuals with ASD were taught how to cook three recipes using remote-based videos that were either commercially available or created by the research team, and all students were able to cook the recipes successfully (L. C. Mechling et al., 2013). In Kim & Kang (2020), three adolescents with ASD used remote-based instruction with iPads to learn how to cook different recipes such as egg pudding and mashed potatoes, and all three participants not only improved in their cooking skills but also maintained during the follow-up assessment (Kim & Kang, 2020). Many of these remote-based studies either lacked a comparison group using in-person instruction or were single-subject designs; therefore, little is known regarding adolescents' preferences for remote-based vs. in-person methods or differences in learning effectiveness between either of the two delivery platforms among individuals with ASD (Moore & Calvert, 2000; Panerai, Catania, Rundo, & Ferri, 2018).

### **Impacts of COVID-19 and disasters in individuals with IDD**

On March 11, 2020, the World Health Organization (WHO) classified the novel coronavirus (COVID-19) as a pandemic. Because of the uncertainty of its spread, many countries who reported cases had enforced their citizens to stay at home and partake in “social distancing,” leading to closures of many events where interaction with other people is inevitable such as schools, restaurants, traveling abroad via airplane or cruise, and entertainment. While staying at

home is considered the best way to prevent the spread of COVID-19, it has served as a challenge for individuals with IDD and their caregivers because of the many physical, emotional, and social needs that people with IDD require in order to function daily.

There is limited research regarding the impact of disaster-related situations and events on individuals with IDD (Courtenay & Perera, 2020; L. Stough, 2010; L. M. Stough et al., 2017), and no studies to date have specifically examined the impact of COVID-19 on this population but rather have speculated its potential consequences (Courtenay & Perera, 2020). In Stough (2010), a systematic review was conducted on existing literature about children with physical, intellectual, or emotional disabilities in the context of a disaster, and it found that these children were usually excluded from emergency preparedness guidelines, did have access to warnings about current disasters, and became disadvantaged in education due to displacement of special education teachers (L. Stough, 2010). In a more recent review on disaster and emergency situations, results showed that individuals with IDD demonstrated more prominent grieving behaviors compared to TD individuals, suggesting that individuals with IDD may experience more psychological distress during emergency situations compared to their TD counterparts (Stough et al., 2017). In an editorial written by Courtenay & Perera (2020) about COVID-19 awareness in people with IDD, it was stressed that more action is needed to protect this group since it is known to face multiple problems such as an increased risk of infection due to pre-existing health conditions, lack of reliance on others about safety protocol, limited access to healthcare, and financial constraints (Courtenay & Perera, 2020).

#### *Impacts of COVID-19 and disasters in individuals with ASD*

In individuals with ASD, this disruption in normal routine and transition from structured to less-structured days, as a result of mandatory stay-at-home orders, can further complicate their



emotional, behavioral, and social issues (Brazendale et al., 2020). When encountering unusual stimuli such as an emergency situation, they are likely to increase in their stereotypical behaviors due to stress and trauma, but are often misunderstood by clinicians as the issue is attributed to their pre-existing condition and not to the disaster situation (L. M. Stough et al., 2017). They may also be overstimulated by the media and social media about the disaster and are likely to rely more on psychotropic medication to calm themselves (Courtenay & Perera, 2020). A prospective cohort study performed by Valenti et al. (2012) examined the adaptive functioning of children and adolescents with ASD to the 2009 earthquake in L'Aquila, Italy using the Vineland Adaptive Behavior Scale (VABS), and it was shown that this demographic was negatively impacted in the communication, daily living, and socialization domains as evidenced by a decrease in these scores after the earthquake, and even after a year, these scores did not return to the level they were before the earthquake occurred (Valenti et al., 2012). Simmons (2020) described a personal anecdote of a woman with ASD to give perspective on coping with the disorder during COVID-19, highlighting that the situation of being isolated is similar to her past memories of being stigmatized and ostracized by society because of her idiosyncratic behavior (Simmons, 2020).

Some articles have reported on the need to increase awareness in individuals with ASD during catastrophes such as COVID-19. The involvement of those with ASD in the planning of emergency preparedness resources is vital, so that bystanders, healthcare professionals, and caregivers are able to know how to assist them in a disaster situation (Edmonds, 2017). Cassidy et al. (2020) moderated an interview on COVID-19 that included several panelists with autism, who expressed the concerns of government discrimination of people with ASD in emergency management. The panelists suggested that remote therapy, easing of social distancing, and public health advocacy were needed to give individuals with ASD the care they needed (Cassidy et al.,

2020). Narzisi (2020) released an article giving ten tips that parents and caregivers can use to help their children with ASD during COVID-19, such as structuring activities during the day, finding alternatives to video games, participating in online therapy for both children and parents, and maintaining contact with the school the child attends (Narzisi, 2020).

### **Impacts of COVID-19 on health-related behaviors in individuals with ASD**

As mentioned earlier, individuals with ASD are more at risk for developing chronic diseases such as obesity because of their emotional lack of flexibility in eating a variety of nutrient-dense foods and partaking in exercise. This issue is exacerbated with disaster-related situations such as COVID-19 because the transition from structured days to less-structured days can pose negative consequences for their nutrition, PA, stress levels, and sleep (Brazendale et al., 2020). As individuals with ASD tend to prefer a structured schedule and routine, the deviation from a structured school day to an unstructured day in isolation, due to the stay-at-home order, may be a source of distress for these individual, thus affecting their ability to adopt positive health-related behaviors.

Some studies have documented perspectives on incorporating a healthier lifestyle, particularly with PA, in individuals with ASD during COVID-19. A cross-sectional study by Esentürk (2020) in Turkey explored parents' perceptions of PA for their children with ASD during COVID-19 and concluded that the parents were aware of the benefits that come with PA but also worried about barriers during quarantine that prevent their children from participating in the recommended amount of PA, elaborating that there is a lack of resources that are available for them to teach their children about PA (Esentürk, 2020). Yarimkaya and Esentürk (2020) subsequently published a guide that demonstrates ways for children with ASD to engage in PA during COVID-19, such as seeking advice from professionals, preparing the home environment

for PA, and incorporating family into the activity (Yarımkaya & Esentürk, 2020). To date, however, there is limited information about nutrition habits in adolescents with ASD during COVID-19 or any other disaster.

### **Summary of Literature**

This review of the literature focused on three distinct areas regarding adolescents with ASD: 1) health promotion programs; 2) in-person learning vs remote learning; 3) and the impact of COVID-19 on this population. From the review, it is clear that more research needs to be done on adolescents specifically with ASD, not including other IDD. The majority of prior studies that have implemented health promotion programs have grouped individuals with ASD with other IDDs, such as Down syndrome and cerebral palsy, and included participants with a broad age range or disregarded adolescents completely. These studies also did not conduct follow-up measurements to examine health-related information retention in the participants. While limited research exists comparing in-person and online learning in individuals with ASD or IDD, further studies must be conducted to determine the effectiveness and approval of these methods. Little research has documented the impacts of COVID-19 or other disaster-related situations on the health behaviors of adolescents with ASD, and the influences of structured and unstructured days in adolescents with ASD must be expanded upon.

### **Purpose/Aims of Study**

The primary purposes of this study are to examine 1) the feasibility and acceptability of a remote-based nutrition program and 2) preliminary efficacy of the remote-based vs. the in-person program. Due to the sudden onset of the restrictions of COVID-19, the study had added a secondary aim, which is to evaluate the impacts of COVID-19 on health-related behaviors, such as nutrition, sleep, and PA, of adolescents with ASD. **It is hypothesized that the initiation of a**

**remote-based nutrition program during COVID-19 will be successful in adolescents with ASD because of its accessibility and efficacy. It is also hypothesized that it will help to attenuate the possible negative outcome of reduction in health-related behaviors caused by mandatory stay-at-home policies enacted during COVID-19.**

## **METHODS**

### **Recruitment of Participants for In-Person Study**

Participants were recruited from a private school in central Florida that enrolled only children and adolescents with ASD. The school's staff and investigators agreed that there should be approximately 8 – 12 students to form the nutrition education class 1) to minimize disruptions during a typical day of school, and 2) to ensure that there was enough space in the testing kitchen where the students would practice their culinary skills. To be eligible for the current study, adolescents had to meet the following criteria: 1) between the ages of 15 – 19 years old; 2) have a primary, physician-based diagnosis of ASD; 3) English-speaking; 4) able to follow directions; 5) attend the partnering school on a full-time basis; and, 6) not have any physical limitations that would stop them from completing the tasks asked of them. Adolescents who were not between 15 and 19 years of age, had a co-occurring serious psychiatric diagnosis, a history of behavioral problems, or only attended the partnering school on a part-time basis were excluded from the study. The school partners identified 12 students from the high school student population. If students were 18 or 19 years of age, the study was presented directly to the eligible participants and those that were interested signed the consent form, but if they were under 18, the study investigators presented the study to the parents or guardians of the children. All procedures for the original study were approved by the University of Central Florida's Institutional Review Board.

### **Program Description**

#### *Original In-Person Culinary Program*

This pilot study was adapted from a previous nutrition education study that was conducted between January and mid-March of 2020 before the COVID-19 pandemic. The original in-person

study consisted of meeting 1 hour twice a week for eight weeks (6 weeks due to COVID-19) in the kitchen of the partnering school. Participants met with the UCF research student team, which consisted of one lead undergraduate instructor, one graduate investigator who oversaw the lessons and activities, and one undergraduate assistant instructor who took observational notes. On Tuesdays, a nutrition lesson was taught to the participants with topics covering serving sizes vs. portion sizes, MyPlate, the nutrition guide introduced by the United States Department of Agriculture Center for Nutrition Policy and Promotion (United States Department of Agriculture, 2020), vitamins & minerals, limiting sugar and salt intake, and others. On one Tuesday of the program, a grocery store mobile truck was hired to provide a healthy food shopping simulation for the participants. On Thursdays, a cooking activity was performed to teach food preparation skills such as cutting fruits & vegetables and utilizing kitchen appliances such as a stove and oven to cook raw food such as meat. Examples of food made were trail mix, guacamole, and build-your-own pizzas. Pre- and post-measures included surveys regarding food preferences, nutrition self-efficacy, and nutrition beliefs and attitudes, which were administered at the beginning of the original study and following the last session prior to the COVID-19 outbreak.

### **Recruitment of Participants for Current Study**

All participants who were participating in the in-person nutrition program prior to COVID-19 were recruited for the current study. An additional requirement that was added to the COVID-19 pilot study was having a functional computer and access to the Zoom application, which was met by all the participants in the original program. Informed consent was taken from the students and their families in the original study and applied to this pilot study, and all of the study procedures were approved by the University of Central Florida's Institutional Review Board (IRB).

## **COVID-19-Adapted Remote-Based Nutrition Program**

The COVID-19 pilot study was adapted from the original study previously explained and conducted after the stay-at-home order in Florida for the pandemic was initiated on April 1<sup>st</sup>, 2020. Between the discontinuation of the original study in mid-March and the beginning of the COVID-19 pilot study, no interactions between the UCF research team and the participants occurred. During this time, the UCF research team met with administration from their partner school to propose a transition from an in-person to a remote format for the remaining four sessions. After receiving unanimous approval from the school, the research team met on numerous occasions to discuss the format, curriculum, and delivery of the remote sessions via Zoom to limit person-to-person contact. Ideas for lessons included ordering healthy options online or over the phone from restaurants, shopping for groceries online to be picked up or delivered, utilizing the USDA MyPlate mobile application to set daily goals for eating healthy during quarantine, and purchasing healthy and inexpensive non-perishables. The curriculum was reviewed and approved by the registered dietitian on the research team, and all lesson plans were then sent to the partnering school for final approval.

A 1-hour session was held over Zoom over the course of four weeks with the student instructors, participants, and the participants' teacher. The first session served as a follow-up to the original study to check in on the participants during the stay-at-home-order and to evaluate how their nutrition behaviors and daily routines have been impacted by COVID-19. The three sessions thereafter consisted of teaching the participants a lesson based on the new ideas approved for the pilot study. The student participants and their teacher were asked to join into the meeting at a pre-scheduled time via a designated URL organized by the overseer. The instructors were able to utilize the "Share Screen" feature in Zoom to share their respective computer screens to the

participants, such as sharing the Walmart.com homescreen for online grocery shopping. Participants were required to turn on their webcams to show their faces and keep their microphones off unless if asked a question. They also had the option to use the Chat component of Zoom in order to exchange messages publicly to their peers or privately to the instructors or overseer. A student researcher continued to take notes in a separate Microsoft Word document as the sessions proceeded. A follow-up meeting was conducted after each session with the entire UCF research team to cover what was reviewed in the meeting and to construct a plan for executing the next meeting.

### **Participant Attendance**

Attendance for each session was recorded by a student research assistant. Participants who entered the Zoom meeting late were still marked as present, however, the reason for their lateness was noted in the session observations. If a participant was not present in the first 5 minutes of the meeting, the teacher made a phone call to the participant's residence to remind them of the meeting. A student research assistant observed the participants during each session, taking notes on participant reactions, interactions with the instructor and other participants, and the occurrence of ASD-related behaviors throughout the lesson.

### **Post Program Assessments**

#### *Participant Survey*

Following the final remote session, participants were asked to complete a 30-item survey that asked to describe the following: 1) how COVID-19 impacted their dietary habits and their retention of skills from the in-person study using response options of "Yes," "No," and "Not sure," (e.g., "Have you prepared any of the food or followed any of the recipes you learned during the culinary class?"), 2) their perceptions of the in-person and Zoom learning using response options



of “Agree,” “Disagree,” and “Neutral” (e.g., “I had adequate opportunity to ask questions of the instructors throughout the semester during [in-person/Zoom] session.”), 3) a comparison of the two methods of learning using “Agree,” “Disagree,” and “Neutral,” (e.g., “I prefer in-person sessions over live Zoom sessions.”), and 4) free response questions about their likes and dislikes of each method of learning (e.g., “What did you like/dislike about the [in-person/Zoom] sessions?”).

#### *Parent & Teacher Interviews*

The parents were also asked to take part in focus group discussions regarding their perceptions of the program. The interviews were conducted with each separate family via Zoom and questions focused on the following: 1) “How did COVID-19 impact the participants’ dietary and other health-related behaviors?” 2) “What was the effectiveness of the Zoom nutrition education program during the COVID-19 pandemic, and what were their preferences for the in-person or Zoom learning?” and 3) “What are suggestions for improving the program if it were to be offered again in the future?” Each session lasted about 10 minutes with each family. To reduce the possibility of information bias, the discussion leader had not been directly involved with the culinary sessions. A second research assistant was present to take descriptive notes.

The classroom teacher was asked to participate in a semi-structured interview with a research assistant, not directly affiliated with the nutrition program. Questions centered on the following: 1) How did they feel COVID-19 impacted the participants; 2) Perceptions of both the in-person and Zoom sessions (i.e., benefits, limitations, etc.); 3) Feasibility of the program for future classes; and 4) Suggestions for improvement. The interview lasted for 60 minutes.

## **Statistical Analysis**

Descriptive analysis was used to evaluate the participant attendance and answers to their surveys, and the answers of the participants, their parents, and the participants' teacher in the interviews. Descriptive statistics were calculated for preferences of either the remote-based or in-person, the nutrition information and cooking skills retained by the participants' during the in-person and remote-based versions of the program, and the effects of staying at home during COVID-19 on their health-related behaviors. All data was analyzed in SAS version 9.4, with a statistical significance level set at  $\alpha \leq .05$ .

# RESULTS

## Quantitative Analysis

### *Participant Characteristics and Attendance Rate*

The sample of the original in-person study included 12 participants clinically diagnosed with ASD; however, two participants showed up to less than 50% of the classes in the program due to reasons unrelated to the program, excluding them from the study. Eleven out of the twelve adolescents originally recruited for the in-person study participated in this COVID-19 pilot study. One participant failed to complete the survey measures, and therefore, was excluded from the analysis. Out of the 10 participants in the final sample, seven of them were male and three were female. The average age of the participants was 16.2 years old, and 60% of them were overweight (85<sup>th</sup> percentile  $\leq$  body mass index  $<$  95<sup>th</sup> percentile), as indicated in Table 1. There was a 97% attendance rate for the four Zoom sessions that took place.

**Table 1: Participant characteristics (n=10).**

Variables	N (%)	Mean (SD)
Males	7 (70%)	
Females	3 (30%)	
Age (years)		16.2 (2.1)
White	8 (80%)	
Multiple Health Conditions*	7 (70%)	
Currently on Medications	6 (60%)	
Overweight ( $\geq$ 85%)	6 (60%)	

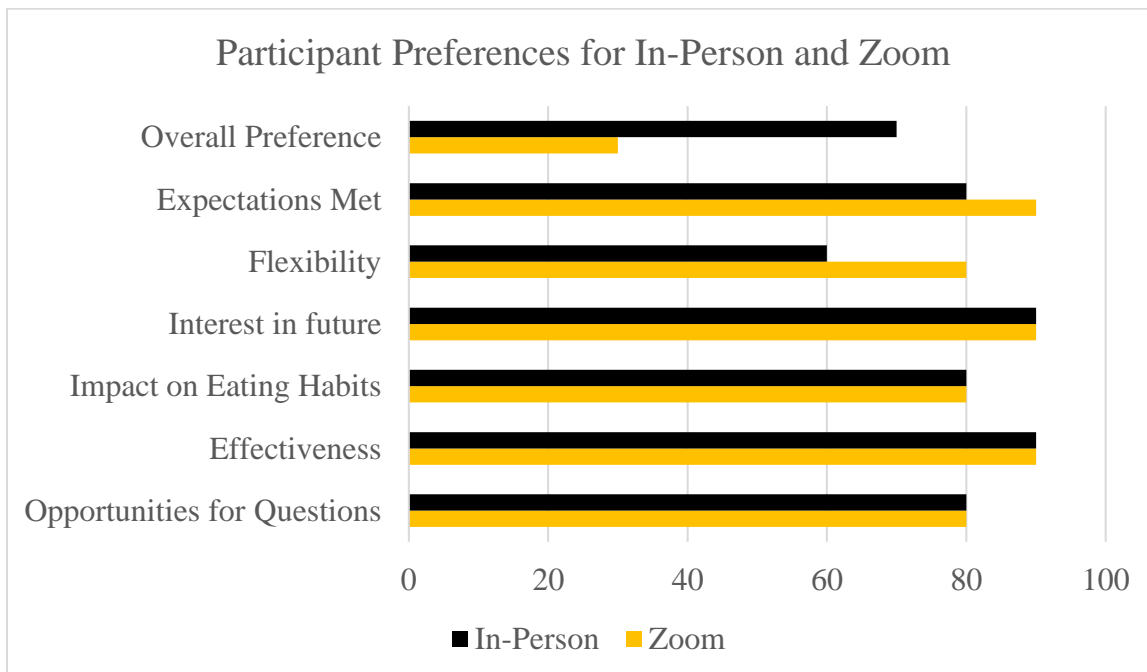
\*Conditions besides ASD include attention deficit hyperactivity disorder, sensory process disorder, anxiety disorders, & mood disorders

## Qualitative Analysis

### *Participants' Close-Ended Responses*

Data collected had demonstrated that COVID-19 negatively affected half of the participants' eating patterns. Participant responses indicated that the in-person and Zoom sessions

were equal in effectiveness, impact on participants’ eating habits, opportunities to ask instructors questions, and interest in taking a similar class in the future. All of the participants claimed they enjoyed the in-person learning, while 90% of them said they enjoyed the Zoom sessions. When asked about their overall preference for either program, 70% of them preferred in-person, 20% of them preferred Zoom, and 10% of them had no preference. This may be due to the hands-on experience and the face-to-face interaction that was provided before COVID-19. Despite more favorability towards in-person learning, participants’ surveys revealed that Zoom also provided certain benefits that in-person did not. For instance, 80% agreed that Zoom allowed more flexibility within their schedules, while 60% said that the in-person provided such flexibility. Ninety percent of participants also felt that Zoom met their expectations, while 80% responded the in-person sessions met their expectations. This can be attributed to the COVID-19 pandemic and many businesses closing in order to follow the stay-at-home order, causing the participants to not attend their extracurricular activities away from school, such as work and sports. Figure 1 depicts participants’ close-ended responses for both methods of instruction.



**Figure 1: Participants’ close-ended responses comparing the in-person and Zoom sessions.**

*Participant’s Open-Ended Responses*

The majority of the participants reported that they were still practicing the nutrition and cooking skills taught during the in-person version of the study. Some of the specific skills mentioned were cutting and preparing ingredients for cooking, reading and interpreting nutrition labels, measuring portion sizes, and kitchen safety procedures (e.g. handling an oven). During quarantine, some of the participants claimed that they had practiced some of the recipes created in-person, such as guacamole and build-your-own tacos, while others practiced recipes learned outside of the classroom, such as grilled steak, and pasta and meatballs.

Many participants agreed that the inclusion of the Zoom nutrition education classes changed their eating patterns or choices. A few of the participants noted that they knew how to shop more effectively while maintaining limited contact with others during the pandemic, and that they were more mindful of the kinds of food they were consuming and portion sizes. Participants also added that the Zoom sessions helped with meal structure, with one participant claiming it aided his weight loss efforts.

**Table 2: Examples of quotes from participant open-ended surveys regarding the impacts of COVID-19 on health behaviors.**

<b>Impacts of COVID-19 on behavior</b>	<b>Comparing In-person and Zoom</b>
<ul style="list-style-type: none"><li>• “It’s harder to make good or healthy choices.”</li><li>• “I don’t get exercise, and I have been going to bed later and waking up later.”</li></ul>	<ul style="list-style-type: none"><li>• “In-person was better due to getting hands-on experience.”</li><li>• “I liked both but preferred in-person a little more.”</li></ul>

	<ul style="list-style-type: none"> <li>• “I could still learn as much over Zoom as when I was in school.”</li> </ul>
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*Parent interviews*

Ten parents participated in semi-structured interviews with a research assistant unfamiliar with the program. The majority of the parents agreed that the new regulations of the pandemic affected the eating and exercise habits of the participants, with some witnessing the participants eat significantly more or less than before the pandemic, and noting higher levels of stress, less exercise, and lack of sleep. There was also some parental involvement in the Zoom sessions as they were able to witness the participants attending the Zoom sessions with a substantial increase in the interest of nutrition and cooking healthier foods. Parents claimed that there was more interaction and communication between them and the participants while the Zoom sessions were taking place. They had noticed that the participants were more receptive to trying new foods and being more mindful of what they ate. This enabled the parents to comment more favorably on the Zoom sessions since they had a better idea of what the participants were doing.

**Table 3: Examples of quotes from parent interviews regarding the impacts of COVID-19 on health behaviors.**

<b>Impacts of COVID-19 on behavior</b>	<b>Comparing In-person and Zoom</b>
<ul style="list-style-type: none"> <li>• “They [parent’s children] are definitely eating a lot more than usual.”</li> <li>• “She [parent’s child] doesn’t exercise, sleeps worse, and wasn’t eating as well.”</li> </ul>	<ul style="list-style-type: none"> <li>• “Our child liked Zoom because she was more involved.”</li> <li>• “We wished we could have been more involved with the in-person study but happy they learned more during COVID.”</li> </ul>

*Classroom teacher interview*

The teacher in their separate interview also recognized negative changes in behaviors as they still taught the participants lessons required by the school. More specifically, they knew that some of the participants were engaging in more sedentary behavior, utilizing the television or the Internet more often, and having altered routines such as sleeping in later and overeating. The teacher claimed that the Zoom sessions helped the participants and their families immensely, noting that many of them now have tighter financial budgets due to the economic burden of the COVID-19 outbreak. They felt that the logistics of the program encouraged the participants to be more responsible for their nutrition.

**Table 4: Examples of quotes from the teacher interview regarding the impacts of COVID-19 on health behaviors.**

<b>Impacts of COVID-19 on behavior</b>	<b>Comparing In-person and Zoom</b>
<ul style="list-style-type: none"><li>• “They [classroom children] were not as active as they were when they were at school.”</li><li>• “They [classroom children] seem to be eating more out of boredom.”</li></ul>	<ul style="list-style-type: none"><li>• “It felt more like a team when we were all doing it [in-person] together.”</li><li>• “Maybe some of the students with more social difficulties would benefit more from Zoom.”</li></ul>

## DISCUSSION

The goal of this study was to assess overall convenience, satisfactoriness, and preliminary efficiency of the transition of a nutrition education intervention from in-person to remote-based delivery during the COVID-19 pandemic in older adolescents with ASD. Specifically, this study measured the effectiveness of the remote-based delivery on the health-related behaviors of individuals with ASD that were predicted to be negatively affected due to COVID-19. It was hypothesized that implementing the remote-based nutrition program during COVID-19 would help to improve health behaviors in adolescents with ASD, that may have been previously lessened by stay-at-home requirements imposed during the pandemic, because of the program's ability to be accessible and beneficial to the participants.

The shift from in-person to remote-based delivery of many different aspects of life during the COVID-19 lockdown led to the development of evaluating the receptiveness of the participants with both methods of instruction in this study. Previous reports have compared remote-based and in-person delivery in individuals with IDD such as ASD in teaching different skills such as education, social interactions, and functional living; however, such reports have indicated conflicting results for accuracy and responses of the participants towards the methods, with neither intervention consecutively being considered more suitable than the other (Bryant et al., 2015; Juban, Kodak, Cariveau, & Campbell, 2017; Travers et al., 2011). In the studies that aimed to teach the participants about health-related behaviors such as shopping at a grocery store, ordering at a restaurant, and cooking, none of them utilized in-person delivery and only relied on remote-based delivery (Hansen & Morgan, 2008; Kim & Kang, 2020; L. Mechling et al., 2002; L. C. Mechling & Cronin, 2006). In contrast, this study closes this large gap in the literature by measuring the



participants' preferences and competence with both in-person and remote-based versions of a health promotion program over a period of 6 weeks.

Interestingly, although the majority of participants preferred the in-person nutrition sessions over the remote-based ones, due to the hands-on learning and face-to-face interaction, the remote-based sessions were still reported as beneficial to participants according to the participants themselves, their parents, and their classroom teacher. The remote-based program continued to work upon fundamental aspects of nutrition taught previous in the in-person study, such as reading nutrition labels more carefully to assess the ingredients and composition of food and practicing healthy food preparation and cooking skills, while introducing significant nutrition-related concepts specific to the pandemic, such as developing financial competence when budgeting for healthy food during COVID-19. Along with these advantages, the remote-based delivery also provided more flexibility in the participants' schedules, confirming the feasibility of the program as previously hypothesized.

This is the first study to examine the transition of a nutrition education intervention from in-person to remote delivery in older adolescents with ASD during the COVID-19 pandemic. It has been demonstrated extensively in the literature that individuals with ASD have more nutrition-related issues than TD individuals because of their rigid social and behavioral predispositions, causing them to suffer from deficiencies in vitamins and minerals and increased rates of obesity and other chronic-related diseases such as cardiovascular disease and diabetes mellitus (Barnhill, Gutierrez, Marti, & Hewitson, 2015; Flygare Wallén et al., 2018; Tanoue, Takamasu, & Matsui, 2016). While several studies have tested nutrition interventions in young children and adults with ASD, the literature on nutrition education interventions in older adolescents is scarce (Goldschmidt & Song, 2016; Hubbard et al., 2014), (Garcia et al., 2020; Kim & Kang, 2020). As older

adolescents with ASD begin to transition to adulthood, a nutrition education program which assists adolescents in making healthy food choices may play an important role in fostering such autonomy and independence in this population.

A few studies have highlighted the detrimental effects of strenuous events, such as COVID-19, on health behaviors in adolescents with ASD. Compared to their TD counterparts, adolescents with ASD may experience increased levels of stress, and spend more time in isolation during disaster-related situations (Edmonds, 2017; Stough, 2010). Colizzi et. al (2020) investigated the behavioral and social challenges faced by individuals with ASD during COVID-19 and found many had difficulties with healthcare support and physical isolation, but also lacked in structured activities, management of meals, and autonomies (Colizzi et al., 2020). This idea of unstructured days and its effects on health-related behaviors in youth, as hypothesized by Brazendale et al. (2017), was validated in this study since the participants, their parents, and their classroom teacher had explained that the lack of routine had negatively shaped health-related behaviors (Brazendale et al., 2017). Anecdotes shared included consuming more or less food than usual, participating in less PA due to closures of gyms, sleeping more inconsistently, and having increased levels of stress, expounding on the lack of literature that has been written about the impacts of disaster-related situations such as COVID-19 on this group's health-related behaviors and how to promote them (Esentürk, 2020; Yarımkaaya & Esentürk, 2020).

This was also the first study to utilize a Zoom platform as the primary mode of remote-based instruction. The use of Zoom for remote instruction in the current study was based on the partnering school's decision to use this platform for virtual learning following the shut-down of in-person classes. The demonstrated feasibility of Zoom in the current study expands our knowledge and application of remote-based delivery to include additional platforms, such as

Zoom, that offer real-time, interactive instruction to individuals with ASD. As previously mentioned, a higher rate of participant attendance was found in the remote-based version of the nutrition program due to more availability during COVID-19, which indicates easy access to the materials. As previously described, Zoom offers many features to improve virtual learning, such as screen sharing, a chat box, and reactions such as raising a hand to ask a question, giving a thumbs up/down, or requesting the host of the meeting to go faster or slower in the lecture. As individuals with ASD tend to be visual learners, these features may provide added benefit during instruction sessions. Future studies should focus on measuring the true effectiveness of these features, especially during a virtual health promotion program.

This study was also the first to incorporate parental involvement, although it was minimally utilized, as previous studies that initiated health promotion programs did not include parents in their sessions. This inclusion was found to be a strength of this study because while the parents did not actively participate in the Zoom meetings with the participants during their interviews, they were able to provide details about how the intervention influenced the participants' health-related behaviors during COVID-19. Parents were able to witness how the effects of COVID-19 negatively impacted such behaviors, and attributed the participants' improvements in nutrition during the stay-at-home order to the implementation of the Zoom nutrition program, claiming that it gave them more consistency in their routines and helped the participants articulate more of their thoughts about nutrition and healthy eating. Along with parental oversight, the study was performed in the convenience of the homes of the participants, which served as a strength because of the increased sensitivity in being exposed to new places and situations commonly found in individuals with ASD, so conducting the study with environments familiar to them could suggest more effectiveness with retention of the program. The same is noted with the in-person version of

this study, which was conducted in the kitchen of the school that the participants attended and visited everyday before the lockdown.

### **Limitations**

The current study had several limitations that should be discussed. First, the small sample size was a limitation of the current study. It should be noted, however, that the current study was considered a pilot study, and feasibility was a primary aim. Additionally, the sample of this study included more males than females, which is representative of the population of individuals diagnosed with ASD. Secondly, although we aimed to compare in-person and remote delivery, findings must be interpreted with caution as the unplanned nature of the pandemic introduces several areas of bias. The curriculum for the remote-based sessions differed from the in-person sessions in that the curriculum had to be modified to accommodate the remote format, and consider new concerns of the participants as a result of the pandemic. For example, the remote study was modified to educate the participants about staying healthy during the pandemic, while the in-person study focused on general nutrition and cooking skills. Due to time restraints, there were no cooking demonstrations performed on Zoom, which could have influenced why the participants preferred the in-person over remote-based learning. On the other hand, parents became unintentionally involved in the remote-based intervention because the participants were at home in the presence of their families as the study was performed. While the parents did not directly participate in the sessions with the participants, there may be a personal bias for parental favorability over the remote-based sessions since they did not witness the participants do the in-person sessions before COVID-19. Furthermore, due to the fluid nature of COVID-19, a maintenance phase was unable to be recorded due to trouble with remote-based contact with the participants and their families. The intention of doing a follow-up evaluation demonstrates the

desire to build upon previous studies that did not even consider conducting a maintenance phase (Lee et al., 2015; Panerai et al., 2018; Williams, Wright, Callaghan, & Coughlan, 2002). Finally, the in-person intervention was only 6 weeks and the Zoom intervention was only 4 weeks, which may not serve as enough time to demonstrate their true effectiveness on the participants.

### **Implications for Future Research**

The results of the current study indicate that remote-based nutrition education intervention was reachable and well-accepted by older adolescents with ASD. This suggests that a transition to online-learning may be a viable opportunity to promote nutrition behaviors during periods of uncertainty and stress, where in-person instruction is not possible. The suggestion for greater parent involvement in the study was mentioned by nearly all ten of the parents and the classroom teacher during their interviews. Given both the suggestions by parents and prior literature describing the importance of parent support for other behaviors, such as providing a consistent routine, in adolescents with ASD (Ratliff-Black & Therrien, 2020), future research should consider parent involvement in the nutrition intervention. They further recommended to assist with weekly homework given to the participants after each nutrition session to recap what they had learned and how they were able to apply it to their personal lives. Almost all of the participants and their parents and teacher also felt that recording the Zoom lessons for students to review at a later time would be ideal, and one change that can be made in the curriculum is conducting cooking demonstrations over Zoom. Video direction may also enhance participation in the program since it is one form of evidence-based technology for youth ASD (Bellini & Akullian, 2007; Galligan, Suhrheinrich, & Kraemer, 2020).

Future research should expand upon this study by possibly combining virtual and in-person methods of instruction for optimum learning. The teacher had explained in their interview that

some students may greatly benefit from Zoom instead of in-person due to increased social difficulties, as commonly seen in ASD. A future study can evaluate the social anxiety levels of adolescents with ASD and determine if a slow transition from remote-based to in-person instruction is efficient in reducing this apprehension. It is also hoped that future research will recruit a larger sample size and continue to focus on this age group as it is crucial to teach them concepts of self-sufficiency as they transition into adulthood.

### **Conclusion**

This original pilot study compared in-person and virtual methods of learning in promoting nutrition in adolescents with ASD, subsequently revealing advantages of utilizing remote-based instruction with Zoom during the COVID-19 pandemic. Participants attended the majority of both the in-person and Zoom lessons of the program, but preferred the in-person version for its hands-on interaction. On the other hand, it was found that Zoom was more feasible and accommodating for ASD. The discovery that COVID-19 negatively affected the health-related behaviors of half of the participants emphasized that a greater need for preventing health-related behaviors from decreasing must be placed upon this population during a disaster-related situation. The recall of nutrition and cooking skills demonstrated by the participants after the outbreak and effectiveness of the Zoom program on the participants' food choices supports the idea that such a program may be well-received by the rest of this population; however, more studies are needed given the novelty and small sample size of this study.

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