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Child-mediated Health Communication: A Conceptual Framework for Increasing Stroke Literacy in Hard to Reach Populations

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ABSTRACT

Effectively engaging economically-disadvantaged ethnic minority communities for promoting health has proved to be challenging for a variety of reasons, including factors related to healthcare access, literacy, inadequate or ineffective cultural appropriateness of materials, and the relatively low priority for health due to competing demands related to economic hardship. We have developed a framework of Child-Mediated Health Communication (CMHC), which focuses on children as channels for carrying out health promotion interventions to parents and other caregivers. CMHC is an innovative, alternative strategy for engaging this underserved population, where traditional methods of health promotion have not been successful. We discuss the theoretical foundation, development, and effectiveness of a CMHC framework in our stroke preparedness communication intervention, Hip Hop Stroke.

Keywords: Health Communication, Public Health, Public Health Education

INTRODUCTION

While the traditional conception of education and socialization focuses on the role of parents, teachers and other adults in shaping the behavior and beliefs of children, sociologists have long recognized a process of “reverse socialization,” by which children alter their elders’ views and behaviors (Brim, 1968; Peters, 1985). Using a process we have termed Child-Mediated Health Communication (CMHC), our group developed an intervention called *Hip Hop Stroke* to improve the awareness of stroke symptoms among at-risk adults and the correct

response when they occur, through children in the community. Hip Hop Stroke was designed to address the critical knowledge gap among the general public regarding the recognition of stroke signs and symptoms and the appropriate response to them which is to call 911 immediately. Indeed delays in hospital arrival due to failure to call 911 immediately (Gillum & Johnston, 2001), is the most common reason why stroke patients are disqualified from time-dependent acute stroke treatments, which need to be given within 4.5 hours of stroke symptom onset.

Despite the tremendous promise and improved chance of recovery for these time-dependent stroke treatments, very few patients actually receive therapy. Recent data suggest that only 22% of patients arrive at the hospital within the treatment time window (Schwamm et al., 2013). The reasons are related to the failure of the public to call 911 immediately, which has been linked to various factors and processes (table 1) such as knowledge of stroke symptoms and their urgency, recognition of stroke symptoms when they are occurring, normative beliefs, perceived seriousness of symptoms, perceived benefits of urgent action, perceived barriers to urgent action, and the decision to choose the best mode of transportation, which is an ambulance. Our Child-Mediated Health Communication is a form of upward communication from child to parent, where children are educated about stroke symptoms and the appropriate response to them, given the self-efficacy for 1) recognizing stroke and calling 911 themselves when witnessing a stroke, and 2) effectively communicating stroke information and the need for an urgent response to their parents or adult caregivers.

Stroke awareness in economically disadvantaged minority populations: A need for a new approach

Stroke is the leading cause of adult disability in the United States, with an estimated 795,000 new and recurrent strokes occurring each year (Scott & Silbergleit, 2006; Stansbury, Jia, Williams, Vogel, & Duncan, 2005). Treatment with intravenous thrombolytic therapy with tissue plasminogen activator (t-PA) following an ischemic stroke can reduce the odds of minimal to zero patient disability by 31-50%, but it must be administered within a strict 4.5-hour time window from the onset of stroke symptoms (Hacke et al., 2008; The National Institute of Neurological Disorders and Stroke rt-PA Stroke Study Group, 1995). Currently, only 7% of diagnosed ischemic stroke events receive t-PA therapy (Schwamm et al., 2013). This low rate of treatment is due predominantly to the public's inability to identify and respond appropriately to stroke symptoms when they occur (Gillum & Johnston, 2001), so they do not arrive to the hospital within the treatment time window.

Economically-disadvantaged minority populations represent a special challenge for stroke preparedness communication interventions. Despite much higher stroke incidence rates compared to Whites, Blacks and Hispanics have low stroke literacy rates (Willey, Williams, & Boden-Albala, 2009), and are less likely to use ambulance services, which is the strongest predictor of early hospital arrival and increased thrombolysis use (Minnerup, Wersching, Unrath, & Berger, 2014; Saver et al., 2013, Lacy, Suh, Bueno, & Kostis, 2001). For stroke victims to get to the hospital's emergency department in a sufficiently timely manner, they must: (1) be able to identify symptoms that indicate a stroke is occurring, (2) overcome a common inertia to act - many perceived barriers to going to the hospital exist, including health insurance status, immigration status, cost and perceived conflict in priorities, and (3) know the correct thing to do upon recognizing a stroke (i.e., immediately call 911). If there is a breakdown anywhere in this chain of events, the patient's arrival at the hospital is delayed, often making them ineligible to receive time-dependent treatments.

The aforementioned barriers to activating 911 and getting to the hospital – healthcare access, costs, literacy, and the relatively low priority for health due to competing demands related to economic hardship – contribute to the failure of traditional mass media approaches to community stroke education among economically-disadvantaged ethnic minority communities (Robinson, Reid, Haunton, Wilson, & Naylor, 2013). As such, designing stroke preparedness communication interventions requires innovative, culturally-tailored approaches that take into account the multiple barriers that exist.

Children as key links in the stroke action chain

A culturally-tailored strategy involving children may offer an important opportunity to effectively reach adult populations that have proven hard to reach by traditional health communication techniques with stroke action information through Child Mediated Health Communication, and also empower children living in high stroke risk communities to take action themselves. Due to several factors, some of which are related to injury from the stroke itself (e.g., cognitive dysfunction, physical incapacitation, inability to speak), stroke patients call 911 themselves approximately 4% of the time, while a witness is responsible for calling 911 the rest of the time (Wein et al., 2000). Witnesses are often bystanders, family members or friends, including young children (Feldman-Hecht, 2014; Wein et al., 2000; O. Williams & Noble, 2008). A 2003 NIH/NINDS Task Force report focusing on goals of stroke care wisely suggested that young children may play a greater role in the chain of stroke recovery (L. Morgenstern et al., 2003) by calling 911 when they witness a stroke or communicating health information to parents. Considering that up to 45% of public stroke knowledge is derived from family and friends (Muller-Nordhorn et al., 2006), children may be an underutilized conduit for stroke education in their homes and communities (Kothari, Hall, Brott, & Broderick, 1997). Moreover, since 1990, at least 30% of children now live with their grandparents (Hayslip & Kaminski, 2005). In addition, many adults are delaying childbirth beyond age 30, resulting in more young children being raised with older, higher stroke-risk parents (Hamilton & Ventura, 2006).

Table 1. *Predictive variables and underlying constructs governing stroke action*

| | Predictive variables | Constructs |
|--------------------|--|--|
| Stroke Onset | Knowledge of symptoms | Subjective Norms |
| | Socio-Economic Status (e.g., education) | |
| | Race (e.g., Black race) | |
| | Comorbid medical conditions (e.g. atrial fibrillation) | |
| Stroke Recognition | Severity of symptoms (e.g., paralysis versus numbness) | Perceived Susceptibility |
| | Transiency of symptoms | Perceived Seriousness |
| | Type of symptoms (e.g., confusion, aphasia, neglect) | |
| | Witness (present or absent) | |
| Stroke Action | Self-management of symptoms | Perceived Cost/Benefit Ratio (includes barriers) |
| | Calling a friend or family member for advice or calling primary physician's office for appointment | Self-Efficacy |
| | Calling 911 | |
| | Public or private transportation to hospital | |

Note: Table 1 was adapted from the NINDS Stroke Proceedings of a National Symposium on Rapid Identification and Treatment of Acute Stroke.

Children as targets and conduits of community health education: A brief history

The idea of children as agents of familial health change is not novel. In 1910, health advocates recognized that “the children of this generation are to be the citizens of the next generation, and we should begin with them and with the chief medium of their education - the schools” (Egbert, 1910). In the 1970s, public health initiatives using children to improve adult health focused on smoking cessation (Great American SmokeOut - GASO, American Cancer Society) and cardio-pulmonary resuscitation training in high-school aged children. In 1985, the

“Open Airways for Schools” school-based program engaged elementary-aged children in an asthma detection and management, and the *children* were able to positively influence *parental* health behaviors (Evans, Clark, Levison, Levin, & Mellins, 2001). Another study showed that children can improve parents’ knowledge about hypertension and increased the likelihood that parents consulted their physician about their blood pressure (Viera & Garrett, 2008). Similar models have been used with adolescents in the cancer education literature, in which adolescent girls were educated about breast and cervical cancers and prompted to encourage their female elders to get screened (Mosavel & Genderson, 2015). However, the generalizability of these program models is limited because they did not target emergency threats requiring urgent attention and action (e.g., such as stroke, myocardial infarction, cardiac arrest), that involve more acute emotional barriers and rapid decision-making. Despite this limitation, these health prevention models identify the opportunity for children to become the vehicles of change for health knowledge and behavior within the family unit.

Potential for Child-Mediated Health Communication in public stroke preparedness education

Since the early 2000s, several programs have assessed children’s stroke knowledge acquired through brief programs. The Brain Child Project showed encouraging results of a basic stroke knowledge program that delivered live action stroke demonstrations to approximately 50 students in K-8th grades in the diverse population of Kansas City, with retention assessed 7-10 days after the program (Dressman & Hunter, 2002). Another focused on the F.A.S.T. mnemonic (Facial droop, Arm weakness, Speech slurred/disturbance, Time to call 911). F.A.S.T. was taught as part of a didactic and interactive program with follow-up after 8 weeks, showing improved stroke knowledge in a largely Caucasian group of students in Cincinnati (Miller, King, Miller, & Kleindorfer, 2007). The Kids Identifying and Defeating Stroke (KIDS) study taught a predominantly Mexican-American 6th grade student cohort about stroke over two years using simulations and computer based vignettes (L. B. Morgenstern et al., 2007). Encouragingly, children were educable on basic stroke concepts, including symptom recognition and stroke urgency, and, to a lesser extent, stroke pathophysiology. While these programs demonstrated the proof-of-concept of children as stroke learners (and potential educators), we recognized the vehicle carrying the message could be improved for reach, sustainability and acceptance into diverse communities.

A child may be the only family member or bystander present during the onset of stroke (O. Williams & Noble, 2008). Schools provide an ideal venue for teaching community-level health interventions that focus on children (Davis, 2008), offering the potential for creating a community of stroke-knowledgeable reporters ready to act when they witness a stroke, and raise awareness of stroke symptoms in their homes. The above programs demonstrate that children can learn stroke information, respond to stroke incidents, and educate their relatives about these issues highlighting the potential of CMHC among diverse communities.

HIP HOP STROKE: A CMHC INTERVENTION TO IMPROVE STROKE LITERACY

Hip Hop Stroke Intervention Development

An American Stroke Association guideline statement regarding public stroke education recommends that interventions target groups with high stroke risk and their families, and address the availability of time-sensitive treatment for stroke and emphasize calling 911 (Jauch et al., 2013). To achieve these goals, stroke associations in many countries have recommended and promoted the use of the acronym F.A.S.T. to raise public awareness of stroke symptoms and the correct course of action. F.A.S.T conveys information on three common stroke symptoms and

the correct behavioral response. Despite the promise of the F.A.S.T. test, traditional mass media campaigns promoting it have shown poor penetration within economically-disadvantaged ethnic minority populations (Robinson et al., 2013). This is likely due to a lack of cultural targeting and an effect on the general population that is not typically sustained beyond the expensive media campaign (Rasura et al., 2014).

In the event an adult is unable to call, the children themselves may serve as first responders by calling 911. Based on the empirical findings concerning recognition of stroke symptoms, we sought to reach economically-disadvantaged ethnic minority communities in New York City and focused our intervention on four predictive variables of stroke action: (1) knowledge transfer using the F.A.S.T acronym, (2) perceived severity of stroke symptoms, (3) availability of time-dependent acute stroke treatment, and (4) the urgent need to call 911. Our direct and proximal targets were school-aged children and their parents (O. Williams & Noble, 2008). We chose to target 9 to 11 year old children (4th to 6th grades) based on the experience of prior stroke education studies that showed poorer results in K through 2nd graders

Figure 1: *Hip Hop Stroke multimedia*



LEGEND: A: *Stroke Ain't No Joke* cartoon. B. *Keep Your Brain Healthy* cartoon. C. *Stroke Hero* "Clotbuster" video game. D. *Hip Hop Stroke* comic

(Dressman & Hunter, 2002) and evidence suggesting that lifestyle behavioral modification health prevention interventions should begin prior to 6th grade (<12), due to early consolidation of health behaviors, before behavioral patterns become more resistant to change (Kelder, Perry, Klepp, & Lytle, 1994).

An interdisciplinary team was established to develop and design the intervention. This team included neurologists, public health experts, a behavioral scientist, an elementary school teacher, a pediatric psychologist, a music producer, two well-known hip hop artists, and a children's television writer. A 16-member student advisory board of 5th-grade students helped inform the initial development by providing insight on what children of our target age group would find compelling, memorable and worth communicating to the adults in their community. This group also provided strategies for overcoming anticipated barriers to the adoption of the mediator role.

Hip Hop Stroke (HHS) uses a multisensory approach to learning, including hip hop music, cartoons, video games and comic books to improve the stroke literacy of 4th, 5th and 6th grade students (Figure 1) (O. Williams, DeSorbo, Noble, & Gerin, 2012; O. Williams, DeSorbo, A., Shafer, M., Noble, J., Gerin, W., 2012; O. Williams, Hecht, DeSorbo, Huq, & Noble, 2014; O. Williams & Noble, 2008). Hip hop as a music genre was specifically selected for several reasons. First, Hip Hop strongly emphasizes rhyme and dance, providing opportunity for physically dynamic programming. It is popular among diverse socioeconomic and ethnic groups (NielsenMedia, 2001). Further, at the time of our early programs, integrated rhyme and dance had been used as educational tools in efforts to improve vocabulary in eleventh graders (Garvin, 2006) and math skills in second graders (Capps, 2003), enable behavioral changes in homeless children (Staum, 1993), and prevent obesity in African-American preschoolers (Fitzgibbon et al., 2005). Health initiatives that incorporate readily learned or familiar, fast-paced music and dance activities have significant impact (Staum, 1993) and could improve the potential for sustained learning. Finally, *music* had been suggested as a strategy for health education programs in adolescents (Stephens, Braithwaite, & Taylor, 1998), strongly indicating that an appropriately devised hip hop-centric program could represent a fun, culturally- and age-appropriate method to introduce health education initiatives to younger children.

Homework and in-school activities were designed to be fun and achieve three purposes: (1) engage the child, increasing the likelihood that the child will remember what he or she was taught in the program, (2) increase the likelihood that the child will communicate what was learned to a parent or other at-risk members of the household, and (3) increase both the child's and the parent's stroke literacy.

Framework for Child-Medicated Health Communication

Building upon previously successful CMHC program models and the concept of reverse socialization, our HHS intervention was developed with Entertainment Education (EE) concepts and theory, which encompass several behavioral theories. EE is the process of designing and delivering a media message to educate and entertain (i.e., "edutainment") in order to increase awareness, create favorable attitudes towards message goals and motivate behavior change in response to the message (Singhal & Rogers, 2002).

"Edutainment" operates through the experience of being cognitively and emotionally involved with messages through transportation into an EE message and identification with its characters (Singhal & Rogers, 2002). We hypothesized that immersion into persuasive subtexts may help overcome children's and parents' counterarguments and resistance to health messages,

which in this case was learning how to recognize stroke and call 911, as well as the communication of this information from child to parents. Our EE messages were delivered in a modular format through effective and culturally-relevant visual associations, music, repetition and rhyme (e.g., a F.A.S.T acronym rhyme), all of which were developed using community-engaged techniques (e.g., focus groups, semi-structured survey data, feasibility studies, iterative development of tools through ongoing feedback and refinement, and pilot studies of tools) by our interdisciplinary team. Theoretical models of EE interventions include the Extended Elaboration Likelihood Model

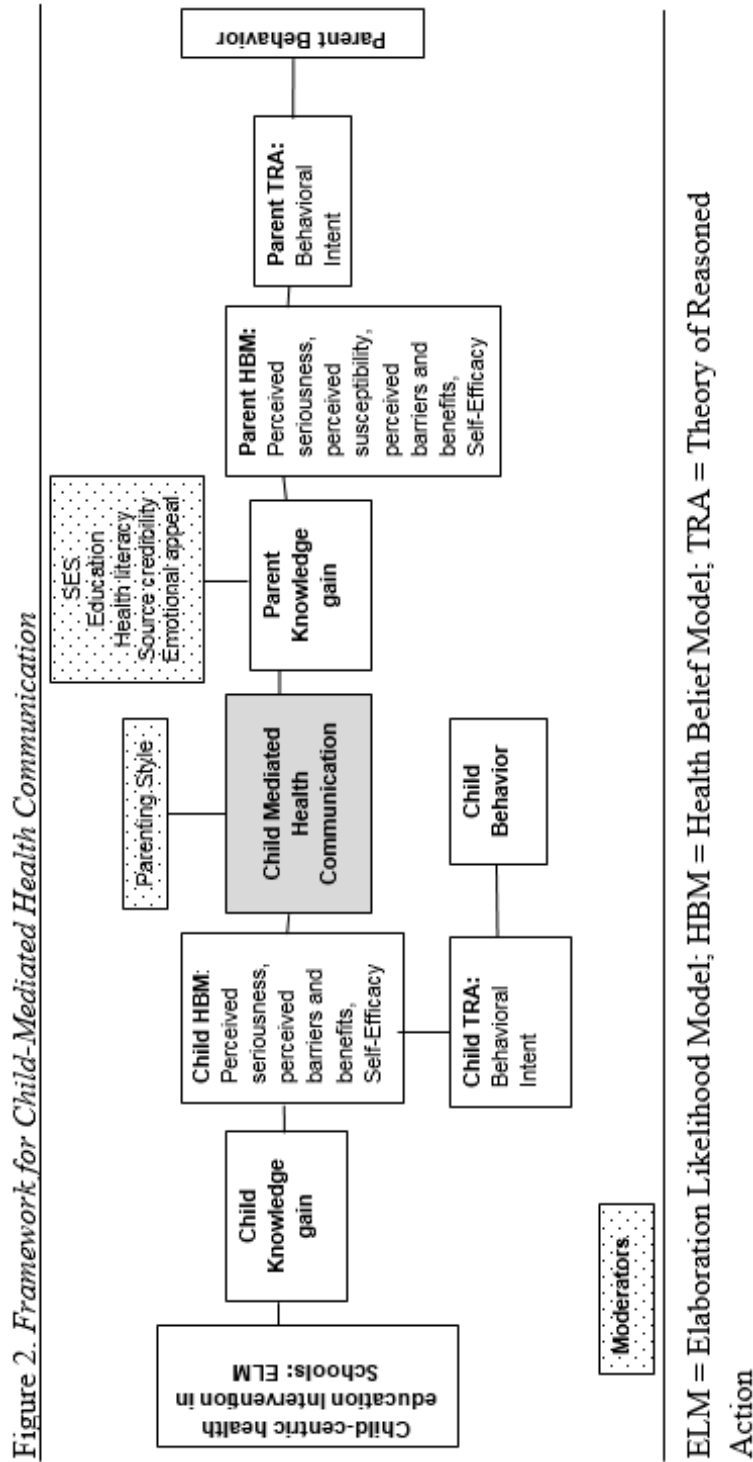
Table 2. *Theoretical constructs of intervention components*

| | Constructs | Intervention Components |
|---------------------------|---|---|
| Self-Efficacy | Performance Accomplishments (mastery) | Stroke Hero “Clotbuster” Video game, Calling 911 Role Play, Hip Hop Stroke Comic Book exercises |
| | Vicarious Experience | Stroke Ain’t No Joke Cartoon, Keep Your Brain Healthy Cartoon, Hip Hop Stroke Comic Books |
| | Verbal Persuasion | Stroke Ain’t No Joke Cartoon, Keep Your Brain Healthy Cartoon |
| | | |
| Theory of Reasoned Action | Attitudes | Hip Hop Health music (making the stroke information “cool”), Stroke Ain’t No Joke Cartoon (emphasizing the heroism of calling 911) |
| | Subjective norms | Using role models (well-known Hip Hop artists in cartoons and stroke songs) advocating calling 911 for stroke symptoms and the need for the child to communicate this to parents health (reframing perceived role of children in family health structure) thereby altering the expectation of what the child thinks he or she should do in this situation |
| | Behavioral Intention | Multiple Intervention components working synergistically to influence stroke recognition and intention of calling 911 including framing children as “Stroke Heroes” |
| | | |

(ELM) (Petty & Cacioppo, 2012) – which addresses engagement, including experiential involvement – the Theory of Reasoned Action (Fishbein, 2008) and Self-Efficacy. The Theory of Reasoned Action (TRA) addresses the decision-making process both for the children, who are the primary targets of the intervention, and the parents, who are the secondary targets. Social

Cognitive Theory (SCT) (Coleman & Pasternak, 2012) posits that control over one's outcomes produces a sense of mastery, or self-efficacy, for those behaviors, and increased self-efficacy leads to increased motivation to engage in the desired behavior (i.e., communication of stroke information to parents and calling 911). These theoretical constructs serve as the basis for the intervention modules (Table 2) to foster stroke action preparedness, including their role as part of the familial health-communication structure. This is a means for increasing the children's self-perception as powerful and central agents of change and establishing this as a desired behavior.

Additional theoretical models were required to address the issue of perception – specifically, the perception of stroke symptoms as serious, regardless of how transient or slight they may appear (Table 1). To address this, our intervention included key constructs from the Health Belief Model (e.g., perceived severity, perceived susceptibility and perceived barriers) (Coleman & Pasternak, 2012) in our final framework for CMHC (Figure 2). Due to the developmentally concrete nature of thinking among 9-11 year olds, the program also incorporated an implementation intentions strategy (Gollwitzer & Sheeran, 2006) to help young children engage in the desired behavior through the use of an “If/Then” plan. In Figure 2, we illustrate the role of ELM in the development of a child-centric intervention such as HHS. We show the mediating influence of key constructs such as self-efficacy, attitudes, perceived severity, perceived susceptibility, and perceived barriers between knowledge gain in children and the transfer of this knowledge to parents through CMHC, as well as translation of knowledge into the desired behavior by children and parents (i.e., calling 911 for acute stroke symptoms). The framework includes the moderating role of parenting style (e.g., authoritative, authoritarian, permissive, neglecting) on CMHC. Parenting style may influence how and the extent to which the health message is transferred from child to parents. For example, authoritarian parents are often strict, and discourage verbal give and take (Baumrind, 1971, 1991), which could discourage the child from sharing information his/her parents. The role of socio-economic status, parent education and health literacy in moderating child to parent communication has also been incorporated. These variables may influence the impact of the child-to-parent communication depending the parent's baseline literacy levels regarding the subject, as well as the parent's ability to understand the information provided for may reduce the effectiveness of communication (Arora & Donsbach, 2008). Source example, high levels of difficulty understanding the material or low literacy levels credibility (Avery, 2010) and emotional appeal (Turner & Cho, 2011) regarding the subject matter may also moderate the effect of communication. For example, lack of source credibility may reduce the effect of communication, and high appeal may increase cognitive consonance and the value of communication. While these collective variables require greater dyadic analysis, they likely represent important moderators for interpersonal communication between children and their parents. In addition, given the potential role of social determinants of parent-child interaction (Brocklebank, Bedford, & Griffiths, 2014), we capture factors related to literacy and numeracy levels (parent education), which have also been incorporated into conceptual models of communication, such as the Structural Influence Model of communication that emphasizes the role of communication inequalities (Viswanath, Ramanadhan, & Kontos, 2007). Finally, the framework elucidates the mediating role of behavioral intent between the aforementioned constructs and the desired behavioral outcome.



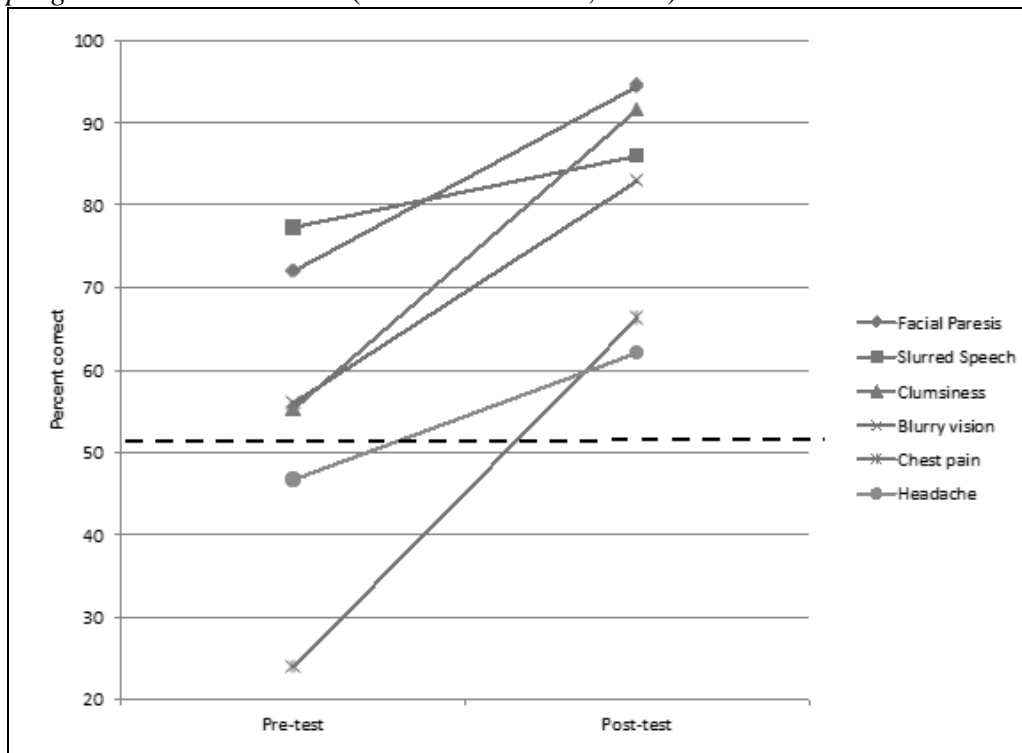
Edutainment media modules

There are four main components that comprise the HHS edutainment media, two cartoons, a video game and a comic book. One of the cartoons, *Stroke Ain't No Joke*, is a musical narrative, "role play," cartoon that teaches F.A.S.T. and non-F.A.S.T. (e.g., gait ataxia, severe headache, and visual loss) stroke symptoms, the need to take immediate action and call 911, as well as the benefit of early treatment. The other cartoon, *Keep Your Brain Healthy*, is also a musical narrative, "role play," cartoon, which teaches children the relationship between stroke risk factors (e.g., diabetes, hypertension, smoking, poor diet, sedentary life) and stroke occurrence, as well as the child's power to positively influence parents behavior. The *Stroke Hero* "clotbuster" video game (O. Williams et al., 2014) involves navigating a clot-busting spaceship intra-arterially, shooting clots that occlude the passage of blood to the brain (i.e., stroke pathophysiology and treatment), and highlights the importance of "time is brain". Finally, the *Hip Hop Stroke* comic book is a colorful comic book that features an extended storyline from the narrative cartoons, *Stroke Ain't No Joke* and *Keep Your Brain Healthy*, and contains an activity sheet to be completed with parents.

Testing the Intervention

The HHS program was presented in the form of three, 1-hour facilitator-drive sessions, delivered assembly style in the schools' auditorium, gymnasium or cafeteria. The initial results of the HHS studies we have conducted to date have demonstrated that children *can* and *will*: (1) learn stroke information required for appropriate action and retain this knowledge for at least 15 months (the follow-up period; it may be longer) (O. Williams, DeSorbo, A., Shafer, M., Noble, J., Gerin, W., 2012), (2) communicate stroke information successfully to parents (figure 3) (O. Williams et al., 2012), and (3) call 911 when they witness stroke symptoms occurring in their homes or community (Feldman-Hecht, 2014; O. Williams & Noble, 2008). A recently concluded NIH-funded randomized trial conducted by our group (O. Williams et al., 2015) involving more than 3,000 public school children has confirmed our earlier reports that children can successfully communicate stroke information to parents (manuscript in preparation), suggesting an increased role for young children in the chain of stroke recovery.

Figure 3. *Before and after parent knowledge of stroke symptoms following Hip Hop Stroke program on their children* (O. Williams et al., 2012)



Note: N=71 dyads

DISCUSSION

Child-Mediated Health Communication may represent a new public health paradigm similar to “purchase influence” or “pester power” frameworks used by the marketing industry (Story & French, 2004). Purchase influence is used by food marketers as a successful strategy to target children not only for their direct buying power, but more importantly for their ability to influence parental purchases. Traditional methods of health education, including those related to stroke preparedness communication, often experience poor penetration in economically-disadvantaged ethnic minority communities, making child-mediated influence on parental behavior a particularly important strategy to consider when designing interventions that target adults in these populations. Moreover, these health-educated children have the potential to become the next generation of a health literate society, possibly influencing subsequent familial generations to make better health decisions through their own health behaviors learned early in the life course.

Public health interventions have traditionally experienced difficulty reaching economically-disadvantaged ethnic minority populations outside of captive audiences, such as school settings, churches and community centers. As a consequence, the impacts of these interventions are limited to the older individuals, who often attend church and community centers, and the youth, who are targeted within the schools. Younger and middle-aged adults, who often dominate the working population and who may have multiple jobs in poor communities, are hard to reach by traditional public health strategies. Studies show that these individuals, typically aged 25-55, experience a disproportionately high risk of developing

chronic disease, highlighting the need for developing innovative public health approaches for this group.

Health communication typically flows from parent to child. More recently, adults are starting families at later stages in life, leading to an increasing number of children being raised by older adults. Moreover, within economically-disadvantaged ethnic minority population, many children are being raised by their grandparents. Therefore, reversing the health communication paradigm through child-mediated health communication from child to parent may present an opportunity to gain access to this hard to reach population.

CONCLUSION

Our framework of child-mediated health communication and our application studies demonstrate that utilizing the captive audience of school-aged children as a “transmission vector” for carrying out interventions aimed at their parents not only provides education regarding specific health topics aimed at children themselves, but it may also serve as a mechanism for health communication to the larger society in other content areas, including care seeking behaviors for other diseases, medication adherence, self-monitoring of hypertension, food purchasing behaviors and healthy eating. If indeed CMHC is effective for the communication of stroke preparedness information, it may well represent a more general model of intervention for health-promoting behavior change in a broad range of behavioral domains.

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