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Tick-borne disease occupational risks and behaviors of Florida Fish, Wildlife, and Parks Service employees – A health belief model perspective

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ABSTRACT

Early research indicates that outdoor workers, such as park rangers and land managers, are at greater risk of tick-borne disease (TBD) infection because of their repeated occupational exposure to ticks, yet few studies have sought to determine predictors of personal protective behavior in this population. The purpose of this study was to identify within the framework of the Health Belief Model, relevant demographic and psychosocial predictors of TBD personal protective behaviors (PPB) among Fish and Wildlife, and State Parks employees in the U.S. State of Florida. Following informed consent, an e-survey was used to obtain cross-sectional data from 631 study participants. Seven scales and one index of items were adopted to operationalize the independent variables in this study. Study findings revealed that only twenty-five percent of respondents reported receiving occupational risk training about TBD from their employer. 'Checking for ticks on skin' was the TBD PPB most adopted by study participants, while the least adopted TBD PPB was 'tucking pants into socks'. We found the most significant predictors of checking for ticks on skin to be 'high specific knowledge of TBD PPB', 'high perceived risk for TBD', 'high intention of taking action to prevent tick bites', and 'high perceived self-efficacy for taking action to prevent tick bites'. This study represents a response to the collective call for TBD research focused on the unique issues in Florida. Study findings suggest that occupational training of employees should tailor interventions toward males. Such efforts should focus on increasing specific knowledge of TBD PPB.

Management implications: Managers of nature-based destinations for which exposure to ticks poses a significant risk to employees will find it useful to develop interventions for reducing tick exposure among employees using the following guidelines:

I. Educational curriculum for occupational training programs should be tailored to increasingly target behavior modification among male employees.

II. Content for curriculum to be used in training programs should emphasize specific, rather than general knowledge of tick-borne disease personal protective behavior. Suggestions for content includes the social, economic and health risks of TBD, specific action that can be taken to prevent TBDs, benefits of taking preventive action, role of checking for ticks, tucking shirts into pants and overall TBD PPB in TBD prevention.

1. Introduction

Tick-borne diseases are transmitted to humans by way of the bite of an infected tick and, thus, exposure to ticks is the fundamental variable upon which risk is determined (U.S. Centers for Disease Control & Prevention, 2015). Accordingly, individuals who spend time outdoors or in close proximity to wildlife or domestic animals that may be carrying ticks are at the greatest risk. Five nationally notifiable tick-borne diseases (TBD) (Lyme, Erlichiosis/Anaplasmosis, Babesiosis, Rocky Mountain spotted fever, and Q fever) have seen increasing case rates and their endemic range has expanded across the U.S. (Bacon, Kugeler, & Mead, 2008). The medical cost of TBD is estimated at 2.5 billion dollars annually in the U.S. and this is expected to follow the epidemiological trends (Carpenter & Wyman, 2008a, 2008b; Carpenter & Maes, Lecomte, & Ray, 1998; Zhang et al., 2006). The real toll of TBD, however, is the profound economic and social impacts on individuals and communities (Donohoe, Pennington-Gray, & Omodior, 2015). The increasing number of reported cases of TBD, coupled with the high

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human costs of infection underscore the need for early disease recognition and treatment, ongoing surveillance and research, and targeted prevention strategies (Gubler, 1998).

Early research in the U.S. has found that outdoor workers such as park rangers and land managers were about 3–10 times more likely to be infected with a TBD than indoor workers (Bown, Schulze, Hayne, & Parkin, 1984; Schwartz & Goldstein, 1990; Smith, Benach, White, Stroup, & Morse, 1988). When over 30% of their sample of outdoor workers tested positive for a TBD, Motiejunas, Bunikis, Barbour, and Sadziene (1994) concluded that a higher risk of infection existed for these workers because of their repeated exposure to ticks. Bartosik, Sitarz, Szymanska, and Buczek (2011), Cisak, Wójcik-Fatla, Zajac, Sroka, and Dutkiewicz (2012), Kuiper et al. (1991), Panczuk, Koziol-Montewka, and Tokarska-Rodak (2014) and Van Charante, Groen, Mulder, Rijpkema, and Osterhaus (1998) conducted independent serological screening of blood samples collected from a sample of farmers, foresters, and wildlife managers in Europe. These researchers also reported higher case rates amongst the workers than the general population and concluded that individuals employed in land and wildlife management–type occupations are at greater risk of exposure to ticks, TBD pathogens, and TBD infection. Additional case studies from Europe (Bartosik et al., 2011; Bochnickova & Szilagyiova, 2011; Franke, Hildebrandt, Meier, Straube, & Dorn, 2011; Jameson & Medlock, 2011; Marcu, Barnett, Uzzell, Vasileiou, & O'connell, 2013; Thorin et al., 2008) confirm that ticks, Lyme and other TBD pathogens pose a significant occupational risk to outdoor workers. Piacentino and Schwartz (2002) published a meta-analysis of articles on the occupational risk for Lyme disease and reported that outdoor workers in endemic areas are at the highest risk because they are exposed to ticks while on the job.

Ticks are common across all of Florida's counties and environmental change processes have resulted in the immigration of non-endemic TBD pathogens from the south and the north (Clark, 2004). For example, Lyme disease is thought to be endemic to the Northeast U.S. but case rates have doubled in Florida in the last 15 years, making it the 21st highest case rate in the country (U.S. Centers for Disease Control & Prevention, 2016). Although Lyme and other TBD incidence rates are relatively small when compared to other areas of the country, the epidemiological trend is clear: tick-borne diseases are an emergent public health problem in Florida because they have the potential to threaten the state's health, tourism, and economy.

The U.S. Centers for Disease Control and Prevention (CDC) recommends that the best defense against tick bites should be avoidance of ticks and their habitat, however, this is not always plausible in the occupational context (Piacentino & Schwartz, 2002; U.S. Centers for Disease Control & Prevention, 2015). Personal Protective Equipment (PPE) and the adoption of personal protective behaviors (PPB) are also important TBD prevention measures. These include the use of insect repellents containing 20–30% DEET on exposed skin and (0.5%) permethrin on clothing, conducting a full-body check, examining gear, removing ticks with proper technique, bathing or showering within two hours of exposure to remove ticks, and drying clothes at a high temperature setting for an hour to kill any remaining ticks. Although research evidence provides support for the effectiveness of these preventive actions in diminishing TBD infection risk, adoption by the general public and among particularly high risk populations, such as land and wildlife managers, and parks services employees has been poor (Daltroy et al., 2007; Hallman, Weinstein, Kadakia, & Chess, 1995; Herrington, 2004; Mowbray, Amlôt, & Rubin, 2012).

Health psychology and behavioral change theories have been used to better understand the many variables that play a role in health protective behavior (Omodior, Pennington-Gray, & Donohoe, 2015). These variables include perceived risk in terms of the susceptibility of contracting a TBD and the perceived severity of TBD (Gould et al., 2008; Mowbray et al., 2012), perceived efficacy of recommended PPE/PPB (Marcu et al., 2013), self-efficacy for recommended PPE/PPB (Daltroy et al., 2007), TBD knowledge, and awareness about ticks and TBD (Bartosik et al., 2011; Gould et al., 2008; Herrington, 2004; Jenks & Trapasso, 2005). Additionally, gender differences in health behavior has been investigated by various researchers and found to significantly predict perceptions and behavior (Ching-hua, Sasidharan, Elmendorf, & Willits, 2005; Lalani et al., 2016).

Given that, 1) there is a magnified risk for outdoor workers in endemic areas, 2) there are thousands of Floridians currently employed in land and wildlife-related industries, and 3) no studies have yet examined the sociodemographic and psychosocial predictors of the adoption of TBD PPE/PPB among outdoor workers in Florida, the purpose of this study is to identify the extent to which select constructs within the Health Belief Model (Janz & Becker, 1984) predict the adoption of TBD PPB amongst Florida Fish and Wildlife, and Florida State Parks employees. An improved understanding of the relationship among these variables is needed to inform the development of targeted and tailored public health interventions to thwart this growing health risk for at-risk populations (Mowbray et al., 2012), such as fish and wildlife, and park service employees. Additionally, study outcomes can be used by managers of outdoor recreation and nature-based tourism to inform decisions aimed at improving occupational and visitor safety to places for outdoor recreation and nature-based tourism, where the risk of tick exposure are reportedly high.

2. Theoretical framework

The Health Belief Model (HBM) is a psychological health behavior change model (Hochbaum, Rosenstock, & Kegels, 1952; Janz & Becker, 1984) that specifies constructs which are hypothesized to predict why individuals engage in health risk prevention. The major constructs of the HBM include perceived susceptibility, perceived severity, perceived benefits, perceived barriers, self-efficacy, and cues to action.

2.1. Perceived susceptibility

Perceived susceptibility refers to a subjective assessment of the risk of developing a specific health problem (Janz & Becker, 1984), and has been shown to significantly affect decision making and behavior (Needham & Vaske, 2008). The HBM posits a positive linear relationship between high perceived susceptibility for a negative health outcome and adoption of health behaviors (Rosenstock, 1974). Studies though, have reported mixed results. For example, while Chen, Fox, Cantrell, Stockdale, and Kagawa-Singer (2007) reported a significant association between perceived susceptibility and getting a flu vaccine, Hyman, Baker, Ephraim, Moadel, and Philip (1994) reported no association between perceived susceptibility and mammography utilization. Furthermore, because perceived susceptibility is subjective, the model also suggests that under certain conditions, individuals will not act to mitigate a health risk and may even engage in unhealthy or risky behaviors because they believe it unlikely that the risk will affect them (Carpenter, 2010). For example, older adults do not practice safe sex because they do not perceive themselves to be at risk for HIV infection (Maes & Louis, 2003). Despite self-identifying as an at-risk population for sexually transmitted diseases, college students have been reported not to practice safe sex, nor do they stop tanning, although they acknowledge the increased risk for skin cancer (Lamanna, 2004; Lewis, Malow, & Ireland, 1997; Mahoney, Thombs, & Ford, 1995).

2.2. Perceived severity

Perceived severity relates to an individual's beliefs about the seriousness or severity of an illness or disease (Rosenstock, 1974). This is often based on health information or knowledge, and their evaluation of the health (e.g. quality of life, disability, death) and social (family life, social relations, ability to work) consequences the illness or disease will have for them or their families (Janz & Becker, 1984). The Health Belief Model posits that the stronger an individual's perception of the

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