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Risk Behaviors and Self-Reported Illnesses among Pacific Northwest Surfers

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Abstract

Although surfers have high incidental exposure to marine waters, no studies have investigated if surfer risk behaviors (such as surfing during advisories, near an outfall, during a rain event, or use of personal protective equipment) increase or decrease the risk of acquiring waterborne illnesses. We used a web-based survey to assess the association between risk-based behaviors with self-reported illnesses among Pacific Northwest surfers. Commonly reported illnesses include: ear infection or discharge (38%), sore throat or a cough (28%), diarrhea (16%), fever (10.5%) and vomiting (7%). Surfing often during rain events was associated with an increased likelihood of diarrhea (OR=2.7; 95% CI: 1.4-5.47), sore throat (OR=1.26; 95% CI:1.01-2.05), and ear infection (OR=1.39; 95% CI: 1.01-2.32). Surfing during a health advisory was associated with increased likelihood of diarrhea (OR = 1.94; 95% CI: 1.03-4.64) and sore throat (OR = 2.32; 95% CI: 1.23-4.40). Other behaviors associated with increased illnesses include body surfing, surfing near an outfall, frequency of surfing and use of ear plugs. Approximately 40% of surfers were unaware if they had surfed during an active health advisory and 29% knowingly surfed during advisories, suggesting the need to engage this population about potential harm and behaviors that may increase health risk.

Keywords: recreational exposure, recreational water illness, surfer, risk, behavior, marine water

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Introduction

Surfers are an under-studied population in the Pacific Northwest and the U.S. with regard to risk behaviors and illnesses. Surfers may comprise a disproportionately large fraction of marine recreationalists, particularly in some regions of the U.S., including the Pacific Northwest and California coastal areas (Turbow et al. 2008). This population is at potential risk from exposure to fecal contamination in marine waters, particularly if engaged in behaviors such as surfing during posted advisories or after rainfall events, when marine waters are more likely to be contaminated with fecal bacteria.

Coastal waters are frequently contaminated with pathogenic organisms from a variety of natural and anthropogenic sources. Contamination may be more prevalent along beaches and near shore areas that receive high recreational use (Dwight et al. 2004; Turbow et al. 2003). Exposure to pathogens in recreational waters is associated with an increased risk of gastrointestinal (GI) illness, respiratory, ear, eye, and skin rashes or infections, meningitis and hepatitis (Cabelli et al. 1983; Corbett et al. 1993; Dewailly et al. 1986; Dwight et al. 2004; Haile et al. 1999; Kay et al. 1994; Pruss 1998; Wade et al. 2003). In particular, Haile et al. (1999) reported higher risk of fever, chills, ear discharges, vomiting and coughing associated with swimming in ocean water receiving untreated stormwater runoff. Although enterococcus density appears to be the indicator most strongly correlated with gastrointestinal illness among bathers in recreational waters (Arnone & Walling 2007), other studies examining the link between health effects and pathogen sources have not been conclusive (Colford et al. 2007; Perez Guzzi et al. 2000). In 1997, the EPA began the Beaches Environmental Assessment and Coastal Health (BEACH) Program in response to increased concern over bacterial and

pathogen-induced disease among recreational users in fresh and marine waters (U.S. EPA 2002).

Surfing represents a higher risk activity when compared with other aquatic recreational activities such as wading or swimming, given the frequency of unanticipated head submersions, chaotic wave activity and the potential for exposures of longer duration (Tsang & Jiang 2012; Turbow et al. 2008). Even when comparing illnesses between swimmers and non-swimmers, Colford et al. (2012) found significant increases in diarrhea for swallowing water and other outcomes in swimmers compared to non-swimmers. Exposure among swimmers (body immersion, head immersion, swallowed water) was associated with increasing risk of gastrointestinal illness. Although the routes of exposure to waterborne pathogens are identical for surfers and swimmers, surfers are likely to have higher exposure compared to swimmers by virtue of more frequent and longer contact with fecal contaminated water (Dwight et al. 2004; Schijven & de Roda Husman 2006; Stone et al. 2008Stone et al. (2008) found that the mean exposure magnitude and frequency were 170 ml of water ingested per day and 77 days spent surfing per year, respectively, which is marketly higher than those for swimmers and divers. This ingestion amount compares to an average amount water swallowed by recreational swimmers who are children and adults to be 37 ml and 16 ml, respectively (Dufour et al. 2006), and by recreational and occupational divers who ingest 9 and 9.8 ml of marine water per dive, respectively (Schijven and de Roda Husman 2006). Estimates of water intake for surfers were markedly higher (mean = 170 ml/day) than those for swimmers and divers. Despite the cold annual water temperatures (13° C), 57 Oregon beaches are used year round for surfing, with the primary surfing activity occurring from fall through spring, which corresponds to the majority of rainfall events throughout the year (Benedict and Neumann 2004). Oregon has 362 miles of coastline, with public access to all of the beaches.

In 2002, the Oregon Beach Monitoring Program (OBMP) began sampling near shore marine waters and freshwater outfalls for the presence of fecal bacteria using enterococci as an indicator organism. From May through September, ocean water is sampled by the OBMP either once a week, every two weeks, or monthly based on the priority ranking of the beach (Oregon Health Authority [OHA] 2013). The priority is determined by beach use, pollution hazards, previous monitoring results, and input from coastal stakeholders. The acceptable swimming associated gastrointestinal (GI) illness rate of 1.9% or 19 illnesses per 1,000 swimmers is calculated at a steady state geometric mean indicator density of 35 CFU/100 ml or a single sample density of 158 CFU/100 ml which corresponds to EPA's "Moderate Full Body Contact Recreation" category (U.S. EPA 1986; U.S. EPA 2004). The latter single sample density is currently the Oregon action level used to issue an advisory, and resampling occurs within 96 hours if the sample density is exceeded, except during winter months (OHA 2013). Oregon Beach monitoring data from 2002-2005 showed that one-third of the 52 beach locations had enterococci levels exceeding Oregon's action level (Neumann et al. 2006). Previous research indicates that while the risk of excess GI illness is not high with surfers in Oregon coastal waters, this group may not be adequately considered in the context of health advisories, due to their higher exposure levels (Stone et al. 2008)

Recreation that involves marine water contact is an extremely popular activity (Turbow 2009), and advisories are not uncommon occurrences. Between 2008 and 2013, there were 357 total advisory days issued for elevated enterococci detections on the Oregon coast (OHA 2013, NRDC 2013). However, little is known about the public's willingness to accept risks during swimming or surfing (Boehm et al. 2009) or the extent to which surfers are aware of health advisories and comply with recommendations to avoid water contact. Previous studies have reported acute and chronic conditions among surfers, which include surfing injuries, lacerations, sprains, fractures, otologic issues and sun exposure (Nathanson et al. 2002; Zoltan et al. 2005).

No studies to date, however, have investigated whether or not surfer risk behaviors (such as surfing during advisories, surfing near an outfall, surfing during a rain event, use of personal protective equipment) may increase or decrease the risk of acquiring waterborne illnesses. This study addresses an important knowledge gap about surfer risk behaviors and to the study of illness in recreational marine waters. Although regional in focus, this study has broad implications for surfers and marine bathers worldwide, as it captures risk behaviors and self-reported illnesses that are likely transferrable among different populations and locations.

Methods

Survey Design and Development

To obtain information on risk behaviors and self-reported illnesses using a cross-sectional study design and point prevalence for the illnesses, we developed a web-based questionnaire with the assistance of Oregon State University's Survey Research Center. We used previously validated swimmer-related questionnaires (Colford et al. 2005) and questions specifically tailored to surfers. The questionnaire collected information in four areas: exposure assessment, risk behaviors, demographics and risk perception. For more information on the questions related to exposure assessment, see Stone et al. (2008). Frequency was based on the number of surfing events per year or month. Risk behaviors assessed by participants included: (1) surfing during a posted advisory; (2) surfing five days prior to or following a rain event; (3) surfing near an outfall; (4) body surfing; (5) surfing with a skin abrasion; (6) incurring cuts or injuries when surfing; (7) showering after surfing; and (8) use of personal protective equipment (PPE), such as ear plugs, goggles and wet suits. Demographic information collected included residency (Oregon or visitor), city and county of residence, age, gender, occupation, income, self-reported skill as a surfer (experience in years) and location of beaches used for surfing.

The questionnaire was pilot tested with a group of 25 surfers prior to conducting the study, and adjustments were made to the questionnaire based on the feedback that was received from the pilot group. The study was approved by Oregon State University's Institutional Review Board for the protection of human subjects, Protocol # 3503, dated April 7, 2007.

Participant Recruitment

The questionnaire was posted on a secure OSU site and linked to the Surfrider Foundation (www.surfrider.org/oregon/) and Oregon Surf (www.oregonsurf.com) websites. The enrollment goal was to obtain 500 questionnaires,based on the estimate of 500 members in the Surfrider organization (which may represent 5-10% of the surfer population in Oregon). The study was restricted to adults 18 years of age and older; however, no restrictions were made based on race, gender, or other demographic characteristics. Informed consent from participants was handled through introductory text which read, "If you are 18 years or older and the above description fits your situation, please indicate your agreement to participate in the questionnaire by clicking CONTINUE to start the questionnaire." Thus, participants provided their consent through completion of the questionnaire. Participants may also print the information related to informed consent and study description, so that they can contact the study investigators at any time.

Participants were recruited into the study using several strategies. First, the online questionnaire was posted on the Surfrider Foundation (http://www.surfrider.org/oregon/) and Oregon Surf (http://www.oregonsurf.com) websites with agreement from representatives of both organizations. Visitors to each of these websites saw a brief announcement about the questionnaire and had easy access to the questionnaire website. Participants were primarily recruited by self-visitation to these websites, and included participants from both Oregon and Washington state. Although we had thought the survey would draw only participants from

Oregon, because the survey was posted on the Surfrider website which draws from interest from both Washington and Oregon, the participants ended up being from the Pacific Northwest rather than solely from Oregon. In addition, coastal surf shops were mailed a letter introducing the study and an informational flyer was included that directed potential participants to either the Surfrider or the Oregon Surf websites. This letter requested the assistance of shop owners to post the flyer and assist the researchers in the recruitment by encouraging shop patrons to go to the websites to participate in the survey. These mailings were followed up by a phone call to answer any questions or concerns about the survey. Potential participants were not required to be paid members of the Surfrider Foundation to participate in the survey

Data Analysis & Storage

Descriptive statistics including proportions or means along with standard errors were calculated for all variables of interest in the study. The proportion of surfers who reported surfing during an advisory, not surfing during an advisory, or not knowing if they surfed during an advisory, was calculated across three categories of self-reported illnesses and a chi-square test was used to evaluate the association. In addition, univariate and multivariate association of covariates with individual self-reported illnesses were evaluated using unadjusted and adjusted logistic regression models, respectively. Univariate analyses were carried out using independent logistic regression models for each predictor and health outcome and multivariate logistic regression models were used to adjust for all significant risk factors on each health outcome. Odds ratios (ORs) and 95% confidence intervals for (CIs) were computed to evaluate and quantify the potential association of risk behaviors to self-reported illnesses. A backward elimination procedure was used to build five final multivariate logistic regression models for each health outcome (fever, diarrhea, sore throat/cough, ear infection/discharge and vomiting) in relationship to risk behaviors. For the backward elimination procedure, all risk behaviors were initially

included in a multivariate model. The variable with the highest p-value is removed and the model is refit with all remaining variables. Another non-significant variable is then eliminated from this model. The model is refit and the process is repeated until arriving at a final model that includes only significant predictors (Myers, 1990). All statistical tests were two-sided and a two-tailed p-value of $\leq$0.05 was used as threshold for statistical significance. Data management and analysis were carried out using Stata version 12.1 (StataCorp, College Station, Texas).

Participant responses were stored on a secure server managed by OSU's Survey Research Center. Data collected from participants did not include any names or email addresses that might allow for identification of participants. Responses were entered into a database until no more completions were submitted and the desired number of responses had been received. Staff at the Survey Research Center monitored data collection and forwarded the database to the investigators after data cleaning and preliminary analysis had been completed.

Results

The set of completed questionnaires were submitted from primarily males (89%), who were white (91%), and had some type of college education (93%). A total of 510 questionnaires were received and the greatest proportion of non-responses were observed for the question rewarding the use of earplugs (30%), but most variables were missing information for less than 10% of the responses. Survey participants ranged between 15 and 64 years of age, with a mean age of 33 years. Surfing experience ranged from less than one year to 51 years, with a mean surfing experience of 12 years. Participants reported annual incomes evenly spread between less than $15,000 to over $100,000. Five illnesses were most commonly reported: ear infection or discharge (38%), sore throat or a cough (28%), diarrhea (16%), fever (10.5%) and vomiting (7%), summarized in Table 1.

Self-reported Risk Behaviors*:*

In addition to surfing-related illnesses, surfers were asked whether they have surfed during the time a health advisory had been issued. The majority of surfers, nearly 40%, were not sure whether they surfed during a health advisory and 28% reported surfing at the time a health advisory had been issued. See Table 2. . Less than a third (32%) reported not surfing during the period of a health advisory. A significant association was observed between the number of self-reported illnesses and surfing during a health advisory (χ^2 P-value=0.003). See Figure 1. Among those who reported no illnesses related to surfing (n=216), 20% surfed during a health advisory, 37% have never surfed during an advisory, and 43% were not sure. For surfers who reported experiencing one or two illnesses (n=134), 32% surfed during a health advisory, 28% never surfed during an advisory, and 40% were not sure. For those experiencing three or more illnesses (n=141), 44% surfed during a health advisory, 32% reported not surfing during an advisory, and 24% were not sure. See Figure 1.

Results of the self-reported behaviors are summarized in Table 2 and were also estimated across self-reported illness. Most surfers reported surfing during a rain event often (41.9%) or sometimes (50.2%), while only a few reported never surfing during a rain event (7.9%). The majority of participants reported sometimes surfing with a cut on their skin (55.56%) or doing this often (35.7%), but only a few reported never doing it (8.7%). About half (51.2%) of respondents never surfed near a sewage outfall. However 16.1% reported often surfing near a sewage outfall, and 32.6% reported doing this sometimes. About a third of surfers (30.6%) reported showering right after surfing while the majority of participants did not (69.4%). A small proportion of surfers self-reported wearing earplugs (9.1%) while surfing but the majority reported not using them (90.9%). The frequency of surfing in a month was relatively high with only 31% of participants reporting surfing once or twice a month, 24.7% surfed 3-4 times a

month, 27.3% surfed 5-10 times during a month and 17% surfed more than 10 times in a month. Lastly, about a third (33%) of surfers reported engaging in body surfing.

Multivariate analyses:

Table 3 summarizes results from the multivariate logistic regression models fit to these data. **Fever:** Individuals who wore earplugs had 3.8 times the odds of reporting a fever related to surfing as compared to individuals who did not wear earplugs (OR= 3.82, 95% CI: 1.91-7.67). Surfers who practiced body surfing had 2.4 times greater odds of reporting a fever as compared to individuals who did not body surf (OR= 2.42, 95% CI: 1.24-4.74). The frequency of surfing was also significantly associated with experiencing a fever. Individuals who surfed more than ten times per month had 7.2 times the odds of reporting a fever as compared to surfers who only surfed once or twice a month (OR=7.22, 95% CI: 2.68-19.43).

Diarrhea: Individuals who surfed during a health advisory had 1.9 times the odds of experiencing diarrhea compared to individuals who did not surf during an advisory (OR=1.94, 95% CI: 1.03-4.64). Individuals who surfed often during a rain event had 2.7 times greater odds of having diarrhea compared to individuals who sometimes surfed during rain events (OR=2.74, 95% CI: 1.37-5.47). Surfers who wore earplugs had a 2.6 times greater odds of suffering diarrhea as compared to individuals who did not wear earplugs (OR=2.63, 95% CI: 1.00-7.16). Body surfing also increased the odds of reporting diarrhea by 2.4 times (OR=2.40, 95% CI: 1.25-4.59), compared to individuals who did not engage in body surfing. Among frequent surfers, those who surfed 5-10 times or more per month had 3 times the odds of experiencing diarrhea (OR=3.00, 95% CI: 1.09-9.26) compared to individuals who surfed only once or twice a month. Surfing more than ten times in a month also increased the odds of experiencing diarrhea (OR=3.17, 95% CI:1.09-9.26) compared to surfing only once or twice in a month.

Sore throat or cough: Individuals who surfed during a health advisory had a 2.3 increase in their odds of experiencing a sore throat/cough, as compared to individuals who had not surfed

during a health advisory (OR=2.32, 95% CI: 1.23-4.40). Surfing during a rain event also increased the odds of reporting a sore throat by 1.26 times as compared to individuals who sometimes surfed during rain events (OR=1.26, 95% CI: 1.01-2.05). Never surfing during a rain event was protective of having a sore throat or cough (OR=0.21, CI:0.05-0.95). Individuals who engaged in body surfing were 2.3 times more likely to report experiencing a sore throat as compared to individuals who did not engage in body surfing (OR=2.32, 95% CI: 1.42-3.77). The odds of reporting sore throat/cough were 2 times higher for individuals who surfed more than 10 times in a month (OR=2.00, 95% CI: 1.47-4.21) as compared to people who only surfed once or twice in a month.

Ear infection or discharge: Surfing often during a rain event increased the odds of experiencing an ear infection as compared to individuals who sometimes surfed during rain events (OR=1.39, 95% CI: 1.01-2.32). A reduction in the odds for having an ear infection or discharge was observed for individuals who never surfed during a rain event (OR=0.15, 95% CI: 0.03-0.70).Individuals who use earplugs for surfing had 6 times greater odds of reporting an ear infection compared to individuals who did not wear earplugs (OR=6.00, 95% CI: 2.30-15.58), and this was highly significant (P<0.001). Individuals who surfed more than 10 times in a month had 2.7 times the odds of self-reporting an ear infection (OR=2.68, 95% CI: 1.23-5.87) compared to surfing only once or twice in a month.

Vomiting: Surfers who engaged in body surfing had twice the odds of reporting vomiting compared to individuals who do not engage in body surfing (OR=2.11, 95% CI: 1.01-4.40). Surfing more than 10 times in a month was also associated with increased odds of vomiting (OR=3.39, 95% CI: 1.34-11.49). Multivariate results are summarized in Table 3.

The range for some of the confidence intervals were wide partially due to the small cell size of the particular health behavior. For example, never surfing during a rain event was reported only by 38 individuals (7.85%) and wearing earplugs was only reported by 33 participants (9.14%)

Even though we did not specifically examine surfing injuries or other hazards, we also asked participants about any previous surfing related injuries or shark encounters. Overall, 290 participants (58.8%) reported having had an injury related to surfing and 89 (18.2%) reported having a shark encounter in the past (data not shown).

Discussion

We identified self-reported adverse illnesses consistent with waterborne exposure to microbial contaminants in our study of active surfers in the Pacific Northwest. These included fever, diarrhea, sore throat or cough, ear infection or discharge and vomiting. Our findings of specific illnesses in this self-selected group of surfers are similar to prior studies that examined recreational users in ambient waters. In a California study, symptoms of GI illness, sore throat, eye and skin infections were observed in surfers, with reported symptoms increasing by 10% for each 2.5 hours of weekly water exposure as estimated by contact time in the water (Dwight et al. 2004). The results of this investigation support existing evidence of the link between exposure to coastal water impairment and adverse illnesses in marine bathers (Cabelli 1983; Colford et al. 2013; Corbett et al. 1993; Dewailly et al. 1986; Dwight et al. 2004; Haile et al. 1999; Kay et al. 1994; Turbow 2008). Even though surfers are generally regarded to be young healthy adults without compromised immune systems, a surprising number of illness complaints were reported, with a low of 7% reporting vomiting, to a high of 37% reporting ear infection or discharge. While these illness reports may seem low, surfers in this study have visited cold marine waters that are relatively low in enterococci densities (Stone et al. 2008). In contrast, other studies have reported higher numbers of illnesses from those who surf in warm waters which are likely to have higher levels of fecal contamination (Dewailly et al. 1986; Turbow et al. 2008; Dwight et al. 2004).

Our findings also demonstrated that the reporting of these signs and symptoms is associated with various risk-based behaviors. One of the primary behavioral determinants that influenced reported illnesses was the frequency of surfing events, which was significantly associated with all of the illnesses surveyed. A higher frequency of surfing is compounded by the disproportionate levels of exposure experienced by surfers compared with other water-based recreational users. The surfing population analyzed for this study reported a mean exposure of 171 ml water ingestion per surfing event (Stone et al. 2008). This level of incidental water ingestion is considerably higher compared to findings from Dorevitch et al. (2012) for rowing (3.9 ml), kayaking (3.8 ml) and canoeing (3.9 ml). It is also 10-fold higher than ingestion levels reported for adults swimming in a pool for 45-minutes (Dufour et al. 2006).

Other risk-based behaviors that influenced the reporting of illnesses included the recognition of whether an advisory was active during surfing and if that knowledge altered behavior (i.e. if the respondent continued to surf). An unexpected finding is that approximately 40% of surfers were unaware if they had surfed during an advisory and 29% stated that they had knowingly surfed with an advisory in effect. A significant response was observed between the number who reported diarrhea and sore throat while surfing during an advisory (Figure 1). We found an increasing number of illnesses reported with increased proportions of surfers who surfed during an advisory. This is important information, as the Oregon Health Authority releases information about advisories to the media (television, newspaper, radio) and to the local authorities, posts advisory information on their website, and posts signs at the affected beaches (OHA 2013). When an advisory is issued for a particular beach, water contact is discouraged, and the website advises that people should avoid any activities during which they might swallow water, such as swimming, surfing, diving, and kayaking. It is also advised that people should wash their hands thoroughly before eating if playing in or around water that has elevated bacteria levels.

Although there is not agreement about the extent to which advisories protect public health, given that advisories are often not synchronous with contamination events, the posting of health advisories is an attempt by state health authorities to warn the potential beach users that fecal indicator bacteria levels exceed thresholds of acceptable health risk (Turbow 2009). Given that surfers in this study either did not know that they were surfing during an advisory, or knowingly surf during a posted advisory, the postings may be serving as a passive management tool and may not deter potential bathers or surfers from entering coastal waters that may be impaired (Pendleton 2001; Turbow 2009). Beach managers, recreational organizations, coastal communities and beach monitoring programs in the Northwest and in other coastal states can use the information obtained from this study to develop risk communication messages that reach their intended audiences, educating surfers and other bathers about the increased risk of illnesses that may result from surfing in water with elevated bacterial counts, and emphasizing the importance of practicing risk reduction behaviors. Researchers have surveyed the public's understanding and awareness of signs that alert beach users to microbial contamination and have suggested recommendations that highlight the role of other alternate communication channels to improve messaging and promote behaviors that decrease risk (Pratap et al. 2013).

Body surfing, in addition to board surfing, was also associated with increased reporting of adverse illnesses. Body surfing, which involves riding a wave without a surfboard or other buoyant object, was practiced by numerous respondents in our sample (33%). Body surfers had 2.4, 2.3 and 2 times the odds of reporting a fever, sore throat and vomiting, respectively, as compared to individuals that did not body surf after adjusting for other demographic and other surfing behavior variables. Individuals who engage in body surfing tend to have a more direct contact with water and sand as the sport is often practiced close to the shore. While Heaney et al. (2009) did not study body surfers, their study did find a 25%-50% increased risk in

gastrointestinal illnesses for beachgoers who were directly exposed to sand. The close proximity and contact with sand along with more novice participants engaging in body surfing makes it a unique exposure scenario, and additional research may be warranted.

Our study also found that surfing during rain events was associated with higher odds of developing an ear infection, sore throat and diarrhea. In particular, there was an approximate 10-fold increase in reported diarrhea among respondents who surfed during rain events versus those that did not. In studying pre- and post-storm conditions at eight Southern California beaches, Tseng & Jiang (2012) found that surfing post-storm may exceed EPA risk guidelines up to 28% of the time and that gastrointestinal illness risks associated with surfing at post-storm conditions were significantly elevated in comparison with swimming. Increased illness has been previously reported during years in which there was greater coastal water contamination due to precipitation, as measured by mean monthly total coliform counts (Dwight et al. 2004). Our finding has important implications for Pacific Northwest surfers since precipitation increases the distribution of pathogenic microbes from freshwater sources into recreational marine waters, and because rain occurs through much of the year and frequently on this part of the U.S. Pacific Coast. Furthermore, surfers frequent the beach during both dry and wet weather, and are attracted to large waves that usually accompany a wet-storm event (Bradley & Hancock 2003). The public is advised to avoid water contact for 48 hours following a heavy rain (OHA 2013) due to shoreline contamination of water, which occur frequently in urbanized areas and are strongly associated with patterns of rainfall and urban runoff (Dwight et al., 2002; Noble et al. 2003; see Tseng & Jiang 2012).

Another unexpected finding was the increased reporting of health effects among respondents who wore earplugs. For these individuals, the odds of reporting a fever, ear infection and diarrhea were significantly higher compared with individuals who did not wear earplugs. Some

earplugs do not provide a proper fit within the ear canal, allowing water to enter into the ear and remain trapped inside, providing an ideal environment for microbial growth (Lee et al. 1999). It has been recognized that impermeable earplugs could act as an irritant and have also been demonstrated to predispose the ear canal to *otitis externa* (Sander, 2001). Cold water surfers have been identified to be at a higher risk of suffering from auditory exostoses compared to warm water surfers (Zoltan et al. 2005). Pacific Northwest surfers are constantly exposed to low water temperatures making them a vulnerable population for suffering auditory exostoses. This is a common risk factor for *otitis externa* and other ear infections that could explain the observed association between earplug use and self-reported fever, diarrhea and ear infections. However, given the cross-sectional design of the present study it is also possible that surfers that used earplugs were doing so because of previous or ongoing ear infections. Therefore, reverse causality cannot be ruled out. Further education on the adequate type and use of earplugs could benefit this population.

The potential for selection bias in our study exists because survey participants self-selected to visit the website (Eysenbach and Wyatt 2002; Lenert and Skoczen 2002; Turbow et al. 2008). Our participant sample may be disproportionately comprised of surfers who are more interested in water pollution as it relates to health issues, and thus may not be representative of the entire group of Northwest surfers or those nationally. On the other hand, web-based methods of disease investigation are regarded as a useful means of studying recreational water illness in marine waters (Turbow 2009), and also demonstrate advantages of quick turn-around time for data collection and accessibility to a large population, as compared to other survey methods (Turbow 2008). Online surveys also offer cost-savings due to reduction in costs due to printing questionnaires and entering data for mail surveys or interviewer time for telephone surveys. These advantages must be viewed along with the limitations of inference due to the self-selected sample. Because our questionnaire was posted on the Oregon Surfrider website, we

441 expected that the majority of our participants would be members of Surfrider Foundation, who
442 would be frequent visitors to this site. However, we also posted announcements for the study
443 on the Oregon Surf website, and in Oregon surf shops, which drew interest from those beyond
444 the Surfrider membership. Only 23% of participants indicated they were members of Surfrider
445 Foundation, so the results may be more representative of a broader population of surfers than
446 expected.
447
448 It is also possible that an individual's perception of risk may affect the validity of self-reported
449 illness associated with environmental exposures, especially if the participants have knowledge
450 about the health effects of a particular environmental exposure (Fleisher & Kay 2006). Although
451 we cannot be sure that risk perception bias did not influence the results, the results from the
452 multivariate model depict reasonable trends based on frequency of exposures (e.g., often or
453 never) and identify illnesses that are consistent with waterborne exposures. There is also the
454 potential for recall bias as participants were asked about previous illnesses experienced that
455 were related to surfing.
456
457 Since there is no list that registers all surfers in the Pacific Northwest, it was not possible to
458 conduct a probability sample of all surfers using a list frame. The approach taken provides a
459 cost-effective approach to obtain views from Pacific Northwest surfers. We recognize the
460 results are not generalizable to the population of surfers regionally, nationally or worldwide, and
461 that the results may be biased since they do not represent the harder-to-select population. It is
462 also not possible to compute response rates since there are no data to determine exactly how
463 many surfers saw the questionnaire. In addition, surfers who were interested in completing this
464 questionnaire may have been more frequent surfers (and therefore ingest more water) than
465 those who did not complete the questionnaire, leading to the possibility of overestimating the
466 reported illnesses from the entire Pacific Northwest surfing population.

We also acknowledge that the questionnaire responses for illnesses are self-reported rather than documented medical "cases." While this is recognized as a limitation, our findings confirm what others who have used web-based illness surveys have also discovered; web-based surveys may be a useful supplement or alternative to epidemiologic investigations of surfers or other marine water recreationalists, and that these methods may ultimately contribute to an improved illness surveillance system (Turbow 2008). We add to our optimism, however, a note of caution in recognizing that web-based surveys does not necessarily provide a representation of all Pacific Northwest surfers because not surfers living in the Pacific Northwest have access to the web to complete surveys online. Finally, this study was cross-sectional and the temporality between exposures and self-reported illnesses cannot be assessed and the possibility for reverse causation and recall bias needs to be considered when interpreting these results. Strengths of our study include the use of previously validated survey items in a similar population and pilot testing those items among surfers. The sample size is also relatively large given the population under study. The cross-sectional nature of our study limits our ability to evaluate cause and effect relationships but provides valuable information to inform future epidemiological studies.

Conclusions

Surfing represents a higher risk activity when compared with other aquatic recreational activities such as wading or swimming, given the frequency of unanticipated head submersions, chaotic wave activity and the potential for long exposure durations. We identified self-reported illnesses consistent with waterborne exposure to microbial contaminants in our study of active surfers in the Pacific Northwest, including fever, diarrhea, sore throat/cough, ear infection/discharge, and vomiting. Certain behaviors were significantly associated with increased reports of illnesses, including use of ear plugs, surfing during a rain event, body surfing, surfing during an active

advisory, frequency of surfing and surfing near an outfall. Showering after surfing was not significantly associated with fewer reports of adverse outcomes. A high proportion of surfers either did not know if they had surfed during an active beach advisory or continued to surf despite the advisory. These findings suggest that beach advisories are not having their intended effect of informing and deterring surfers from entering coastal waters that exceed thresholds of acceptable risk. This study highlights the need to examine the extent to which surfers and other potential marine water users are aware of health advisories and comply with recommendations, and the need to further educate this population both about behaviors that are protective of health and those that may increase risk of illnesses in contaminated waters.

References

Arnone, R.D. & Walling J.P. 2007 Waterborne pathogens in urban watersheds. *J. Water Health* **5**, 149-162.

Benedict, R.T. & Neumann, C.M. 2004 Evaluating Oregon's beach sites for application to United States Environmental Protection Agency's BEACH Act criteria. *Marine Pollut. Bull.* **49**, 630-636.

Boehm, A.B., Ashbolt, N.J., Colford, J.M., Dunbar, L.E., Fleming, L.E., Gold, M.A., Hansel, J.A., Hunter, P.R., Ichida, A.M., McGee, C.D., Soller, J.A. &Weisberg, S.B. 2009 A sea change ahead for recreational water quality criteria. *J. Water Health* **7**, 9-20.

Bradley, G., Hancock, C. 2002 Increased risk of non-seasonal and body immersion recreational marine bathers contacting indicator microorganisms of sewage pollution. *Marine Pollut. Bull*. **46,** 791-794.

Cabelli, V.J., Dufour, A.P., McCabe, L.J., and Levin, M.A. 1983. A marine recreational water quality criterion consistent with indicator concepts and risk analysis. *J. Water Pollut. Control Fed.* **55**, 1306-1314.

Colford, J.M., Wade, T.J., Schiff, K., Wright, C., Griffith, J., Sandhu, S.K. & Weisberg, S.B. 2005 *Recreational Water Contact and Illness in Mission Bay, California, Technical Report No. 449.* Southern California Coastal Water Research Project. Los Angeles, CA. Available at: ftp://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/449_mb_epi.pdf [accessed 15 November 2013].

Colford, J.M., Wade, T.J., Schiff, K.C., Wright, C.C., Griffith, J.F., Sundhu, S.K., Burns, S., Sobsey, M., Lovelace, G., and Weisberg, S.B. 2007. Water quality indicators and risk of illness at beaches with nonpoint sources of fecal contamination. *Epidemiology* **18**, 27-35.

Colford, J.M., Schiff, K.C., Griffith, J.F., Yau, V., Arnold, B.F., Wright, C.C., Gruber, J.S., Wade, T.J., Burns, S., Hayes, J., McGee, C., Gold, M., Cao, Y., Noble, R.T., Haugland, R., and Weisberg, S.B. 2012. Using rapid indicators for *Enterococcus* to assess the risk of illness after exposure to urban runoff contaminated marine water. *Water Res* **46**. 2176-2186.

Corbett, S.J., Rubin, G.L., Curry, G.K., Kleinbaum, D.G., and Sydney Beach Users Advisory Group. 1993. The health effects of swimming at Sydney beaches. *Am. J. Public Health* **83**, 1701-1706.

Dewailly, E., Poirier, C., and Meyer, F.M. 1986. Health hazards associated with windsurfing on polluted water. *Am. J. Public Health* **76**, 690-691.

Dufour, A.P., Evans, O., Behymer, T.D., and Cantu, R. 2006. Water ingestion during swimming activities in a pool: a pilot study. *J. Water Health* **4**, 425-430.

Dwight, R., Semenza, J., Baker, D. & Olson, B. 2002 Association of urban runoff with coastal water quality in Orange County, California. *Water Environ.Res.* **74**, 82-90.

Dwight, R.H., Baker, D.B., Semenza, J.C., and Olson, B.H. 2004. Health effects associated with recreational coastal water use: urban versus rural California. *Am. J. Public Health* 94, 565-567.

Eysenback, G., and Wyatt, J. 2002. Using the internet for surveys and health research. *J. Med. Internet Res.* **4**, e13.

544 Fleisher, J.M. & Kay, D. 2006 Risk perception bias, self-reporting of illness, and the validity of
545 reported results in an epidemiologic study of recreational water associated illnesses.
546 *Marine Poll. Bull*. **52**, 264-268
547 Haile, R., Witte, J., Gold, M.N., Cressey, R., McGee, C., Millikan, R., Glasser, A., Harawa, N.,
548 Ervin, C., Harmon, P. et al. 1999. The health effects of swimming in ocean water
549 contaminated by storm drain runoff. *Epidemiol*ogy **10**, 355-363.
550 Heaney, C.D., Sams, E., Wing, S., Marshall, S., Brenner, K., Dufour, A.P. & Wade, T.J. 2009
551 Contact with beach sand among beachgoers and risk of illness. *Am. J. Epidemiology* **170,**
552 164-172.
553 Kay, D., Fleisher, J., Salomon, R., Jones, F., Wyer, M., Godfree, A., Zelenauch-Jacquotte, Z. &
554 Shore, R. 1994 Predicting likelihood of gastroenteritis from seabathing: results from
555 randomized exposure. *Lancet* **344**, 905-909.
556 Kay, D., Bartram, J., Prüss, A., Ashbolt, N., Wyer, M.D., Fleisher, J.M., Fewtrell, L., Rogers, A.
557 & Rees, G. 2004 Derivation of numerical values for the World Health Organization
558 guidelines for recreational waters. *Water Res.* **38**, 1296-1304.
559 Lee, D., Youk, A. & Goldstein, N.A. Nira A. Goldstein 1999 A meta-analysis of swimming and
560 water precautions. *The Laryngoscope* **109**, 536-540.
561 Lenert, L., and Skoczen, S. 2002. The internet as a research tool: Worth the price of
562 admission? *Ann. Beh. Med.* 24:251-256.
563 Myers, R. H. (1990). *Classical and modern regression with applications* (Vol. 2): Duxbury Press
564 Belmont, CA.
565 Nathanson, A., Haynes, P., and Galanis, D. 2002. Surfing injuries. *Am. J. Emerg. Med.*
566 20:155-160.
567 National Resources Defense Council (2013). Testing the Waters 2013: Oregon. Available at:
568 http://www.nrdc.org/water/oceans/ttw/or.asp [accessed 15 October 2013).

569 Neumann, C.M., Harding, A.K., Sherman, J.M. 2006. Oregon Beach Monitoring Program:
570 Bacterial exceedances in marine and freshwater creeks/outfall samples, October 2002-
571 April 2005. *Marine Pollut. Bull*. **52**, 1270-1277.
572 Noble, R., Weisberg., S. Leecaster, M., McGee, C., Dorsey, J., Vainik, P. & Orozco-Borbon, V.
573 2003 Storm effects on regional beach water quality along the southern California shoreline.
574 *J. Water Health* **1**, 23-31.
575 Oregon Health Authority 2013 Beach Water Quality Program. Available
576 at: http://public.health.oregon.gov/HealthyEnvironments/Recreation/BeachWaterQuality/Pa
577 ges/beaches.aspx [accessed 15 October 2013].
578 Pendleton, L. 2001 Managing beach amenities to reduce exposure to coastal hazards: storm
579 water pollution. Coastal Management **29**, 239-252.
580 Perez Guzzi, J., Folabella, A., Miliwebsky, E., Rivas, M., Fernandez Pascua, C., Gomez, D.,
581 Zomora, A., Zotta, C. & Cordoba, M. 2000 Isolation of Escherichia coli 0157:H7 in
582 combined-sewer overflows with fecal bacterial contamination in Mar del Plata. *Argentina de*
583 *Microbiol* **32**, 161.
584 Pratap, P., Redman, S., Fagen, M. & Dorevitch, S. 2013. Improving water quality
585 communications at beaches: input from stakeholders. J. Water Health **11**, 647-658.
586 Prüss, A. 1998. Review of epidemiological studies on health effects from exposure to
587 recreational water. *Int. J. Epidemiol.* **27**, 1-9.
588 Sander, R. 2001 Otitis externa: a practical guide to treatment and prevention. *Am. Family*
589 *Physician* **63**, 927-942.
590 Schijven, J. and de Roda Husman, M. 2006. A survey of diving behavior and accidental water
591 ingestion among Dutch occupational and sport divers to assess the risk of infection with
592 waterborne pathogenic microorganisms. *Environ. Health Persp.* **114**, 712-717.

593 Stone, D.L., Harding, A.K., Hope, B.K., Slaughter-Mason, S. 2008. Exposure assessment and
594 risk of gastrointestinal illness among surfers. *J Toxicology & Environ. Health, Part A.* **71**,
595 1603-1615.
596 Tseng, L.Y. & Jiang, S.C. 2012 Comparison of recreational health risks associated with surfing
597 and swimming in dry weather and post-storm conditions at Southern California beaches
598 using quantitative microbial risk assessment (QMRA). *Mar. Pollut. Bull*. **64**, 912-918.
599 Turbow, D. 2009. Addressing disease surveillance needs for marine recreational bathers. *J.*
600 *Water & Health* **7**, 45-54.
601 Turbow, D.J., Kent, E.E. & Jiang, S.C. 2008. Web-based investigation of water associated
602 illness in marine bathers. *Environ. Res.* **106**, 101-109.
603 Turbow, D.J., Osgood, N.D. & Jiang, S.C. 2003. Evaluation of recreational health risk in coastal
604 waters based on enterococcus densities and bathing patterns. *Environ. Health Persp*. **111**,
605 598-603.
606 United States Environmental Protection Agency (USEPA) 1986. *Ambient Water Quality Criteria*
607 *for Bacteria-1986.* EPA440/5-84-002. Washington, DC: Office of Water, U.S.
608 Environmental Protection Agency.
609 United States Environmental Protection Agency (USEPA) 2002 *Implementation Guidance for*
610 *Ambient Water Quality Criteria for Bacteria.* EPA-823-B-02-003. Washington, DC: U.S.
611 Environmental Protection Agency.
612 United States Environmental Protection Agency (USEPA) 2004 Water quality standards for
613 coastal and Great Lakes recreation waters: final rule. Fed Regist. **69**(220), 67218-67243.
614 Wade, T.J., Pai, N., Eisenberg, J.N.S. & Colford, J.M. 2003. Do US EPA water quality
615 guidelines for recreational waters prevent gastrointestinal illness*?* A systematic review
616 and meta-analysis. *Environ. Health Persp.* **111**, 1102-1109.
617 Zoltan, T.B. Taylor, K.S. & Achar, S.A. 2005 Health issues for surfers. *Am. Family*
618 *Physician.* **71**, 2313-2317.

Table 1. Overall sample characteristics (n=492)

Characteristics	n	Frequency	Percentage (%)
Gender	492		
Male		438	89.0%
Female		54	11.0%
Race/Ethnicity	492		
White/Caucasian		446	90.7%
Black/African American		1	0.2%
Asian		4	0.8%
Hawaiian or Pacific Islander		4	0.8%
American Indian/Alaska Native		3	0.6%
Mixed race		20	4.1%
Other		14	2.8%
Education	492		
No High school		4	0.8%
High School		29	5.9%
Some College		160	32.5%
Bachelor's degree		184	37.4%
Master's		85	17.3%
Doctorate		27	5.5%
Other		3	0.6%
Income	480		
Less than $15,000		49	10.2%
$15,000 to $34,000		83	17.3%
$35,000 to $49,999		72	15.0%
$50,000 to $74,999		123	25.6%
$75,000 to $99,999		70	14.6%
$100,000 to $124,999		38	7.9%
$125,000 or More		45	9.4%
Surfing related illnesses experienced	467		
Ear Infection/Discharge		176	37.7%
Sore Throat/Cough		132	28.2%
Diarrhea		76	16.3%
Fever		49	10.5%
Vomiting		34	7.3%
Continuous variables		**mean, (median) [min-max]**	
Age (years)	488	33, (32) [15-64]	
Overall Surfing Experience (years)	492	12, (8) [0.5-51]	

Table 2. Estimated sample numbers and proportions for self-reported risk behaviors across self-reported illnesses evaluated in the cross-sectional sample

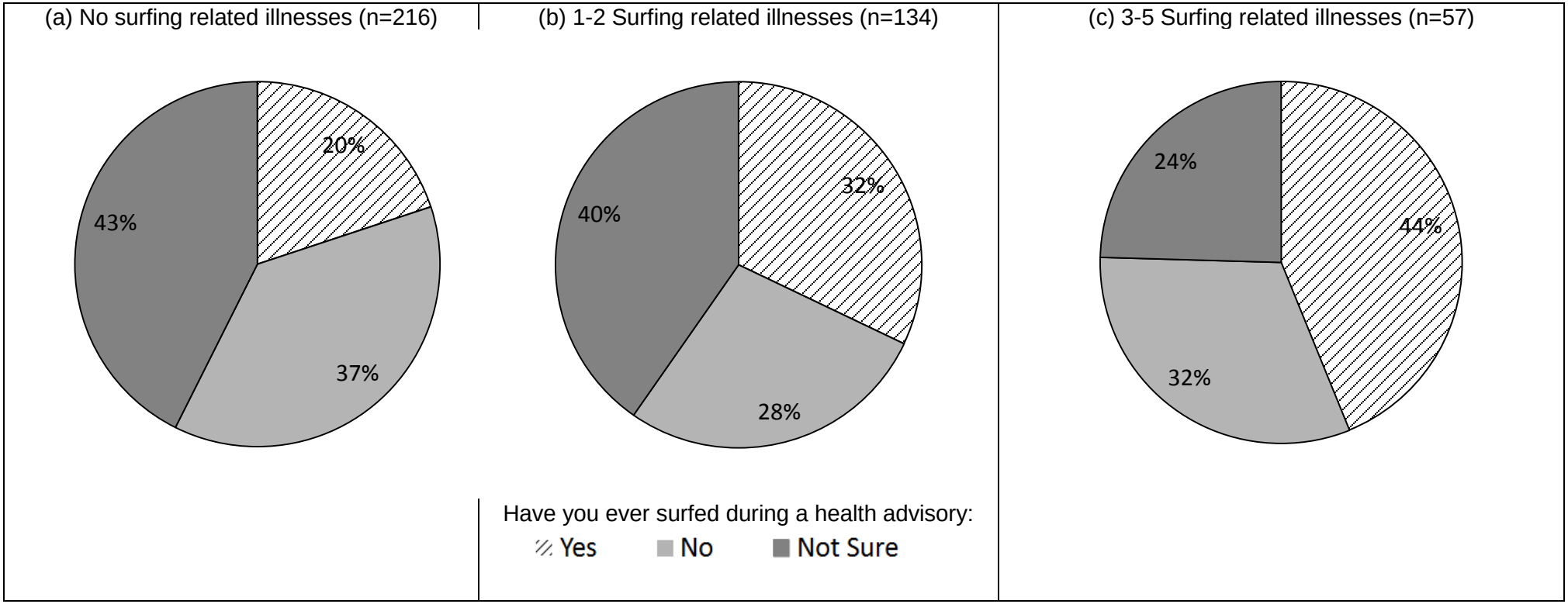
			Self-reported Illnesses				
	During a Rain event	**N (%)**	**Fever**	**Diarrhea**	**Sore Throat/Cough**	**Ear Infection/Discharge**	**Vomiting**
Risk Behaviors	Often	203 (41.9%)	28 (58.4%)	47 (62.7%)	67 (51.1%)	93 (53.4%)	17 (51.5%)
	Sometimes	243 (50.2%)	16 (33.3%)	22 (29.3%)	61 (46.6%)	76 (43.7%)	16 (48.5%)
	Never	38 (7.9%)	4 (8.3%)	6 (8.0%)	3 (2.3%)	5 (2.9%)	0
	With a cut on your Skin						
	Often	164 (35.7%)	23 (51.1%)	40 (55.5%)	5 (4.0%)	77 (45.8%)	19 (59.4%)
	Sometimes	255 (55.6%)	21 (46.7%)	29 (40.3%)	64 (51.0%)	86 (51.2%)	12 (37.5%)
	Never	40 (8.7%)	1 (2.2%)	3 (4.2%)	5 (4.0%)	5 (3.0%)	1 (3.1%)
	Near a Sewage Outfall						
	Often	39 (16.1%)	11 (36.7%)	16 (34.8%)	21 (26.9%)	23 (24.5%)	6 (27.3%)
	Sometimes	79 (32.7%)	12 (40.0%)	15 (31.6%)	28 (35.9%)	38 (40.4%)	9 (40.9%)
	Never	124 (51.2%)	7 (23.3%)	15 (32.6%)	29 (37.2%)	33 (35.1%)	7 (31.8%)
	During Health Advisory						
	Yes	140 (28.5%)	18 (37.5%)	33 (40.0%)	52 (40.0%)	66 (37.9%)	16 (47.1%)
	No	157 (32.0%)	16 (33.3%)	18 (24.0%)	28 (21.5%)	52 (29.9%)	11 (32.3%)
	Not sure	194 (39.5%)	14 (29.2%)	24 (32.0%)	50 (38.5%)	56 (32.2%)	7 (20.6%)
	Shower After Surfing						
	Yes	151 (30.6%)	18 (36.7%)	22 (29.0%)	37 (28.0%)	49 (27.8%)	25 (73.5%)
	No	343 (69.4%)	31 (63.3%)	54 (71.0%)	95 (72.0%)	127 (72.2%)	9 (26.5%)
Use of PPE	**Ear Plugs**						
	Yes	33 (9.1%)	16 (34.8%)	10 (17.5%)	9 (9.5%)	21 (16.9%)	2 (8.0%)
	No	328 (90.9%)	30 (65.2%)	47 (82.5%)	86 (90.5%)	103 (83.1%)	23 (92.0%)
Other Activities	**Frequency of Surfing**						
	Once or twice a month	153 (31.0%)	11 (23.4%)	16 (21.6%)	31 (23.7%)	40 (23.7%)	10 (31.2%)
	3-4 times a month	122 (24.7%)	6 (12.8%)	15 (20.3%)	28 (21.4%)	39 (23.1%)	3 (9.4%)
	5-10 times a month	135 (27.3%)	13 (27.6%)	24 (32.4%)	41 (31.3%)	55 (32.5%)	8 (25.0%)
	More than 10 times	84 (17.0%)	17 (36.2%)	19 (25.7%)	31 (23.6%)	35 (20.7%)	11 (34.4%)
	Body Surfing						
	Yes	150 (33.0%)	23 (51.1%)	34 (47.2%)	61 (48.8%)	58 (36.3%)	16 (50.0%)
	No	305 (67.0%)	22 (48.9%)	38 (52.8%)	64 (51.2%)	102 (63.7%)	16 (50.0%)

Table 3. Final multivariate logistic regression models of self-reported illnesses and odd ratios (with 95% confidence intervals) for the associations with risk behaviors, use of personal protective equipment and other activities

	Illnesses				
	Fever	**Diarrhea**	**Sore Throat/Cough**	**Ear Infection/Discharge**	**Vomiting**
	OR [95% CI]	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**
Surfing during a health advisory					
Yes	*NS*	1.94* [1.03-4.64]	2.32* [1.23-4.40]	*NS*	*NS*
Not sure	*NS*	1.34 [0.56-3.21]	1.32 [0.73-2.39]	*NS*	*NS*
No	*reference*	*reference*	*reference*	*reference*	*reference*
Surfing during a rain event					
Often	*NS*	2.74* [1.37-5.47]	1.26* [1.01-2.05]	1.39 [1.01-2.32]	NS
Sometimes	*reference*	*reference*	*reference*	*reference*	*reference*
Never	*NS*	†0.35 [0.43-2.91]	†0.21* [0.05-0.95]	†0.15* [0.03-0.70]	*NS*
Wearing ear plugs					
Yes	3.82* [1.91-7.67]	2.63* [1.00-7.16]	*NS*	6.00** [2.30-15.58]	*NS*
No	*reference*	*reference*	*reference*	*reference*	*reference*
Body surfing					
Yes	2.42* [1.24-4.74]	2.40* [1.25-4.59]	2.32* [1.42-3.77]	*NS*	2.11* [1.01-4.40]
No	*reference*	*reference*	*reference*	*reference*	*reference*
Frequency of Surfing/Month					
Once or twice	*reference*	*reference*	*reference*	*reference*	*reference*
3-4 times	1.40 [0.47-4.17]	1.98 [0.73-5.41]	0.71 [0.36-1.36]	1.39 [0.74-2.64]	1.25 [0.39-4.06]
5-10 times	2.32 [0.84-6.36]	3.00* [1.12-7.96]	0.95 [0.50-1.81]	1.84 [0.96-3.53]	2.28 [0.79-6.57]
More than 10 times	7.22** [2.68-19.43]	3.17* [1.09-9.26]	2.00**[1.47-4.21]	2.68* [1.23-5.87]	3.39* [1.34-11.49]

*p-value<0.05, **p-value <0.001, †category with less than 10 responses
NS: Not significant and therefore not included in the final multivariate model

Figure 1. Proportion of surfers who surfed during a health advisory, summarized by the number of surfing-related illnesses experienced (χ^2 P-value=0.003).



Risk behaviors and self-reported illnesses among Pacific Northwest surfers

APPENDIX

2006 Surfer Exposure Study

Q1. For how many years overall have you been surfing? (Please type in your answer)

Q2. Do you currently live in Oregon or are you visiting? (Please click on your answer. If you make a mistake, click on the correct choice and the previous answer will disappear)

Live in Oregon
Visiting

Q2A. Please click on the Oregon county in which you live.

Q2B. Do you live in the United States or some other country?

Live in the United States
Live in another country

Q2C. Please type in the name of the country in which you live

Q2D. Please type in the name of the U.S. state in which you live.

Q2E. For how many years have you been surfing Oregon beaches?

Q3. On average, how many days per month do you surf?

Once or twice per month
3 to 4 times per month
5 to 10 times per month
More than 10 times per month

Q4. Please indicate whether or not you typically surf during each of the following times of year.

Yes *No*

(a) Fall (October–December)
(b) Winter (January–March)
(c) Spring (April–June)
(d) Summer (July–September)

Q5. Please indicate whether or not you typically engage in each of the following other water-related activities while at the beach.

Yes *No*

(a) Body surfing
(b) Swimming
(c) Boogie boarding
(d) Scuba diving

Q6. Which of the following items do you typically wear while surfing?

Yes *No*

(a) Ear plugs
(b) Wet suit
(c) Nose plugs
(d) Eye goggles
(e) Booties
(f) Gloves

Q7. Thinking about a typical day of surfing for you, about how much time do you spend in the water?

Less than 1 hour
1 hour to less than 3 hours
3 hours to less than 5 hours
5 or more hours

Q8. How often in the past 12 months have you surfed the following Oregon beaches?

North Coast Area

Never *Very rarely* *Rarely* *Occasionally* *Frequently* *Not sure*

(a) Seaside Cove
(b) Indian Beach (in Ecola State Park)
(c) Short Sands (Oswald West State Park)
(d) Oceanside
(e) Pacific City (Cape Kiwanda)

Any other north Oregon beach?(Please specify)

Central Coast Area

Never *Very rarely* *Rarely* *Occasionally* *Frequently* *Not sure*

f. Lincoln City
g. Otter Rock
h. Agate Beach
i. South Beach State Park
j. Florence–South Jetty

Any other central Oregon beach? (Please specify)

South Coast Area

Never *Very rarely* *Rarely* *Occasionally* *Frequently* *Not sure*

k. Coos Bay–Bastendorff Beach
l. Port Orford–Battle Rock
m. Hubbard Creek
n. Nesika Beach
o. Brookings–South Jetty

Any other south Oregon beach? (Please specify)

Q9. Have you swallowed sea water or taken in water through your nose while surfing in the last 12 months?

Yes
No

Q9A. Please indicate whether or not you have swallowed sea water in the last 12 months doing each of the following.

Yes *No*

(a) Paddling out
(b) Waiting for a wave
(c) Riding the wave
(d) Falling off the board

Q9B. Each time you swallow sea water (or take it in through your nose), how much do you think you ingest?

A few drops
Amount in a shot glass (4 ounces)
Amount in a small juice glass (6 ounces)
Cannot estimate

Q9C. On a typical surfing day, how many times a day do you think you ingest sea water?

1 to 2 times per day
3 to 4 times per day
5 to 6 times per day
7 to 8 times per day
9 times or more per day

Q10. Please indicate whether or not you have worried about each of the following health risks when surfing Oregon beaches?

Yes, a lot *Yes, sometimes* *No, never*

(a) Sharks
(b) Drowning
(c) Bacterial contamination of water (from sewage outfalls, animal waste, runoff)
(d) Red tide/toxins (from natural sources)
(e) Toxic chemicals in the water (from pesticides, industrial releases, wastewater effluent)
(f) Hypothermia
(g) Surfing-related injuries (broken bones, cuts/abrasions, head injuries)

Q11. Now please indicate whether or not you have experienced each of the following while surfing Oregon beaches.

Yes *No*

(a) A shark encounter
(b) Hypothermia
(c) Surfing-related injuries (broken bones, cuts/abrasions, head injury)
(d) Drowning or near drowning
(e) Contamination from bacteria, toxins or waste materials

Q12. Indicate which of the following illnesses you have experienced that you feel were due to surfing.

Yes *No* *Not sure*

(a) Fever
(b) Chills
(c) Stomach pains
(d) Diarrhea
(e) Nausea
(f) Vomiting
(g) Sore throat or cough
(h) Earache, ear infection or discharge
(i) Eye infection
(j) Rash or itchy skin
(k) Sunburn
(l) Other

Q13. If you could grade the environmental quality of Oregon beach waters, what grade would you give them overall?

Q14. Please indicate how often in the last 12 months you have surfed an Oregon beach with each of the following conditions.

Never *Sometimes* *Often*

(a) Within 5 days after a rain event
(b) During a rain event
(c) With a cut on your skin
(d) Near a sewage outfall
(e) During high tide
(f) During low tide
(g) During on-shore winds

Q15. Have you ever surfed during the time a health advisory had been issued?

Yes
No

Q16. Do you typically shower immediately after surfing?

Yes
No

*The remaining questions are for statistical purposes only. We ask them so we can group your responses with others of similar backgrounds.

Please remember that all information you provide will remain strictly confidential.*

Q17. Are you male or female

Male
Female

Q18. How old were you on your last birthday? (type in a number)

Q19. What is the highest level of education you have completed?

0 to 8 years (no GED)
9 to 12 years (no high school diploma or GED)
High school diploma or GED
Some college, no degree
Associate's degree (AA, AS)
Bachelor's degree (BS, BA, AB)
Master's degree (MA, MS, MBA)
Doctorate or professional degree (PhD, JD, EDD, MD, DDS)
Other

Q20. Are you hispanic or latino?

Yes
No

Q21. Which best describes your race or ethnicity?

White/caucasian
Black/African American
Asian
Native Hawaiian or Pacific Islander
American Indian/Alaska Native
Mixed race
Other

Q22. What is your total annual household income, from all sources, before taxes?

Less than $15,000
$15,000 to $24,999
$25,000 to $34,999
$35,000 to $49,999
$50,000 to $74,999
$75,000 to $99,999
$100,000 to $124,999
$125,000 or more

Q23. Please indicate the industry in which you currently work for pay.

Unemployed/do not currently work for pay
Agriculture. forestry, and fisheries
Mining
Construction
Manufacturing, nondurable goods
Manufacturing, durable goods
Transportation
Communications and other public utilities
Wholesale trade/Retail trade
Finance, insurance, and real estate
Business and repair services
Personal services
Entertainment and recreation services
Health services
Education services
Other professional and related services
Public administration

Q24. What kind of work do you do? (For example, registered nurse, personnel manager, auto mechanic, accountant, teacher, etc.) Please type in your answer.

Q25. Are you currently a member of Oregon Surfrider Foundation?

Yes
No

Q26. Are you aware of the Oregon Beach Advisory system?
Yes
No

Q27. Have you signed up for the Oregon Beach Alert email system?
Yes
No

If you would like to sign up to the Oregon Beach Alert Email system, please click here.

Thank you for completing this survey!

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Author Queries

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No Queries