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# Risk factors for norovirus outbreaks associated with attack rate and genogroup

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## Objective

The purpose of this study was to identify global epidemiologic trends in human norovirus (NoV) outbreaks by transmission route and setting, and describe relationships between these characteristics, attack rates and the occurrence of genogroup I (GI) or genogroup II (GII) strains in outbreaks.

## Introduction

Noroviruses are the single most common cause of epidemic, nonbacterial gastroenteritis worldwide. NoVs cause an estimated 68–80% of gastroenteritis outbreaks in industrialized countries and possibly more in developing countries.

## Methods

Data were analyzed from 900 RT-PCR-confirmed NoV outbreaks extracted from a systematic review of articles published from 1993 to 2011, indexed under the terms 'norovirus' and 'outbreak'. Seventy–four variables were included in the database.

## Results

Of the 894 outbreaks documenting year of occurrence, 72% occurred between 2000 and 2010. More than 90% of outbreaks occurred in the northern hemisphere and 45% took place during the winter. In general, we found the number of primary cases and persons at risk was significantly lower in outbreaks related to food and waterborne transmission as well as foodservice and healthcare settings. The attack rates were significantly higher in outbreaks related to food, water and those that occurred in the winter. Attack rates were also lower in healthcare-related outbreaks, perhaps on account of proper infection control practices and active surveillance by healthcare facilities to limit the spread of disease.

Multivariate regression analyses demonstrated that higher attack rates were significantly associated with foodservice ($\beta =$ 14.70, $p = 0.02$) and winter outbreaks ($\beta = 9.81$, $p = <0.01$). A combination of strains was most common among food and waterborne outbreaks. Waterborne outbreaks were also significantly associated with GI strains (odds ratio [OR] = 0.10, 95% confidence interval [CI] = 0.03–0.41 where the odds of an outbreak being caused by a GII strain are less than the odds of the outbreak being caused by a GI strain), while healthcare-related (OR = 40.42, 95% CI = 2.09–783.15 where the odds of the outbreak being caused by a GII strain are greater than the odds of the outbreak being caused by a GI strain) and winter outbreaks (OR = 5.56, 95% CI = 1.97–15.69) were associated with GII strains (Table 1).

## Conclusions

Food and waterborne outbreaks may have greater attack rates due to: (1) efficient viral transmission, especially within smaller confines, via drinking water or food items, and (2) more accurate identification of persons at risk.

*Table 1.* Adjusted multiple linear regression coefficients modeling attack rate as a function of potential NoV outbreak risk factors

| Variable | *Adjusted, with multiple trans.* | | |
|---|---|---|---|
| | *Beta* | *Std Error* | *p* |
| Intercept | 222.82 | 787.21 | 0.78 |
| Transmission | | | |
| Foodborne | 5.71 | 4.05 | 0.16 |
| Waterborne | 8.96 | 5.57 | 0.11 |
| Environmental | −2.92 | 5.50 | 0.60 |
| Person to person | Ref. | – | – |
| Setting | | | |
| Foodservice | 14.70 | 6.25 | 0.02* |
| Healthcare | −3.70 | 6.93 | 0.59 |
| Leisure | −3.13 | 6.30 | 0.62 |
| Other | −0.33 | 7.15 | 0.96 |
| School/daycare | Ref. | – | – |
| Outbreak year | −0.10 | 0.39 | 0.81 |
| Season | | | |
| Winter | 9.81 | 3.64 | <0.01* |
| Spring | 6.76 | 4.23 | 0.11 |
| Summer | 1.57 | 4.36 | 0.72 |
| Fall | Ref. | – | – |
| Action to stop transmission | | | |
| Described in article | 3.05 | 3.28 | 0.35 |
| Not described | Ref. | – | – |
| Genogroup‡ | | | |
| Genogroup II | −2.85 | 4.35 | 0.51 |
| Both GI and GII | 0.19 | 5.03 | 0.97 |
| Genogroup I | Ref. | – | – |

*Statistically significant at $\alpha = 0.05$.

Decreased mobility of infected persons in healthcare settings may also limit transmission of NoV to healthy individuals. As mentioned previously, the clustering of people indoors during seasonal cold weather may facilitate person-to-person NoV transmission. These results identify important trends for epidemic NoV detection, prevention and control.

## Keywords

Norovirus; outbreak; transmission; surveillance; risk factors

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