Hand washing practices of the residents of Silesia (Poland) based on observations in public toilets
Jolanta Malinowska-Borowska, Magdalena Wolny and Marcin Krause

ABSTRACT
In numerous medical reports and scientific papers, it is unequivocally stated that dirty hands increase the risk of gastrointestinal, respiratory and skin infections. The aim of the present study was to assess hand hygiene practices in Silesia, Poland. In 2012, 400 persons were observed in public toilets located in shopping centres of Silesia. Disguised, participant and controlled observations were used. Results indicated that women wash their hands more frequently and longer than men. Women washed their hands for 10.2 (standard deviation (SD) = 7.3) s on average, while men devoted an average of 8.2 (SD = 5.8) s to this activity. Men dried their hands for about 3 s longer and used soap more frequently than women. The study also revealed a significant relationship between the correctness of the hand-washing procedure and the place of observation (p < 0.05). Based on the research and available literature, it can be concluded that health activities promoting the hand-washing procedure need to be introduced in Poland.

Key words | disinfection, hand observation, hand washing, Poland, public toilets

INTRODUCTION
In 1938, Price established that bacteria recovered from the hands could be divided into two categories, namely resident or transient (Price 1938). The resident flora is characterised by low pathogenicity and is safe for human health. Microorganisms that are not natural flora, but pass onto the hands by contact with dirty surfaces, may also be temporarily present on hands (Larson et al. 1998). These include pathogenic bacteria, viruses, fungi and parasites. The microorganisms of the transient flora pose a big threat, being one of the main causes of gastrointestinal, respiratory and skin infections (Aiello & Larson 2002; Larson et al. 2003).

The transmission of disease through the faecal-oral route poses a serious public health problem. E. coli 0157: H7-associated diarrhoea, cholera, typhoid fever, salmonellosis, cryptosporidiosis, the common cold, shigellosis and hepatitis A are just a few examples of diseases that could be caused by improper hand washing (Timmreck 1998). This fact is proven by the results of a study, which was carried out in a low-income population in Karachi, Pakistan and ended in 2003, concerning the impact of hand washing on the incidence of food poisoning, pneumonia and impetigo contagiosa among children. One year after hand washing promotion among inhabitants of Karachi, a significant decrease in the incidence of diseases among the children was noticed (Luby et al. 2005). Children in households that received plain soap and hand washing promotion had a 50% lower incidence of pneumonia than controls. Children washing hands had also a 53% lower incidence of diarrhoea and a 34% lower incidence of impetigo (Luby et al. 2005).

It is possible to limit the number of infections only by applying correct everyday hand-washing procedures.
which comprise washing, rinsing and drying (Bloomfield et al. 2007). Routine everyday hand wash is usually called social hand wash and it is performed to render the hands physically clean and to remove transient microorganisms. A hand-rubbing time of 15 s with soap is generally recommended for social hand washing (Patrick et al. 1997). However, some data indicate that 30 s to 1 min is needed to achieve the optimum of 2- to 3-log reduction of both bacteria and viruses on hands (Bloomfield et al. 2007). In practice, it is doubtful whether people comply with even a 15 s hand wash. There are not many studies based on observations, which measure the time spent by people on hand washing (Kinnison et al. 2004; Garbutt et al. 2007; Borchgrevink et al. 2013).

There are various hand washing products available in the market, from ordinary to antibacterial soap. A meta-analysis conducted by Aiello and co-workers shows that there are no differences between the effectiveness of washing hands with these two types of soap (Aiello et al. 2008). Scientists have even suggested that antibacterial detergents reduce the immunity to allergic diseases such as asthma or hay fever (Bloomfield et al. 2010). Antibacterial soaps kill saprophytic bacteria, oxidising ammonia, a major component of sweat, to nitric oxide, which is one of the key immunoregulatory molecules.

Not only washing hands, but also drying them has a significant impact on hand hygiene. In drying hands, both the time and the selected method of drying are essential (Knights et al. 1995). According to the research conducted by Redway and Fawdar in 2008 on volunteers, 10 s of drying hands with an electric hand dryer achieves 45% dryness (dryness was calculated as a percentage of the total water load removed after the use of each drying method at each time). Wiping of hands with a disposable towel for 10 s removes up to 96% of moisture from hands, while the electric dryer brings the same effect after 45 s. Accordingly, people should dry their hands for 10 s using a disposable towel or for 45 s using an electric dryer (Redway & Fawdar 2008). Shorter drying times limit the effectiveness of hand washing.

Knowledge of hand hygiene procedures among residents of developed countries is taken for granted. However, observational studies published in these countries have shown that despite easy access to water and soap, negligence in hand hygiene among citizens is often revealed (Garbutt et al. 2007; The American Cleaning Institute & the American Society for Microbiology (ACI ASM) 2010). There are few scientific reports on hygiene behaviours of Europeans gathered with observational studies. Previously conducted observational studies concerned only health care workers because proper hand hygiene of medical staff is an efficient and inexpensive means of combating hospital-acquired infections (Eveillard et al. 2010; Garus-Pakowska et al. 2013; Mernelius et al. 2013; Rossini et al. 2013). Moreover, according to ‘Guidelines on hand hygiene in healthcare’ direct observation is currently the gold standard and the most reliable method to detect all occurring hand hygiene actions, to assess the number of times, appropriate timing and adherence rates (World Health Organization (WHO) 2009).

As there are no scientific reports based on direct observation of hygiene practices of Polish society, it was decided to focus on the assessment of the habits and behaviour of residents of Silesia, Poland after going to the toilet. Results from this study can be used to compare Polish hand washing rates to the rates observed in other countries. Identifying hand washing behaviours could provide preliminary evidence to help health educators better focus future hand washing programmes for the Polish population.

**METHODS**

The participants of this study were 200 males and 200 females entering the restrooms at public shopping malls in Silesia (a largely industrial province in southern Poland). Only individuals using the toilet facilities were included as participants. Individuals entering to wash hands or apply make-up were not included.

The observed persons, based on a subjective age assessment made by the observer, were divided into three age groups; youth (≤25 years old), adults (26–54 years old) and elderly people (≥55 years old). Youth accounted for 30% of the subjects while those between 26 and 54 years of age accounted for almost 60% of the total number of the observed people (59.5%). Elderly people were the least numerous group (10.5%).

Hygienic behaviour of the residents of Silesia, Poland was observed in public toilets in three shopping centres in three different cities located in the area of Silesia (Katowice, 

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Rossini, P. et al. (2013). *Moreover, according to ‘Guidelines on hand hygiene in healthcare’ direct observation is currently the gold standard and the most reliable method to detect all occurring hand hygiene actions,*
Zabrze, Ruda Śląska). All the toilets were equipped with electric hand dryers. The centres where the observation took place were significantly different in terms of customers. The centre in Ruda Śląska is a relatively small local facility. The goods of the shopping mall located in Zabrze are aimed at the customers representing the middle social class. The shopping centre in Katowice (the capital city of Silesia) includes shops for customers of average economic status, as well as luxury shops targeting wealthy customers. All observation sessions were completed on Sundays from 2 to 5 p.m. in summer 2012.

Disguised, participant and controlled observations were used in the study. The observers behaved like typical users of the public toilet: they were washing their hands, combing their hair, correcting make-up and, at the same time, observing the other users. They were in view of the sink for all observations. The observed individuals had no knowledge that they were research subjects, thus they behaved in a natural way and displayed normal hand washing behaviours. The person conducting disguised observation took notes of the research results on a specially prepared research form covering the following information: subjectively assessed age of a subject, non-washing of hands, any rings worn, taking the rings off before washing of hands, failure to use soap, failure to dry hands and the time of hands washing/drying. There were two trained and validated observers: a woman and a man. During validation, two observers were engaged in observation sessions and each completed an observation form separately while observing the same subject. Results were then compared and discussed. During four sessions (the first one was done to pre-test and modify the form, another three sessions took place on Saturdays before the experiment to check concordance between observers), 46 individuals were observed.

Measurements of hand washing and drying time were made using a stopwatch HS47-003 (Q&Q) with accuracy to 1 s placed in the pocket of the observer. When more than one person was present in the toilet at the same time, the observer focused on one randomly chosen individual. Rubbing hands under running water was considered washing of hands for the purpose of the study. Use of an electric dryer was considered drying of hands. In accordance with the Polish law ethics committee, approval for this study was not required (Journal of Laws 2005).

Data analysis was performed with the statistical software Statistica version 10, Statsoft Poland. The following tests were used in the statistical analysis: Pearson’s chi-squared test, Mann–Whitney U test and the Kruskal–Wallis analysis. The Shapiro–Wilk test was used to examine the compliance of tested variables distribution against normal distribution. The significance level was set at $p = 0.0500$.

## RESULTS

Over 80% in the observed group washed their hands after going to the toilet (80.2%). However, 65% washed their hands for less than the recommended time of 15 s. Only 19% of individuals washed their hands properly (Table 1).

<table>
<thead>
<tr>
<th>Hand washing time (s)</th>
<th>Katowice</th>
<th>Zabrze</th>
<th>Ruda Śląska</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 15</td>
<td>88</td>
<td>88</td>
<td>84</td>
</tr>
<tr>
<td>15–30</td>
<td>37</td>
<td>13</td>
<td>9</td>
</tr>
<tr>
<td>&gt; 30</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>126</td>
<td>101</td>
<td>94</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hand drying time (s)</th>
<th>Katowice</th>
<th>Zabrze</th>
<th>Ruda Śląska</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 10</td>
<td>54</td>
<td>43</td>
<td>35</td>
</tr>
<tr>
<td>10–32</td>
<td>42</td>
<td>26</td>
<td>16</td>
</tr>
<tr>
<td>Total</td>
<td>96</td>
<td>69</td>
<td>51</td>
</tr>
</tbody>
</table>

Figure 1 | Adherence of residents of Silesia, Poland to hand washing practices after using the toilet (hand washing, use of soap and hand drying) according to the gender ($N = 400$).
More than half of the persons (51%) used soap and 45.7% dried their hands (Figure 1). Almost 40% of people (38.9%) who dried their hands spent at least 10 s for this activity (Table 1). No participants dried their hands for more than 45 s.

Most of the observed individuals had no rings (79.7%), and only one person among those wearing jewellery took it off before washing his/her hands.

Women washed their hands more frequently than men after using the toilet (86 versus 74.5%). However, men (55.4%) used soap more frequently (Figure 1). These tendencies were confirmed statistically with the use of a chi-squared test ($p < 0.05$). Men were drying their hands more frequently than women. But in the case of hands drying, the difference between men and women, expressed as a percentage value, was not statistically significant.

The hand washing activity took 9.2 s on average, while the hand drying activity took 6.9 s in the tested individuals. Women washed their hands for 10.2 s (SD = 7.3), while men devoted an average of 8.2 s (SD = 5.8) to this activity. Men dried their hands for about 3 s longer than women (Table 2). Women dried their hands for 5.4 s (SD = 7.5) on average.

The Mann–Whitney $U$ test confirmed a correlation between the time devoted to hand washing and drying and the gender. Women washed their hands longer than men ($p = 0.0004$). But men spent more time drying their hands ($p = 0.0001$) (Figures 2 and 3).

### Table 2

| Hand washing time (s) and hand drying time (s) according to gender, age of observed people and place of observation ($N = 400$). Age was subjectively assessed by observers |
|-------------------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Gender                                          | Hand washing    | Hand drying     |
| Mean value | SD | Mean value | SD | Mean value | SD |
| Women ($N = 200$)                                | 10.2            | 7.3             | 5.4             | 7.5             |
| Men ($N = 200$)                                  | 8.2             | 5.8             | 8.5             | 6.7             |
| Age                                              |                 |                 |                 |                 |
| Youth ($\leq 25$ years old) $N = 120$            | 7.4             | 6.7             | 3.2             | 5.8             |
| Adults (26–54 years old) $N = 238$               | 8.1             | 7.0             | 4.4             | 6.2             |
| Elderly people ($\geq 55$ years old) $N = 42$   | 7.3             | 7.9             | 2.3             | 4.7             |
| Place of observation                             |                 |                 |                 |                 |
| Katowice ($N = 147$)                             | 11.5            | 7.9             | 9.3             | 7.7             |
| Zabrze ($N = 125$)                               | 8.2             | 5.2             | 7.4             | 8.1             |
| Ruda Śląska ($N = 128$)                          | 7.2             | 6.0             | 4.3             | 5.8             |
| Total                                            | 9.2             | 6.5             | 6.9             | 5.3             |

SD – standard deviation.
A correlation was also discovered between the frequency of hand washing and the assessed age of the individuals in the observed group \((p = 0.0001, \text{Pearson’s chi-squared test})\). According to the correlation, adults washed their hands more frequently, and elderly people the least often (86.6 versus 61.9%). Over 38% of older participants did not wash their hands at all (Figure 4).

Adults used soap (61.3%) and dried their hands (61.8%) most frequently. Slightly more than 40% of young and elderly people dried their hands. The comparison of time devoted to hand washing and drying by the observed at various ages shows that adults devoted more time to both activities (Table 2 and Figure 4). However, this relation was not significant \((p > 0.05)\).

Nevertheless, there was a relationship between the time of washing and drying hands and the place of observation. Cities where shopping centres were located differ from each other in size and the degree of development. The results showed that the frequency of washing and drying hands and the use of soap are correlated with the place of observation \((p < 0.05)\). According to this relationship, hands were most frequently washed (87.1%) and dried and the soap was most frequently used in Katowice, less so in Zabrze (80% of observed subjects washed hands) and the least in Ruda Śląska (Figure 5). In Ruda Śląska, 72.7% of people washed their hands and only 42.2% dried them.

The Kruskal–Wallis analysis confirmed the presence of strong correlation between the average hand washing \((p = 0.0000)\) and drying times \((p = 0.0004)\) and the place of observation. The individuals observed in Katowice washed and dried their hands longer than the ones in other cities. Average time of washing hands in Katowice was 11.5 s (SD = 7.9) whereas in Ruda Śląska it was only 7.2 s (SD = 6.1).

**DISCUSSION**

Hands play an extremely important role in the life of every human being, because people use their hands to perform all activities necessary to ensure proper functioning in social life. At the same time, hands, due to their continuous contact with microorganisms present in the environment, pose a significant threat to human health (Bloomfield et al. 2007). Even in the twenty-first century, dirty hands are still the cause of many nutritional, respiratory and skin infections. It is possible to limit the number of infections by applying correct social hand washing, which comprises washing, rinsing and drying (Bloomfield et al. 2007).

Time devoted to social hand washing affects the accuracy of the procedure. The longer a person rubs his/her hands with soap under running water, the more effective the hand washing. The recommended hand washing time is minimum 15 s (Patrick et al. 1997). During observations in shopping centres, hands were washed for 9 s, on average. Washing hands for this period of time does not provide a satisfactory result, as it is definitely too short to do it thoroughly and to reduce significantly the number of transient flora microbes (Patrick et al. 1997).
Comparing the results obtained in this work against the ones from other available studies, it is clear that the average time of hand washing and drying by the Poles is not significantly different from the practices of people from other countries. In New Zealand, in 2007, Garbutt et al. conducted an observational study and noticed that the participants washed their hands for about 10 s. This observation covered a group of 1,200 people: 600 women and 600 men, and was conducted in four shopping centres. The study report showed that the time spent washing hands was not age-dependent (Garbutt et al. 2007).

In 2002, an observational study was also conducted among the residents of Australia (Garbutt et al. 2007). The group participating in the study consisted of 200 people, and the observation was conducted in the public toilet of a shopping mall in Canberra (Garbutt et al. 2007). It was found that only 23% of women and 15% of men washed their hands for more than 10 s, while in the case of the residents of Silesia, as many as 37% of women and 23% of men devoted more than 10 s to hand washing. Only 19% individuals washed their hands for the recommended time of 15 s.

In 2004, hand washing practices in public toilets in Minnesota, USA, were observed (Allwood 2005). The group participating in the study consisted of 1,175 people. It was found that women were more likely to wash their hands than men. Female youths had the highest average observed hand washing rate of the four groups observed (66%), followed by adult males (53%), adult females (50%) and male youths (18%) (Allwood 2005). In our study, adults washed their hands more frequently than youths (86.6 versus 74.2%). This finding suggests that adults have greater hand washing awareness. Disparities between people of different age highlight the need for a shift in the health education strategies to specifically target children and teenagers.

In the study realised by the American Cleaning Institute and the American Society for Microbiology, 6,028 people aged over 18 were observed in public toilets located in four large US cities: Atlanta, Chicago, New York City and San Francisco. The observation consisted of an assessment of whether a given person washed his/her hands properly, i.e. using soap, washing of hands for more than 15 s and their precise drying (ACI ASM 2010). As many as 85% of the US population in 2010 washed their hands in this way, after using the toilet. The result was 3% higher than the result obtained in the case of Silesians in this paper. Frequency of hand washing among women from Silesia was even 7% lower than among the American women. In both studies, women were more likely to perform the social hand-washing procedure and the same conclusion was also drawn by the researchers in New Zealand (Garbutt et al. 2007).

The ACI ASM study showed that the correctness of the hand-washing procedure was not related to the place of observation (ACI ASM 2010). In this study, there was a significant statistical correlation between the observed quality of the hand-washing procedure and the place of observation. Socio-economic status of customers could be different in all observed shopping centres. Shopping centres in Zabrze and Ruda Śląska are directed at customers of average economic status, hence they lack brand luxury shops. The group observed in Katowice could have a higher social status than the one observed in the two other cities. In this shopping centre, there are mostly brand shops.

The social hand-washing procedure is effective only if soap is used (Bloomfield et al. 2007; Hiremath et al. 2012). During the observation, only half of the individuals used soap while washing their hands. This is a very alarming fact and it shows that hygiene behaviours of the Silesians are at a low level and need to be improved. In New Zealand, the group that used soap amounted to 71%, whereas in the USA, this group amounted to over 80% (Garbutt et al. 2007; ACI ASM 2010). The results were only lower in the case of a study conducted in Australia: only 31% of women and 27% of men in the Australian study used soap when washing their hands (Garbutt et al. 2007).

An essential element of the hand-washing procedure is thorough drying of the hands. In this study, only 45% of the observed individuals dried their hands, and men were more likely to dry their hands than women. According to Garbutt and co-workers, as much as 91% of the subjects dried their hands and the women did it more frequently than men (Garbutt et al. 2007). The reason for such a low hand drying rate among Silesian citizens is unclear. In all toilets, there were only electric dryers. The hand drying rate could be higher if observations were realised in toilets equipped with paper towel dispensers.

During our observations, average time devoted to hand drying with an electric dryer was 7 s. Women were drying
their hands for an average of 5 s and the men for 8 s. None of the people observed dried their hands for 45 s. The average drying time was around six times shorter than is recommended. Also, in a study conducted in a New Zealand hospital, men used electric dryers for a longer time; an average of 17 s whereas women used them for 13 s (Jumaa 2005). Redway & Fawdar (2008), in the UK, observed an average drying time of 25 s for women and 20 s for men.

**LIMITATIONS**

The technique of direct observation in this study had both advantages and disadvantages. As an alternative to the self-reporting method, direct observations of hand washing were used as a way to enhance reliability. However, even an apparent disguised observation may influence hand washing behaviours, as the simple presence of others in a restroom may lead to increased compliance (Nalbone et al. 2005). The observation of the same subjects conducted at their homes, rather than at the shopping malls, may give different results.

Observational studies could be susceptible to bias. Human perceptual errors and a different data collector for each gender could affect the information that is obtained. Several measures were taken to address potential bias. Firstly, the observational form was pre-tested and modified, secondly, the observers were trained and validated to maximise accuracy.

Because overall times were fairly short, even some of the larger ratios between variables in washing and drying times may represent an absolute difference of only a few seconds. Therefore, the statistical correlations should be viewed as a relevant overview of some relations between factors, without overemphasising small differences between categories, even if they are statistically significant.

**CONCLUSIONS**

The results of observations clearly indicate that citizens of Silesia neglect hand hygiene or carry out the procedure improperly. The finding that almost 20% of participants did not practise any form of hand hygiene after going to the toilet is of concern. The residents of Silesia, Poland are not hand hygiene compliant. Hand washing and hand drying times obtained during observation were lower than most of the results of other similar studies conducted worldwide. The fact that hand washing is ignored by some Silesians makes it necessary to take promotional actions in terms of hand hygiene. Health educators in all settings including worksites, schools, public health departments and health care facilities need to develop programmes that encourage proper hand washing practices. Any hand hygiene promoting measures should aim to achieve a condition in which hand washing practices become a common, natural and obvious standard for all people. This may be achieved only if wide-ranging promotional activities are carried out continuously and are organised in accordance with hand hygiene promotion rules.

Social hand washing practice is cheap and at the same time an effective way to combat infections. Members of Polish society should become aware of this in their everyday life and apply the hand washing principles. For this reason, it is necessary to form desirable hygienic habits and to teach proper hand hygiene behaviours, which will help to implement appropriate health culture in Poland.

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