

Report submission – Classic Marble Showers Ltd.

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User experience of an innovative non-slip shower tray surface

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Background:

Bathing and showering to maintain hygiene can be dangerous and the injury rate rises with age.

Spencer et al conducted an epidemiological study of childhood bathtub related injuries in 2005. The authors investigated bathroom related slips and falls in a consecutive series of 204 children (age range 4 months -16 years) attending a paediatric emergency department over a 3-year period. Slips and falls accounted for 82% of injuries with laceration the most common injury type (67%) with the head or face being the most common injury location (68%). Interestingly, adult supervision was present during 85% of the injuries among children younger than 5 years and following the incident, parents altered the bathing environment in 82% of cases.

The authors concluded that in the case of child bathing, increased supervision alone was insufficient to prevent injury and that passive methods such as providing a slip resistant bathtub surface to increase the coefficient of friction would be most effective in preventing injury (Spencer et al, 2005).

In a retrospective study by Mao et al (2009) using nationally representative data from the US Consumer Product Safety Commission National Electronic Injury Surveillance System from 1990-2007 there were an estimated 791,200 bathtub and shower-related injuries among children ≤ 18 years of age. The most common mechanism of injury was a slip, trip, or fall, accounting for 81% of cases prompting the authors' conclusion that the incidence of such injuries may be decreased by increasing the coefficient of friction of bathtub and shower surfaces (Mao et al, 2009).

Overall, about two-thirds of accidental injuries across all ages happen in and getting out of the bath or shower. Mishaps near the bath, shower, toilet and sink caused an estimated 234,094 nonfatal injuries in the U.S. in 2008 among people at least 15 years old according to the Centres for Disease Control and Prevention reported online in its Morbidity and Mortality Weekly Report.

Introduction:

Classic Marble (Showers) Ltd are a NI family owned business that have developed a unique type of shower tray.

In the current market, all shower trays have to be CE marked in accordance with BS EN 14527:2016, Shower Trays for Domestic Purposes. However, within this British standard no reference is made to anti-slip properties. So for a barefoot, wet and soapy environment anti-slip properties are not considered.

Because anti-slip properties are not addressed in the CE marking, marketers have exploited the concept of anti-slip post-sprayed properties in their small print with a limited guarantee on slip resistance properties, typically three years and limitations of use - e.g. not allowed to use hair dyes with their products.

Classic Marble (Showers) Ltd have taken the relevant British and German standards which deal with slip potential (BS 7976-2:2002 and DIN 51 097) and developed a shower tray which comfortably meets the lowest slip potential that can be declared. The company have even added a soaping agent to the tray before testing to the British Standard and double the level of soaping agent as required by the German standard and still comfortably exceed the lowest slip potential.

The company's product is unique because the anti-slip properties are tooled into the design of the shower tray (i.e. not a post spraying operation). The tooling design consists of flat-topped dimples of 4.5mm diameter and 0.75mm depth with spacing of 12mm between centres in a square grid pattern. This means that the shower tray anti-slip properties will be guaranteed for the lifetime of the product and there are no limitations on use, i.e. you will be able to use hair dyes with the tray.

The specific issue the company needs addressed is how the end user will perceive the experience of showering on the new surface, across a range of ages. They require external independent validation as to whether this new design will be accepted in the market or if they need to reconsider the design before production. The company have obtained an innovation voucher from Invest NI and approached the Podiatry department at Ulster to devise a small trial on a sample of people, replicating a showering experience, complete the trial and obtain feedback/results on the perceived comfort/added safety provided by the product. The company have requested a report and a recommendation as to whether to proceed to production or review the surface design.

Aims and Objectives:

Aim: To investigate and report on user perception of the Classic Marble shower tray product.

Objectives:

- 1) To collect sample data, including age, gender, frequency of shower use and if subjects have previously experienced slips/falls whilst showering.

- 2) To collect data on user perception of comfort, stability and safety of the new surface to prevent slips or falls during use.

- 3) To collect user opinions on whether they would use this product if it were commercially available.

- 4) To make a recommendation to proceed either to manufacture or to review the surface design.

Method:

The company supplied a shower tray unit and a sample of the soaping agent used for the non-slip German test standards.

The shower tray unit was secured over the current shower tray and outlet of the male changing room (1D102) on Floor D of the Podiatry clinic, Ulster University, Jordanstown campus. A safety support in the form of a Zimmer frame was provided for subjects and situated beside the tray should it be required.

A rig was designed and built by the engineering department at Ulster consisting of a jet, reservoir and pump to simulate flowing soapy shower water. The reservoir was a container that held at least 20L of water and was filled from the shower supply itself. The temperature was set to approx. 25-30°C and measured with a thermometer. A small motorised pump was connected by a hose from the reservoir to the shower tray surface and a flow rate set to approx. 6L a min simulating the flow rate of the German tests.

The soaping agent used was a non-ionic surfactant (Triton X-100) diluted with water to a concentration of 1 g/L and was added to the reservoir by the Chief Investigator

(CI) prior to testing. The concentrate volume was pre-prepared in syringes for addition to the reservoir and matched that of the German test standards.

25 subjects who use showers as their main method of hygiene were recruited from the University staff and student population (age range 18-70 yrs) via email shot and screened for pre-existing musculoskeletal (MSK) sources of foot pain, skin allergy to soap products or an open foot wound by the CI prior to testing. Only subjects without clear sources of pre-existing MSK foot pain, allergies or wounds and who consented to the testing procedure were tested.

The study protocol was peer reviewed and approved by the Research Governance Filter Committee of Ulster University.

The pre-test procedure was as follows:

1. The reservoir was filled with warm shower water to 20L volume and the temperature measured with a thermometer to ensure a temperature of 25-30°C.
2. Using gloves the pre-measured volume of surfactant was added to the reservoir using a disposable syringe and the water mixed.
3. The shower tray surface was cleaned using Trionic wipes
4. Wash basins containing warm water and towelling roll were placed in the 3 cubicles in the changing room for subject use post testing

The testing procedure was as follows:

1. The subjects were taken from the waiting area on floor D into the changing room by the CI and allocated a cubicle.
2. Each subject was required to remove their socks and shoes and roll-up their clothing to the knees, the CI checked for any open wounds, cuts, abrasions on the feet and for any sources of foot pain. Provided none were found, the subjects were given a consent form to sign and completed the pre-test section of the questionnaire.
3. If any subject was found with foot pain or an open wound they would be precluded from testing and directed to the Podiatry reception on Floor B, Block 1 (1 floor below the testing area) where the receptionist will offer the individual a free appointment in the Podiatry student clinic should they wish to be seen.
4. Each consented subject was taken individually to the shower unit to stand on the tray surface. The pump was switched on and water flowed over the surface from the reservoir. The subject was required to simulate foot movements in a shower by standing for 1 min, walking on the spot for 1 min and half circle turns for 1 min under the supervision of the CI.

5. On completion of testing the pump was switched off and the CI provided some towelling roll for the subject to dry their feet prior to them returning to their cubicle. The CI then wiped the tray surface with a Trionic wipe prior to collecting the next test subject.
6. On returning to their cubicle the subject bathed their feet in warm water to remove any soap residue, dried with towelling roll and put on their socks and shoes. They then completed the post-test questions of the questionnaire.
7. On completion, the questionnaires were collected by the CI prior to leaving the test area and subjects were given a lunch voucher for their participation.
8. All subjects attended the testing procedure only once and the total time for testing was 10-15 minutes per subject.
9. The questionnaires were stored in a locked cabinet in room 1D115 and accessed only by the CI. All statistical data were stored on a password-protected laptop and available only to the CI and the statistician.

Strategy for data analysis:

This was a small-scale study for descriptive purposes only and involved a convenience sample of 25 participants.

The outcome being measured was user experience of an innovative non-slip shower tray surface. The questionnaire included both closed and open questions. The closed questions related to product comfort, safety and desirability and Likert scales that are ordinal level measurements were used.

Analysis of responses to the closed questions involved descriptive statistics: frequencies and percentage summaries for the categories of each question. This category (ordinal) data was also presented as bar charts.

Cross-tabulation was undertaken to investigate the association between key variables e.g. question 4 concerning previous experience of slips or falls whilst showering and question 7 concerning confidence in the surface preventing slips or falls.

A Chi Square statistical test of association was precluded due to the small sample size (each cell in the crosstabs table must have an expected frequency of at least 5 for the Chi Square test to be valid).

The data from the open questions was analysed by applying qualitative data analysis techniques to identify reported issues and recurring themes.



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Results:

The subject sample consisted of $n = 25$ adults, 15 female and 10 male, age range (18-59) with a mean age of 34.7 years.

Pre-test, all subjects reported a high frequency of shower use with 76% indicating daily use and 24% regular use.

60% of subjects reported some previous experience of a slip or fall whilst showering though none reported this as a frequent occurrence (see Appendix 1).

Post-test analysis indicates 88% of subjects found the surface comfortable to extremely comfortable to stand and move on and all subjects reported the surface to be stable and safe.

All subjects agreed the surface would prevent them from slipping or falling with 76% in strong agreement and 24% in agreement with this statement.

In addition, 80% of tested subjects indicated they would be keen to use the Classic Marble shower tray in their own home if the cost compared favourably to other products on the market with only 16% undecided (see Appendix 2).

Bar charts of the results of questions 4, 5 and 8 are included in Appendix 3.

The data from the open questions and comments made by subjects are listed in Appendix 4.

There are a total of 51 comments, 2 relating to pre-test question 4 and 49 to all post-test questions.

Of the post-test questions 46/49 comments (94%) were a positive endorsement of the feel and stability of the surface of the shower tray or confidence in the product to prevent slipping or falling.

Some subjects suggested the design had the potential of a massaging / therapeutic effect on the feet.

Conclusions:

The results from this small consumer survey clearly indicate that the Classic Marble shower tray is fit for purpose.

All tested subjects found the surface stable and safe and agreed it would prevent them slipping or falling, with 88% reporting a high comfort level when standing and moving on the surface.

In addition, 80% of subjects positively endorsed the product as a potential market purchase for home use.

Individual subject comments were very positive in terms of the product design (94%) and some subjects found the experience of standing and moving in the tray therapeutic for the feet.

It is important to point out some weaknesses of this survey which includes the sample size being small (n=25), a convenience sample being used and that no subjects over the age of 60 were recruited which may have influenced the range of responses to some of the survey questions.

Nonetheless, the study protocol was diligently followed and the tests conducted to match the German DIN 51 097 standard in relation to contaminant concentration and flow rates.

The purpose of this work was to independently validate how the end user would perceive the experience of showering on the new Classic Marble shower tray surface, across a range of ages.

It is fair to conclude from the data collected that this new design will be accepted in the marketplace and there is no need to reconsider the surface design prior to production.

References:

Mao, JS; McKenzie, LB; Xiang, H; Smith, GA. (2009) Injuries associated with bathtubs and showers among children in the United States. *Pediatrics* 124; (2): 541–547.

Spencer, SP; Shields, BJ, Smith GA. (2005) Childhood Bathtub-Related Injuries: Slip and Fall Prevalence and Prevention. *Clinical Pediatrics* 44:311-318.

Stevens, JA; Haas, EN. Div of Unintentional Injury Prevention; Tadesse Haileyesus, MS, Office of Program and Statistics, National Center for Injury Prevention and Control, CDC.

Appendix 1

Sample: Frequencies and percentages

Age

	N	Minimum	Maximum	Mean	Std. Deviation
Age in years	25	18	59	34.72	12.818
Valid N (listwise)	25				

Sex

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	10	40.0	40.0	40.0
	Female	15	60.0	60.0	100.0
	Total	25	100.0	100.0	

Frequency of shower use

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Regularly	6	24.0	24.0	24.0
	Every day	19	76.0	76.0	100.0
	Total	25	100.0	100.0	

Ever experienced slips or fall

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	10	40.0	40.0	40.0
	Once or twice	11	44.0	44.0	84.0
	Occasionally	4	16.0	16.0	100.0
	Total	25	100.0	100.0	

Appendix 2

Sample: Perception of shower tray

Comfort of surface

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Slightly uncomfortable	3	12.0	12.0	12.0
	Comfortable	5	20.0	20.0	32.0
	Very comfortable	11	44.0	44.0	76.0
	Extremely comfortable	6	24.0	24.0	100.0
	Total	25	100.0	100.0	

Surface stability and safety

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	2	8.0	8.0	8.0
	Strongly agree	23	92.0	92.0	100.0
	Total	25	100.0	100.0	

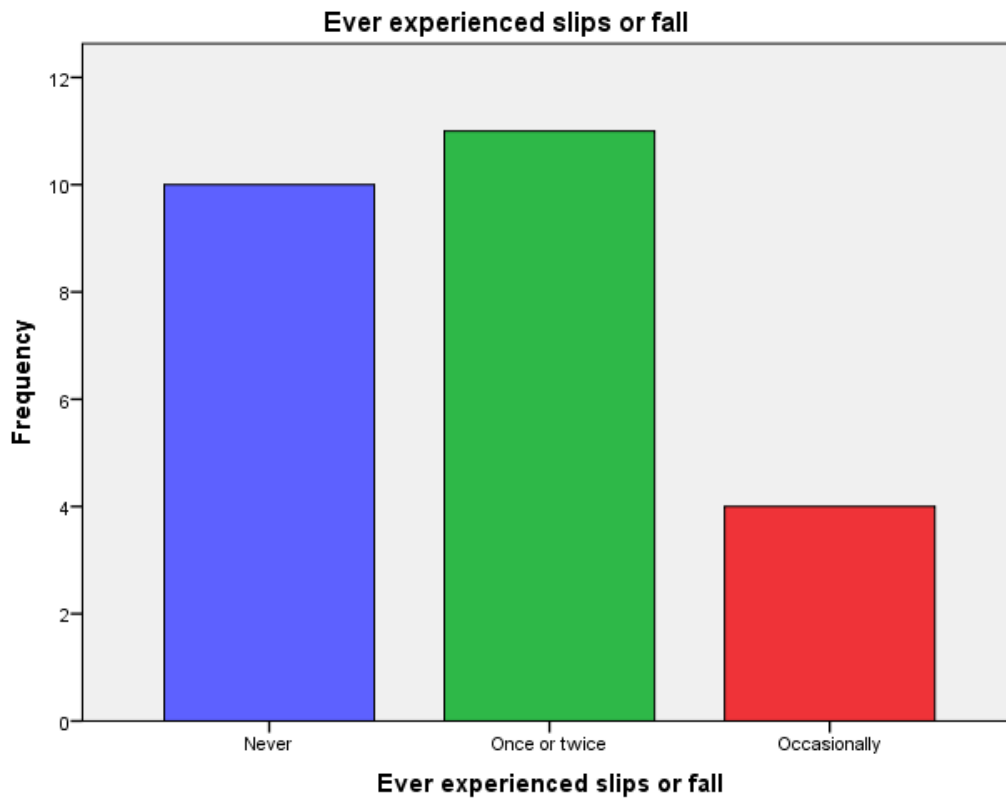
Felt confident the surface would prevent me falling

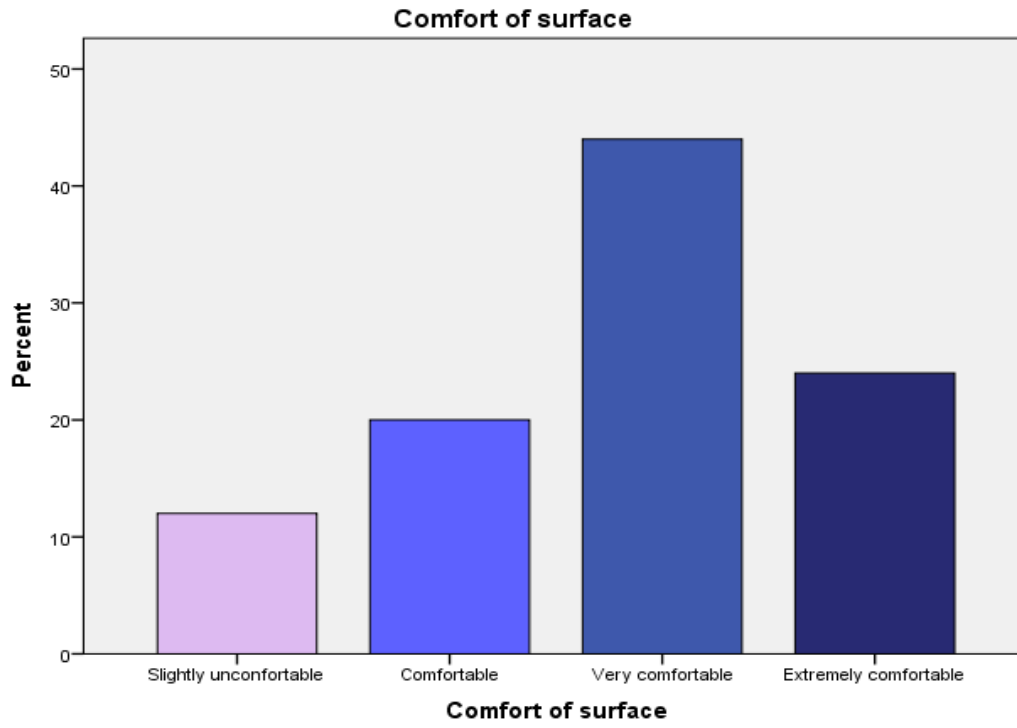
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	6	24.0	24.0	24.0
	Strongly agree	19	76.0	76.0	100.0
	Total	25	100.0	100.0	

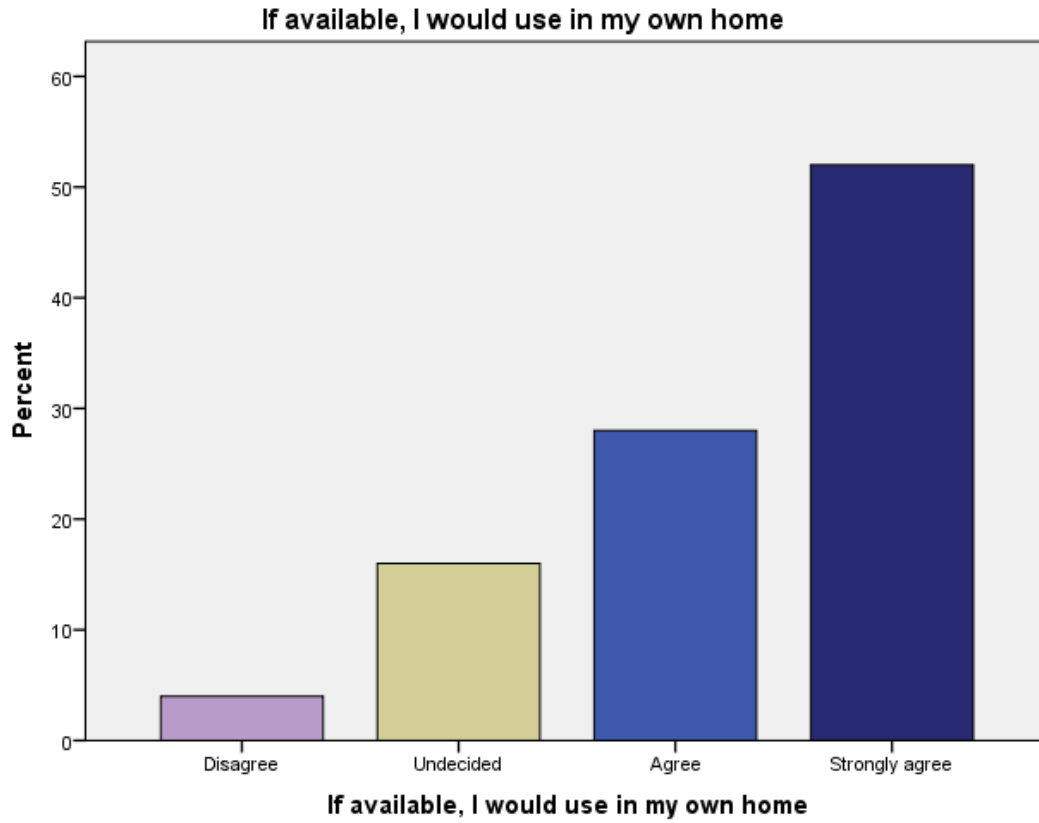
If available, I would use in my own home

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	1	4.0	4.0	4.0
	Undecided	4	16.0	16.0	20.0
	Agree	7	28.0	28.0	48.0
	Strongly agree	13	52.0	52.0	100.0
	Total	25	100.0	100.0	

Appendix 3







Appendix 4

Pre-test comments

'New shower tray installed but was slip risk, so purchased an anti-slip mat'

'My children tend to leave soap residue in the shower after use, this has caused me to slip from time to time'

Post-test comments

'The surface was very comfortable and quite sensual – a bit like reflexology'

'Surface provides a good sturdy grip and I felt very securely grounded!'

'Slightly tickly'

'Slight roughness, felt comfortable'

'Dimples felt like they added grip'

'Very good grip'

'As the bumps do not sit flush with the base surface, the ridge around the edges were quite abrasive'

'I found the shower tray comfortable to stand on, I have good padded feet and the dimples did not feel uncomfortable'

'Good grip'

'Was able to turn around without the use of the aid provided'

'I found this shower tray comfortable and felt safe when walking on the spot and turning around'

'No issues, comfier than it looked'

'Felt quite safe and not slippy underfoot'

'Didn't feel slippy, quite confident to move'

'Doesn't look ugly or unattractive. It doesn't look like a 'medical device''

'I was impressed how it provided 'grip' as well as comfort'

'Surface was extremely stable which gave me a feeling of confidence moving about it'

'Even in the soapy water as I moved about I was extremely confident after the initial moves that I wouldn't slip'

'An impressive product'

'Bumps on surface felt a bit weird initially but not uncomfortable'

'Surface felt secure underfoot'

'I have very flat feet so the raised surface would be much safer than my current shower surface'

'Very safe – no fear of sliding even when I tried to!'

'Slightly uncomfortable because of raised bumps however, puts you at ease from slipping which I felt made me feel more comfortable'

'When I got out, the soles of my feet felt very smooth – it was like a foot spa!'

'I felt very safe and stable'

'I have older children and teenagers and I would feel safer that they would not slip or fall and could be left to shower by themselves independently'

'Very comfortable – almost massaging'

'Very safe to stand on – didn't feel slippery throughout experiment'

'Agree that it didn't feel slippery'

'Yes, would buy it as feels safe'

'Far better than any shower mat I've ever used'

'Good addition to any shower unit'

'Water went between the dimples and not up over my feet'

'Slightly more uncomfortable when walking around than when standing stationary'

'Very comfortable to stand on, no discomfort'

'At no time was I concerned when using this product'

'Even when moving around on the surface I felt very stable and secure'

'Great concept when showering young children – price is influential on choice'

'On a par with other trays'

'I felt very secure standing on the surface, didn't feel slippery at all'

'Wasn't slippery, I took steps confidently'

'I would definitely consider using this product; I would like to try it with a soap/scum build up perhaps?'

'Even when twisting my foot, it gave no hint of slipping'

'The surface provides excellent stimulation to the sole of the foot which is likely to provide good proprioception and resultingly good balance'

'The dimples on the shower tray are comfortable on the foot. The surface and dimples are evenly spread and has a consistent feel'

'The dimples on the tray add a safety layer to the showering process, the soap and water flow between the dimples and you feel more confident moving around'

'Price would influence my decision though'

'Because I don't necessarily have any other surface to compare it with, I'm undecided as to whether I use it in my own home or not. But I can certainly see the benefits'