

Article

A Study into Public Awareness of the Environmental Impact of Menstrual Products and Product Choice

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Abstract: This paper explores the level of awareness people have about the environmental impact of menstrual products. Currently the most popular types of product are also the most detrimental to the natural environment, particularly due to the amount of hidden plastic in disposable items. This research seeks to find out whether people realize that this is the case and whether those that are more aware of the damage are likely to make choices that are less harmful to the environment. A mixed method approach was taken, using online surveys and focus groups. The results of the study show that most participants were not aware at the amount of plastic in disposable menstrual products, and that there are other issues linked to their environmental impact that people are generally not aware of. Some participants were more aware of the issues than others and the research suggests that those with a higher awareness are more likely to choose products that are less harmful to the environment. Based on these findings, future actions and areas of further research are suggested.

Keywords: single use plastics; menstrual products; environmental impact; consumption

1. Introduction

Single-use plastics have recently become a target for action, but it seems that menstrual products are going under the radar, with disposables often not recognized publicly as a source of single-use plastic. Although the presence of microplastics in the ocean was highlighted in the 1970s by scientists who warned that their concentration was likely to increase and cause problems [1], renewed interest has sparked more studies into its effects.

Much of the environmental impact from popular menstrual products comes from their disposable nature [2]. Freidenfelds [3] conducted interviews with women of various generations to reveal their personal experiences of dealing with menstruation and compared modern views with those of past generations. She found that before commercially produced disposable pads and tampons were available, women used whatever fabric they could find to make their own pads, which were commonly hand washed and reused.

Historically, women felt that menstruation was something to be ashamed of, a feeling that is still prevalent in society and popular culture today [4–6]. It is this taboo that creates a difficult arena for discussion of more sustainable alternatives. Feminist critiques claim that disposable menstrual products are loaded with patriarchal ideas that suggest menstruation is an unhygienic problem and one that should be hidden [7]. Berkeley [8] explains the increased use of these items by women's entry into more male-dominated workplaces. It could also, however, be seen as a liberation of women, as the history of menstruation would suggest that modern management of the menstrual cycle is a much more convenient experience [3,9].

This desire of companies to make a profit could help to explain why disposables have become more popular than reusables. They have a higher commodity potential than reusables as the consumer

is required to re-purchase them regularly, whereas a menstrual cup, for example, can last for up to 10 years [9].

Although reusable menstrual cups were developed shortly after disposable pads and around the same time as tampons with cardboard applicators in the 1930s, they did not become popular at the time. Shure [10] suggests that this was due to the high levels of marketing for disposable products and comparatively poor marketing for the cups, but she also notes that women were not keen on getting that intimate with their own body after these discreet disposables had been made available. Ashley et al. [11] suggest that contemporary women are now so accustomed to efficient and discreet sanitary products that reusables are not viable in developed countries as a result. There is, however, a more recent surge of interest in these reusable products, which appears to have spread via social media [12].

Table 1 gives a brief overview of the most popular products.

Table 1. Current popular product options.

Product	Brief Description
Inorganic tampon with/without applicator	Worn inside the body to absorb menstrual fluid. The main absorbent body of the tampon is commonly made from cotton or rayon and often has a thin outer layer of synthetic fibre (polyethylene and polypropylene) to prevent fibre loss and create a smoother surface. There is a cord attached for removal, made from polyester or polypropylene. Applicators can be made from card or plastic [13]. One tampon can be used for 4–8 h, then it should be disposed of in a bin [14].
Organic tampon with/without applicator	Used in the same way as a non-organic tampon, but the main absorbent body of the tampon and the attached string is made from organic cotton. Applicators are made from cardboard [15]. One tampon can be used for 4–8 h then it should be disposed of in a bin or composted.
Inorganic disposable pads	Worn outside the body using an adhesive strip to fix the product to underwear. Made up of various layers. A permeable top layer made from a polymer such as polypropylene or polyethylene, an absorbent layer made of cellulose, a ‘super absorbent polymer’ or ‘smart foam’ inner core (different brands give different names to this part but do not reveal the ingredients) and a polyethylene bottom layer [16,17]. One pad can be used for 4–6 h depending on flow and should be disposed of in a bin.
Organic disposable pads	Worn in the same way as inorganic disposable pads, fixed to underwear with adhesive strip. Absorbent cellulose centre and cotton top layer. One pad can be used for 4–6 h depending on flow and should be disposed of in a bin or composted [18].
Reusable pads	Worn outside the body and fixed to underwear using poppers. Made from layers of absorbent fabric. Can be made from natural fibres such as cotton and bamboo, or from synthetic fibres such as polyester. Pads can be worn for 4–6 h and should be washed after each use. They will last approximately 5 years [19].
Menstrual cup	Worn inside the body to collect menstrual fluid. Made from medical grade silicone or natural rubber and available in two sizes. Cups can be worn for 12 h before emptying, should be sanitised after each monthly use and can last up to 10 years [20].
Period pants	Worn as regular underwear. Can be made from natural fibres such as cotton or synthetic fibres. Contains a top layer of cotton, an inner layer of ‘super-absorbent’ fabric and an outer leak-resistant layer [21]. Products are available in a range of sizes, shapes and absorbencies, should be washed after each use and will last approximately 2 years [22].

Within the UK, the most popular and easily available items are non-organic tampons and disposable pads [23]. Some organic disposables and reusable menstrual cups are available in specific high street stores, but many are only available to purchase online. It is estimated that tampons, which are the preferred choice in Western Europe and the US [24], are used by 100 million women globally,

each using on average 11,000 of them in their lifetime. Research suggests that disposable pads are even more popular worldwide, due to a cultural taboo around tampons in some areas of the world [2].

Widespread use of these disposable products comes with an environmental cost at end of use. It has been estimated that a regular non-organic pad can take 500–800 years to break down [25] and as plastic makes up such a large amount of these products, they will never truly biodegrade. Tampons are significantly quicker to biodegrade at around six months [25], as they are mostly made from natural materials such as cotton. However, as many brands of tampon now contain plastic within them and are often wrapped in plastic, this compounds the issue. These estimations of degradation are based on respirometry tests in lab conditions, so in reality, what actually happens to these products in landfill could be very different, as there is often a lack of oxygen making them unlikely to degrade [26]. Much of the plastic used in disposable pads and tampons is polyethylene and most microorganisms do not recognize this material as food, so do not decompose it. Polyethylene can break down into smaller pieces as a result of photodegradation, but once the material is buried in landfill, there is very little light available for this to occur [27].

Disposable products that do not make it to landfill can end up in our oceans or washed up on our beaches, where they create a different problem. Plastic tampon applicators are commonly found on beaches and even inside the stomachs of dead seabirds [28]. The Marine Conservation Society reported an increase in sanitary products, including menstrual products and wet wipes, found during beach cleans in 2017 [24], with nine plastic applicators found per km on UK beaches [29].

Plastic applicators and other menstrual products containing plastic can play a part in another set of problems. Slowly, with the presence of light, they can break down into smaller fragments and eventually become secondary microplastics. Microplastics are small pieces of plastic less than 5 mm in size, now found in the most remote marine environments [30] and they can pose a serious threat to marine systems and human health [31].

Lusher et al. [32] found that 36.5% of fish sampled in the English Channel contained microplastics. At lower trophic levels, the microplastics can be easily ingested as many of these organisms are not selective, eating anything which is the right size. Once ingested, it can either be egested naturally, or can block the small digestive systems of those that have eaten it [30]. Research has shown that not only can plastics be ingested, if they break down further into nanoplastics they can also be adsorbed into the bodies of some algal cells [33]. Once it has entered the food chain at these lower trophic levels, bioaccumulation can occur, with levels building as we go up the food chain [34], potentially reaching harmful concentrations for those organisms.

With so many less-wasteful methods of menstrual protection available, it is easy to begin questioning why people do not choose more environmentally-friendly products, but as Weir [20] writes, there are many factors that can affect purchasing behavior.

1.1. Factors Affecting Choice

Product reliability is essential. Above all, users of menstrual products want to be confident that the product that they choose will perform well [2]. Arguably, this itself can be linked to social factors, as a measure of performance is often its ability to protect from leakage and associated embarrassment [9]. Modern methods have come a long way since the days of old rags; however, with most products being highly reliable and the range of products being so wide, this choice is not necessarily clear cut [16]. Thus, if modern products are reliable and safe for the majority of users, that initial choice and future loyalty to a particular product is affected by other factors such as availability of products and social expectations [35].

Peer opinion can be a strong factor in menstrual product choice. Oster and Thornton [36] found those with friends who used menstrual cups were more likely to try the product for themselves after gaining confidence from peers. Similarly, Koff and Rierdan [37] found that although a mother's support is important, peers were vital for learning about menstrual products.

Borowski [38] suggests that the cost of a product is an important factor for many people, particularly for those on low incomes. Menstrual products can vary dramatically in their upfront cost, with reusables being more expensive to purchase than disposables. This creates a barrier for many, meaning they are tied to using low priced, more wasteful products even though in the long-term reusables work out cheaper [19]. Pedrini and Ferri [39] found that those with a higher income and post-secondary education were more likely to be socially conscious consumers, but it is not clear in this research whether the consumer's income or their education, or indeed both, was the reason for this heightened desire to purchase more environmentally-friendly products.

Davidson [9] suggests that convenience and availability of products is another important factor that influences people's purchasing decisions. Even if an individual is armed with a wealth of information on the environmental impact of different products and wishes to make an 'environmentally friendly' purchase, if these products are not available, then they cannot buy them. The high availability of disposable products and comparably low availability of reusables potentially affects the uptake of these items [40].

Marketing has been shown to be highly influential in the purchasing choices of menstrual product users [20] and disposables are advertised much more than reusables [40]. Consumers can, understandably, be overwhelmed by having such a large range of menstrual products to choose from because of the range of brands, age-specific marketing, fragrances, sizes, absorbency levels and discretion claims. Kent and Allen [41] suggest that when faced with a large number of options, consumers will use familiarity as a justification for buying a certain brand of product rather than considering other factors. Familiarity comes with a certain level of trust that the product will not let them down, a fear exacerbated by the advertising campaigns that promote secrecy. Reliance on familiarity may allow popular brands to assert their brand dominance, affecting buyers' decision-making by bombarding them with advertising and product options.

1.2. Existing Research into Awareness of Environmental Impact

Borowski [38] studied whether American women are turning to reusable and 'greener' menstrual products because of environmental and health concerns. Although there has been much research into awareness of environmental impacts and behavior in relation to other products and environmental issues [42], this is the only example found of research into people's awareness and views of the environmental impact of menstrual products. Borowski [38] used a mixed method approach, conducting an online survey of 160 people and interviewing key individuals. Although not peer reviewed, the research was broad, covering both environmental and health concerns associated with menstrual products and trying to ascertain whether women are changing their product choices as a result of these concerns. Borowski [38] found the answer to their question was no, they are not.

Although some interesting points are brought up, there are many limitations to the research. Borowski [38] claims that many women do not realize that there are environmental and health concerns associated with menstruation products. This research, however, relied on questions that asked whether women are aware of 'green' menstrual products and how likely were they to choose 'green' products, without giving a clear explanation of what was meant by 'green' or providing any examples of reusable products. The survey also did not ask what products the women currently used, ignoring the fact that some may already be choosing to use products that have a low environmental impact. Borowski [38] also failed to ascertain whether the women taking part in the survey actually menstruated, simply asking whether the participant identified as a woman or not. It is a clear flaw to assume that all women menstruate or that only women menstruate, possibly alienating some members of the population such as transgender men or non-binary individuals [43]. In support of Borowski [38], Weir [20] states that there are no studies to suggest that the environmental impact of menstrual products is a factor when people are deciding which menstrual product to buy. Weir [20] seems not to have acknowledged that this could be because the information given to purchasers is not clear enough for them to take it into consideration. Indeed, data on the environmental impact of menstrual products such as tampons and

pads are difficult to find. To date, peer-reviewed research comparing the environmental impact of different products is not available [20], although two non-peer reviewed studies covering a limited range of products have been published [14,20]. If the public are not aware of the environmental impact of different menstrual products, they cannot be expected to consider it when making the choice of what to purchase.

1.3. Study Aim and Research Question

The aim of the study was to analyze what level of awareness people have about the environmental impact of menstrual products and whether this level of awareness affects their product choices.

To achieve this, the study explores the following research question:

What level of awareness do people have about the environmental impact of menstrual products?

In answering this question, we then test the following hypothesis:

Individuals with greater awareness of the environmental impacts of menstrual products are more likely to choose environmentally-friendly product options.

2. Materials and Methods

This research employed a mixed-method approach, with the intention of increasing validity [44] by providing a more holistic perspective, collecting both quantitative and qualitative data [45]. An anonymous online survey was used to gather the views of a broad range of participants using a mixture of multiple choice and open questions. In addition, two focus groups were used to allow a more in-depth discussion and exploration of different menstrual products. In both methods of data collection, it was very clear to participants that the questions referred only to the menstrual products themselves, not their packaging. Ethics approval was obtained from the Departmental Research Ethics Panel at the university of the authors. All participants were given an information sheet and gave informed consent (written for the focus groups and an online form for the questionnaire), including confirming that they were not minors (under 17 years old).

2.1. Online Surveys

Due to the taboo nature of the topic, anonymous online surveys were used in the hope of encouraging those who may have otherwise avoided sharing views on menstrual products face to face to take part comfortably. The software used was Online Surveys (OS) (formally Bristol Online Surveys). OS was chosen as it provided a platform that was totally compliant with UK data protection laws [46].

The survey was designed to assess participants' awareness of the environmental impact of various menstrual products, as well as being informative. After being piloted, the survey was distributed online using Facebook, Twitter and LinkedIn. Participants were encouraged to share the survey once completed, to create a snowball effect. The target number of 300 participants was reached within one week, after which the survey was taken offline.

The survey was kept short, taking participants up to 10 minutes to complete. The structure of the survey was designed to first test the respondents' awareness before providing them with an explanation of the correct answers to the questions asked and the opportunity to watch a short, publicly available, and informative video [47]. The questions were designed to be clear and offered the participants the chance to answer 'unsure' to avoid pushing them into giving an answer they were not confident with. It was decided to make the survey accessible to participants of any gender because, if the stigma around periods is to be reduced, then nobody should be excluded from the conversation [48]. As a result, one of the questions—do you menstruate, or have you in the past—was routed, to allow the survey to be tailored slightly to the participant. OS software was used primarily in the analysis of the results and a chi square test, using Microsoft Excel, was used to check whether any correlation in results was statistically significant [49]. The chi-square p -value of $p \leq 0.05$ was used as the level of statistical significance.

2.2. Focus Groups

Two focus groups were used to provide the opportunity for increased qualitative data through more in-depth conversation around the topic and to validate the findings of the questionnaire [50]. Farquhar and Das [51] suggest that focus groups can be useful for sensitive topics to be discussed and explored in a way that does not generally happen in routine conversation. It was hoped that this would provide an opportunity for participants to feel empowered by having the chance to share thoughts, ask questions, and possibly gain additional knowledge about different types of menstrual products and their environmental impact. Participants were recruited using posters in areas commonly used by the local community and on a local Facebook group. The only restriction given for participation was that the participants had not already taken part in the online survey, as this may have affected their responses to the activities. It was decided to make the focus groups single sex, as a mix of sexes may have affected the dynamics of the groups [50]. If enough males had volunteered, a separate focus group would have been arranged, but only females volunteered to participate in the focus groups.

Prompts in the form of various menstrual products were used to aid discussion and assess the knowledge and views of the participants. After making sure that important participant information was understood and allowing the participants to decide whether to consent, the focus groups began with the chance to explore the products and ask any questions about them.

Following a short discussion about each item, the participants were given tasks designed to test their awareness of environmental impact of the products and encourage further discussion around the topic. The focus groups were recorded using audio and visual recording to allow for an accurate transcription of the conversations. Qualitative thematic analysis was used to analyze the transcripts from the focus groups, finding common themes and patterns in conversations [52].

2.3. Possible Sources of Bias and Mitigation Methods

There is the possibility of sampling bias with both the survey and focus groups. The survey was initially shared using the social media accounts of the researcher, and McPherson et al. [53] suggest that members of a close social network are more likely to share similar views. This was mitigated by others sharing the survey, using links between networks to create a snowball effect, and allowing the survey to reach individuals that were unknown to the researcher. As the survey was only shared online, it would have been unavailable to some individuals who do not have internet access or do not use social media. The Office for National Statistics [54] suggests, however, that 89% of the population in the UK have regular access to the internet and 85% own a smartphone [55], so for the majority of individuals in the UK, this would not have been an issue. The adverts for focus groups were only shared locally, for practical reasons, but made use of both physical adverts in areas used by the local community and an electronic version shared on a local social media group.

Non-response bias could also have had an effect, as even if the survey and focus group advert was to reach 100% of the population, some people are more likely to choose to complete it than others. Bias occurs when those who choose to participate share a certain set of values [56], such as an interest in environmental issues for example. To try and mitigate this non-response bias with the online survey, the survey was kept short and simple in the hope that participants would find it easy to complete the questions whilst scrolling through social media. The title 'plastic-free periods' was used as a shorter alternative to the research question to try and gain the attention of potential participants.

This high level of reported awareness could also be as a result of response bias, as respondents may wish to appear more intelligent and aware of the issues. Response bias is a possibility with both surveys and focus groups, as participants can work out the purpose of the study and try to respond accordingly [57]. Leading questions were avoided, and true or false statements were used to assess respondents' awareness of environmental impact after they had self-reported it, to reduce the possibility of this bias. Desirability bias can also occur, as participants may try to avoid revealing any undesirable traits [57]. Participants with a strong awareness of the environmental effects of menstrual products may, for example, claim to use products that they believe have a lower environmental

impact or claim to act in a more ‘environmentally friendly’ manner because they believe that this is more desirable. Complete anonymity was used in the surveys in an attempt to reduce this, but this anonymity was not possible during the focus groups.

3. Results

3.1. Online Surveys

Of the 300 participants, 289 were female. So, although the survey was open to all, the majority of participants were females who all reported that they menstruate or have in the past. This majority was unsurprising, and the fact that 11 males chose to show an interest in the topic could be seen as positive.

There was a broad age range of participants, with most falling into the 21–30 and 31–40 brackets, but with nobody over the age of 70 choosing to take part (Figure 1). This could possibly be due to less people over 70 using social media. The lower numbers of participants over 50 could also be due to the topic being less relevant, as the average age for females to stop having periods in the UK is 51 [58].

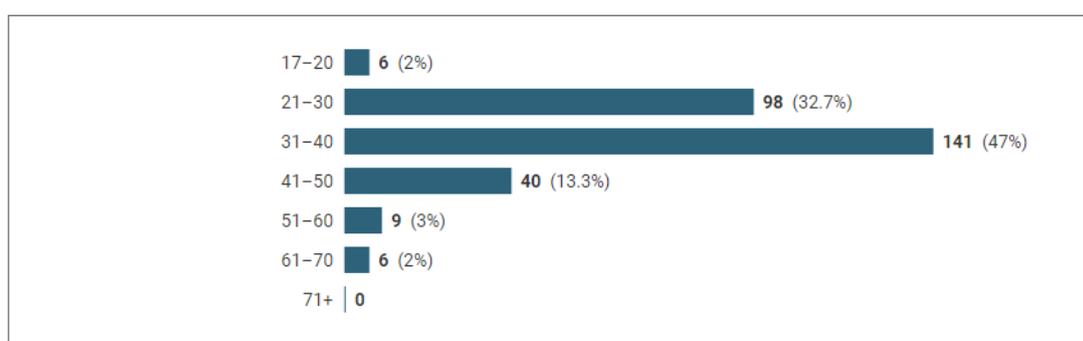


Figure 1. Graph to show age range of participants of the online survey.

3.1.1. Levels of Awareness

When asked to rate their own awareness of the environmental impact of menstrual products, 43.3% reported that they were ‘very aware’ and 42.7% ‘somewhat aware’, leaving just 14% of those participating reporting that they had not previously considered the environmental impact of menstrual products. At face value, this response seems positive, suggesting that participants could be relatively aware of the impact that menstrual products have on the environment. This is, of course, based on self-reported levels of awareness, however, which may not give an accurate rating of the participants’ actual awareness.

Questions related to environmental impact served to test the accuracy of these self-reported levels of awareness. They showed that, for each question, a higher percentage of those who reported a higher level of awareness answered the questions correctly compared to those who reported a low awareness (Tables 2 and 3).

A chi-squared test showed that those who reported a high level of awareness were more likely to correctly answer questions related to environmental impact at a statistically significant level ($p < 0.0001$). This statistical significance was true for questions related to whether tampons should be flushed ($p = 0.0001$), whether biodegradable menstrual products have an environmental impact ($p < 0.0001$), and the lifetime of a menstrual cup ($p < 0.0001$). The chi-squared test showed that the difference in results was not statistically significant for all the questions, as there were some questions in which all groups of participants scored poorly. There was a low awareness of whether cardboard applicators can be recycled ($p = 0.32$), whether organic menstrual products can be composted ($p = 0.63$), and whether organic and non-organic tampons contain plastic ($p = 0.38$). The statistical significance for awareness on the environmental impact of an organic tampon ($p = 0.0549$) was marginal, but rejected on the basis of a 0.05 p -value acceptance criteria.

Table 2. Analysis of response to true/false questions (Q10 of online survey). Those marked with an * are accepted as statistically significant in the chi-squared test with $p \leq 0.05$.

True/False Question	% with Correct Answer		
	High Awareness	Low Awareness	Average of All Participants
It is OK to flush tampons (f)*	89.2%	59.5%	80%
If an item is biodegradable there is no environmental impact (f)*	90.8%	61.9%	81.7%
Non-organic tampons can contain plastic (t)	68.5%	59.5%	68.3%
Disposable non-organic pads have the highest environmental impact because they generally contain the most plastic (t)	70%	64.3%	69.7%
Menstrual cups can last up to 10 years (t)*	80.8%	35.7%	62.7%
Cardboard tampon applicators can be recycled (f)	42.6%	40.5%	38.5%
Organic tampons can be composted (t)	15.4%	11.9%	16%
Manufacturers of menstrual products are not required to list ingredients (t)	55.8%	45.2%	50.2%

Table 3. Analysis of response to whether items contain plastic (Q8 of online survey).

Does the Item Contain Plastic?	% with Correct Answer		
	High Awareness	Low Awareness	Average of All Participants
Disposable non-organic pads	93.8%	64.3%	84.9%
Non-organic tampons	61.4%	52.4%	54.5%
Organic tampon	35.4%	51.2%	38.3%
Reusable cotton pads	69.5%	64.3%	65.9%
Menstrual cup	30.5%	0%	20.3%
Period pants	35.7%	35.7%	32.8%

The analysis reveals that, although those who reported a high level of awareness did indeed have a higher level than those who reported that they were somewhat aware or not aware, the general level of awareness for many of the issues related to environmental impact was low, supporting claims by Borowski [38] that many women do not realize the environmental issues associated with menstrual products.

There were clear ‘unknown unknowns’, even for those who believed their awareness was high; for example, of those who reported a high awareness of environmental impact:

- 39% did not know that non-organic tampons can contain plastic.
- 64% did not know that organic tampons do not contain plastic.
- 85% did not know organic menstrual products can be composted.

61% of participants reported that they were surprised by something they had learnt whilst completing the survey. By far, the most common theme in the responses was a general surprise regarding the amount of plastic present in disposable non-organic menstrual products, particularly pads. One hundred and six participants left responses to an optional open question, stating that they were surprised how much plastic was involved. This was emphasized by a response from a participant of the online survey, suggesting that if people were educated about the reasons for not flushing tampons, as well as being informed of the correct way to dispose of them, the guidance may be more likely to be followed. There is an apparent split between the participants of the online survey: those that were aware that tampons should not be flushed, and those who are surprised to find out that they should not have been flushing them.

One of the areas that showed a low awareness amongst participants of the online surveys was the question of whether cardboard applicators can be recycled. Purchasers of tampons may believe

that they are buying a more environmentally friendly option by choosing a product with a cardboard applicator, which will be recycled or will biodegrade. In the right conditions, they could biodegrade, but these items cannot be recycled as they are contaminated with menstrual blood, and if disposed of in the bin as recommended by manufacturers, they will end up in landfill where conditions are not ideal for biodegradation [26].

Cooper [24] and Moss [23] state that tampons and disposable pads are the most commonly used menstrual product in Western Europe and this pattern continues with the participants of the online survey. Despite being very similar both visually and in their method of use, organic tampons and pads proved to be much less popular than the non-organic counterparts (Figure 2).

Which menstrual product(s) do you most commonly use?

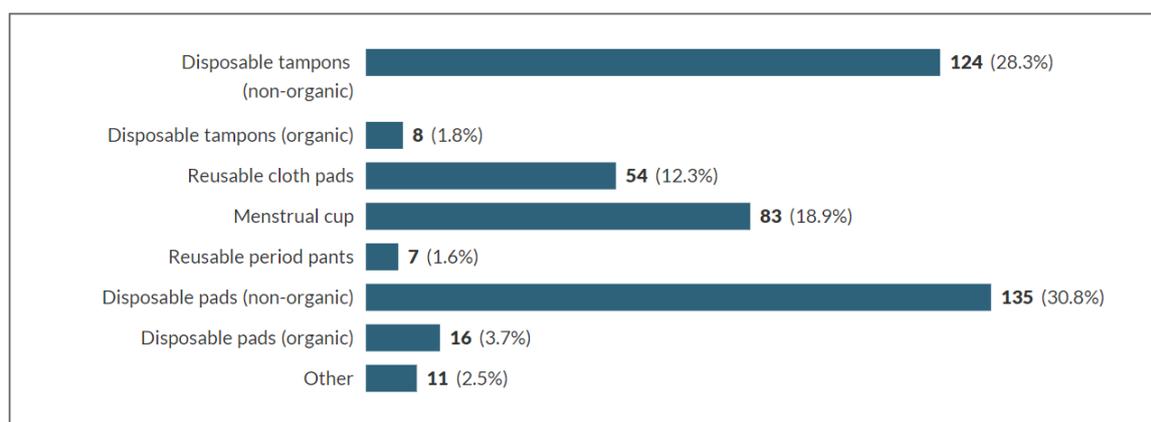


Figure 2. Graph to show menstrual product choice by participants of the online survey.

There are various possible reasons for this lack of popularity in comparison with non-organic disposables, such as cost and availability.

The low level of awareness about whether organic products could be composted was also shown in responses to the online survey. Some participants also chose to express their surprise that these products could be composted in an optional open question within the online survey. Participants' confusion over whether organic products contain plastic, and therefore being unaware that the organic products are biodegradable, may have led to a lack of awareness of the possibility of composting.

Many participants in the online survey made comments conveying their concern that nobody talks about periods and menstrual products.

3.1.2. Link between Awareness and Choice

The second purpose of this research was to find out whether peoples' level of awareness of the environmental impact affects their choice of menstrual product. The chi-square test shows that those who reported a high awareness did indeed have a higher level of awareness than those who labelled themselves 'somewhat aware' or 'not aware' ($p < 0.0001$). This grouping of participants was then used to compare choices of menstrual products. The results can be seen in Figures 3 and 4.

The results show a significant difference in the choice of menstrual product by each group. Research by Mazgaj et al. [14] and Weir [20] suggests that disposable non-organic pads and tampons cause the highest environmental impact and reusable products create a lower impact, with menstrual cups causing the lowest environmental impact.

The clearest difference in products used by the high awareness and low awareness groups is that none of the participants in the low awareness group have reported choosing reusable products, whereas for the high awareness group the menstrual cups and reusable cloth pads are the most popular. Some of the participants in the high awareness group do use products with a high environmental impact such as disposable non-organic pads and non-organic tampons, but it is a much lower percentage

(35.4%) than the average for all participants (59.1%). The most popular choice of menstrual products for participants in the low awareness group were those with the highest environmental impact, namely disposable non-organic pads and non-organic tampons. Ninety-five percent of participants in the low awareness group report using these products.

Which menstrual product(s) do you most commonly use?

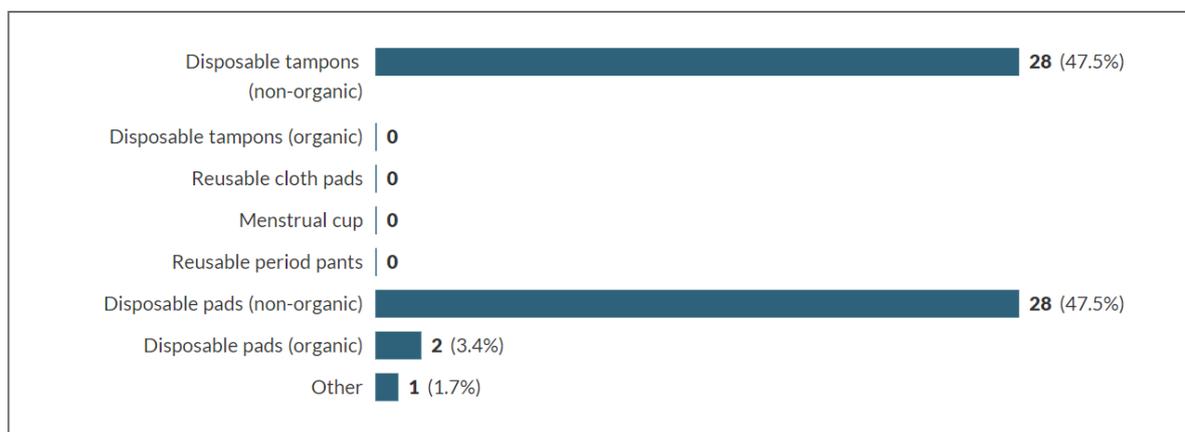


Figure 3. Graph to show menstrual product choices by the low awareness group of participants.

Which menstrual product(s) do you most commonly use?

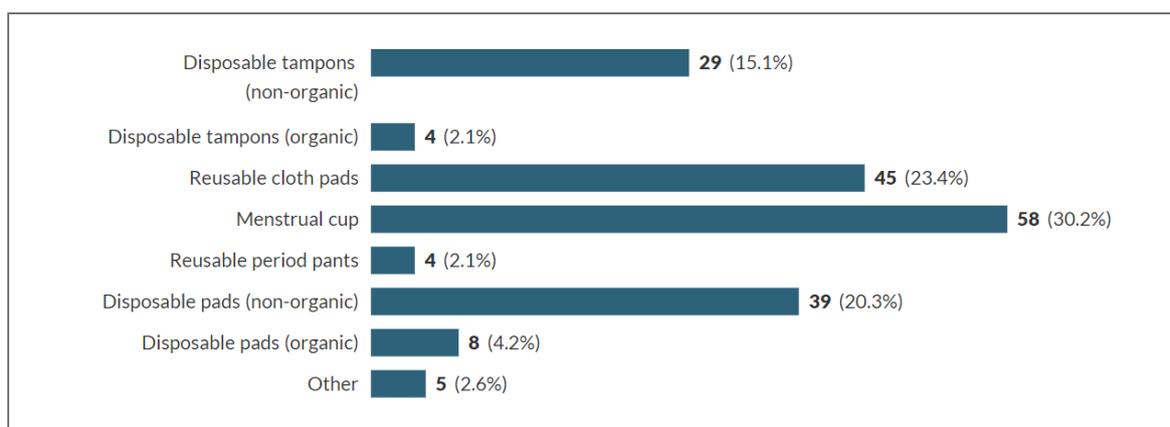


Figure 4. Graph to show menstrual product choices by the high awareness group of participants.

A chi-square test revealed that there was a highly significant difference between the low awareness group, the somewhat aware group, and the high awareness group in their choice of menstrual products ($p < 0.0001$). Therefore, this suggests that peoples' levels of awareness regarding the environmental impact of menstrual products does affect their choice of product. This contradicts claims by Borowski [38] that women are not turning to reusables because of environmental concerns.

Weir [20] notes that there are no studies to suggest that environmental impact is a factor when deciding which menstrual product to purchase, but results from the online survey show that 62% of all participants reported that it is either quite important or very important, rising to 79% of those who rated themselves as 'very aware' of environmental impact. Only 3% of all participants responded that environmental impact was not important when choosing a menstrual product to use or purchase.

If participants' level of awareness regarding environmental impact affects their choice of menstrual product, then the question arises of whether it could be possible to create a change in behavior using education about the environmental impact of these products. This question is beyond the scope of this research, but results from the online survey seem to suggest that this may be possible.

As part of the online survey, participants were asked what they believed should be done to improve the environmental impact of menstrual products. The results can be seen in the graph below (Figure 5).

What do you think should be done (if anything) to reduce the environmental impact of menstrual products?

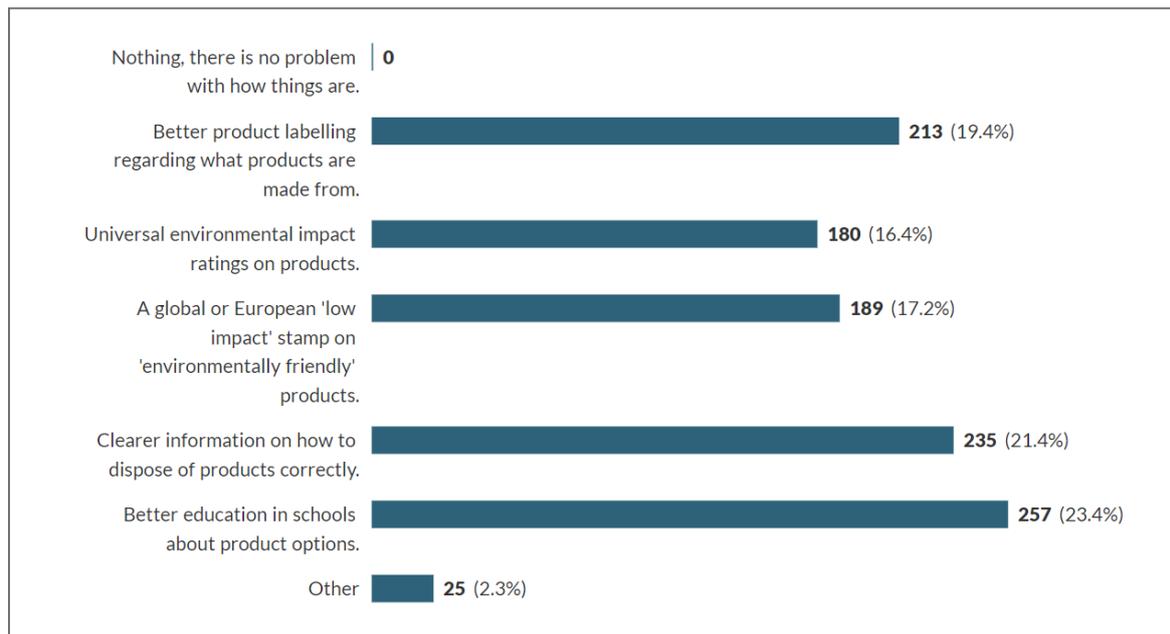


Figure 5. Graph to show response to online survey question regarding steps to improve the environmental impact of menstrual products.

This response suggests that participants believe that doing nothing is a poor choice, as every participant chose at least one of the options which involved action. The most popular choice was that of education. Participants' responses suggested that they believe that better education in schools about product options is important, which supports Friedenfelds [3], who notes that the current education on this topic is inadequate. Participants' responses also suggest that they believe raising awareness within the general population is an important step, not just in schools.

Better information on how to dispose of products properly was the second-most popular answer; closely following this was better labelling on packaging. Seventy-eight percent of the participants of the online survey reported a belief that the information provided on packaging was not adequate to make an informed decision. If buyers and users do not know what ingredients are involved, then it is difficult to consider the impact that the product may have, both in its production and at end of use. Clearly, participants wish to be given more information about the products that they may choose to purchase. This is an issue that has been picked up on by the European Commission [59], with a proposal for better labelling and raised awareness of both proper disposal and environmental impact of menstrual pads.

Despite some concerns surrounding the availability of cheaper disposable products for those on low incomes and the complexity of the social issues entwined into their availability and use, 71% of the participants generally believed that disposable menstrual products should be considered in the same way as other single use plastics.

This response suggests that most participants are open to the idea of change, believing that attitudes to disposable menstrual products containing plastic need to adapt to the changing world that we live in. It is not yet clear what that change may look like, as many participants have commented; it should be down to the manufacturers to provide a suitable alternative that has a smaller impact on our environment.

3.2. Focus Groups

Two focus groups, each consisting of four participants plus the researcher, were used to provide the opportunity for increased qualitative data through more in-depth conversation around the topic and to validate the findings of the online survey. Similar themes to the online survey also showed in the focus group conversations.

Participants in the focus groups were not aware of the use of plastic in non-organic tampons, so they were surprised to see the outer plastic layer peel away from the core. Surprise that tampons contain plastic was also shown in the open questions of the online survey.

With many participants not aware that tampons often contain plastic, it is not surprising that some were also not aware that these items should not be flushed down the toilet. Most participants of the focus groups were aware that tampons should not be flushed, but were not aware of the reasons relating to plastic pollution.

The low awareness amongst participants of the online surveys around whether cardboard applicators can be recycled or whether organic products could be composted was found to also be the case in the focus groups.

There was a general lack of knowledge about organic menstrual products by participants of the focus groups. Some people were not aware that they were available and there was uncertainty about what the term organic meant. Some participants believed that the label 'organic' could still mean that the product contained plastic. It appears that generally people are unclear what makes a product organic.

It seems that people forget about the pollution that is created with constant production of disposable items and this was shown in the focus group conversations. One of the activities used in the focus groups involved participants working together to order the products based on its environmental impact over 10 years. When attempting to order the product from highest to lowest impact, the deciding factor for participants was how much waste there would be at end of use, with no apparent consideration for the resources used or pollution created in the production of the item without prompting from the researcher.

One group considered the energy and water used in washing reusable pads and one did not. Most were aware that the presence of plastic could increase a product's environmental impact. Participants did not mention the use of resources such as cotton, water or oil, the effects of pesticides and fertilizers on soils and water sources during production or the pollution created in the manufacturing of plastics.

Rosewarne [4] speaks of the problems associated with the taboo associated with menstruation in history, and it appears that in some ways it is still prevalent, leading to a lack of knowledge about the alternatives to that of the mainstream disposable market. This was highlighted in the focus groups, as there were admissions by participants that some of these items were totally new to them. A clear example of this taboo was shown in Focus group 2 when one participant found out about menstrual cups for the first time. Her initial reaction was that of disgust, but after having the chance to talk openly about the product and ask questions about it, her disgust turned to intrigue and finally a desire to purchase one.

Spinks [2] suggests that a lack of opportunity to talk about periods prevents people from learning about more sustainable options. The conversation in this focus group is one clear example of how having the opportunity to talk to peers and learn about different options can make a huge difference in people's opinions and why a taboo around the subject prevents this kind of opportunity from happening.

4. Discussion and Conclusions

In answering our research question, this paper shows that there is a wide spectrum of awareness within the general population. There are issues related to the environmental impact of menstrual products that are not widely known about or considered, particularly regarding their production. Even for those who appear to have a higher awareness of this impact, there are some environmental aspects

that people are not aware of. For the general population, this research suggests that there is a lack of awareness particularly regarding the amount of plastic used in non-organic products.

When comparing peoples' awareness of the environmental impact of menstrual products and the products they choose to use or buy, results suggest that there is a link between awareness levels and product choice. Those with a higher awareness are more likely to choose products with a lower environmental impact. In conclusion, we therefore accept our hypothesis that the level of awareness of environmental impact does affect menstrual product choices.

It is clear from participants' responses that they believe education and awareness about the topic could and should be improved. This education could come from school curriculums, but this is not the only possible avenue. Increased awareness could be achieved in many ways, from public awareness campaigns to better labelling on products. Manufacturers are unlikely to be keen on highlighting the levels of plastic waste that their own products create, so changes in labelling are likely to require new legislation, creating forced action. Deloitte [60] suggests that consumers are gaining more power, using the connectivity of the internet and social media in particular to become increasingly informed and mistrusting of big brands. As a result, businesses need to work hard to keep up with customers and providers of commercial products can be affected by public demand.

The results from this study pave the way for further research into raising awareness and behavior change. This research found that, once participants had completed the survey, those who previously reported using products shown to have a high environmental impact were likely to report an intention to change their purchasing habits. A longitudinal study into whether this reported intention actually transforms into a long-term change in behavior was not part of the remit of this study, but could be an interesting piece of further research.

Exploring existing literature clearly highlighted that there is a lack of research into the environmental impacts of different products. Although research has studied the impacts of some products independently, product design has developed since and there no clear comparison of all popular products, which consumers can use to make an informed decision. If a life cycle assessment was completed for a range of the most popular products, including both disposable and reusable products, then this could be used to highlight the impact and may prove invaluable for raising awareness.

This research focused mostly on attitudes and awareness in the UK, with some participants of the online survey reporting that they reside in other areas of Europe. The survey did not ask participants to specify ethnicity or the country in which they were living, so this information was not analyzed, but it highlighted that product availability and awareness may vary depending on these factors. This leads to another possible area of future research, studying whether awareness of environmental impact varies between countries in Europe, or even globally, and whether this affects the products that people use.

If taboos associated with menstruation can be tackled and public attitudes to disposables changed, then perhaps there is chance of reducing the environmental impact that menstrual products have on our world. Clearly, it will not be easy because the social issues are complex and habits ingrained, but if the response from this study is anything to go by, there is certainly a chance of change.

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