# Enhancing Comfort and Absorbency: A Comparative Analysis of Commercial Nursing Pads and Proposal for the Integration of Nanofiber Technology

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**Introduction.** Breastfeeding mothers frequently rely on nursing pads to prevent leaks and maintain hygiene and comfort between nursing sessions. Despite the widespread use of commercial nursing pads, existing literature has highlighted their poor performance, prompting the need for a quantitative evaluation of their functional properties. To bridge this gap, this study evaluates nine commercially available nursing pads and a proposed new nanofiber material for the nursing pad, assessing their functional characteristics, such as the capacity of absorbing liquid. Ultimately, this research aims to provide new insights into the functional properties of nursing pads and evaluate the efficacy of a new alternative.

**Literature Reviews.** Breastmilk leakage is a common challenge faced by nursing mothers and can be attributed to both physical and physiological factors (Morse & Bottorff, 1989). This occurrence often results in unsightly stains on undergarments, clothing, and bedding, leading to embarrassment and inconvenience for nursing mothers. To combat this issue, nursing mothers often opt to wear nursing pads underneath their bras to absorb leaked milk. These pads can be categorized into two types: reusable and disposable. Typically, both reusable and disposable pads consist of three layers – a non-permeable back layer that prevents staining of outer garments, and an absorbent middle layer that retains moisture and breastmilk, and a wicking top layer that draws breastmilk away from the nipple and transfers it into the absorbent layers (Ibrahim, 2011). The primary difference between reusable and disposable pads lies in their materials, with reusable pads being made of fabric and having a serged edge that allows for multiple washes, while disposable pads are made of non-woven fabrics and must be discarded after one single use.

Current nursing pads on the market have several notable disadvantages. Firstly, their bulkiness often makes them visible through clothing. Secondly, the lack of breathability in bulky nursing pads can create moisture on the skin, leading to conditions that promote yeast overgrowth (Zeretzke, 1998; Mannel & Dixon, 2015) and potentially causing nipple or breast thrush. Thirdly, inadequate absorbency is a significant disadvantage of existing nursing pads (Hebert, 1998; Ibrahim, 2011). To address these common discomforts and concerns associated with nursing pads, it is crucial to develop new materials that provide lighter weight, increased absorbency, and better comfort for nursing mothers.

Electrospinning is a method of producing fibrous polymer nonwoven structures with nanosized fiber in diameter. The nanofiber nonwoven fabrics have an exceptionally large surface-to-mass ratio, a high porosity, and a small pore size. The nanosized fiber diameter of electrospun

fibers leads to large specific surface areas which have been shown to provide increased absorbency over other textile fabrics. (Xiang et al., 2007)

**Methods.** For this study, a control group was established consisting of five disposable (D-1, D-2, D-3, D-4, D-5) and four reusable nursing pads (R-1, R-2, R-3, R-4). To select these pads, researchers conducted a thorough search on Amazon.com, identifying the most popular options based on both the value of the global rating and the number of customer reviews. This rigorous selection process ensures that the control group is representative of the pads that nursing mothers are most likely to purchase and use in their day-to-day lives.

Poly (lactic acid) (PLA) nanofiber mats were developed through electrospinning to investigate the feasibility of nanofiber mats in nursing pad applications. Swelling of the nanofiber mats and commercially available nursing pads were measured upon exposure in deionized water for 24 h. The samples were removed from the water and carefully blotted with tissue paper to remove the excess from the surface. The degree of swelling due to the water uptake was determined and weight loss was calculated at the end after drying for 4 h at 70 ºC in an oven. The percentage of degree of swelling was calculated as follows (Çay et al., 2017):

$$\text{Degree of swelling (\%)} = \frac{M - Md}{Md} \text{ x } 100$$

where M was the weight of each nanofiber mat sample upon exposure in distilled water for 24 h, $M_d$ was the weight of the samples after swelling and subsequent drying.

**Results.** Swelling percentages of the PLA nanofiber mats and the control group nursing pads in deionized water for 24h are shown in Figure 1. The average sample weight for disposable nursing pads (D-1, D-2, D-3, D-4, D-5) was 3.08g, 3.97g, 2.39g, 3.74g, and 2.59g respectively. The average sample weight for reusable nursing pads (R-1, R-2, R-3, R-4) was 8.52g, 6.65g, 8.3g, and 8.23g respectively. While the average weight for PLA nanofiber mats was 0.12g. The swelling percentage of disposal nursing pads ranged between 5434% - 9927% due to the materials. The swelling percentage of the reusable nursing pads was between 310% - 562%. While the swelling percentage of the PLA nanofiber mats was 1279%. In consideration of the super light weight, PLA nanofiber mat shows great potential to use as nursing pads for better performance and more comfort.

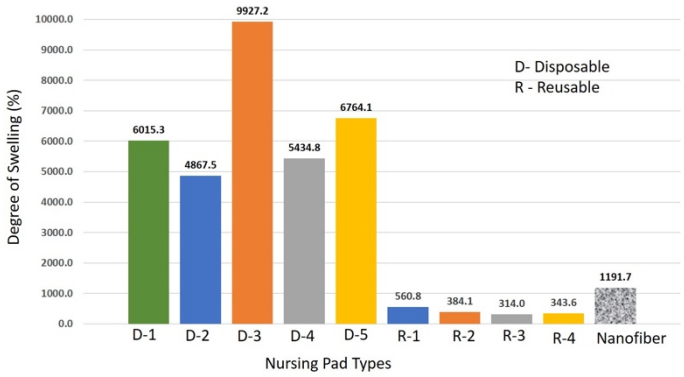


***Figure 1.*** Swelling of PLA nanofibers and control group nursing pads.

**Conclusion and Implications.** This research provides insights into the swelling of nursing pads and evaluates the efficacy of a new alternative. Disposable nursing pads have the greatest capacity for absorbing liquid, while reusable pads have the least capacity for absorbing liquid. As absorbance is essential for preventing leakage, disposable nursing pads function well. However, further development is needed to improve reusable nursing pads, due to their low absorbance. The nanofiber mat had a higher capacity for absorbing liquid than the reusable pads. As such, PLA nanofiber mat shows great potential to use as nursing pads for better performance and more comfort. Future research may address additional functional characteristics, such as wet and dry tests, air permeability, and thickness. The findings on these characteristics will provide further direction on the application of the nanofiber mat to nursing pads.

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