



Web Scraping for Evaluating the Physical and Cognitive Ergonomics of Baby Carrier Products Based on Digital Voice of Customers

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ABSTRACT

This study evaluates baby carriers from the perspectives of physical and cognitive ergonomics using the "digital voice of the customer" approach. Consumer reviews were collected from Tokopedia via web scraping; 287 data entries were cleaned down to 267 valid text reviews. Through text mining, the reviews were normalized and classified using Python-based keyword matching rules (taking into account affixes, typos, and negations) into four categories: physical ergonomics, cognitive ergonomics, physical and cognitive ergonomics, and general feedback. The classification was checked against 60 randomly selected, manually labeled reviews and showed limited agreement (accuracy 68.33%, macro-F1 0.31, Cohen's kappa 0.255), so the results are indicative; the frequency of categories was analyzed using a Pareto chart. A total of 50.19% of the reviews discussed physical ergonomics, 12.36% cognitive ergonomics, 12.36% both, and 25.09% general feedback; overall, 74.91% of the reviews addressed at least one aspect of ergonomics. Among the ergonomics-related reviews, most expressed satisfaction (63.0%) and only 15.5% contained complaints. Of these 31 complaints, 64.52% related to cognitive ergonomics, particularly sizing, while physical complaints mostly concerned the thin fabric. Proposed solutions included a sizing guide based on height and weight equipped with a QR code, as well as thicker fabric that still allows for air circulation.

1. INTRODUCTION

In Indonesia, e-commerce has grown rapidly over the past five years, making it the largest shopping channel in the country. The value of national e-commerce transactions reached Rp487 trillion in 2024, up 7.3% from Rp453.75 trillion in 2023 [1]. with the number of e-commerce users projected to reach 73.06 million by 2025 [2]. This massive use of marketplaces leaves a digital footprint in the form of star ratings, reviews, and consumer comments known as the Digital Voice of the Customer (DVoC). This data emerges naturally, is unstructured, and is continuous, without requiring conventional surveys [3]. Online consumer reviews reveal emotional needs, complaints, and consumer preferences regarding a product on a large scale, while simultaneously generating the real-time voice of the customer in far greater volume than conventional surveys [4]. The use of DVoC derived from online review data is particularly relevant for high-involvement product sectors, such as baby products. In Indonesia, the total fertility rate stands at 2.13 and is relatively stable [5]. Parents' awareness of ergonomics, quality, and safety may further support the growth of the baby products market. The population of young children (ages 0–6) stands at approximately 30.2 million [6], which represents a large potential market for baby products sold through online platforms. Baby products have received little attention in DVoC studies; one such product is the soft structured carrier (SSC), or baby carrier. Baby carriers come into direct contact with the baby's hip position, while also affecting the muscular load and movement of the person carrying the baby [7], [8]. A previous study evaluated the risk of developmental dysplasia of the hip (DDH) by comparing alpha angles in infants using baby carriers and Pavlik harnesses with both wide and narrow bases [9]. Another study showed that the size of the waist

belt on a baby carrier affects the erector spinae and multifidus muscles of the person carrying the baby when the baby is positioned in front [7]. Recent biomechanical studies have also linked carrying methods to the joint health of the person carrying the infant [8]. Research on online product reviews has been conducted [3], however, to the best of the authors' knowledge, no studies on baby products based on online reviews using a text mining approach have been reported. Text mining of reviews has been combined with the Taguchi method for the service sector [4]. Review-based evaluation models have utilized the Kansei approach [10]. And other similar studies have combined review mining with the fuzzy analytic hierarchy process (FAHP) [11]. These studies have focused on automotive products, electronics, and services; to the best of the author's knowledge, none have specifically examined the ergonomic aspects of baby products, whether from a physical or cognitive perspective. Text mining for sentiment analysis of reviews on marketplaces has also evolved, including through the application of N-Gram, Naïve Bayes, and Information Gain methods [12], as well as studies on User-Centered Design in marketplace applications [13].

Existing review-mining studies mostly address other products or services, and some merely discuss positive or negative sentiment. The following research gaps exist: (a) studies on baby carriers from an ergonomic perspective focus only on the physical qualities of the product (biomechanics); (b) studies using text mining techniques on online reviews do not discuss specific products particularly baby carriers and there has been no specific focus on baby carriers from either a physical or cognitive ergonomic perspective, (c) there is no integrated mapping between physical ergonomic aspects (posture, load comfort, muscle pain) and cognitive ergonomic aspects (clarity of usage instructions, ease of adjusting straps). Given these gaps, this study aims to evaluate baby carriers from both physical and cognitive ergonomic perspectives through DVoC analysis using web scraping from Tokopedia and to translate these findings into design recommendations.

Data was collected from the best-selling baby carrier of each of the five top-selling stores on Tokopedia. After the reviews were collected, the steps carried out in this study included text preprocessing and normalization, keyword matching with affix, typo, and negation handling, and rule-based classification of the reviews into ergonomic and cognitive categories, supplemented by a tone flag (complaint, satisfied, or mixed/neutral). This study offers several innovations: first, an effort to integrate ergonomic and cognitive frameworks into baby carrier products based on online reviews, an approach previously applied to other product categories such as automotive and electronic products [3]. The second novelty is that this study bridges small-scale laboratory studies focusing on physical aspects [9], [7] with the processing of consumer review data through a data-driven approach, that can be scaled to larger volumes of online product reviews. Another novelty of this study lies in the provision of recommendations derived from the processing of customer reviews, which can be used to develop more ergonomic baby carriers.

2. RESEARCH METHOD

The research method is described in five parts: (1) research flow and design, (2) data acquisition and scope, (3) text pre-processing and classification procedure, (4) validation of the classification, and (5) Pareto-based priority analysis. The overall research flow (Figure 1) consists of six steps: web scraping, pre-processing, classification, validation, Pareto analysis, and recommendations.

2.1. Research Flow and Design

This study uses a mixed-method approach (quantitative frequency analysis combined with qualitative verbatim analysis) on an e-commerce platform by utilizing User-Generated Content (UGC) in the form of product reviews [3], [4]. Capturing consumer opinions through text mining of reviews can complement conventional questionnaires [14]. The research flow is shown in Figure 1.

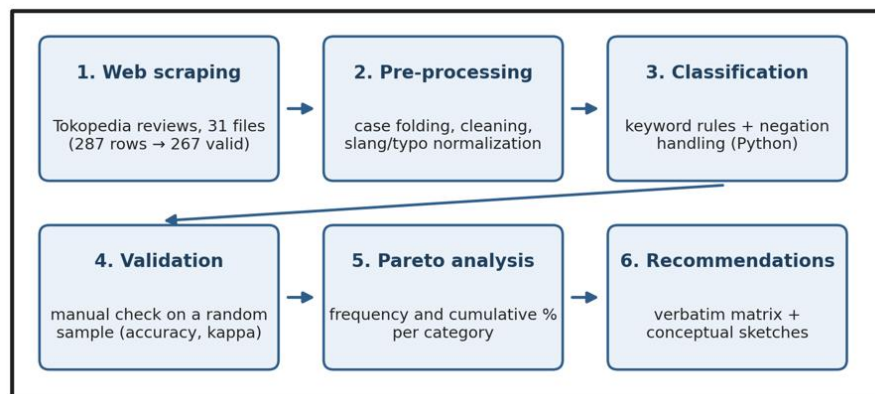


Figure 1. Research flow and design

2.2. *Data Acquisition and Scope*

Review data was collected using web scraping techniques from Tokopedia, one of Indonesia's leading online marketplaces [1]. The products from which data was collected were baby carriers sold by five stores in the baby carrier category on Tokopedia. The author selected these five stores because they had the highest sales figures in this category. Each store sells a variety of baby products, and from each store, the best-selling baby carrier was selected. The stores' names were disguised as Store A, Store B, Store C, Store D, and Store E. Reviews were collected on August 20, 2026, using Data Scraper, a browser extension for web scraping. A total of 31 CSV files were obtained and then combined into a single table consisting of 287 rows.

Fourteen entries that did not include the reviewer's name or free-text comments (consisting only of ratings or incomplete data), as well as six exact duplicates (with the same reviewer, text, date, and variant), were removed, leaving 267 valid reviews. These reviews were posted ranging from a few days to more than a year before data collection began. This dataset does not record information about the store or product for each review, so the analysis results are not broken down by store. Only publicly available review text was analyzed; reviewer names were used solely to identify incomplete entries and duplicates and are not reported in this paper.

2.3. *Text Pre-Processing and Classification Procedure*

The procedure for text mining and classifying customer reviews uses keyword matching implemented in Python [15]. The analysis was run with Python 3.13 in Google Colab, using the pandas library for data handling, the standard difflib module for approximate string matching, and scikit-learn for the validation metrics. The keyword lists are given in Table 1, and the matching parameters were a similarity threshold of 0.85 for approximate matching and a negation window of three words. The slang dictionary and the script are available from the authors upon request. The processing stages are as follows:

- a. Data integration and cleaning: The retrieved files were merged; only rows containing the reviewer's name and free-text comments were retained, and exact duplicates were removed (Section 2.2).
- b. Text preprocessing: Sentences are converted to lowercase, and special characters are removed. Instructions on the Tokopedia review form (Material "(Bahan)", Design "(Desain)", Durability "(Durabilitas)") are removed because they are not the reviewer's own words. Slang, abbreviations, and elongated letters are normalized with a dictionary.
- c. Ergonomic logic classification: The words under review are matched against two lists of key terms derived from the field definitions in Table 1. A word is considered a match for a key term if it is identical to that key term or identical to that key term with a common Indonesian affix. (e.g., the material "(bahannya)" , installed "(dipasang)", too big "(kebesaran)"); misspelled words are matched by approximate string matching (similarity ≥ 0.85), so that typographical errors are not missed and keywords inside unrelated words are not matched.
- d. Keyword refinement: a first version of the list contained generic words "(pakai, pake, tali, sendiri, posisi, buku, setting, jelas)" that occur in almost every review (e.g., "enak dipakai", comfortable to wear) and do not indicate a cognitive issue. They were removed after inspecting the matches, and size-related words (ukuran, size, kebesaran, kekecilan, kegedean, kepanjangan) were added because sizing was a recurring topic.
- e. Negation handling and tone: negation markers (e.g., tidak, nggak, gak, bukan, tanpa, belum) within a window of three words before a keyword are detected. The four categories describe the ergonomic topic of a review, so a negated keyword (e.g., "tidak pegal", not sore) keeps the review in the same category. In addition, each ergonomics-related review receives a tone flag: complaint (a keyword with a negative meaning such as susah, tipis, or kebesaran, or a negated positive word such as "tidak nyaman"), satisfied (a positive keyword, or a negated negative word), or mixed/neutral.
- f. Categorization: (a) Physical and Cognitive Ergonomics, if at least one physical and one cognitive keyword are present; (b) Physical Ergonomics, if only physical keywords are present; (c) Cognitive Ergonomics, if only cognitive keywords are present; and (d) General Feedback, if neither list is matched.
- g. Data storage: the classification results are stored in files, and the frequencies are calculated for the Pareto diagram.

Table 1. Keyword categorization of ergonomic domains (Indonesian keywords, with English glosses).

Ergonomic domain	Theoretical definition	Evaluation parameters	Keywords used (English gloss)
Physical ergonomics	Concerned with human anatomical, anthropometric, physiological, and biomechanical characteristics as they relate to physical activity [16].	Carrying comfort, thermal comfort, material feel, pressure on the shoulders and back.	pegal/pegel (sore), sakit (pain), nyeri (ache), encok, kemeng, bahu, pundak (shoulder), pinggang (waist), punggung (back), berat (heavy), ringan (light), panas (hot), gerah (stuffy), adem (cool), sesak (tight), longgar (loose), busa (foam), paha (thigh), mshape/shape, tebal (thick), tipis (thin), empuk (soft/padded), kain (fabric), bahan (material), nyaman (comfortable), enak (pleasant), lembut (soft), halus (smooth), ergonomis (ergonomic)
Cognitive ergonomics	Concerned with mental processes, such as perception, memory, reasoning, and motor response, as they affect interactions among humans and other elements of a system [16].	Ease of use, clarity of instructions, size selection.	susah/sulit (difficult), bingung (confused), kaku (stiff), ribet/rumit (complicated), buckle, bakel, ceklik/cetklik (click), klip, petunjuk/instruksi/manual/tutorial (instructions), pasang (attach), setel (adjust), mudah/gampang/praktis (easy), paham (understand); size selection: ukuran, size, kebesaran (too big), kekecilan (too small), kegedean, kepanjangan (too long), kependekan, kesempitan, sempit (narrow)
Physical and cognitive	Operational definition of this study: a review that contains both physical and cognitive keywords, indicating that comfort and a usability or sizing issue are discussed together.	Comfort related to size choice or instructions.	At least one keyword from each list in the same review.

Terms related to size selection are classified under the cognitive domain because they reflect caregivers' judgments when determining size based on available information; these terms can also be viewed as anthropometric (physical) aspects, which are discussed in Section 3.4.

2.4. Validation of the Classification

Keyword matching can lead to misclassification in texts containing negation, spelling errors, or ambiguous words. To assess this risk, a random sample of 60 reviews was manually labeled by two coders using the definitions listed in Table 1, and disagreements were resolved through discussion. The automatic classification was then compared with the consensus manual labels using accuracy, the macro-averaged F1-score, and Cohen's kappa (agreement between the automatic classification and the manual labels). Misclassified reviews were examined to update the normalization dictionary and keyword list, after which the classification was rerun on the entire dataset and the metrics were calculated on the 60-review sample using this updated version. The final results were: 68.33% accuracy, a macro-F1 score of 0.31, and Cohen's kappa of 0.255, which indicates only fair agreement and weak performance for the smaller categories. Because the same sample was used to refine the rules, these metrics are likely optimistic and describe agreement on this sample only; the category frequencies reported in Section 3 should therefore be read as indicative rather than precise estimates. Validation on a new, independent sample is needed to confirm the accuracy of the rules.

2.5. Priority Analysis Method

The Pareto principle was applied to the distribution of classification results to identify the categories that contributed most to the content of the reviews [17]. The cumulative percentage was calculated as

$$P_k = \sum_{i=1}^k \left(\frac{f_i}{N} \right) \times 100\%$$

where f_i is the frequency of reviews in the i -th category (sorted from highest to lowest), and N is the total number of valid reviews ($N = 267$), and P_k is the cumulative percentage.

3. RESULT AND DISCUSSION

This chapter consists of four subsections: issues encountered in processing the reviews, quantitative distribution of ergonomic categories, qualitative analysis along with redesign recommendations, and research limitations.

3.1. Problems in Processing the Reviews

Consumer reviews, which are processed as user-generated content (UGC), present significant challenges due to the high variability and uncertainty in text format, including disruptions such as abbreviations and typos. To address this, a preprocessing step using Python was implemented: all review attributes were converted to lowercase, cleaned of non-alphanumeric characters, normalized to remove slang and spelling errors, and then combined into a single text string to be processed by the algorithm.

The next challenge involves overlapping categories, where consumers express concerns regarding both physical and cognitive aspects in the same review. This issue was resolved through rule-based categorization that includes a combined category titled “Physical and Cognitive Ergonomics,” thereby preventing bias resulting from the use of a single reference. Another challenge relates to the use of negations and positive statements; for example, reviews stating that a baby carrier does not cause pain such reviews still address physical ergonomics but do not constitute a complaint which were then handled through negation rules as described in Section 2.3. To complement the quantitative frequency results, a Pareto chart and a verbatim analysis matrix were used to map specific reviews to the product’s technical components.

3.2. Quantitative Distribution of Ergonomic Categories

Four categories were identified from 267 valid reviews. The Pareto chart in Figure 2 and the values in Table 2 show their distribution and cumulative percentages.

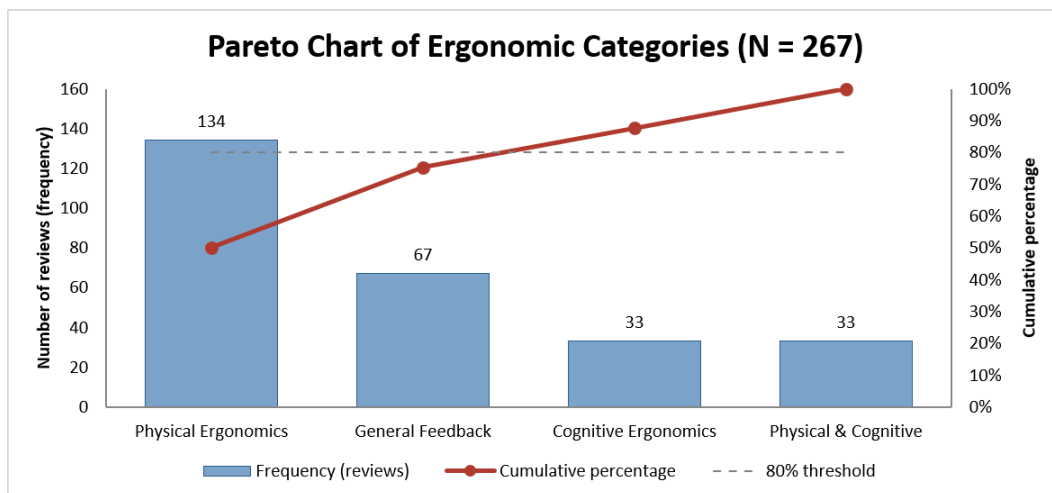


Figure 2. Pareto chart of the ergonomic category distribution of SSC baby carrier reviews ($N = 267$).

Table 2. Pareto distribution of ergonomic categories ($N = 267$ valid reviews).

Ergonomic category	Frequency (reviews)	Percentage (%)	Cumulative percentage (%)	Pareto qualification
Physical Ergonomics	134	50.19	50.19	Vital few (top priority)
General Feedback	67	25.09	75.28	Contains no ergonomic keyword
Cognitive Ergonomics	33	12.36	87.64	Passes the 80% threshold
Physical & Cognitive	33	12.36	100.00	Supporting factor
Total	267	100.00		

Physical Ergonomics and General Feedback combined reached 75.28%, slightly below the 80% threshold according to the Pareto principle; that threshold was only exceeded when Cognitive Ergonomics was included (87.64%). Since General Feedback consists of reviews that contain none of the ergonomic keywords in Table 1, this category cannot be analyzed further. If General Feedback is excluded, the 200 ergonomics-related reviews are distributed as follows: physical ergonomics only 67.0%, cognitive ergonomics only 16.5%, and both domains 16.5%, so physical ergonomics plus cognitive ergonomics reach 83.5% and pass the 80% threshold. When counting all reviews that mention at least one aspect of ergonomics, 200 out of 267 reviews (74.91%) relate to ergonomics: 167 reviews (62.55%) mention physical aspects and 66 reviews (24.72%) mention cognitive aspects, including 33 reviews that mention both.

Because the Pareto analysis categorizes reviews by topic, reviews expressing satisfaction were also included. Of the 200 reviews related to ergonomics, 126 reviews (63.0%) expressed satisfaction, 31 reviews (15.5%) were complaints, and 43 reviews (21.5%) were mixed or neutral. If the analysis is limited to only those 31 complaints, the rankings change: 20 complaints (64.52%) relate to cognitive ergonomics, 6 complaints (19.35%) cover both domains, and 5 complaints (16.13%) relate only to physical ergonomics. Complaints regarding physical aspects mostly highlighted thin materials, while the foam padding on the shoulder area actually received positive feedback. Thus, ergonomics topics dominated the reviews mostly in the form of satisfaction with the materials while issues requiring follow-up focused more on selecting the correct size. Tone flags were assigned automatically based on specific rules and were not separately validated against manual labeling; given that there were only 31 reviews classified as complaints, the specific distribution of these complaints should be understood as an indication only. In addition, size-related keywords were added to the cognitive list after inspecting the data (Section 2.3) and are themselves negative in tone (e.g., *kebesaran*, “too big”), so the prominence of sizing among the complaints partly reflects how the keyword list was constructed. If the six complaints that involve both domains are included, 26 of the 31 complaints (83.87%) involve a cognitive aspect.

3.3. Qualitative Analysis and Proposed Product Redesign

The original (unfiltered) reviews were qualitatively linked to the product’s physical components to provide an in-depth understanding of the issues within each category. The analysis and redesign proposals are presented in Table 3, while conceptual sketches of these redesign proposals are shown in Figure 3. The original reviews were translated from Indonesian; the original terms are indicated in *italics*. These sketches illustrate the design direction; they do not specify dimensions or materials, which require anthropometric data and prototype testing.

Table 3. Matrix of verbatim review findings and redesign recommendations.

Ergonomic category	Consumer pain point	Sample verbatim reviews	Related component	Recommended redesign (sketch)
Physical	Fabric perceived as too thin, and thickness different from a previous order. Padded shoulders are praised.	“The fabric is thin, not the same as my first order, which was thick.” (<i>Kain nya ko tipis ,, gk sama kaya pertama aku pesan tebal</i>)	Fabric panels, shoulder padding	Use a denser breathable fabric with a controlled specification between batches; keep the padded shoulder foam. (Fig. 3a)
		“The shoulder support is soft, so it does not hurt even when worn for a long time.” (<i>penyangga pundak empuk jdi gk sakit walu lama dipakai</i>)		
Cognitive	Wrong size chosen (too big, too small, or too long)	“First I bought size L, too big. Then I bought M, still the same.” (<i>Pertama beli yg uk L kebesaran.. Lanjut beli yg M. Ehhh.... Masih aja</i>)	Size information	Print a height/weight-based size matrix on the product listing and label, with a QR code to the size guide. (Fig. 3b)
		“The carrier is too long, so it slips; it had to be sewn shorter.” (<i>gendongannya kepanjangan jadi melorot harus dijahit dipendekin lagi</i>)		

Physical and cognitive

Size does not fit even after following the instructions, so the carrier is uncomfortable.

“Way too loose; disappointed even though I followed the instructions in the description, so it is uncomfortable to use.”

(Kelonggaran bgt kecewa pdhl udah ikut intruksi di deskripsi jadi ga nyaman dipake nya)

“The material is good, but even though I followed the instructions it was still too big.” *(Bahannya bagus, tapi sayang aku udah ikut intruksi tetap aja kebesaran)*

Size guide and instructions

Validate the size guide against caregiver body measurements and print the instructions on the size label. (Fig. 3b)

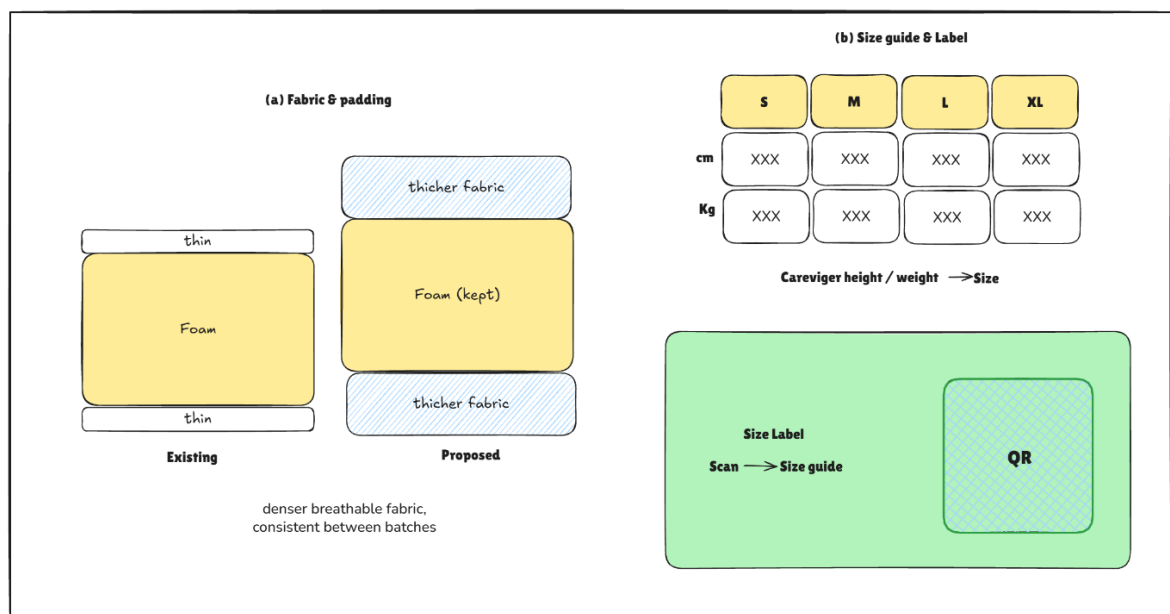


Figure 3. Conceptual sketches of the recommended redesign: (a) fabric and padding; (b) size guide and label (XXX = value to be determined by each manufacturer's product dimensions).

The qualitative synthesis in Table 3 shows that reviewers were generally satisfied with the soft material, good air circulation, and shoulder padding. Conversely, the issues that arose were more related to cognitive aspects specifically, selecting the right size based on the available information which could ultimately lead to physical discomfort. Therefore, the redesign of baby carriers should focus on the presentation of sizing information and the use of more consistent fabric types. The values marked “XXX” in Figure 3b are intentionally left unspecified: the actual height and weight ranges (e.g., in cm and kg) for each size depend on the dimensions of the carrier set by each manufacturer, and should be determined from the manufacturer's product specifications and caregiver anthropometric data.

3.4. Limitations

This study has several limitations. First, the dataset consists of 267 valid reviews from a single marketplace (Tokopedia) covering the best-selling baby carrier from each of the five highest-selling stores, so the resulting percentages reflect only this dataset and may differ when applied to other platforms or products; a larger dataset covering various platforms is needed to confirm these priorities. Since the selection of stores and products was based on sales volume, the existing reviews reflect products from popular sellers and may differ from reviews for smaller-scale sellers or less popular products. Second, keyword matching is rule-based; although normalization, approximate matching, and negation handling have been implemented to reduce errors, this method cannot fully account for sarcasm, ambiguous words, or context spread across multiple sentences. Furthermore, its agreement with the manual labels was limited (accuracy 68.33%, macro-F1 0.31, kappa 0.255), and it was tested only on a subset of 60 reviews that was also used to refine the rules (Section 2.4). The keyword list was also refined after reviewing the data (Section 2.3), which may have caused the analysis results to be biased toward this dataset; in particular, the prominence of sizing among complaints partly reflects

the size-related keywords added during refinement. Third, the Pareto analysis counts reviews by topic including reviews from satisfied users so this analysis shows what consumers are discussing, not just what they are complaining about. The tone flags used to categorize complaints are also automated, with a relatively small number of complaints (31) serving as the basis for analysis. Fourth, the selection of measurements falls within the cognitive domain because it depends on caregivers' assessment of the available information; however, this can also be viewed as an anthropometric issue, meaning it relates to physical aspects. Fifth, the recommendations and redesign sketches are derived from the content of the review and are conceptual in nature; the design has not yet been tested through prototyping, anthropometric measurements, or user testing.

4. CONCLUSION

This study aligns with the objectives outlined in the introduction. A Python-based approach combined with text mining classified 267 valid consumer reviews from Tokopedia into four ergonomic categories using transparent rules; this classification was then checked against manual labels and showed limited agreement (68.33% accuracy, kappa value of 0.255), so the results should be regarded as indicative. A Pareto analysis showed that 74.91% of the reviews mentioned at least one ergonomic aspect most of which were physical in nature (50.19% were solely physical aspects) primarily involving satisfaction with soft materials, good air circulation, and shoulder padding. Complaints were fewer in number (15.5% of ergonomics-related reviews) and focused on cognitive aspects, primarily regarding the selection of the correct size (64.52% of these 31 complaints, indicative only), while physical complaints related to thin fabric. The "General Feedback" category (25.09%) did not contain any ergonomic keywords and is not an actionable category. Therefore, the redesign recommendations include improving sizing information and using a denser fabric that still provides good and consistent airflow, while retaining the foam padding on the shoulders, as illustrated in Figure 3. Prospects for further research and development:

- a. Advanced machine learning: Future research could integrate NLP models such as BERT (for example, IndoBERT for Indonesian-language text) to classify consumer sentiment and ergonomics-related topics on a larger scale and across various marketplaces.
- b. Integration of design methodologies: The mapping results can be carried forward to the Quality Function Deployment (QFD) stage and combined with direct experimental testing of biomechanical aspects (electromyography/EMG) to measure reductions in physiological load following product redesign.

REFERENCES

- [1] Muhamad N, "E-commerce yang sering diakses masyarakat Indonesia pada 2025," GoodStat. Accessed: Aug. 24, 2026. [Online]. Available: <https://databoks.katadata.co.id/infografik/2025/08/19/e-commerce-yang-sering-diakses-masyarakat-indonesia-pada-2025>
- [2] Ahdiat A, "Proyeksi pertumbuhan pengguna e-commerce di indonesia 2020-2025," GoodStat. Accessed: Aug. 24, 2026. [Online]. Available: <https://databoks.katadata.co.id/teknologi-telekomunikasi/statistik/67dba21b67867/proyeksi-pertumbuhan-pengguna-e-commerce-di-indonesia-2020-2025>
- [3] Z. Liu, J. Wu, Q. Chen, and T. Hu, "An improved Kansei engineering method based on the mining of online product reviews," *Alexandria Engineering Journal*, vol. 65, pp. 797–808, Feb. 2023, doi: 10.1016/j.aej.2022.09.044.
- [4] M. Hartono, D. N. Prayogo, I. M. Ronyastra, and A. Baredwan, "Kansei engineering with online review mining methodology for robust service design," *Theor. Issues Ergon. Sci.*, vol. 25, no. 4, pp. 495–520, Jul. 2024, doi: 10.1080/1463922X.2023.2261995.
- [5] Badan Pusat Statistik, "SUPAS 2025: the total fertility rate (TFR) is 2.13, the infant mortality rate (IMR) is 14.12, and the percentage of older persons has reached 11.97 percent," Badan Pusat Statistik. Accessed: Aug. 24, 2026. [Online]. Available: <https://bps.go.id/en/pressrelease/2026/05/05/2645/supas-2025--the-total-fertility-rate--tfr--is-2-13---the-infant-mortality-rate--imr--is-14-12--an..>
- [6] Anisah L, "Anak indonesia dalam statistik," Badan Pusat Statistik. Accessed: Aug. 24, 2026. [Online]. Available: <https://semarangkota.bps.go.id/id/news/2024/07/22/198/-opini--anak-indonesia-dalam-statistik.html>
- [7] C. P. Ojukwu *et al.*, "Can infant carrier hip belts of 2-inch, 4-inch, and 6-inch dimensions influence trunk muscle activities during front infant carrying tasks?," *Bulletin of Faculty of Physical Therapy*, vol. 28, no. 1, p. 18, May 2023, doi: 10.1186/s43161-023-00130-1.
- [8] S. Pehlivan, M. Tanriverdi, H. Argunsah, and T. Uygur Şahin, "Infant-carrying methods and their biomechanical influence on maternal gait patterns and joint mechanics," *J. Back Musculoskelet. Rehabil.*, vol. 38, no. 5, pp. 1004–1011, Sep. 2025, doi: 10.1177/10538127251321771.
- [9] S. Siddicky, J. Eckels, B. Rabenhorst, and E. Mannen, "Ultrasonographic evaluation of infant hips in the Pavlik harness compared to body-worn commercial baby carriers," *Journal of Orthopaedic Research*, vol. 41, no. 11, pp. 2495–2500, Nov. 2023, doi: 10.1002/jor.25571.
- [10] Z. Ren, F. Guo, M. Hu, Q. Qu, and F. Li, "A consumer-oriented kansei evaluation model through online product reviews," *Journal of Intelligent & Fuzzy Systems*, vol. 45, no. 6, pp. 10997–11012, Dec. 2023, doi: 10.3233/JIFS-230654.

- [11] Y. Du, M. Zhang, M. Cai, and K. Park, "Construction of Product Appearance Kansei Evaluation Model Based on Online Reviews and FAHP: A Case Study of Household Portable Air Conditioners," *Sustainability*, vol. 16, no. 8, p. 3132, Apr. 2024, doi: 10.3390/su16083132.
- [12] A. Sunjaya, N. Wijaya, N. P. Wong, and S. Winardi, "Implementation of Sentiment Analysis of Shopee E-Commerce Reviews using Naïve Bayes, N-Gram, and Information Gain," in *2023 Eighth International Conference on Informatics and Computing (ICIC)*, IEEE, Dec. 2023, pp. 1–6. doi: 10.1109/ICIC60109.2023.10381959.
- [13] R. A. Sihombing, N. A. Rumapea, J. C. Tarigan, F. Pandi, and F. M. Sinaga, "Evaluasi Usability Aplikasi Shopee pada Proses Pembelian Online Dengan Metode User Centered Design," *Jurnal SIFO Mikroskil*, vol. 24, no. 2, pp. 81–94, Oct. 2023, doi: 10.55601/jsm.v24i2.1023.
- [14] H. Yu and Y. Li, "Mining Customer Satisfaction from Online Reviews: An Explainable Kano-Based Framework for Product Improvement," *Systems*, vol. 14, no. 5, p. 585, May 2026, doi: 10.3390/systems14050585.
- [15] R. S. T. Lee, *Natural Language Processing*. Singapore: Springer Nature Singapore, 2024. doi: 10.1007/978-981-99-1999-4.
- [16] Robert Bridger, *Introduction to Human Factors and Ergonomics, Fourth Edition*, 4th Edition. CRC Press, 2017. doi: 10.1201/9781351228442.
- [17] H. B. Harvey and S. T. Sotardi, "The Pareto Principle," *Journal of the American College of Radiology*, vol. 15, no. 6, p. 931, Jun. 2018, doi: 10.1016/j.jacr.2018.02.026.