

A meta-analysis of Nanostores: A 10-year assessment.

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Abstract– *The effect of nanostores, i.e., small traditional, disorganized retailing, composed of millions of independent family-owned businesses, on consumer-packaged goods (CPG), has been studied in the existing literature, but results remain mixed. Therefore, it is important to provide a meta-analysis to investigate this relationship. In this study, 6 empirical journal articles published over the past 11 years have been reviewed and evaluated through a meta-analysis. The results reveal that nanostores are positively related to CPG. This study provides the first publication of meta-analysis on this relationship, which will contribute to the knowledge of practitioners and researchers to solve engineering problems and improve performance in nanostores and CPG, as well as to contrast nanostores to alternative retailing that are more modern and organized, such as convenience stores and supermarkets. This area of knowledge is new, so it is key to select, evaluate and statistically synthesize the available evidence, by also achieving significant methodological value applied to nanostores, where no similar publication exists to date.*

Keywords– *Nanostore, Meta-analysis, Consumer-packaged goods (CPG)*

I. INTRODUCTION

Scientists rely more on empirical studies about nanostores rather than considering government statistics, since there is a myriad of difficult problems in their operations,[1]. There are also challenges associated with reliable designs and technology, which further complicates the environment of nanostores. This is because research on their characteristics shows uncertain and varied behavior, for their imprecise and multifaceted nature that mostly benefits modern retailers[2]. Modern channel stores (MCS) like Walmart, are grocery retailers that rely on high volumes and quick stock turnover to reach the economies of scale, like supermarkets and wholesalers. The chain convenience stores (CCS), such as 7 Eleven or OXXO, or other traditional stores, are small, but modern retailers that stock a range of everyday items such as groceries, snack foods, candy, toiletries, soft drinks, tobacco products, magazines, and newspapers[3].

Some of the characteristics of the traditional Channel Nanostore is a single store, sells by unit of consumption and

provides credit based on proximity to customers, while the Modern Channel Supermarket has dispersed professionals, distribution centers, provides formal credit, and accepts bank transfers[4]. On the other hand, non-traditional retail channels (e.g., pharmacies, convenience stores and franchised mini markets) show much more homogeneity.

High throughput operations in a context of e-commerce disruption with Information and Communications Technology (ICT) based innovations can help to evaluate available options with respect to a successful outcome of nanostores[5]. High performance (HP) offers the necessary tools for CPG distribution to make quick and in most cases better decisions to improve the quality of their performance and reduce risks in integrating their chains with nanostores. Numerous researchers have analyzed the performance and structure of HP especially to business[6]. as the main concern of this study. To elaborate, a single nanostore typically serves less than one hundred households within its neighborhood as its core client base. Hence, a shopkeeper has intimate knowledge about each of its core customers and can influence their customers' product and brand choices. This kind of business environment is significantly different from the modern retail channel, where product and brand choices are influenced by formal mechanisms such as store merchandising and online/offline advertising [7]

Knowledge of the limits of a customer's spending (budget constraints) helps managers avoid overspending on customers who have a low ceiling and underspending on customers who have a high ceiling. In the CPG setting, consumers tend to purchase assortments of products/brands in a shopping trip, thus leading to the multiple discreteness problem [8]. The purchase motives of nanostore consumers consist of product attributes, self-orientation, and service guarantees. These three dimensions of purchase motives can be used by nanostore entrepreneurs as a strategy to attract consumers[9]. Despite the growing devotion of academics and practitioners, the research field around Nanostore remains fragmented and irregular[10]. This fact becomes apparent when we think about the various perspectives from which the topic is approached. These can border from being important part of CPG distributors' revenues, the underestimation of the market dominance of nanostores, or contradictory evidence that on the one hand present arguments

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that can lead to the demise of nanostores, or on the other hand, show advantages for competitive nanostores. Hence, one of the key concepts within CPG distribution is the Nanostore, also referred to as small store, or convenience store ("bodega", "colmado", "warehouse", "kiosko" or "lojinha [7], since it represents a future state of a fully connected distribution system in smart supply chain and e-commerce channels, through continuous technology investments and disruptive business models. Similarly, smart cities and big data by themselves have limited ability to improve Supply Chain Management (SCM) processes, but when combined, they can support improvement initiatives. However, smart cities and big data can also pose some novel obstacles to effective SCM [11]. Moreover, it is consistent that such a concept can be approached by modifying focal points and therefore cannot be covered by a single stream of research. In recent years, some scholars have successfully attempted and presented approaches as well as HP methods and techniques for CPG on nanostores[12]). However, there are still very few High-Performance CPG studies. comparing the nanostore with modern, organized small retail channels. Thus, there is not only an absence of review of research conducted in the area, but also a high demand for a comprehensive review study, combining available small retail channels and current studies. Therefore, one gap points to the need for advancing research in the Nanostore field, explicitly claiming the need to condense and structure the emerging knowledge, not only broaden the research.

Besides, although the literature has covered some perspectives regarding nanostores, there seems to be a lack of comprehensive consideration of the impact of nanostores from a technical and managerial perspective, as well as holistic analysis of the CPG chain. Therefore, the authors seek to fill

this gap by conducting a meta-analysis, attempting to answer the following three research questions:

(1) RQ1. How advanced is the research on the concept of nanostore? (2) RQ2. How can the various perspectives of nanostores be grouped with respect to their CPG context? (3) RQ3. What research needs to be done?

Based on those questions, two objectives are formulated: (1) To provide a comprehensive overview of this research topic, describing current progress; and (2) to relate advances in this research field to promising avenues for nanostores, seeking to provide a basis for future research.

The rest of the meta-analysis of the literature is structured as follows. Next, we explain the background of the research, indicating how we proceeded to find and analyze the literature in detail, before presenting the literature investigated by meta-analysis. Subsequently, we elaborate the findings, discussing their significance for academia and professionals, ending with the conclusions, limitations, and strengths of nanostores.

II. FRAMEWORK AND PROPOSITION

This section reviews the application of Nanostores and non-traditional or modern channels in the CPG retail industry. Since 2010 and up to the date of this research, there are more than 53 academic research articles in the field of CPG retail industry, which are indexed in Elsevier, DSpace@MIT, research.tue.nl, repositorio.tec.mx, IJABO. The distribution of articles published in the area considered, according to Journal and the distribution of articles by Journals, on the use of Nanostore-based models in CPG retail industry, is tabulated in Table I.

TABLE I
DISTRIBUTION OF ARTICLES BY JOURNALS ON CPG RETAIL INDUSTRY

Title	Publisher	Title	%	2010	2014	2016	2020	2021	Cite per year	%
Last-mile transport of fragmented deliveries: delivery preferences of nanostore owners	Elsevier	2	33.33	X			X		0	0
Small versus large retail stores in an emerging market-México									5.73	89.53
Segmentation strategies in urban retail: an application to nanostores in Bogotá	dspace.mit.edu	1	16.66		X				0.17	2.66
Replenishing nanostores in megacities for a consumer-packaged goods company	research.tue.nl	1	16.66			X			0.5	7.81
The evolution of the grocery retail landscape in a megacity in emerging markets. The case of Mexico City.	repsonatorio.tec.mx	1	16.66				X		0	0
Analysis of Nano Store Consumer Behavior During the Covid-19 Pandemic (Case Study of Nanostores Consumers in Kabupaten Subang, Indonesia.	IJABO	1	16.6					X	0	0
Total	Total	6	100	1	1	1	2	1	6.4	100

In this regard, when the search is narrowed down to the application of traditional and organized nanostores and small retailers in the subject, only 6 articles remained, from an extremely limited number of Journals. Table 1 also shows the subject of Nanostore application in the field of CPG retail industry, by both: (1) total publications per year; and (2) cumulative citation per year. The number of publications has increased dramatically from 1 publication in the year 2014 to 6 publications in the year 2020. To contextualize the readers about the interest of CPG retail industry of academic researchers, the authors listed the journals that publish on the topic in Table I.

Despite the above, there is little to no literature on performance of the nanostore as part of the CPG retail industry. Therefore, it is meaningful to establish a direct comparison between the implementation of nanostores and CPG. This study compares the competitive levels of CPG in nanostores, making the following proposition (P): Nanostores present evidence of high returns as the CPG small traditional retailing.

III. METHODOLOGY

The PRISMA method is used for systematic review and meta-analysis, which allows finding the research topics, providing summaries of the objectives and what has been written in the literature. Thus, a complete description of the research studies conducted on the specific topic on nanostores and CPG to date is presented. In our study, five main phases are considered:

- Search in X-indexed studies.
- Selection of eligible studies.
- Data set extraction and data summarization.
- Risk of bias and quality assessment.
- Statistical analysis.

The PRISMA method is a set of elements that is based on demonstrating evidence for reporting systematic reviews and meta-analyses. Keyword search terms included: Nanostore, Meta-analysis, Consumer-packaged goods (CPG), the criteria and characteristic used was that the studies were empirical. The meta-analysis was performed with Review manager 5.4.1. and JAMOVI.

The authors independently explore electronic literature from Scopus, Science direct, Google Scholar, Elsevier, DSpace@MIT, research.tue.nl, repositorio.tec.mx, IJABO, databases from the inception dates of nanostore studies through 2021 to provide a review of the practices of manufacturing-based models of consumer-packaged goods on the topic of nanostores. The most recent published studies are found based on the following search strategy. It was performed a meta-analysis following PRISMA guidelines. Two independent reviewers performed data extraction and assessed study quality.

A. Search Strategy

Studies comparing the combined use of nanostores and CPG, as well as for CPG with the “search keywords” included "Nanostore, packaged goods, small retail, conveniences store," as well as different approaches to nanostore and CPG based models used in the field of distribution and sourcing. Related studies and reference lists of all selected studies were reviewed to avoid omissions, as well as previous systematic reviews and meta-analyses manually. In addition, grey literature sources were searched.

B. Study Selection: Inclusion and Exclusion Criteria

In the end, studies were selected based on the different structures of the articles, such as titles, keywords, topics, abstracts, and studies that were not related to the topic of this review were eliminated, according to the criteria presented below. The inclusion criteria are as follows: nanostores were investigated with CPG; studies comparing the combined use of nanostores and –modern and/or retail channels, and other retailers, such as franchised convenience stores; results including sales, distribution, and consumer preferences of small stores.

In order to decide how to group the nanostore research for the meta-analysis, a map was constructed based on bibliographic data, using the keywords of the papers obtained in the literature review and the VOS viewer software to build a network of the main topics; Using a semantic network model, or word co-occurrence maps, the most commonly co-occurring words in the titles, abstracts, or keywords of articles in a given set are shown.

These networks are useful for showing how potentially diverse areas of research interrelate and overlap; through this technique, the decision was made to build two broad categories, with the objective of encompassing papers related to distribution, supply, sales, revenues, etc. which are sales and distribution, as shown in the Fig. 1.

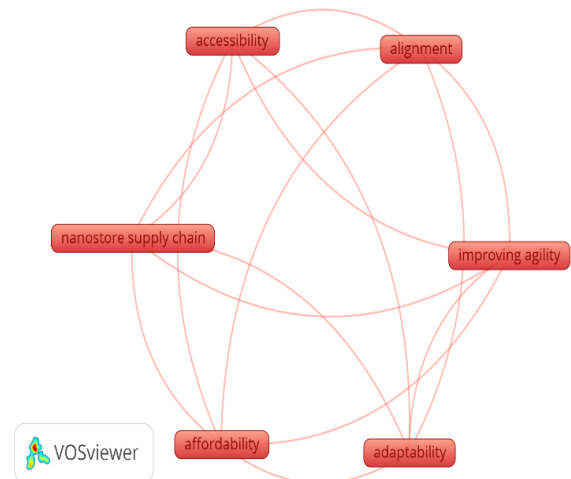


Fig. 1. Network Visualization of literature review.

In the literature review, during the period from 2010 to 2021, 6 empirical articles were found, where a total population of 48,762 nanostores was analyzed in the context of CPG by 6 different authors; 62.54% of the nanostores studied were

analyzed in the context of their relationship with the CPG distribution process.as shown in Table II.

TABLE II
DISTRIBUTION OF NANOSTORE STUDIES IN CONSUMER-PACKAGED GOODS RETAIL INDUSTRY (BY YEAR, STUDY FIELD AND JOURNAL)

Year			Study field			Journal		
Year	N	%	Study field	N	%	Journal	N	%
2010	166	0.34	Sales	18266	37.46	Elsevier	2	33.3
2014	30148	61.83	Distribution	30496	62.54	dspace.mit.edu	1	16.7
2016	18000	36.91				research.tue.nl	1	16.7
2020	292	0.60				repositorio.tec.mx	1	16.7
2020	56	0.11				IJABO	1	16.7
2021	100	0.21						
Total	48762	100.00	Total	48762	100.00	Total	6	100.00

Although there is not much literature on nanostores in their CPG context, it was deemed appropriate to group the articles in relation to the sales and distribution topics for meta-analysis[13]. Certainly, there are a wide variety of factors affecting the length of the channels and types of distribution. Contemporary research suggests that designs of sales and distribution channel should be aligned to the specific requirements of customers and end-consumers.

C. Data Extraction

Five researchers independently extracted data from included studies using a standardized form including lead author, year of publication, sample size, reference frame or model, methodological criteria, causal or correlational factors, outcomes, and future research. In addition, data are collected for nanostores with CPGs, as well as combinations of nanostores and traditional retail channels. Differences and disagreements are resolved by consensus. If studies consider wholesale channels, they only extract information of interest. Fig.2 shows the main method for the selection steps of the included studies, as a result, out of a total of 53 studies identified, 23 were from Emerald, 20, were from Elsevier, 4 articles were from Taylor & Francis and 5 were from Springer, 1 from Research.TUE, 1 from Ritec and 1 from IJABO.

Of the 6 studies:[14],[15], [16],[17],[18],[19],[20] that included nanostores and small retailers (see Fig. 2). There were 48,304 businesses in the combined CPG and nanostore utilization group, and 472 businesses in the CPG group with alternative, traditional retail channels.

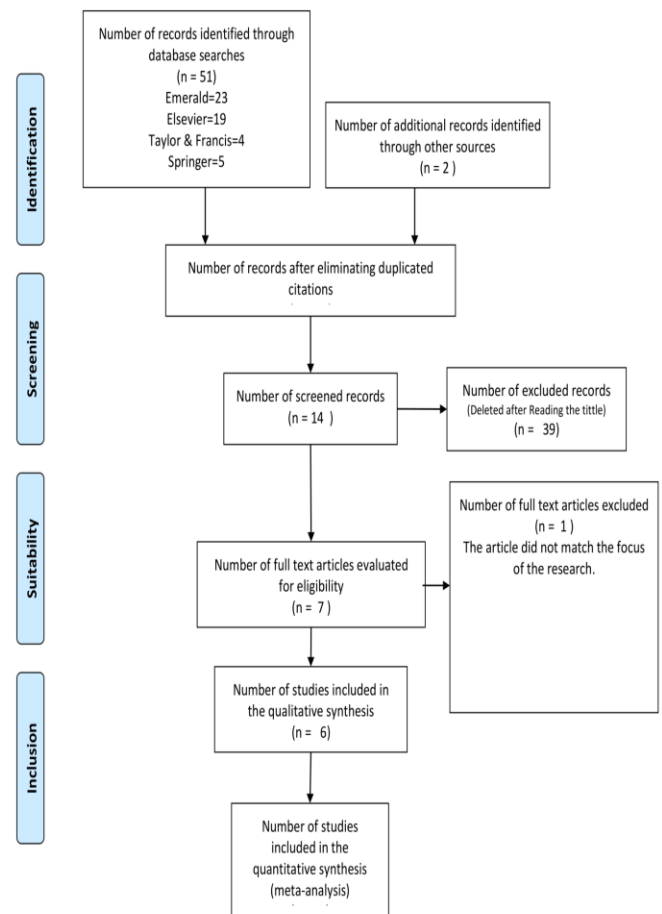


Fig. 2. PRISMA chart of the selection steps of included studies.

D. Risk of bias and quality assessment

Five reviewers independently assess the quality of the included studies, based on an adaptation of the Cochrane Collaboration's tool for assessing risk of bias applied to non-health publications. The tool includes the following elements: Selection bias, performance bias, detection bias, attrition bias and reporting bias. The third reviewer resolved all disagreements.

E. Statistical analysis

The analysis was performed with Review Manager software and JAMOVI. For continuous outcome data, the standard mean difference (SMD) and 95% confidence interval (CI) are calculated, with means and SDs, as shown in Fig. 3.

Study or Subgroup	Distribution			Sales			Weight	Risk of Bias						
	Mean	SD	Total	Mean	SD	Total		A	B	C	D	E	F	G
Kin et al 2020	4.69	0.92	56	4.82	0.796	56	0.2%	●	?	?	?	?	?	?
Mora 2020	10.5	3.412	292	0.863	0.3185	292	0.3%	●	?	?	?	?	?	?
Pan 2014	206	279	30148	11,286	4,274	30148	40.0%	●	?	?	?	?	?	?
Paswan et al 2010	3.3	0.79	166	3.95	0.82	166	0.5%	●	?	?	?	?	?	?
Ramadhan 2021	3.79	0.91337	100	3.31	1.041	100	0.3%	●	?	?	?	?	?	?
Spoore et al 2016	59	93	18000	3.2	2.1	18000	58.6%	●	?	?	?	?	?	?

Fig. 3 Statistical data of included studies.

For dichotomous outcomes, the risk ratio or relative risk (RR) and 95% CI are calculated as summary statistics. Statistical heterogeneity is determined with the χ^2 and I^2 tests. $I^2 < 25\%$ indicates low statistical heterogeneity; $25\% \leq I^2 < 50\%$ indicates moderate statistical heterogeneity; $50\% \leq I^2 < 75\%$ indicates high statistical heterogeneity [21]. $P < 0.00001$ is considered statistically significant. To synthesize the data, when heterogeneity exists, a random effects analysis is used, while when it does not exist, a fixed effects analysis is performed.

IV. EXPERIMENTAL/NUMERICAL SETTING

F. Risk of bias of included research

Fig. 4 shows that two of the six studies show a tendency towards topics related to the study of nanostore sales, although this represents only a proportion of 0.11%. For the remaining 4 studies, it can be concluded that there is no significant difference favoring the sales or distribution group, which influences the considerable percentage of heterogeneity obtained in the analysis.

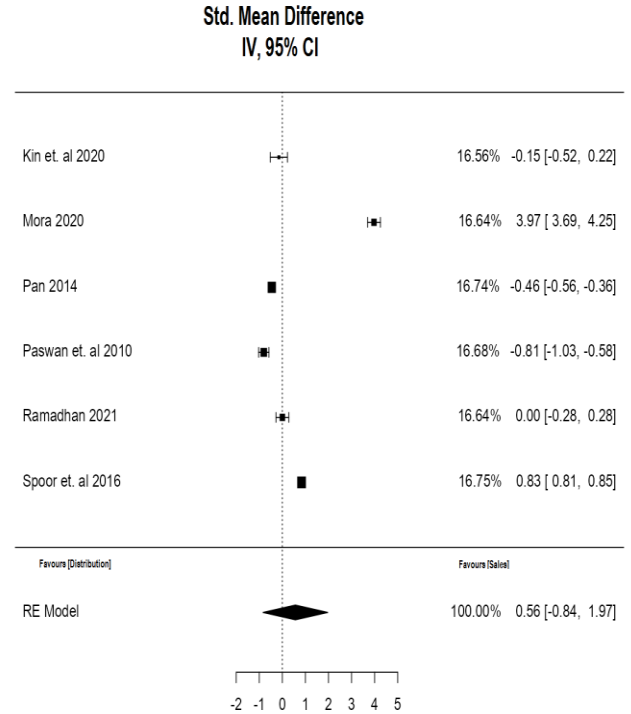


Fig. 4 Forest Plot of included studies

A total of $k=6$ studies were included in the analysis. The observed standardized mean differences ranged from -0.8055 to 3.9719, with most estimates being negative. The estimated average standardized mean difference based on the random-effects model was $\hat{\mu} = 0.5647$ (95% CI: -0.8395 to 1.9690). Therefore, the average outcome did not differ significantly from zero ($z = 0.7882$, $p = 0.4306$).

According to the Q-test, the true outcomes are heterogeneous ($Q(5) = 1374.6321$, $p < 0.0001$, $\tau^2 = 3.0646$, $I^2 = 99.8567\%$). A 95% prediction interval for the true outcomes is given by -3.1426 to 4.2721. Hence, although the average outcome is estimated to be positive, in some studies the true outcome may in fact be negative.

An examination of the studentized residuals revealed that one study (Mora 2020) had a value larger than ± 2.6383 and may be a potential outlier in the context of this model. According to the Cook's distances, one study (Mora 2020) could be overly influential. Neither the rank correlation nor the regression test indicated any funnel plot asymmetry ($p = 0.4694$ and $p = 0.8183$, respectively).

Fig. 5 presents the details about the risk of bias graph and the bias summary. To assess random sequence generation, the risk of bias was ambiguous in 3 of 6 studies. For assessing allocation concealment, the risk of bias was ambiguous and large in 1 of 6 studies, respectively.

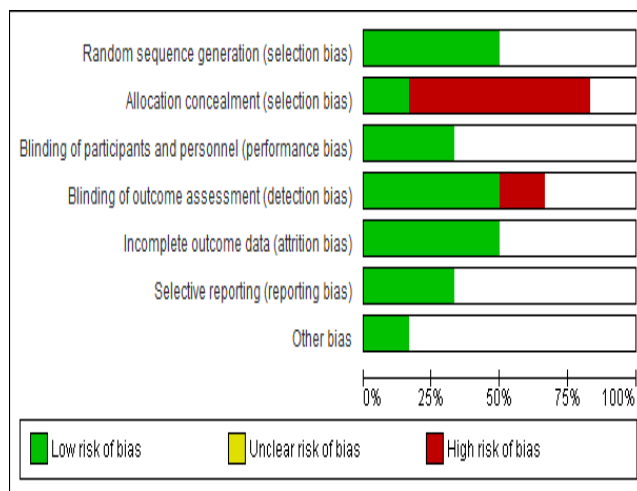


Fig. 5 Risk of bias of included studies

V. DISCUSSION OF RESULTS

The included studies were published between 2010 and 2021. The sample size of the included studies ranged from 56 to 30,148. 6 studies used nanostores. The duration of the studies ranged from 1 to 3 months.

To respond to the proposition on how the nanostore channel presents evidence of higher returns than small modern retailers in the CPG retail industry, some studies assert that the influence of digital transformation influences the behavior of nanostore consumers, and that the ability of small retailers to adapt to these trends will ensure their survival in a competitive environment with ever changing consumer behavior. Consumer trends are pressing grocery stores to provide higher quality, availability, innovation, and environmental performance than in the past. Some studies showed that future grocery retailers would use real-time information, and gain agility, efficiency, and transparency in their operations[22].

However, through the literature review, it was possible to conclude that people go to small retailers looking for selective assortment, proximity, and practicality in doing their shopping. Furthermore, modern lifestyles push people to spend less time shopping for groceries and consumer packaged goods, and sometimes the best alternative is to buy from the small store nearby.

Nanostores have high performance, by the preference of customers due to the proximity in their places of residence, even if the difficulties to supply them may cause the selling prices of products to be high that may cause customers to buy in more modern stores where there are more likely to find the products they need. Further, the present meta-analysis comprehensively and systematically reviewed the current available literature and

found that nanostore adoption compared to modern retailers exhibited the following characteristics:

- The frequency of nanostore purchases is higher due to the proximity of nanostores and customers.
- Difficulties in stocking nanostores in urban environments represent a challenge for retailers.
- During the COVID-19 crisis, people got more concerned about going to supermarkets and being more exposed to the virus because of the high foot traffic, thus buying in Nanostores represented a much lesser risk [23].

In addition, subgroup analysis found that adoption of nanostores was higher than modern retailers in urban environments in the Latin American region, especially in countries such as Mexico and Colombia, where 3 of the 6 studies included in the sample were conducted, followed by Indonesia on the Asian continent where two studies were conducted. This shows the high degree of adoption of nanostores in the studied megacities.

VI. CONCLUSIONS, LIMITATION AND STRENGTH OF NANOSTORES

In general, research on nanostores has made little progress. Through the meta-analysis, it was possible to find 53 papers dealing with the topic of nanostores and the distribution of CPG. Although there has been an increase in the number of articles on the topic, the number of empirical studies on the subject are low.

Through the 6 studies used in the review for the elaboration of the meta-analysis it was possible to group the retailers according to the distribution and sales of the packaged products that occur in the nanostores. In addition to answering the 3 research questions and 3 objectives proposed in the introduction, this study also achieves significant methodological value by developing a meta-analysis, originating from medical research, in nanostore knowledge. To date there is no similar study, given that the area in question is new, being key to selecting, evaluating, and statistically synthesizing the available evidence.

The findings of this research show that despite performing a key role in SCM, nanostores have yet to be researched more deeply.

The papers selected and reviewed for this research were assessed for the quality of the evidence they produced and analyzed to answer the research questions. Firstly, through the literature search of articles for meta-analysis, it was found that although this field has been studied more frequently in the last eleven years, there is still a need to address nanostores through empirical studies. It is crucial to develop such studies that compare consumer preferences in purchasing consumer packaged goods in nanostores, and their competitiveness compared to high-performance stores, where large-scale

retailers operate, either independent business owners or franchises. With this, it will be possible to identify gaps in the knowledge of supply chain practices in nanostore and develop techniques to ensure the survival and improvement of nanostores in SC. For instance, the large companies have typically professionals to support the various decision functions, such as marketing, merchandising, category management, logistics, and store operations. [4].

Secondly, the different perspectives of traditional nanostores and small modern channels with respect to their context can be grouped, into two main categories: (1) those that focus on the study of sales-related aspects; and (2) those that study distribution-related issues. Although at the time of the search there were few empirical papers on nanostores, it was possible to identify the tendency of the authors to focus on topics within these two categories.

With the studies of the meta-analysis, it can be concluded that nanostores and small modern sales channels are quite different concerning sales and distribution channels. According to the data collected, a clear example is the difficulties for suppliers of nanostores because of their locations, a situation that is not present in modern channels that are better integrated[24]. However, research with larger samples is needed to deepen the study and thus clarify the causes of these perspectives.

Thirdly, this review with meta-analysis found that the adoption of nanostores appears to be more effective in relation to customer preference than modern convenience stores, as it reduces customer mobilization to obtain CPGs[23]. However, more rigorously designed studies of nanostores and modern convenience stores with larger sizes are needed to confirm the effectiveness of nanostore adoption in urban environments across different regions.

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