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Product, individual and environmental factors impacting the consumption of no and low alcoholic drinks: A systematic review and future research agenda

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ABSTRACT

The no and low alcohol (NOLO) drinks industry is undergoing a significant transformation Currently the nolo beer market is worth $9.5billion globally and is predicted to grow 7.5 % a year until 2026 (Lawton, 2022). Our review seeks to answer research questions relating to understanding the current state of scholarly research on NOLO consumption and areas for future research. Using the three elements of the Mojet model: Product factors, Individual factors, and Environmental factors we analyse research highlighted through a systematic literature review using the Preferred Reporting Items for Systematic Review and Meta-Analyses framework (PRISMA) process. 60 articles published between 1990 and 2023 were selected from three comprehensive databases (Scopus, Web of Science, EBSCO) and subjected to analysis. Only papers focused on NOLO and consumers were included with papers not peer reviewed or in English excluded. The review reveals that while research has examined all Mojet areas the results are often contradictory and extensive further research is needed to fully understand the area of NOLO consumer behaviour. Additionally, the extant research is theoretically weak, draws predominantly on quantitative data and is geographically narrow focusing principally on studies in the Global North. We complete our review by proposing a future research agenda, dedicated to a comprehensive understanding of NOLO consumers, focusing on all Mojet factors fully and with more geographically, methodologically, and theoretically diverse projects.

1. Introduction

The no– and low-alcohol (NOLO) drinks industry (promoting drinks mimicking alcohol in some way, distinguishing them from soft drinks (Nicholls, 2023a)) is undergoing a period of substantial growth. Currently worth £255 million in the UK its value is expected to reach £432 million by 2027 (Mintel, 2023b). Between 2018 and 2023 the sale of no and low alcoholic drinks more than doubled with volume sales growing by 88.6 % over the period according to Mintel (2023b) in comparison the alcohol drink market between 2017 and 2022 only grew by 12.4 % (Mintel, 2023a). Additionally, compared to 52 % of drinkers who had an alcoholic beer in the last three months, 24 % also had a NOLO drink (Mintel, 2023b). However, while their recent growth is a modern phenomenon, NOLO drinks are not new. Beer in the Mediaeval period was often low in alcohol, being called small or table beer (Beer, 2023). Early branded NOLO beers, such as Barbican and Kaliber, appeared in the 1980s, but were unsuccessful due to poor taste and presentation not mimicking consumption practices (they were served in small bottles rather than standard pints) (Williams & Katwala, 2022). In the 1990s increasing levels of teetotalism were seen as a threat, rather than an opportunity to publicans (Howe, 1996) and little investment in this area was made.

Changing consumer behaviour and innovations within the drinks industry are key reasons for the recent growth of NOLO. More consumers are moderating their drinking, especially younger audiences, building on a health trend since Covid and wishing to reduce their risk of disease or manage their weight (Marsh & Jones, 2023; Mintel, 2023b). Additionally, as conversations about mental health are increasing, consumers are more openly discussing their relationship with alcohol and taking a more mindful approach to alcohol consumption (Williams & Katwala, 2022). Weller (2023) suggests that NOLO products are becoming 'ingrained' in the drinking culture. In response to these trends, drinks companies have improved the taste and flavour profile of NOLO drinks and especially NOLO beers have made great progress when it

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comes to, more carefully mimicking the mouth feel of alcoholic drinks and branding has been designed to appeal to audiences through social media platforms (Williams & Katwala, 2022). Additionally, established brands, who already have strong followings, have launched on to the NOLO market (Mintel, 2023b). These drinks have particularly shown promise with younger markets with 64 % of 18–24-year-olds drinking NOLO drinks in the previous three months (Mintel, 2023b). Pubs have also joined the trend with 85 % of venues estimated to be serving at least one NOLO option (Marsh & Jones, 2023). Furthermore, alcohol free off licences have also been launched (Lough, 2022) to cater for this growing market.

In addition, Governments and alcohol charities have shown an increased interest in NOLO drinks, given public health debates centred on problematic alcohol consumption and the impact of alcohol consumption on health (Anderson, Kokole, & Llopis, 2021a; Nicholls, 2022). However, as Anderson, Kokole, and Llopis (2021a) notes the evidence base for the health benefits from NOLO, whether they replace alcoholic drinks or are simply added, is weak and further understanding is needed.

Given recent interest in the area of NOLO it is however surprising that there is no agreed definition of NOLO (Okaru & Lachenmeier, 2022). According to the UK Licencing Act of 2003 (section 191) alcohol is any drink with a strength exceeding 0.5 % and anything lower is considered alcohol free, but no definition of low alcohol is given. A worldwide review of the definition of NOLO alcohol products was conducted by Okaru and Lachenmeier (2022). According to their review in, for example, Finland low alcohol beverages are alcoholic products up to 3.7 %. While these levels provide some clarification for beer, these do not take into account wine or spirits where lower alcohol versions may be significantly above this limit (Bucher et al., 2020; Masson, Aurier, & D'hauteville, 2008; Meillon et al., 2010). In this paper we utilise Okaru and Lachenmeier (2022) definition of NOLO beer being up to 3.7 %. Additionally, for spirits we follow their definition stating "reduction of content of at least 30 % as compared with similar products" (Okaru & Lachenmeier, 2022). So for example a spirit which would normally be sold at 40 % would need to be under 28 % to be considered a NOLO spirit. For NOLO wine we refer to "wine based" (BBC, 2023) products with an alcohol content under 8.5 % which is in line with the definition by the International Organisation of Vine and Wine (OIV, 2023).

Previous reviews have started to make sense of the NOLO consumer behaviour but further work is needed. Shemilt et al. (2017) completed a systematic review but only focused on 'low alcohol' product labelling, Pickering (2000) and Bucher et al. (2018) only focused on low-alcohol wines and conducted a non systematic review of the literature, and Sohrabvandi et al. (2010) focused only on beer production methods, sensory defects and health effects and again conducted a non systematic review of the literature. The most relevant, although not systematic review, was by Anderson, Kokole, and Llopis (2021a) who focused on consumer behaviour but in particular on policy and only used two databases (PubMed and Web of Science).

Our current review builds on and extends the scope of these previous reviews by examining NOLO consumer behaviour more broadly, drawing out product, individual and environmental factors of relevance (using the Mojet model), utilising additional databases (Scopus and EBSCO) which were not used by Anderson and O'Donnell et al. (2021). Gusenbauer and Haddaway (2020) identified our applied databases Scopus, Web of Science and EBSCO as principal databases based on levels of coverage, recall, precision, efficiency and reproducibility, which could each be used on their own to deliver rigorous evidence for systematic reviewers. Unlike earlier reviews such as Anderson, Kokole, and Llopis (2021a) we also do not restrict our analytical time frame. Thus we provide a comprehensive synthesis of the NOLO literature encompassing consumers' motivators and enablers to consume NOLO drinks and in doing so answering the following research questions:

1. What is the current state of scholarly research on consumers and their consumption of NOLO drinks?
2. What are the key areas for future research on consumer behaviour and NOLO drinks?

In the next section we outline the systematic review process followed in this study. This includes an overview of our search protocol, inclusion and exclusion criteria, and our approach to data extraction and analysis (Szablewska & Kubacki, 2023). We follow this by outlining our analytical method, which utilises the Mojet model (Köster, 2009). Finally, we summarise key components of the extant literature and conclude by outlining a future research agenda.

2. Methodology

Our systematic review followed the Preferred Reporting Items for Systematic Review and Meta-Analyses framework (PRISMA) to ensure transparency and complete reporting of our work.

Our search terms were developed through discussions between co-authors based on their prior knowledge in the area, through discussions with experts in the field (2 brewery owners - with an accumulated 15 years of industry experience) and another academic who also worked in the field. The academics who reviewed the papers had extensive experience researching in similar and close areas to the topic such as NOLO, beer, pubs and drinking spaces, consumer behaviour, brewing and breweries, macromarketing, social marketing, ethics and sustainability. Testing of the search string showed that wine, spirits and other no and low alcoholic products were found using the terms NOLO, low alcohol, alcohol free and low strength and therefore it was not necessary to include a list of additional specific wine or spirit-based products within the search strings (see the section on descriptive statistics for more detail). However we use the term beer specifically in the search strings to capture the use of the term 'light beer' which was not always captured via NOLO. We used two search strings to include the most common synonyms of our search terms and followed the databases protocols regarding the use of Boolean operators OR, AND and appropriate truncations (*) as a "wild card" to include possible plurals and American/British spelling versions of the relevant terms respectively (Page et al., 2021; Siemieniako et al., 2022). Our final search strings were:

- ("low alcohol" OR "NOLO" OR "alcohol free" OR "zero alcohol" OR "low strength" OR "NOLOw" OR "no* alcohol*" OR "light beer" OR "low alcohol strength" OR "without alcohol" OR "nonalcoholic") AND "market*"
- ("low alcohol" OR "NOLO" OR "alcohol free" OR "zero alcohol" OR "low strength" OR inclusion"NOLOw" OR "no* alcohol*" OR "light beer" OR "low alcohol strength" OR "without alcohol" OR "nonalcoholic") AND "consum*"

Our search was not interested in studies that solely focused on regular strength, as our search strings show.

We conducted our search using three comprehensive databases, Scopus (Glińska & Siemieniako, 2018; Paul & Criado, 2020; Siemieniako et al., 2022), Web of Science and EBSCO (Gusenbauer & Haddaway, 2020) to provide a broad and holistic overview of the topics (Caso & Vecchio, 2022; Falagas et al., 2008). We conducted our search on the 28th February 2023 with no time limits, in order to capture the historical development of the literature. We initially identified 19,833 records, then using our exclusion criteria (not in English, not peer-reviewed) and removing duplicates this left us with 1,554 publications. Three colleagues (two co-authors and one independent researcher who all already published in the field of drinking studies) applied our inclusion criteria (focus on NOLO drinks and consumers) to the abstract and titles. Conflicts over inclusion of a manuscript were resolved by consensus via discussions on zoom/in person. This reduced the number

of relevant articles to 70 (see Fig. 1. for exclusion/inclusion). These papers were then subjected to full text analysis by the two co-authors utilising the inclusion criteria and a final set of 45 papers were retained for the review. We removed another 25 publications because of reasons such as not being able to access the full text (4), they were reviews not including any primary data collection (8), they were not actually peer reviewed articles (for example editorials) (2) or not actually focused on NOLO (11) but instead on abstinence, medical issues, or market comparisons. Each of those 45 papers selected contained at least one or more measures defined by the Mojet model. Similar protocols were followed by Szablewska & Kubacki, 2023; Leonidou et al., 2020 and Vrontis & Christofi, 2021.

In the next stage citation tracking (also called backward and forward search) were conducted which included examination of the reference lists of the 45 articles and all papers which cited those 45 papers to locate additional relevant academic articles and maximise the search coverage (Szablewska & Kubacki, 2023). For this citation tracking we used "Citation Chaser" a freely available, easy to use tool, developed by Haddaway et al. (2022). This software, according to Mahmić-Kaknjo et al. (2023) is the "…most advanced in the field. (p.4). It enables a standardised process which allows for easy replicability. For this process we entered the DOI of the 45 papers, 44 of which were available through The software and the final one (Anderson et al., 2022c) was added manually). The backward search found 1214 and the forward search found 587 papers. Out of these 1801 papers we first removed the duplicates and then assessed via the inclusion/exclusion criteria, a title and abstract and then, if necessary a full text search from which 15 papers remained. These were added to the 45 papers to bring us to 60 papers in total for the systematic review.

Our full research process of this systematic review was adapted from Siemieniako et al. (2022), can be seen in Fig. 1.

2.1. Data extraction and analysis

As a guide to extract relevant data during our review we used the Mojet model to summarise and thematically guide our data extraction and analysis. The Mojet model was developed to systematically address food preference and has recently been used to methodically examine consumer behaviours relating to finfish (Saidi et al., 2022), eggs (Rondoni et al., 2020), beer (Betancur et al., 2020), clean labels (Asioli et al., 2017) and (un)healthy food choice (Caso & Vecchio, 2022) making it relevant to our focus on NOLO. The Mojet model was developed by Köster (2009) who in turn built on the work of Kahn (1981) who had developed a seven-factor model of food preference. The model is designed to be interdisciplinary, drawing on biology, physiology, sociology, culture, economics, marketing, and psychology and encouraging a holistic understanding of food preference (Köster, 2009). The Mojet model highlights three pillars of food choice behaviour which align with the work of Meiselman (2007) and relate to the characteristics of the product, the characteristics of the consumer and the environment in which the product is consumed. In the Mojet model these three pillars are further split into 6 macro factors as follows: *Product factors*: 1. Extrinsic factors, 2. Intrinsic factors; *Individual factors*: 3. Biological factors and Physiological factors, 4. Psychological factors; *Environmental factors*: 5. Situational factors, 6. Sociocultural factors.

Intrinsic product factors include the physical product and its sensory characteristics (flavour, ingredients; appearance, smell, texture) (Aqueveque, 2006). Extrinsic factors include product aspects that can be altered without changing the actual product such as price, packaging, brand, country of origin, labelling, sustainability, animal welfare, health claims etc (Agarwal & Teas, 2001; Aqueveque, 2006; Betancur et al., 2020; Saidi et al., 2022). Biological/physiological factors relate to how consumers perceive products (e.g., bitter, sweet etc), the control of eating (need versus hedonic choices) and health issues (Köster, 2009; Lunde et al., 2012; Yeomans, 2007). Psychological factors relate to learning and experiences with the product such as habitual consumption, novelty seeking, variety seeking, personality characteristics, attitudes, and beliefs (Köster, 2009; Saidi et al., 2022; Vabø & Hansen, 2014). Situational factors include the settings (both physical and social) in which consumption takes place and may include availability, location (on or off trade), occasion for drinking etc (Asioli et al., 2017; Betancur et al., 2020; Rondoni et al., 2020; Saidi et al., 2022). Finally

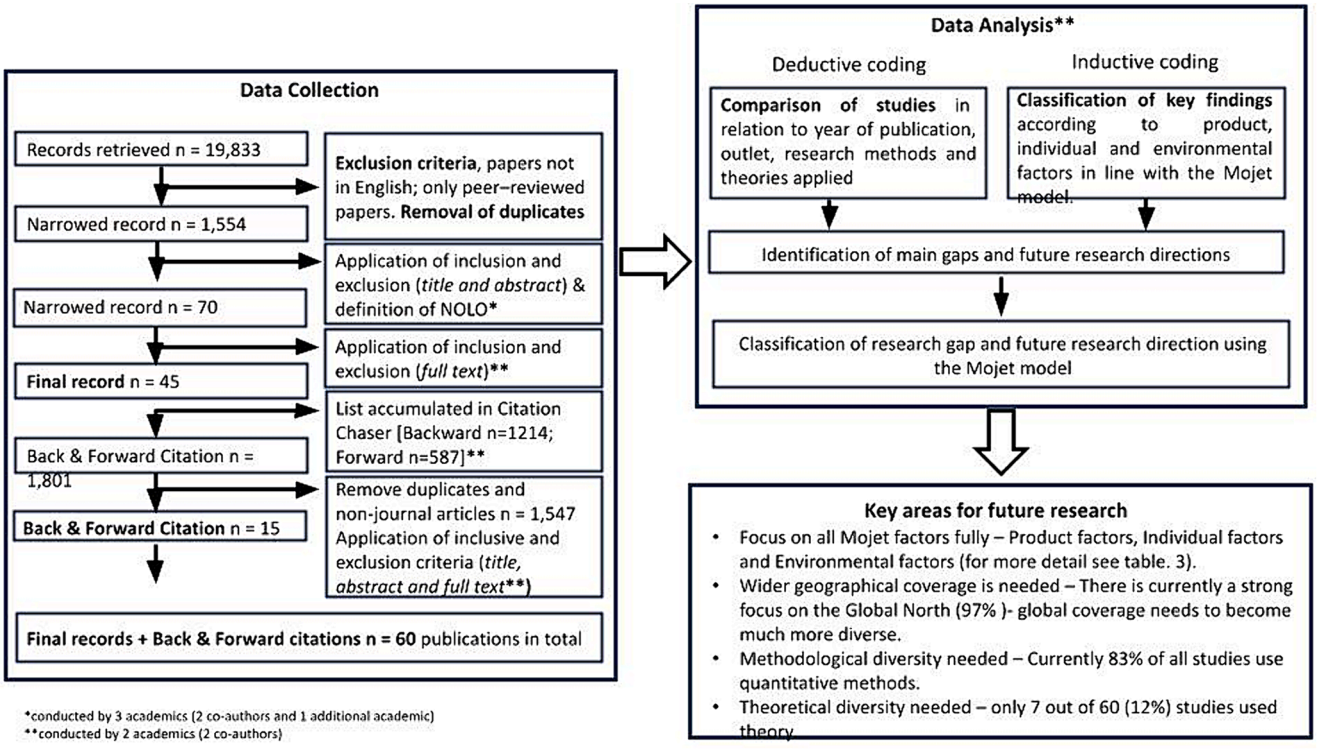

Fig. 1. Research process (showing full research process including suggestions for future research).

sociocultural factors include systems of social relations such as class, ethnicity, marital status, religion and education level (Drewnowski et al., 2020; Miassi et al., 2022; Musaiger, 1993).

In the section below we first analyse the research in this area (descriptive analysis) and then thematically analyse the body of research using the Mojet framework (thematic analysis).

3. Descriptive analysis

In this section, we provide a descriptive analysis of the 60 studies (see Table 1) identified in our systematic review.

Academic interest in NOLO has rapidly expanded over the last five years. 62 % of all studies in our sample have been published between 2019 and our cutoff date in February 2023. While the first study appeared in 1990, there was little interest in the area until 2012 (with no papers being published from 1997 to 2007) (see Fig. 2). As there has been increasing commercial interest in NOLO correspondingly there has also been a greater interest from the academic community.

Studies in our sample had been published in 40 different outlets (See Table 2) with the majority published in food related journals (e.g., Food Quality and Preference and Nutrients). The most popular journal, with 10 studies published, is Food Quality and Preference which has an impact factor of 6.345. Two other journals which have more than two publications are: Journal of the Institute of Brewing with five publications and Nutrients with three publications. Other publications are scattered across a range of disciplines and subject area journals including those focused on food chemical composition and sensory perception (e.g., Food Chemistry, Chemical Sense), alcohol and drug journals (e.g., International Journal of Drug and Policy, Addiction behaviour, Alcohol and Alcoholism) and medical journals (e.g., BMJ, BMC Public Health, Journal of Public Health).

38 papers focused on NOLO beer (63 %), nine on wine based drink/sparkling wine based drinks (15 %), eight papers looked at NOLO beer and wine based drinks (13 %), only two publications looked into NOLO beer and cider and another two publications did not specify which non-alcoholic drinks they were assessing. Finally one publication looked into Spirits vs NOLO Spirits. This aligns with Euromonitor (2021) data that currently 78 % of NOLO drinks are beer based followed by wine based drink at just under 11 %.

A range of countries were covered in the review with work on NOLO Beer, Cider and Wine-based drinks taking place in the UK, work on NOLO beer and wine-based drinks taking place in Australia, Spain, Italy, and France. Work just on NOLO beer has taken place in Finland, Canada, Germany, USA, Brazil, Netherlands, Austria and Iceland with work just on NOLO wine-based drinks taking place in Malaysia. Overall 21 studies were conducted in Europe (36 %) with 21 of those conducted in the UK (36 %). Nine studies (15 %) were completed in North America and three studies in Australia (5 %). The remaining studies were completed in Brazil (1), Malaysia (1) and Iceland (1) and overall three studies (5 %) were conducted in multiple countries of which one was just the EU and two studies EU and UK. Overall, there is a strong Global North focus with 97 % of all publications in this area.

50 of the 60 studies (83 %) utilised quantitative methods including laboratory experiments (22), secondary data analysis (12), online experiments (4), surveys (8) and field experiments (4). The experimental research designs intentionally induced variation in the intervention to examine causal variation while the surveys did not use this variation. Some surveys were completed in person and some online. Perhaps surprisingly only four of the studies used qualitative methods, two using focus groups and two a netnography and six of the 60 studies used mixed methods.

There is a low level of theoretical underpinning of studies with only seven of the 60 papers (12 %) stating a use of theory. Assimilation and Contrast Theory is used by one paper (Blackmore, Hidrio, & Yeomans, 2022), Theory of Change is used by one paper (Anderson & Kokole, 2022b), Signalling Theory is used by one paper (Johnson et al., 2020), Expectation-disconfirmation and Categorization theories are used simultaneously in one paper (Masson & Aurier, 2015), Random Utility Theory is used in one paper (Stasi et al., 2014), the Theory of Reasoned Action is used in one paper (Thompson & Thompson, 1996) and finally One paper used Lancester's Choice Theory (Porretta & Donadini, 2008).

The most prolific author in the area is Professor Peter Anderson who is lead author or co-author on just over 17 % of the 60 publications selected for review. He is a professor of Substance Abuse at Newcastle University and is a trained professional and specialist in public health medicine (2022). Anderson works at the Population Health Sciences Institute at Newcastle University and the department of health promotion, faculty of Health, Medicine and life Sciences, at Maastricht University in the Netherlands (Anderson, O'Donnell, Jané Llopis, & Kaner, 2022d).

4. Thematic analysis

In this section we review the final 60 papers using the Mojet model parameters. In doing so we acknowledge that the borderlines between different factors (e.g., psychological, and situational or socio-cultural factors) may be blurred (Caso & Vecchio, 2022; Rondoni et al., 2020) and where necessary we highlight the overlap between factors. All factors affecting NOLO consumption discussed below are contained in Fig. 3.

4.1. Product factors: intrinsic and extrinsic factors

In terms of intrinsic factors taste (including flavour/sensory profile, aroma, mouthfeel, colour, chemical composition and sound) is a key issue regarding consumers' willingness to try and consume NOLO products (Chrysochou, 2014; Missbach et al., 2017; Naspetti et al., 2020; Saliba et al., 2013; Smeets & de Graaf, 2019; Thompson & Thompson, 1996). NOLO products have a reputation for having an inferior taste compared to alcoholic products (Staub et al., 2022). However, a study by Naspetti et al., 2020 found that participants in blind or manipulated "informed" conditions are not able to discriminate among NOLO and wine containing normal levels of alcohol. While many elements of taste have been studied there is little consensus regarding the optimum combination for NOLO products. Malfliet et al. (2012) note that potential flavour deficiencies of lower alcohol beers as perceived by a trained tasting panel are too much sweetness, lack of bitterness and reduced fullness. Bauwens et al. (2021) and Sancho et al. (2021) also suggest that non-alcoholic beers are higher in sweetness levels and lower in fullness. Blackmore, Hidrio, and Yeomans (2022) also noted full strength beers were reported as having a fuller body compared to NOLO beers. Lafontaine, Senn, Knoke, et al. (2020b) however, notes that NOLO consumers prefer less bitterness (with bitterness intensity being noted as lower in NOLO beers by Bauwens et al. (2021) and Blackmore, Hidrio, & Yeomans, 2022) with profiles that are more hoppy, citrusy, stone fruit, tropical, and floral in character. They note that NOLOs were described as "skunk, malty, stale, grape nuts, dried yeast" (pp 12). This is supported by Lafontaine, Senn, Dennenlöhr, et al. (2020a) work which highlights that American consumers prefer sweet tasting NOLOs.

Ivanova et al. (2022) noted that while body was highlighted as important, consumers' understanding of this term was poor. They also noted important flavours associated with alcohol which included dark fruit (blackberry, cherry, plum), citrus and tropical fruit flavours, and cereal, as well as the barrel-age flavours (chocolate, coffee, caramel, smoke, grain, oak, roasted malt) and highlighted that these flavours were important in all no, low and regular alcohol products for them to be accepted. Moss et al. (2022) highlight that consumers did not like NOLOs that are watery or bland.

Additionally, alcohol, amount and sensation has also been studied by a range of authors. Martin et al. (1990) in an early study on non-alcoholic beers found that regular beer drinkers were much more able to tell non-alcoholic and alcoholic beers apart in blind taste tests.

Table 1
List of publications included in the NOLO Consumer Systematic Literature Review.

Authors	Year	Source	Country of focus	Method	drink type	Sample	Main findings
Katainen et al.	2023	International Journal of Drug Policy	Finland	Secondary Data	NOLO beer	n: 47,066	Men and older people purchased non-alcoholic beer more often than women and younger people. Non-alcoholic beer purchases were most common among the highly educated and high-income consumers.
Blackmore et al.	2022	Food quality and preference	Belgium	Laboratory Experiment	NOLO beer	n:87	Beer colour and under some circumstances sensory descriptors can shape consumers' perception of beer taste, flavour, and mouthfeel. Liking of beer was only influenced by labelled and actual alcohol content, not by beer colour or sensory descriptors. Expectations act as a mediator, transferring the effect of intrinsic (beer colour) and extrinsic (labelled alcohol content and sensory descriptor) product cues to shape consumer sensory experience.
Myles et al.	2022	Nutrients	USA	Netnography	NOLO beer	n: 400 (craft brewery websites)	15.5 % of the breweries surveyed offered a beer with an ABV of less than 4 %; however, an additional 67.9 % offered a beer with an ABV of less than 5 %. The representations of these low(er) alcohol products focused mostly on taste, health, and demographic indicators.
Llopis et al.	2022	Alcohol and Alcoholism	UK	Secondary Data	NOLO beer	n: 64,280	The increased availability of new no- and low-alcohol beers is not a gateway to the purchase of same-branded higher strength beers but instead it replaces purchases of these higher-strength products.
Anderson et al.	2022c	Drug and Alcohol Review	UK	Secondary Data	NOLO beer	n: 75,376	Minimum Unit Price appears to be an effective policy to reduce off-trade purchases of alcohol and encourage shifts to lower strength beers.
Srivastava et al.	2022	Economic Record	Australia	Secondary Data	NOLO beer and wine based drink	n: 149,091	Drinking low-strength beer or fortified wine reduces the probability of risky and unlawful behaviours.
Ivanova et al.	2022	Food Quality and Preference	UK	Focus Groups	NOLO beer and wine based drink	n: 90	Studies have shown that low-alcoholic beverages lack body. Paper notes that the body of beer and wine is made up of several modalities, including flavour, mouthfeel, and aroma. Other essential factors for body perception included appearance and overall beverage quality and specific flavours, including dark fruit (blackberry, cherry, plum), citrus and tropical fruit flavours, and cereal, as well as the barrel-age flavours (chocolate, coffee, caramel, smoke, grain, oak, roasted malt). Mouthfeel attributes, such as velvety, smooth, and creamy, were also perceived to be responsible for body perception in beer and wine.
Moss et al.	2022	Food Quality and Preference	Canada	Mixed Methods	NOLO beer	n: 98 (consumer acceptability trial), 127 (emotional response trial), 22 (focus groups)	The focus groups identified that those interested in a healthy lifestyle would be more likely to consume NOLOs, as well as those who want to decrease their alcohol consumption. Participants also felt that people typically consume NOLOs at home or at a social gathering at someone's house. A consumer acceptability trial demonstrated that NOLOs were associated with wateriness and were bland compared to their alcoholic counterparts. In an emotional response trial, participants associated positive emotions with brands they perceived to be produced by a micro-brewery. The participants were also

(*continued on next page*)

Table 1 (*continued*)

Authors	Year	Source	Country of focus	Method	drink type	Sample	Main findings
							willing to pay more for the NOLOs they felt were more flavourful and not produced by large companies
Staub et al.	2022	Food Quality and Preference	Germany	Survey	NOLO beer	n: 509	Drinking NOLO was associated with being health-conscious, rational, disciplined, modern, strong, feminine, tolerant, satisfied, and relaxed. As choosing NOLO may be motivated by a desire to convey a particular image or other social and individual factors, the study investigated the determinants of NOLO consumption frequency. For women, being health-conscious and not having a negative view of NOLO's taste positively predicted NOLO consumption frequency. For men, in addition to a negative view on NOLO's taste, subjective norms were a negative predictor of NOLO consumption frequency. Thus, although consumers may have positive associations with NOLO consumption, NOLO's reputation for having an inferior taste compared to alcoholic beer and consumers' subjective norms of drinking alcoholic beer may prevent them from drinking NOLO.
Anderson et al.	2022d	Journal of public health	UK	Secondary Data	NOLO beer	n: 69,803	In general, although there has been a growth in lower strength alcohol products this is not connected to British households who have bought fewer grams of alcohol over the 5-year period from 2015 to 2019.
Clarke al.	2022	medRxiv	UK	Mixed Methods	Alcohol vs non-alcoholic drinks (specific not mentioned)	n: 607	Substantially increasing the proportion of non-alcoholic drinks-from 25 % to 50 % or 75 % meaningfully reduces regular strength alcohol selection and purchasing.
Anderson & Kokole	2022 a	Nutrients	Spain	Secondary Data	NOLO beer	n: 18,954	A key to reducing purchases of regular strength alcohol, which also results in increased purchases of no-alcohol beers, is to increase the price of regular strength beers (ABV $>$ 3.5 %) with the price per gram of alcohol increasing as the ABV of the product increases.
Anderson & Kokole	2022b	Nutrients	Spain	Secondary Data	NOLO beer and wine based drink	n: 18,954	For households that recently bought either no-alcohol beer or wine (ABV $\leq$ 0.5 %), the subsequent associated purchases of higher-strength beers and wines, respectively, and total grams of alcohol were reduced, the more so the higher the volume of initial purchases of beers and wines
Bauwens et al.	2021	Journal of the Institute of Brewing	Belgium	Laboratory Experiment	NOLO Beer	n:11 (trained panellists)	The panel was able to discriminate between NABs and Pale Lager Beers (PLB) but also between the NABs. Sensory findings demonstrate that the sweetbitter balance, mouthfeel properties 'fullness/watery', and worty aroma, are the largest discriminating factors between NAB and PLB.
Kokole et al.	2021	Drug and alcohol review	EU & UK	Secondary data	NOLO Beer	volume sale from EU-27 & UK	There is increasing availability of non-alcoholic beer in the EU-27, although overall changes seem to be driven by a small number of countries.
Perman-Howe et al.	2021	Pilot and Feasibility Studies	UK	Field Experiment	NOLO Beer	n: 36	Participants found the reduced-strength lager less enjoyable and they perceived themselves to be less intoxicated after consuming it compared to the full strength alternative.
Sancho et al.	2021	Journal of Food and Nutrition Research	Spain	Laboratory Experiment	NOLO Beer	n:13 (trained panel)	Non-alcoholic beers have a higher sweetness than regular beers.
Vasiljevic et al.	2021	Addiction	UK	Laboratory Experiment	Wine based drinks	n:147	This bar laboratory study estimated that a greater quantity of 'lower' strength wine was consumed when the label

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Table 1 (*continued*)

Authors	Year	Source	Country of focus	Method	drink type	Sample	Main findings
							included a numerical strength descriptor compared with a verbal only strength descriptor.
Ramsey et al.	2021	Food Chemistry-X	UK	Laboratory Experiment	NOLO beer	n: 104	Ethanol concentration influences consumer temporal sensory characterisation of beer. In higher ethanol samples, liking was determined more rapidly compared to the lower alcohol samples. 5 % beer was reported as having significantly more sweetness, fullness/body and alcohol warming sensation compared to NOLO.
Rodriguez et al.	2021	Foods	USA	Survey	NOLO beer	n: 192	A beer bottle pouring sound helped suppress some of the negativity that is commonly associated with the experience of a NOLO.
Anderson et al.	2021b	International Journal of Environmental Research and Public Health	UK	Secondary Data	NOLO beer	n: 79,411	The study found that buying and consuming zero alcohol beer is much more likely to occur in younger age groups, in more affluent households, and in those with higher social grades, with gaps in buying zero alcohol beer between households in higher and lower social grades widening between 2015 and 2020.
Llopis et al.	2021	Social Science and Medicine	UK	Secondary Data	NOLO beer and cider	n: 70,303	The minimum unit price in Scotland shifted purchases from higher to lower strength products, more so for ciders than beers. Changes did not differ by household income or the age of the main shopper.
Ramsey et al.	2020	Scientific reports	UK	Laboratory Experiment	NOLO beer	n:101	0 % lager was perceived as maltier with reduced fruitiness, sweetness, fullness/ body and alcohol warming sensation
Lafontaine et al.	2020a	ACS Omega	USA	Laboratory Experiments	NOLO beer	n: 144 (consumers), 11 trained panellists)	The study showed that there is clear evidence that American consumers preferred sweet NOLOs.
Anderson et al.	2020b	Alcohol	UK	Secondary Data	NOLO beer and cider	n: 30,000	Greater decreases in purchases of alcoholic products with an ABV of 3.5 % or less, were found in younger age groups, the highest purchasing households in terms of grams of alcohol, class groups D and E, and Scotland; there was no clear pattern by household income.
Paixão et al.	2020	Beverages	Brazil	Laboratory Experiment	NOLO beer	n: 20 (potential panel), 11 (selected for Quantitative Descriptive Analysis), 120 (consumer test)	Alcoholic flavour and the alcoholic aroma are attributes that contribute positively to acceptance of NOLO samples.
Blackwell et al.	2020	BMC Public Health	UK	Online Experiment	NOLO beer	n: 808	Greater availability of non-alcoholic drinks, compared to alcoholic drinks, increased their online selection.
Anderson et al.	2020a	BMJ Open	UK	Secondary Data	NOLO beer	n: 64,286	The reductions were greater for reformulation than for the introduction of new low and no alcohol products. Reductions were independently higher for younger age groups of shoppers and for households that bought the most alcohol.
Naspetti et al.	2020	British Food Journal	Italy	Mixed Methods	Wine based drink	n: 240	The results demonstrate that participants in blind or manipulated "informed" conditions are not able to discriminate among wine based drinks and wine, whereas significant differences in preferences for brands under investigation appeared when labels and other information were disclosed. In effect, drinkers and non-drinkers did not differ in hedonic scores of mock wines. While younger participants exhibited the highest scores in blind liking, the overall expected liking is significantly higher for non-drinkers and women if compared,

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Table 1 (*continued*)

Authors	Year	Source	Country of focus	Method	drink type	Sample	Main findings
							respectively, to drinkers and men. Willingness to pay for mock wines is influenced by taste, glass bottle packaging and an organic label, while NOLO wine colour is not relevant.
Blackmore et al.	2020	Food Quality and Preference	UK	Survey	NOLO beer	n: 166	Label colour, labelled alcohol content and sensory descriptor had the potential to generate or alter participants' expectations of NOLO, but the design of the label and the size of the information did not seem to play a role. The present study suggests that labelled alcohol content conveys information about taste, flavour and mouthfeel that consumers use to generate sensory expectations of beer and perhaps other alcoholic drinks. The study did not find any effect of labelled alcohol content on expected liking. Sensory descriptors generated the strongest expectations, followed by labelled alcohol content and label colour.
Lafontaine et al.	2020b	Foods	USA	Laboratory Experiment	NOLO beer	n: 11 (trained panellists), 129 (consumers)	The study suggests that Northern California consumers were generally not satisfied with non alcoholic beverages e.g. NOLO lager styles (mostly lager styles) and perceived them as more beer like in aroma (i.e., skunk, malty, stale, grape nuts, dried yeast, etc.) and beer like in taste and mouthfeel (i.e., bitterness). Instead they preferred NOLOs which were more like soda and sparkling flavoured water has more satisfying include more fruity aroma e.g stone fruit, tropical etc.
Johnson et al.	2020	Journal of Food Products Marketing	www.winebeerserkers.com	Netnography	Wine based drink	n: 164 posts	The research suggests that NOLO wine is more likely to be chosen for social consumption occasions. In addition to health-related and religious reasons, the study proposes that there may also be social externalities that are considered by consumers opting for NOLO wine.
Bucher et al.	2020	Public Health Nutrition	Australia	Laboratory Experiment	Wine based drink	n: 90	People who tasted low-alcohol wine consumed approximately 30 % less alcohol. However, participants were willing to pay more for normal wine compared with the low-alcohol wine.
Harwood et la.	2019	Journal of sensory studies	USA	Laboratory Experiment	Spirits vs NOLO Spirits	n: 8 (trained panellists)	Ethanol plays a significant role in the sensory perception of aged rums and that ethanol concentrations evaluated by trained panels (~20 % ABV) may inaccurately represent certain aspects of commercial rums.
Vasiljevic et al.	2019	BMJ open	UK	Online Experiment	NOLO beer and wine based drink	n: 3,390	Lower strength products were seen as targeting non-traditional consumers (pregnant women) and occasions (weekday lunchtimes), suggesting these products may be perceived as extensions to regular strength alcoholic drinks rather than as substitutes for them.
Smeets et al.	2019	Chemical Senses	Netherlands	Laboratory Experiment	NOLO beer	n: 21	The research suggests that for regular consumers, beer flavour rather than the presence of alcohol is the main driver of the consumption experience.
Delarue et al.	2019	Food quality and preference	France	Laboratory Experiment	NOLO beer	n: 249	There was overall very little effect of the testing conditions (nightclub vs beach) on the liking scores in which they tested products such as fruit flavoured non-alcoholic beers.
Vasiljevic et al.	2018c	British Journal of Health Psychology	UK	Online Experiment	NOLO beer and wine based drink	n: 1,600	Impact of label descriptores revealed that regular was the most appealing strength descriptor and the description low and high were rated least appealing, meaning verbal descriptors using intensifiers rated least appealing.

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Table 1 (*continued*)

Authors	Year	Source	Country of focus	Method	drink type	Sample	Main findings
Vasiljevic et al.	2018a	Health psychology	UK	Laboratory Experiment	NOLO beer and wine based drink	n: 264	Results suggest that labelling drinks as lower in strength increases the amount consumed.
Vasiljevic et al.	2018b	Psychology of addictive behaviours	UK	Online Experiment	NOLO beer and wine based drink	n:3,390	Results suggest an impact on product appeal from %ABV labelling on wine and beer. Appeal decreased as %ABV decreased.
Ramsey et al.	2018	Food Quality and Preference	UK	Laboratory Experiment	NOLO beer	n: 101	Consumers were split into 3 groups based on their responses. Group 1 consumers preferred the high ethanol beer whilst Group 3 consumers preferred the low or no ethanol beer samples. Group 2 was composed of consumers who did not show any preference for the samples. 'enthusiasts' as their overall liking for all samples was considerably higher than other groups.
Silva et al.	2017	Food Quality and Preference	Netherlands	Field Experiment	NOLO beer	n: 155	When beer was presented as NOLO it did not affect the liking but did significantly reduce the intensity of six positive emotions. Participants felt less comforted, exuberant, good, happy, joyful and loving. This study showed that labelling and the conceptual information generated in consumers might influence their response after consumption of these beverages.
Missbach et al.	2017	Food Science and Nutrition	Austria	Laboratory Experiment	NOLO beer	n: 10 (trained panellists)	Results show that beers with different alcohol content displayed similar flavour dominance (e.g., bitterness) and displayed differences in worthy-off flavour, malty flavour, and astringency. In alcohol-free beers, worthy-off flavour was most pronounced in dominating between 5 and 30 s and malty flavour increased after swallowing. For bitterness and astringency, higher alcohol content resulted in higher flavour dominance, especially prior to swallowing ($\leq$40 sec)
Silva et al.	2016	Food Quality and Preference	Portugal and Netherlands	Focus groups	NOLO beer and wine based drink	n: 56	Beer and wine are rich in both functional and emotional content. Wine is associated with positive low arousal emotional responses, such as calm and loving. Beer is associated with positive high arousal emotional responses, such as adventurous and energetic. NOLO evokes neutral and negative emotional responses, such as rational, conscious, and disappointed. The difference in conceptualisations of NOLO versus regular beer/wine might be why NOLO is not adopted more widely as a substitute as it does not deliver a comparable emotional response to consumers.
Franco et la.	2015	Clinical Neurochemistry	Spain	Field Experiment	NOLO Beer	n:16	The consumption of non alcoholic beer significantly reduced nocturnal serotonin levels whereas there were no substantial changes on melatonin and cortisol levels. In line with this, Anxiety/State parameters underwent a significant decrease after consumption of nonalcoholic beer at dinner time.
Masson & Aurier	2015	Journal of Wine Economics	France	Laboratory Experiment	Wine based drink	n: 51	Even though consumers declare in surveys that it is not crucial in choosing wine, the alcohol content appears to be a central choice attribute of the wine category (and is not easily changeable).
Stasi et al.	2014	Wine Economics and Policy	Italie	Survey	Wine based drink	n:330	Results suggest that alcohol content of wine positively influences consumers' preferences and that dealcoholization generates aversion. Consumers tend to buy dealcoholized wine only for a discount proportional to the reduction

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Table 1 (*continued*)

Authors	Year	Source	Country of focus	Method	drink type	Sample	Main findings
							in alcohol content. The target group for dealcoholized wine is younger, infrequent consumers, label readers, and people with alcohol dependency problems.
Chrysochou	2014	Food Quality and Preference	Iceland	Mixed Method	NOLO beer	n:5 (interviews), 328 (survey)	The findings show that light beer is perceived as healthier than regular beer, while the most important motives for light beer purchase are taste, health and weight management. Preferences for light beer are driven mostly by taste, prior experience and brand.
Saliba et al.	2013	International Journal of Wine Research	Australia	Survey	Wine based drink	n: 851	Results indicated that those most likely to purchase low-alcohol wine were female and those who drink wine with food. Reasons for preferring a low-alcohol wine included driving after drinking, to lessen the adverse effects of alcohol, and to consume more without the effects of a higher-alcohol wine. Finally, results pointed to the importance of taste as a driver of consumption.
Chan et al.	2012	Journal of Food Products Marketing	Malaysia	Survey	Wine based drink	n: 200	Only 9 % of the sample consumed dealcoholized wine. Most respondents (81 %) perceived dealcoholized wine as not halal, hence the low consumption level.
Franco et al.	2012	PloS one	Spain	Field Experiment	NOLO beer	n: 17	Moderate consumption of non-alcoholic beer will favour night-time rest, due to its hop components.
Malfliet et al.	2012	Journal of the Institute of Brewing	Brussels	Laboratory Experiment	NOLO beer	n: 8 (trained panellists)	Light beers were considered sweeter lacking bitterness and fullness and were less preferred than regular alcohol beer.
Nowak	2011	Journal of Human Kinetics	Poland	Mixed Methods	Alcohol vs non-alcoholic drinks (specific not mentioned)	n: 1,361	Women's physical activity was found to be related to maintenance of proper weight (BMI) ($p \leq 0.05$), moderate consumption of low-alcohol beverages ($p \leq 0.05$) and regular dental check-ups ($p \leq 0.05$).
Pickering et al.	2010	Journal of the Institute of Brewing	Canada	Laboratory Experiment	NOLO beer	n: 53	The research concluded that genetics may be an important determinant of individual differences in the perception of beer flavour, but beer liking, and preference are more complex phenomena than can be accounted for by genetics alone.
Porretta & Donadini	2008	Journal of the Institute of Brewing	Italy	Mixed Methods	NOLO beer	n:90	Results show that packaging is the most important attribute followed by price, flavour, claims and colour. Glass and twist-off caps are the utilities that most increase preference of alcohol free beer.
Thompson & Thompson	1996	Journal of Marketing Practice: Applied Marketing Science	UK	Survey	NOLO beer	n:78	Not getting drunk was not found to be an important predictor of intention to drink NOLO beer, and, instead, behavioural intention was chiefly determined by beliefs concerning taste and health. The research discovered that normative influences, especially friends for non-users (consumers who have tried NOLO beers) and family for users, were secondary predictors, and that neither habit nor perceived behavioural control added to the efficacy of the model.
King & Moreau	1996	Journal of the Institute of Brewing	Netherlands	Laboratory Experiment	NOLO beer	n: 17 (trained panellists), 138 (consumers)	Consumers showed no difference in preference between Amstel Malt 0.1 % and AMplus (added bitterness to test consumer preference). Hypotheses regarding bitterness preference as a function of gender, age or regularity of beer consumption could not be supported
d'Hauteville	1994	International journal of wine marketing	France, UK, Germany	Survey	Wine based drink	n:344	The results suggest that low alcohol wine marketers should choose a "wine" positioning rather than a "diet"

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Table 1 (*continued*)

Authors	Year	Source	Country of focus	Method	drink type	Sample	Main findings
							positioning, even for diet concerned customers.
Corcoran & Segrist	1993	Addictive Behaviours	USA	Laboratory Experiment	NOLO beer	n: 64	The results indicate that non-alcoholic beers may provide a viable alternative to normal alcoholic beers..
Martin et al.	1990	Addictive Behaviour	USA	Laboratory Experiment	NOLO beer	n: 21	Subjects with higher beer consumption practices were more accurate than subjects with lower beer consumption practices in the identification of nonalcoholic beers.

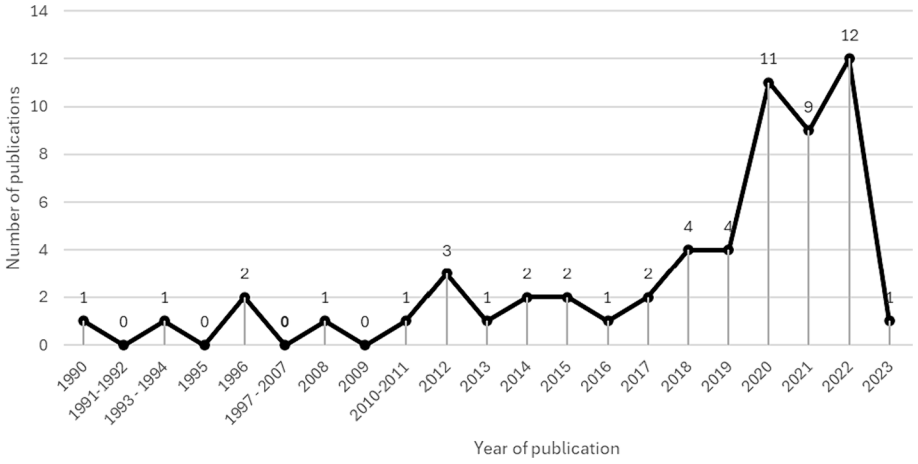

Fig. 2. Year of publication (number of nolo research publications per year from 1993 to 2023).

Table 2
Outlets for publications of reviewed NOLO consumer publications and impact factors of the reviewed publications - (Academic Accelerator, n.d.).

Journal	impact factor	Number of publications
Food Quality and Preference	6.345 (2023–24)	10
Journal of the Institute of Brewing	2.216 (2023–24)	5
Nutrients	6.706 (2023–24)	3
5 Journals with 2 publications		10
32 journals with 1 publication		32

Consumers often declare in surveys that alcohol is not central within wine choice; but authors do suggest that alcohol is seen as important by consumers, at least within the wine category (Masson & Aurier, 2015; Paixão et al., 2020). Paixão et al. (2020) highlight that having an alcoholic aroma and alcoholic flavour are important for NOLO acceptance. Smeets and de Graaf (2019) found that regular consumers rated beer flavour positively rather than the presence of alcohol and Ramsey et al. (2021) note that a higher ethanol concentration influenced consumers' sensory characterization of beer and that 5 % beer has significantly more sweetness and a warming alcohol sensation compared to lower alcohol versions although this contradicts other work suggesting NOLO beers are sweeter than alcoholic versions. Ramsey et al. (2020), testing different ethanol level beers between 0 and 5 %, noted that consumers could not tell any difference between the beers when they were smelt only (orthonasal perception) but when they tasted the beers (retronasal perception) the 0 % ethanol beer was reported as being maltier but with reduced fruitiness, sweetness, fullness/body and alcohol warming sensation. Ramsey et al. (2018) were also able to segment consumers by their preferences for higher or lower ethanol content which was often linked to different dominant flavours at similar alcohol levels, suggesting it may be the exact flavour rather than the level of alcohol alone that may affect preference. Harwood et al. (2019) also noted that ethanol played a significant role in the sensory perception of rums at different alcohol levels but only used a trained panel to determine this with no discussion of how this may affect wider consumers.

However, although studies of flavour highlight its importance flavour was only ranked the third most important factor after two other key factors (packaging and price) as attributes considered when purchasing NOLO beer in a recent study (Porretta & Donadini, 2008).

Related to flavour, Chan et al. (2012) and Porretta and Donadini (2008) highlight the role of mouthfeel, aroma and colour as important in NOLOs. Ivanova et al. (2022) note important mouthfeel attributes, such as velvety, smooth, and creamy, which were also perceived to be responsible for perceptions of beer and wine based drinks with 5 % beer having significantly more fullness/body (Ramsey et al., 2021). In wines, Longo et al. (2018) showed that dealcoholised wines had reduced mouthfeel and aroma intensity compared to alcoholic versions. Additionally, research suggests that consumers also preferred fizzier NOLOs (Lafontaine, Senn, Dennenlöhr, et al., 2020a) and Sancho et al. (2021) suggest that non-alcoholic beers are reported as having higher levels of carbonation (but only for national Spanish brands, compared to import brands).

It is worth noting at this point that a number of researchers are looking into production methods to overcome some of the sensory deficits highlighted in studies although we do not include these in our review as they either do not contain empirical data related to consumers (e.g. Krebs et al., 2019; Gernat et al., 2020).

Sound also played a role with Rodríguez et al. (2021) suggesting that a beer bottle pouring sound helped to suppress negative associations with NOLOs. Pickering et al. (2010) examined whether temperature played a role in NOLO choice but found it did not. Overall, it is suggested that NOLOs are developing more complex sensorial profiles (Ramsey et al., 2021) and may be becoming better at mimicking alcoholic

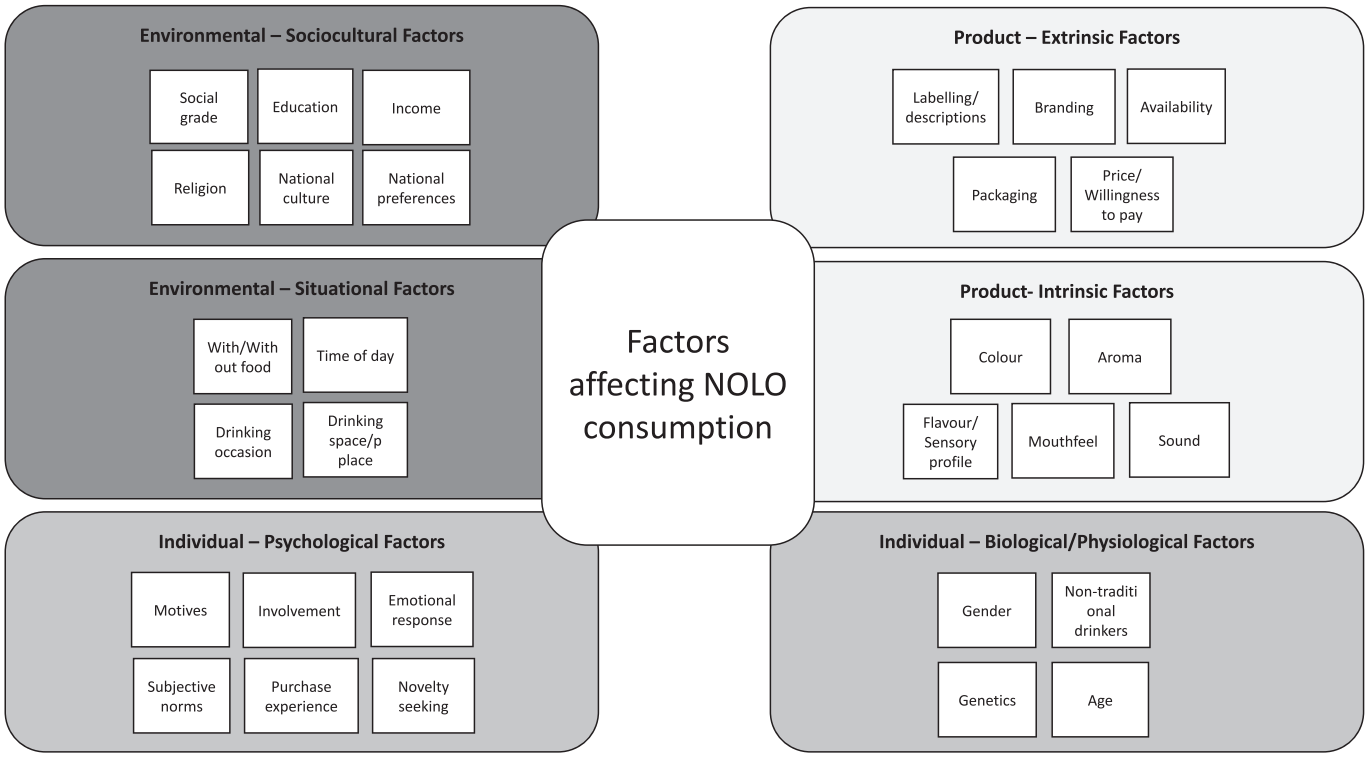

Fig. 3. Summary of Factors impacting consumer NoLo consumption (showing the factors extracted from current research impacting nolo consumer behaviour by the Mojet factors of 1) Product – Extrinsic factors, 2) product – intrinsic factors, 3) individual – biological/physiological factors, 4) individual – psychological factors, 5) environmental – situational factors and f 6) environmental – sociocultural factors.

products.

In terms of extrinsic product factors, availability, labelling, branding, packaging/descriptions and price/willingness to pay had key effects on NOLO consumption. Availability has been noted as important in a number of studies but sometimes with mixed results and increased availability of NOLO does not necessarily mean that more is purchased and consumed (Anderson, O'Donnell, Jané Llopis, & Kaner, 2022d; Blackwell et al., 2020). Myles et al. (2022) examined the offerings of NOLO amongst craft brewers in the United States noting that of the 400 craft breweries included in the study only 15.5 % offered a beer less than 4 % although 67.9 % offered a beer of less than 5 %. However this work did not take into account the availability of non craft beers and other NOLOs. Kokole et al. (2021) highlight that in Europe non-alcoholic beer represented only 3.8 % of all beer volume but note this has increased from 1.8 % in 2013. They also highlight that in terms of apparent consumption that the EU countries highest for non-alcoholic beer consumption are Luxembourg (9.2 %), Cyprus (6.2 %), the Netherlands (5.5 %), Czechia (5.4 %), Spain (4.8 %) and Hungary (4.7 %) although data is not available for all countries.

Clarke et al. (2022) states that substantially increasing the proportion of non-alcoholic drinks-from 25 % to 50 % or 75 %-meaningfully reduces alcohol selection and purchasing. This is in line with an earlier study by Blackwell et al. (2020) who note that greater availability of non-alcoholic drinks, compared to alcoholic drinks, increased their selection when presented online. But importantly a study by Llopis et al. (2022) found that increased availability of new no- and low-alcohol beers is not a gateway to purchasing same-branded higher strength beers but replaces purchases of these higher-strength products. Anderson, O'Donnell, Jané Llopis, and Kaner (2022d) suggested that over the period of their study consumers of beer bought less standard strength beer and more standard strength wine and spirit, but this was not associated with increases in NOLO consumption and increased availability. Perman-Howe et al. (2021) in a pilot intervention found that their study participants consumed fewer units of alcohol when they consumed low strength (3.5 %) lager but drank the same number of pints overall.

Labelling and descriptions of the product contained on pack have the strongest effects on consumers, followed by alcohol content labels and label colour according to Blackmore, Hidrio, Godineau, and Yeomans (2020). Vasiljevic and Couturier et al. (2018a; 2018b) found that labelling drinks as lower in strength (labelled as *Super Low* rather than *Regular*) increases the amount consumed, but reduces their appeal and in later research Vasiljevic et al. (2021) found that numerical strength descriptors on labelling had a greater impact on the purchase of more NOLO than verbal only strength descriptors. Blackmore, Hidrio, and Yeomans (2022) found that labelled and actual alcohol content affected how much beer was linked with 0 % beers lowering participants' expectations of liking and actual liking during a taste test. Silva et al. (2017), Vasiljevic and Couturier et al. (2018) and Vasiljevic, Couturier, and Marteau (2019) found that the more the labelling and descriptions suggested a deviation from 'regular drinks' the less appealing the products became. This is also the case with dealcoholized wines where Stasi et al. (2014) note that having this information on labels makes the wine less attractive to consumers. This appears to be related to the role of alcohol aroma and taste within the intrinsic product factor. Bucher et al. (2020) noted that in blind taste tests, without the labelling of NOLO alcohol products are rated the same. Again, linking to the intrinsic factors, above, Blackmore, Hidrio, Godineau, and Yeomans (2020) notes how the labelling content and design can signal expectations about bitterness, smoothness, sweetness, refreshment, beer colour, body and liking. Additionally, they found that red and brown labels increased expected bitterness, but this effect disappeared with alcohol content being removed from labels and sensory descriptors being added.

Linked to labelling, branding is also noted as having a key effect on NOLO consumption and is important in developing consumer preference (Chan et al., 2012; Chrysochou, 2014). This may be particularly important for microbreweries who often get a more favourable evaluation of their NOLO (Moss et al., 2022). Furthermore, other non-sensory

product information like geographic origin and production method can be significant (Masson & Aurier, 2015) although this outcome is not always supported (Naspetti et al., 2020). In terms of packaging Porretta and Donadini (2008) show that glass packaging and twist off caps are significant in determining liking with use of plastic having a negative effect with the same finding from Naspetti et al. (2020) who also found that glass bottles for wine based drinks had a positive effect on consumers preference.

Finally, there are two elements of price that have an effect on NOLO consumption. The first, unit pricing, notes that a higher minimum unit price of alcohol, and a lower price of NOLO (as standard or as part of promotion) does drive NOLO sales (Anderson et al., 2022c; Llopis et al., 2021). The minimum unit price in Scotland shifted purchases from higher to lower strength products, more so for ciders than beers (Llopis et al., 2021). Additionally, Anderson and Kokole (2022a) note that the key to reducing purchases of grams of alcohol, which also results in increased purchases of no-alcohol beers, is to increase the price of higher strength beers (Anderson & Kokole, 2022a). The second element of price, willingness to pay was examined with Bucher et al. (2020) finding overall a low willingness to pay for NOLO while Moss et al. (2022) found a higher willingness to pay for NOLO produced by micro-breweries.

4.2. Individual factors: biological/physiological and psychological

Only a few studies have discussed either Biological or Physiological aspects of NOLO consumption such as genetics, age, gender and "non-traditional consumers". It is suggested that genetics may be an important determinant of individual differences in the perception of beer flavour, but beer liking, and preference are a more complex phenomena than can be accounted for by these genetics (Pickering et al., 2010).

One of the key discussions in this area is the target audience for NOLO drinks. The most heavily studied elements here are gender and age. A number of studies have highlighted that women are more likely to prefer and drink NOLO (Naspetti et al., 2020; Nowak, 2011; Saliba et al., 2013). For women, being health-conscious and having a less negative view of the taste of NOLO positively predicted NOLO consumption frequency. For men, in addition to a negative view of NOLO taste, subjective norms (see psychological factors below) were also a negative predictor of NOLO consumption frequency (Staub et al., 2022). However other studies have suggested that men purchase more NOLO beer (Katainen et al., 2023) and another study found that there were no gender differences (King & Moreau, 1996).

In terms of age, studies suggest that 0.0 % products could be promoted to young adults and children as young as six (Porretta & Donadini, 2008; Vasiljevic, Couturier, & Marteau, 2019) but the majority of NOLO is targeted towards those over the age of 18 (Vasiljevic, Couturier, & Marteau, 2019). Younger audiences have been noted as being a key audience for NOLOs (as noted in the introduction) (Anderson et al., 2020b; Anderson & O'Donnell et al., 2021b; Llopis et al., 2021; Naspetti et al., 2020) but other authors also suggest that older consumers purchase and consume NOLO (Anderson, Kokole, & Llopis, 2021b; Katainen et al., 2023).

Other key target audiences noted in the literature include "non-traditional consumers" such as pregnant women (Vasiljevic, Couturier, & Marteau, 2019), sportspeople (Nowak, 2011; Vasiljevic, Couturier, & Marteau, 2019), households that buy higher amounts of alcohol (Anderson et al., 2020a), consumers with prior experience of light beer (Chrysochou, 2014) and non-drinkers (Naspetti et al., 2020).

The literature also highlights a number of psychological factors affecting the uptake of NOLO products such as motives, involvement, emotional response, subjective norms, purchase experience and novelty seeking. Firstly, motives play an important role in NOLO uptake amongst consumers. Johnson et al. (2020) suggest that wine based drinks need to allow consumers to feel relaxed, to enhance mood and comfort to meet their objectives. Many consumers report motives of health and weight loss for consuming NOLO products (Chrysochou, 2014; Johnson et al., 2020; Moss et al., 2022; Staub et al., 2022; Thompson & Thompson, 1996). However, the study by d'Hauteville, 1994 found that wine based drink marketers should choose a "wine" positioning rather than a "diet" positioning, even for diet concerned customers. Consumers also note that not having a hangover (Chan et al., 2012; Moss et al., 2022), being able to drive after drinking (Chan et al., 2012; Saliba et al., 2013), to lessen the adverse effects of alcohol, and to consume more overall (Saliba et al., 2013) are important motivators. Finally, Franco et al. (2014) assessed the positive effect of hop extract on night-time rest, although this is not mentioned by consumers, as a motive but has been shown to work in a field (Franco et al., 2012) and additionally Franco et al. (2015) studied the effect of non-alcoholic beer on anxiety and stress showing that non-alcoholic beer was successful in reducing this. In terms of broader associations which may motivate consumption of NOLOs Staub et al. (2022) found that NOLOs were associated with being health-conscious, rational, disciplined, modern, stronger, feminine, tolerant, satisfied, and relaxed.

Emotional response to drinks, especially alcohol, in comparison to NOLO, is highlighted in the literature. Alcoholic beer and wine provide consumers with a range of emotions from calm to adventurous and energetic. NOLO provokes more neutral and negative rational responses and so it is suggested that they may not be able to compete effectively with alcoholic products (Silva et al., 2016). Moss et al. (2022) in examining reactions to NOLO found that when beer was presented as non-alcoholic the intensity of positive emotions reported reduced.

Finally, consumers who have had a positive purchase experience with NOLO drinks are more likely to repeat purchase and a preference for novelty might drive them to try NOLO in the first place (Chrysochou, 2014; d'Hauteville, 1994). However, Thompson and Thompson (1996) did not support this point and highlighted that habit was not an important predictor of intention to purchase although more recent consumers may have changed their behaviour.

4.3. Environmental factors impacting consumption

A number of situational factors have been highlighted as important for NOLO consumption in the literature such as time of day, drinking occasion and drinking space/place. Context plays an important role with Vasiljevic, Couturier, and Marteau (2019) noting that 0.0 % drinks are associated with lunchtimes while low alcohol drinks may be associated with parties, holidays and celebrations. Johnson et al. (2020) also notes that wine based drinks are more likely to be chosen for social consumption occasions. The literature agrees that NOLOs can be important for non-drinkers in facilitating social situations (linked to motives above) (Johnson et al., 2020; Moss et al., 2022; Saliba et al., 2013; Silva et al., 2016). Participants also felt that people typically consume NOLOs at home or at a social gathering at someone's house (Moss et al., 2022) which could imply more NOLOs are being consumed at home than in hospitality settings. Overall, there is also disagreement as to whether they are predominantly consumed with or without food (Saliba et al., 2013; Silva et al., 2016). Only one study has examined the role of drinking space style and this study did not find any difference in liking of NOLOs between a nightclub or beach environment (Delarue et al., 2019).

Research has also shown that sociocultural factors can have an effect on NOLO consumption and uptake such as national preference, religious beliefs, social grade, education and income level. Firstly, some studies suggest that certain national cultures may have preferences overall for NOLO versus alcohol (e.g middle east, Naspetti et al. (2020)) or may have preferences for particular styles/flavour profiles of NOLO. There is clear evidence that sweet NOLOs were preferred by American consumers (Lafontaine, Senn, Dennenlöhr, Schubert, Knoke, Maxminer, Cantu, Rettberg, & Heymann, 2020a). Additionally, it is suggested that religious beliefs may affect NOLO consumption (Chan et al., 2012; Johnson et al., 2020) and in particular whether NOLOs have achieved Halal certification (Chan et al., 2012; Naspetti et al., 2020). Regarding wine

based drinks, only 9 % of halal consumers would be willing to consume dealcoholized wine and most respondents (81 %) perceived dealcoholized wine as not halal, which the authors suggest explains the low consumption level (Chan et al., 2012). Additionally, some faiths put limitations on (potentially Protestants in the US) or completely prohibit drinking (Muslim faith) and whether these groups would embrace 0.0 % varieties is not known (Johnson et al., 2020).

A number of studies have commented on the role of social class although there is little agreement with some authors suggesting that mid social grade groups consume more NOLOs (Anderson, Llopis and Rehm 2020b) and others suggesting they are more popular with higher grade consumers (Anderson & O'Donnell et al., 2021b). Similarly, income effects on NOLO consumption have shown mixed results with some authors suggesting income is irrelevant to NOLO consumption (Anderson et al., 2020b) with others suggesting it is purchased more by higher income consumers (Katainen et al., 2023). Katainen et al. (2023) claim that non-alcoholic beer purchases were most common among highly educated and high-income consumers.. Anderson and O'Donnell et al. (2021b) found that buying and consuming zero alcohol beer is much more likely to occur in younger age groups, in more affluent households, and in those with higher social grades. The minimum unit price in Scotland shifted purchases from higher to lower strength products, more so for ciders than beers. However, changes were not found to differ by household income or the age of the main shopper (Anderson et al., 2020b; Llopis et al., 2021). Finally, one study has examined the role of education suggesting that NOLOs are consumed by more highly educated consumers (Katainen et al., 2023). Overall the effect of class and income is not consistent across studies but there is agreement that more highly educated consumers drink more NOLO.

The next section will summarise the studies above and, based on this, will put forward detail of a future research agenda for NOLO consumer behaviour.

5. Discussion

5.1. Summary and limitations

This study sought to answer two research questions. The first of these was: What is the current state of scholarly research on consumers and their consumption of NOLO drinks? As noted above, using the Mojet model framework a range of variables have been identified and have begun to be examined regarding their effects on NOLO consumer behaviour. For product related factors both intrinsic and extrinsic factors have been identified and some initial suggestions of their relevance have been put forward. Further research is required to understand these better and for marketers to be able to use them to attract consumers to the NOLO market. With regards to individual factors both biological/physiological and psychological factors have begun to be isolated but many of these are related to potential target audience classifications and this work needs to go much further to understand the micro influences on NOLO consumer behaviour. Finally, a number of environmental, macro factors have also been examined. Context and culture are key elements here but the extant research shows little agreement over these issues and further research is necessary to isolate and understand key variables.

In addition, many studies focus on a single or limited range of individual variables (or focus on particular factors) which does not provide a holistic view of the phenomena. Additionally, theory is used very little, and the geographical scope of the work is limited.

Overall, in answering research question one the extant literature has begun to examine variables of interest but needs to examine these more comprehensively to determine key issues in the consumption of NOLO. The literature is also theoretically weak and geographically limited. For this reason, further research is urgently required to comprehensively map and comprehend this expanding market. We provide a future research agenda in the next section.

5.2. Future research agenda

The study sought to answer a second research question: What are the key areas for future research on consumer behaviour and NOLO drinks? As noted above, there is still much research needed to gain a more detailed understanding of NOLO consumer behaviour. With many studies examining only a single or small number of variables, future research should examine NOLO consumer behaviour holistically taking into account all factors which have the potential to affect this behaviour simultaneously. The Mojet model effectively highlights both what has been studied (answering RQ 1 above) but also allows us to highlight where future research is required. Key areas of future research and suggested research questions are contained in Table 3.

With regards to intrinsic product factors, current work on NOLO has begun to analyse taste and appearance variables as well as some work touching on complexity through work on sensory profile. However, work in these areas needs more depth and it is clear, comparing with Betancur et al. (2020) work on beer choice, that there is scope for extensive future research taking into account a wider range of sensory attributes including style (e.g. lager versus ale in beer etc), aroma, foam/head, quality, aftertaste and expanding on work examining temperature and colour.

Most importantly more work needs to be conducted to examine the effects of different alcohol levels. A 0.0 % wine based drink versus a 9 % wine, both which would fall within current definitions of NOLO might have considerably different factors affecting their uptake. Additionally, while health as a motivation has been highlighted (see individual psychological factors) further work could be completed on health aspects from a product perspective including nutrients, ingredients and portion size (Betancur et al., 2020).

For extrinsic product factors work has started to examine labelling, descriptions and packaging but further work is needed to examine these features more deeply. With a growing number of successful NOLO only brands and a range of big-name breweries/wineries/spirit companies releasing NOLO lines there could be a significant advantage in understanding how consumers react to these brands, both established and novel. Köster (2009) notes that integrity, sustainability and risk perceptions play an important role in food choice and these elements should also be examined with regards NOLO consumption. These might be communicated, where relevant, via labelling or packaging or through wider advertising and communications regarding the product. While work has started, minimally, to look at packaging this requires considerable future research. Practical aspects such as the effects of packaging and containers on beer quality and protection from sun damage are important to consumers as well as the weight of materials (glass, metal, plastic) and the feel and quality of these (Betancur et al., 2020).

Of importance for future study is also how these choices compare to, and allow consumers to make evaluations of NOLO versus full alcohol varieties of drinks. This is of particular importance in hospitality environments where NOLO may be served differently from alcohol products (i.e., being served in bottle/can rather than a glass) and whether this encourages or discourages consumers or means they evaluate these products differently. Packaging also has a knock-on effect to intrinsic factors where, for example, colour can be obscured, and aromas can be affected.

Finally, while studies have initially started to look at pricing and product elements a deeper look at promotion of NOLOs (independently or in comparison to alcoholic versions) encompassing point of purchase (pump clips, fridges, shop signage), traditional media (TV, magazine) and digital/online would allow a greater understanding of consumer reactions to these elements. Overall, much more can be done to examine the influence of the marketing variables of product, price, promotion, and place (distribution) on NOLO consumption, and much can be learnt from commercial survey research in the area. Mintel (2023b) states that NOLO drinks are often (perceived) as overpriced for example but academic research has not yet studied this issue in depth.

Table 3
Summary of future research agenda and potential research questions around NOLO drinks and consumer behaviour.

Mojet Area	Specific focus	Potential Research Questions
Product: Intrinsic Factors	Sensory attributes	What preferences do NOLO consumers have regarding style, aroma, foam/head, quality, aftertaste, temperature, colour and mouthfeel?How do taste evaluations differ between sensory trained panels and real world consumers?
	Different alcohol levels	What consumer behaviours are related to different alcohol levels in low alcohol products and no-alcohol products?
	Nutrients and ingredients	Do consumers seek particular nutrients and ingredients in NOLO products (which they may or may not consider in full alcohol versions of drinks)? If so, what nutrients and ingredients do consumers prefer in NOLO?Do consumers engage with nutrient/ingredient labelling for NOLO products and if so when and how do they do this? Do consumers engage with companies' materials (for example online) regarding nutrients and ingredients of NOLO products? How can products with different nutrients and ingredients be designed to appeal to NOLO consumers?
Product: Extrinsic Factors	Brands	Do consumers prefer (and consume differently) NOLOs from brands with existing brand equity and longevity (for example brands such as Guinness, Magners, Carlsberg etc produced by companies such as Anheuser-Busch InBev, Asahi Group Holdings Ltd., Kirin Holdings, Pernod Ricard and Molson Coors Beverage Company)? Do consumers buy and consume NOLO versions of brands they already drink in full alcohol versions (e.g. do they buy Guinness 0.0 % as well as Guinness full strength)? Do consumers switch between NOLO and full alcohol versions of the same, or different brands? How do consumers react to and consume these brand extensions? Do consumers understand the brand architecture of these established brands?Do consumers welcome NOLO brands from craft producers and how do they compare these to brands with established brand equity and longevity?How do consumers react to and consume NOLO products from companies who are new to the drinks industry? How do they gain brand awareness with consumers? How do these brands position themselves versus brands with longevity/existing equity?Are there brand personality differences between NOLO and full alcohol versions?
	Integrity and sustainability	Is CSR an important element in NOLO choice behaviour?Are consumers concerned regarding the economic, social and environmental sustainability of NOLO producers?
	Packaging, labels and containers	How do consumers react to different elements of NOLO packaging and messages? How do NOLO consumers prefer to receive NOLO- in glass, aluminium, plastic and does this difference between home and on trade consumption? Do consumers show different preference levels for NOLO products in different containers and containers of a different colour or style?Do the style of container/ glass affect NOLO consumption in on trade environments?
	Marketing Mix	How do consumers react to different levels of NOLO pricing in comparison to alcoholic beverages? What is their willingness to pay for NOLO and expectations of cost versus value? Do NOLO consumers believe NOLO provides value for money? How does consumers' perceived value of NOLO influence their purchase intent? If necessary, how can the perceived value of NOLO be increased? What is the optimum promotional mix for NOLO? How do point of sale promotions help nudge consumers toward NOLO? How might tastings and face to face sales promotions be used to encourage trial of NOLO products.What traditional and digital elements of promotions work well with NOLO consumers? How do consumers react and respond to on and offline promotions and advertising relating to NOLO.
Individual: Biological and Physiological Factors	Genetics	Do various genetic factors such as PROP taster status, sweet-liker status and Thermal taster status affect consumer liking and preference for NOLO beverages?
Individual: Psychological Factors	Motives and Involvement	Do consumers choose NOLOs in addition to or instead of alcoholic beverages and is this choice affected by occasion, context etc? Do motives to drink NOLO differ by (socio)demographic factors?Are NOLO consumed by people who have high involvement in alcoholic beverages and/or NOLO?
	Personality	Are consumers with particular personality traits more likely to consume NOLO?
	Behaviour patterns	Do consumers substitute NOLO for alcoholic beverages? Do consumers add NOLO to their current consumption of alcoholic beverages? Do consumers intersperse NOLO with alcoholic beverages and other soft drinks on the same occasion, and if so how and why?Are consumers brand loyal to and repeat purchase NOLO drinks?

(*continued on next page*)

Table 3 (*continued*)

Mojet Area	Specific focus	Potential Research Questions
Environment: Situational Factors	Context	Are NOLO consumed at different times of day, on different occasions and in different seasons etc, and if so why? Do NOLO drinkers consume them to facilitate and support social situations?Are NOLOs more likely to be consumed, in or out of the home, at different types of venues and with or without food?
Environment: Socio-cultural Factors	National Culture and Religion	Do different nations prefer different styles, types of sensory profiles of NOLOs? How do these preferences different geographically? How do these preferences differ by religion?Are NOLO halal?
	Social Grade and Income	Are NOLOs consumed by different social grades and incomes in the same way, or are there different preferences between different social grades and incomes?
	Education	Do more educated consumers purchase more NOLO?

In terms of individual factors work has begun to examine different consumer (socio)demographics such as age, gender, and particular groups. From a biological and physiological perspective this can be developed much further. Sensory and genetic factors are likely to be a fruitful area for future research. In studying beer consumption Betancur et al. (2020) note that particular genetic variables have been associated with preference and liking for different beers. These include PROP taster status, sweet-liker status and Thermal taster status. How these affect NOLO, at different levels, and in comparison, to alcoholic beverages would be of great use to product developers and researchers.

In terms of psychological factors, work has made basic inroads to the study of NOLOs in relation to motives, norms, emotions and some basic buying patterns but much more is needed in each of these areas (each of which is important in the Mojet model highlighted by Köster, 2009). While studies generally state the consumption of NOLO is greater amongst younger consumers, some also suggest that it could find a home with older consumers. Understanding this more carefully is important as commercial research suggests that "Targeting the older generation in marketing can help unlock further growth potential in this market and capitalise on this age group's ongoing rapid expansion" (Mintel, 2023b). Motives for NOLO consumption like health and to allow driving have been noted but do these change over time, and between drinking occasions etc. Köster (2009) notes that personality traits may have an influence on food consumption behaviour and could affect NOLO consumption. Additionally, involvement in the area of alcohol consumption might also highlight why people start drinking NOLO.

Building on motives for consumption a deep understanding of patterns of NOLO consumption is needed comparing consumer behaviour patterns related to alcohol drinkers, hybrid drinkers that drink both alcohol and NOLO and non-drinkers. Little is known about the levels of substitution of NOLO drinks for alcohol, in or between drinking occasions and indeed for other soft drinks, or whether these are added as an extension to current alcohol purposes, especially at the macro level (Corcoran & Segrist, 1993; Vasiljevic, Couturier, & Marteau, 2019). As the World Health Organisation (WHO) (2023) notes this knowledge is particularly needed to determine policy interventions. For example, whether while drinking consumers will drink NOLO products at the same rate and frequency, whether they will intersperse NOLO with alcohol or keep them separate and how these influence overall drinking rates are important questions. Health benefits of NOLO are built on the idea that NOLO will replace alcohol but we do not have reliable information as to whether this is the case. These patterns may also be affected by price and need fuller explanation.

Exploratory, small scale research published since our SLR cut off point of February 2023 suggests that while advertising wants consumers to add NOLO products to their consumption of regular alcohol drinks (addition marketing) consumers actually use these products as replacements for regular strength products and many consumers drink in a hybrid manner (drinking both NOLO and regular strength) although further research is needed to determine how widespread this practice is (Nicholls, 2023b, 2023c). These issues could be studied using reporting measures like diaries but discrete observation of drinking patterns may be a good approach to ensure data is accurate. As consumers become more familiar with NOLO it will also become important to understand repeat buying and loyalty patterns, in isolation and in comparison, to other products.

For environmental factors the extant literature has started to examine aspects such as context, but little detailed work has been done in this area. Any future research in this area must also consider the role of NOLOs in pubs, restaurants and in a range of diverse hospitality settings as well as those bought in supermarkets, specialist producers and online. Comparisons between NOLO in on and off trade contexts will add necessary detail to our understanding. Field experiments would be useful to examine in situ real world behaviour and to test various nudges and marketing strategies related to NOLO. As Delarue et al. (2019) highlights, these types of studies can improve ecological validity and test a product under real market conditions which is likely to result in more successful product launches. As Betancur et al. (2020) note, visual and auditory aspects such as music and background noise of on trade environments can affect the consumption of beer, with more enjoyment in beer reported when there is background music, and whether this is also the case for NOLO is important to learn.

From a sociocultural perspective there has been some work on elements of social class, income and education but results from these studies are often contradictory, and need, alongside many of the other elements highlighted above, further consideration. Finally further research is needed in non-global north countries and to analyse more carefully the differences between NOLO acceptance and uptake across different geographic regions, religions and national cultures. Providing a cross cultural analysis will allow a greater understanding of uptake and spread of NOLO consumption in different regions.

As noted, the area of NOLO consumer behaviour is theoretically weak and future research should seek to strengthen projects with a theoretical grounding. Köster and Mojet (2007) note a range of theories of food choice which could be relevant to the study of NOLO uptake and usage such as learning theories, theories of motivation (such as need for activation), and variety seeking amongst others. In terms of methods more qualitative research is desperately needed in the area where the work has been predominantly quantitative in orientation. While quantitative panel research can examine and discuss patterns of NOLO consumption at the macro level, and surveys can provide some understanding of limitations and motivators relating to NOLO, more detailed interviews and other qualitative techniques can more carefully help us to understand the why of NOLO consumption and enhance many of the future research endeavours highlighted above. Additionally a number of studies employed trained expert panels, especially for sensory profiling, but future research should use real world consumers to ensure wider applicability.

Finally, as noted above, there continues to be debate regarding the definition of no and low alcohol products and how these differ across countries, studies and between individuals. While it may not be possible to define this in a way which would suit all NOLO beverages, it would be extremely useful if future research were to examine definitions of these products and their relation to alcohol levels carefully to allow greater understanding.

5.3. Concluding remarks and study limitations

In its current state the extant research on NOLO consumer behaviour is in its infancy. Interest has been sparked in this growing commercial success but the academic literature has fallen behind in its understanding. Initial forays have been made examining some variables of interest but our analysis using the Mojet framework highlights a number of areas with little or no research and highlights the contradictory findings within factors. This has allowed us to develop a detailed and extensive future research agenda for the area.

While our study has provided an overview of the area, we must acknowledge limitations of our approach with some of these limitations additionally providing future research directions. We chose, due to funding and time constraints to exclude grey literature and while we made our best efforts to consult widely on search terms, we may have excluded papers of use through this process such as the area around "wine based" products where some wine styles may be low alcohol. In such a fast developing area, future work should examine and include the developing terminology in this area. We focused on English language publications and any future research should also seek to include non english language publications to ensure a fully global approach. In summary, future research could focus on examining the grey literature, exploring different search terms and terminology for NOLO products, and expanding the review into different languages.

CRediT authorship contribution statement

Nadine Waehning: Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Formal analysis, Data curation, Conceptualization. **Victoria K. Wells:** Conceptualization, Data Curation, Writing – orignal draft, Writing – review & editing, Visualization, Investigation, Validation, Formal analysis.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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