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The digital foodscape and non-communicable diseases
Analysis of the risk factors of meal delivery applications in Denmark

DTU Skylab FoodLab Report 2021-01

Ristil Emma Skovgaard, Roberto Flore and Josef Oehmen

January 2021
The digital foodscape and non-communicable diseases

Analysis of the risk factors of meal delivery applications in Denmark

DTU Skylab FoodLab Report 2021-01
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Preface

Eating and food sourcing may well be the longest-running focus of human innovation. This innovation continues unbroken and undiminished today. Food is the most important ingredient in any socio-technical system – without it, no system with a human component would endure for very long. Food is both social, and at least since the discovery of fire, also technical.

In this report, we take a first look at a megatrend in this fascinating socio-technical food universe that will need our full attention: Our emerging digital foodscape.

Like other innovations, innovation in the digital foodscape is driven by immediate and highly relevant value propositions: convenience, variety, affordability, and, as demonstrated effectively during our current pandemic, resilience.

The digital foodscape spans the entire field-to-fork lifecycle of our food. It is the digital component that enables two critical functions: communication and financial transactions. This report focuses on the “last mile”, figuratively and literally, of the digital foodscape: meal delivery services implemented as online food delivery services.

As any innovation, online food delivery systems do not only come with the obvious benefits for food producers, delivery services, and consumers. They also create new risks. This report focuses on a particular risk cluster: The impact of online food delivery systems on the risk of non-communicable diseases associated with modern out of home food culture.

We believe it is critical that any innovation is informed by a thorough understanding of the associated risks. Without it, it is impossible to innovate responsibly – from an industry perspective, a consumer perspective, but also from a regulatory perspective.

This report was prepared by Ristil Emma Skovgaard, based on a project assigned by the DTU Skylab FoodLab and conducted as part of her studies at DTU. Ristil is one of these bright, unstoppable students. The praise for the report is all hers, while any mistakes are due to oversights by her supervisors (us).

Roberto Flore, DTU Skylab FoodLab
Josef Oehmen, DTU Management

Kongens Lyngby, January 2021
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1 Abstract: Is Online Food Delivery a Health Burden?

This report explores the mitigation of non-communicable disease (NCD) risk factors associated with out of home modern food culture through a system-oriented design approach. Using a holistic approach, the authors explored the food system surrounding the modern out of home food culture in Denmark with a focus on stakeholder interviews. From this, the authors identified online food delivery (OFD) as an area in need of innovative solutions to mitigate the threat OFD pose to public health by giving consumers easy access to food prepared away from home anytime and anywhere.

The report primarily investigates the connection between healthy diets and the type of OFD platform defined as meal delivery (MD) applications (apps). An analysis of how the five MD apps operating in Denmark impact food choices in the Danish digital foodscape was conducted. This report offers a tangible overview of MD apps and the opportunities and challenges related to NCDs that these platforms pose.

It is determined that MD apps contribute to food accessibility by extending reach of food outlets (FO) and that they operate in both urban and rural areas. Further, it is found that there exists misinformation and that current policies on provision of food information to consumers are not adhered to. Moreover, it is found that the MD apps have the potential to nudge consumer decisions through their user interface and the companies’ use of digital marketing. This report does not aim to stop OFD but investigates what measures should be made to ensure the expansion of the digital foodscape will not lead to an increased health burden.
2 Introduction: Diet, NCDs and Online Food Delivery Services

Strong indications of the link between poor diet quality and NCDs, such as cardiovascular diseases, diabetes, and some cancers exist [1]. Dietary risks, high blood pressure, high body mass index (BMI) and high fasting plasma glucose are all in the top six risk factors that drive the most death and disability combined in Denmark [2]. There is evidence that consumption of meals prepared away of home is linked with higher calorie consumption and unhealthy dietary patterns [3]–[6]. More than one in five Danes had an unhealthy diet in 2014 [7] and weekly fast food consumption in Denmark has increased from 13.30% in 2013 to 19.5% in 2017 [8].

To address this and achieve individual behavior change, the food environment where people make dietary decisions needs to be regulated [9]. Accessing the internet through smartphones and the telecommunication network has become an integral part of the daily life for most Danes [10]. Connectivity, among other drivers, has created a new part of the food environment where consumers have easy access to food prepared away from home, anytime and anywhere [11]. The few studies that have investigated the health outcomes of OFD platforms concludes that there are several worrying points for diet-related health [11], [12] and that most food offered cannot be considered healthy [13], [14].

Further, the delivery e-service sector for prepared meals is forecasted to grow 8.9% annually in Denmark [15]. Thus, investigating the concept of out-of-home-food eaten at home is critical to ensure that policies reach this growing corner of the food environment, the digital foodscape. Thus, the aim of the paper is to better understand the digital decision-making landscape and create an overview of the MD apps in the Danish digital foodscape.
3 Methods: Empirical Study of Online Food Delivery Platforms in Denmark

3.1 Context

The digital foodscape has been defined as the digital components that are part of food environments and influence health and nutrition [16]. OFD platforms as part of the digital foodscape exist in a great variety including delivery of ingredient boxes, supermarket produce, and leftover food. These varying business models share an underlying component that consumers access food through online platforms; however, how, what and when consumers access food from the digital foodscape differs from each platform type.

In order to define a group of OFD platforms that the authors could compare and analyze using the same methods, the research focuses on mobile applications (apps), as opposed to desktop or other types of browser-based platforms, as the primary OFD platform. Apps were chosen as the OFD platform of interest given the following considerations: 1) preliminary research showed that a prominent, multinational OFD company did not offer website ordering (table 1), and 2) existing literature deem apps the bigger part of food delivery market, as these apps provide convenience across time and location [17], [18]. To distinguish from the wider definition of OFD, the term meal delivery (MD) apps in the context of this paper describes apps that provide consumers with prepared meals including the choice of beverages. An important note here is that some of these MD apps additionally provide OFD services from supermarkets and meal boxes.

![Figure 1](image-url) MD app as the link between consumer and FO with the two ways of obtaining the meal. A detailed version of the figure is found in appendix A4.

From the consumers perspective the meal from MD apps can be obtained in two ways: delivery or pickup (figure 1). The delivery can either be organized be the FO (restaurant-to-consumer) or by the MD company (platform-to-consumer). The MD apps can facilitate both restaurant-to-consumer and platform-to-consumer services.

Nine multinational MD app providers (not including subsidiaries) with consumer apps were identified in the WHO European Region. Inclusion criteria for multinational MD app providers were delivery service in three or more countries. Three of these operated in Denmark with an additional two companies operating exclusively in Denmark. Only MD apps with more than 10,000 downloads on Google play were included.
3.2 Procedure

Using a holistic approach, the food system surrounding the modern out of home food culture in Denmark was assessed through stakeholder interviews and desktop research. The mapping of the system can be seen in appendix A.

A qualitative and explorative approach was used throughout the data collection and analysis of the MD apps. The author downloaded the apps on October 1st, 2020 and registered as a first-time user on the apps. During a period of four weeks, a vegetarian meal was purchased by one of the authors of this report (RS) from each app and notification settings were set to full functionality. The user experience was mapped with screen shots of each step. The aforementioned methods combined with a geographical analysis of where the apps operate in Denmark concluded the analysis of the MD apps.

3.3 Measures

Relevant literature review was included by evaluating results from searches of the terms “NCDs” and “health” combined with the following phrases: “meal delivery,” “food delivery”, “take away”, “food prepared away from home” and, “offline to online”. Data reporting the characteristics of the MD apps were obtained on their respective websites.

The collected data from the MD app user experience through the four-week period was then analyzed across three categories: 1) the information provided about the meal and FO, 2) the user interface that determined the flow and process of ordering, and 3) the marketing elements the MD apps used both in app and on external medias. Overviews of the user experiences are presented in figure 5 through 9, the general flow chart that these are categorized in are seen in figure 2. Existing analyses of OFD platforms served as the basis for this paper’s analysis measures of the MD apps; however, only measures with a potential effect on usage and food choices were included [17], [19].

Social media presence of the MD apps was determined by searching the name of the MD app on the respective social media platform. The social media platforms include Instagram, Facebook, Twitter, and YouTube. The brand images have been evaluated by looking at the slogans, the words the platforms use to describe themselves, and the influencers that collaborate with the MD company.

The author collected geographic and demographic data of the MD apps on the MD platforms’ websites and through email correspondence. Three out of five of MD companies replied to the email inquiry. Geographic data included either names of cities or postal codes. Postal codes were compared with the Danish Postal service data to remove non-existing postal codes and postal codes covering central and west Copenhagen and Frederiksberg centrum, as these have postal codes for every third road. The postal codes were then marked on a vector-based map. City names were imported to Google Maps as ‘name, Denmark’ and the location of the city marked on a vector-based map.

To compare the built-food-environment with the digital foodscape all McDonalds Denmark addresses was scraped from their website. In total 90 McDonalds restaurants were identified in Denmark. The address line was imported to Google Maps and marked on a vector-based map. McDonalds was chosen as a restaurant to evaluate on the potential extension
of reach MD apps have because it is a well-established restaurant chain that exists across Denmark.

Figure 2 The flow chart of purchasing through MD apps,
4 Results: Coverage and User Experience of the Digital Foodscape in Denmark

4.1 MD apps in the digital foodscape

The initial scoping interviews revealed weaknesses surrounding MD apps as government, municipalities, and interest groups were aware of the potential impact on health MD apps pose, however no legislation, guidelines, or campaigns specifically targeted or regulated MD apps in Denmark (Appendix B). However, actions towards mitigating diet and nutrition related NCDs in the built-food-environment was revealed in the scoping interviews.

Figure 3 illustrates the difference in the built and digital food environment. The McDonalds restaurant addresses are seen with the 1 km buffer radius (left) as research of Danish data from 2010 shows that the built-food-environment in a 1 km network buffer significantly impacts fast food intake [20]. This represents access to McDonalds in the built-food-environment. With the average delivery radius of 12 km the illustration also shows access through the digital foodscape (right). Between the two modes the reach of the individual restaurants is visibly increased in the digital foodscape.

McDonalds notified the author via email that McDelivery is not available from all 90 restaurants yet; however, the process of enrolling all is ongoing. McDonalds currently uses three MD apps: Hungry, JustEat, and Wolt. Combining these three MD platforms operating in Denmark gives McDonalds a broader reach both in geographical coverage (figure 10) and consumers as they have different brand images (table 4).

Table 1 shows the key characteristics of the companies providing MD apps evaluated in this research. With the interest of investigating the homogeneity of the digital foodscape across the WHO European region table 1 includes multinational MD apps not operating in
Denmark. These MD apps were downloaded and included in the overview in table 1, however no food items were bought as no service were provided at the authors location. The first wave of companies arrived around year 2000, the second wave arrived around 2014. The first wave transitioned into providing apps, whereas the second wave launched with apps. Bolt Food, as the newest company, solely provides the functionality to order through an app and not a website, whereas all others are multi-platform companies.

Another difference in the two waves is the possibility of restaurant-to-consumer delivery. Focusing on the Danish context; Hungry and JustEat started out by only providing restaurant-to-consumer delivery but now also have their own delivery riders. Delivery riders have their own logistics platform that matches delivery rider, with FO and consumer. The delivery riders use bikes, cars, and motorbikes, either provided by MD app company or using private means. In the current market all MD apps have their own pool of delivery riders who handles platform-to-consumer deliveries. Takeout.dk used to provide restaurant-to-consumer solution via the app, but now only provide platform-to-consumer. This means that the app does not provide that the FO manages their own delivery. If a FO wants to manage their own delivery, they can purchase technology and run their own platform or use the solutions provided by JustEat and Hungry.

Table 1 Overview of the MD apps operating in Denmark and MD apps operating in more than one country in the WHO European region. MD app inclusion requirement of +10.000 downloads on Google play and further for the multinational MD apps that they operate in three or more countries.

<table>
<thead>
<tr>
<th>MD app company</th>
<th>Founded</th>
<th>HQ</th>
<th>Listed</th>
<th>Website</th>
<th>Restaurant-to-consumer</th>
<th>Platform-to-consumer</th>
<th>WHO EU countries***</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Just Eat</strong></td>
<td>2001</td>
<td>LDN</td>
<td>2014</td>
<td>Yes</td>
<td>Yes, OM**</td>
<td>Yes, 2017</td>
<td>8</td>
</tr>
<tr>
<td><strong>Hungry.dk</strong></td>
<td>2013</td>
<td>AAR</td>
<td>No</td>
<td>Yes</td>
<td>Yes, OM</td>
<td>Yes</td>
<td>1</td>
</tr>
<tr>
<td><strong>Wolt</strong></td>
<td>2014</td>
<td>HKI</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes, OM</td>
<td>15</td>
</tr>
<tr>
<td><strong>Takeout waiteer</strong></td>
<td>2003</td>
<td>CPH</td>
<td>No</td>
<td>Yes</td>
<td>No, OM</td>
<td>Yes</td>
<td>6</td>
</tr>
<tr>
<td><strong>Uber Eats</strong></td>
<td>2014</td>
<td>SF</td>
<td>2019</td>
<td>Yes</td>
<td>No</td>
<td>Yes, OM</td>
<td>14</td>
</tr>
<tr>
<td><strong>Glovo</strong></td>
<td>2015</td>
<td>BCN</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes, OM</td>
<td>10</td>
</tr>
<tr>
<td><strong>Bolt Food</strong></td>
<td>2019</td>
<td>TLL</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes, OM</td>
<td>28</td>
</tr>
<tr>
<td><strong>Takeaway.com</strong></td>
<td>1999</td>
<td>AMS</td>
<td>2016</td>
<td>Yes</td>
<td>Yes, OM</td>
<td>Yes, 2016</td>
<td>10</td>
</tr>
<tr>
<td><strong>Delivery Hero</strong></td>
<td>2011</td>
<td>BLN</td>
<td>2017</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes OM</td>
<td>14</td>
</tr>
<tr>
<td><strong>deliveroo</strong></td>
<td>2013</td>
<td>LND</td>
<td>No</td>
<td>Yes</td>
<td>Yes -2018</td>
<td>Yes - OM</td>
<td>7</td>
</tr>
</tbody>
</table>

* Takeaway.com and JustEat merged in 2020, keeping their names in the accumulated 18 countries in the WHO European region they cover together **Original Model (OM) ***Including subsidiaries

4.2 User experience results

Three out of five MD apps provided the user with a link or direct access to the Danish food safety grade: The Smiley Scheme from the Danish Veterinary and Food Administration (table 2). Information on how to obtain allergen information was provided on two out of three. Direct contact (phone number) to the FO was provided in four out of five cases.
Ingredients in the meal and pictures of the meal depended on the FO. Provision of meal pictures also varied across the individual menus. Header pictures (the picture representing the FO) was always there, however on several platforms the same header picture was used on unique FOs. Thus, the pictures did not always represent the food served. Ingredient information varied from non-descriptive names of a dish to full ingredient lists. Misinformation due to lacking or misleading ingredient information was also found (figure 4).

Table 2 Information provided on meal delivery apps in Denmark.

<table>
<thead>
<tr>
<th>MD app company</th>
<th>Food safety report</th>
<th>Allergen information</th>
<th>Nutrition information</th>
<th>FO contact</th>
<th>Ingredients*</th>
<th>Pictures*</th>
</tr>
</thead>
<tbody>
<tr>
<td>hungry.dk</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Possibly</td>
<td>Possibly</td>
</tr>
<tr>
<td>wolt</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Possibly</td>
<td>Possibly</td>
</tr>
<tr>
<td>takeout</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Possibly</td>
<td>Likely</td>
</tr>
<tr>
<td>waiteer</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Possibly</td>
<td>Possibly</td>
</tr>
</tbody>
</table>

*Varies across FOs and menu

Purchases on the MD apps can only be placed on one FO per order. To purchase a meal on any of the MD apps in Denmark, the user needs to register by making a user profile (table 3). On all the MD apps recommendations of restaurants, that were not actively sought out, were presented the user. The recommendations were presented on pop-ups, on the start-page, and in the default search bar list. This means that even if the desired meal is known, other offers would be presented before reaching the desired meal.

Figure 4 Examples of (left) Disinformation: A vegan dish that can be customized to contain beef, however the name still says 100% vegan. (center) Add-on deals: Before payment extra side dishes and beverages can be added. (right) Push notification: “Order what you crave” received after closing app.

To seek out a meal the MD apps had different ways of searching. Two of the MD apps had filters (e.g. only showing restaurants with offers) and sorting options (e.g. sort by delivery cost) to aid the search. They all had the possibility of searching on FO name and searching through categories. The available categories differ from specific meals to cuisines and four MD apps also had a “Healthy” category. All but one app had add-on deals, that is recommended side dishes, extra meals and/or beverages often displayed right before the transaction (figure 4).
Table 3 User interface elements that impact the flow of the ordering process.

<table>
<thead>
<tr>
<th>MD app company</th>
<th>Forced registration</th>
<th>Recommendations</th>
<th>Add-on deals</th>
<th>Filters and sorting</th>
<th>Categories</th>
<th>Healthy category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Just Eat Hungry.dk</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Wolt</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>TakeOut waiteer</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

The MD apps all used promotion codes that gives special discounts or offers as parts of e.g. campaigns or collaborations with influencers (table 4). Four apps also had credit systems, these had different structures, but all resulted in obtaining an in-app credit that can be used to get a discount on a future purchase.

Push notifications were received on three apps. The nature of these varied and could contain offers, competition or news regarding a new FO. It is hard to find the structure of these, however one specific push notification from JustEat continuously arrived just after closing the app without a purchase asking if the user is craving anything (figure 4).

Table 4 Marketing elements of meal delivery apps in Denmark.

<table>
<thead>
<tr>
<th>MD app company</th>
<th>Promotion codes</th>
<th>Credit system</th>
<th>Push notifications</th>
<th>Social media*</th>
<th>Brand image</th>
</tr>
</thead>
<tbody>
<tr>
<td>Just Eat Hungry.dk</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>ig, tw, fb, yt</td>
<td>Pleasure, fast food, easy</td>
</tr>
<tr>
<td>Wolt</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>ig, tw, fb, yt</td>
<td>Fast food, easy, masculine</td>
</tr>
<tr>
<td>TakeOut waiteer</td>
<td>Yes</td>
<td>Yes</td>
<td>None received</td>
<td>ig, tw, fb, yt</td>
<td>Climate friendly, young, fresh</td>
</tr>
<tr>
<td>waiteer</td>
<td>Yes</td>
<td>Yes</td>
<td>None received</td>
<td>ig, tw, fb, yt</td>
<td>Premium meals, better delivery</td>
</tr>
</tbody>
</table>

*fb: Facebook, ig: Instagram, tw: Twitter, yt: YouTube, inf: influencers.

The MD apps were all investing heavily in social media, creating profiles that support their brand (table 4). Wolt and JustEat had profiles on TikTok, however not verified profiles as is possible on the media and thus not included here. The use of influencers was present on Instagram and YouTube and often included special promotion codes. The Waiteer app is in itself a social media, with features where the user can follow other users and see and order the same as other profiles.
Figure 5 Overview of the user experience of the MD app JustEat
Figure 6 Overview of the user experience of the MD app Hungry.dk
Figure 7: Overview of the user experience of the MD app Wolt.
Figure 8: Overview of the user experience of the MD app, Waiteer.

Byens bedste takeaway
waiteer.com 15-10-2020

Ordering a meal

Open ➔ Search ➔ Select restaurant

Marketing

Push notifications:

Fri levering på din første bestilling! Brug koden TAKFORMAD, så får du gratis levering på første køb over 99 kr.

Primary focus on women age 18-40. Marketing on Instagram, Snapchat, Facebook og Youtube.
- waiteer employee

SoMe:

Ongoing competition/campaign:

Skovgaard et al. 2021: The Digital Foodscape and NCDs.
Figure 9: Overview of the user experience of the MD app Takeout
4.3 Geographic and demographic results

All MD apps in Denmark provides delivery service in Copenhagen (table 4). The two MD apps providing restaurant-to-consumer option have an increased geographical presence (figure 10). Thus, Hungry and JustEat cover rural areas where the only FOs on the apps are the ones capable of own delivery. These areas generally have less FO options, but the delivery distance is longer as it is not determined by the delivery rider service. The type of delivery riders also affects the delivery range. Wolt and Waiteer almost exclusively use bicycles and their delivery range is up to five and six kilometers. The remaining companies have delivery riders on a mixture of bicycles, scooters, and cars having a longer delivery range. Takeout.dk provide delivery to greater Copenhagen with the longest delivery range, with the infrastructure ready for two more cities on the app.

![Figure 10 Geographical presence of MD apps in Denmark. Blue color marks the areas the MD app provides service in.](image)

The delivery fee charged to the consumer generally corresponds with the distance. Waiteer is the only MD app to have a general delivery fee for all deliveries. The restaurant-to-consumer delivery on JustEat and Hungry is fixed by the individual FO. The commission charged the FO for an order with platform-to-consumer delivery ranges from 15-30 %. The commission is lower if the delivery is a restaurant-to-consumer or a pick-up order. The demographic data from the MD companies averages out to an almost even distribution of genders.
Table 5 Geographical characteristics of MD platforms in Denmark. Data from MD platforms website and mail correspondence.

<table>
<thead>
<tr>
<th>MD app company</th>
<th>Greater CPH</th>
<th>Delivery range</th>
<th>Delivery fee</th>
<th>Commission charged FO</th>
<th>Number of FO</th>
<th>Demographic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>JUST EAT</strong></td>
<td>Yes</td>
<td>12 km</td>
<td>19-99 dkk</td>
<td>22% *</td>
<td>&gt;2400</td>
<td>-</td>
</tr>
<tr>
<td><strong>Hungry.dk</strong></td>
<td>Yes</td>
<td>12 km</td>
<td>19-79 dkk</td>
<td>19.95% **</td>
<td>&gt;1800</td>
<td>M: 60%</td>
</tr>
<tr>
<td><strong>Wolt</strong></td>
<td>Yes</td>
<td>5 km</td>
<td>39-69 dkk</td>
<td>30%*</td>
<td>&gt;600</td>
<td>F: 40%</td>
</tr>
<tr>
<td><strong>TAKEOUT</strong></td>
<td>Yes</td>
<td>25 km</td>
<td>39-249 dkk</td>
<td>20% ***</td>
<td>200</td>
<td>M: 55.1%</td>
</tr>
<tr>
<td><strong>waiter</strong></td>
<td>Yes oct 2020</td>
<td>6 km</td>
<td>39 dkk</td>
<td>&gt;15% ****</td>
<td>225</td>
<td>M: 30%</td>
</tr>
</tbody>
</table>

5 Discussion: Availability, Design-for-Behavior and Commercial Objectives in the Context of the Digital Foodscape

This study provides an overview of MD apps in the Danish digital foodscape, linking the design of the apps’ interface and an assessment of the user experience together with the geographical presence. The assessment of the user experience was based on information provided on the MD apps, the user interface of the mobile application, and each company’s marketing. The results showed extended geographic accessibility and behavior changing elements built into the software and marketing design. Both dimensions have the possibility of a double-edged effect on the public health and diet related NCDs (figure 11).

Delivery range expansion enabled by the digital foodscape (often increased by several kilometers) creates an opportunity to equalize foodscapes [13]. With an expanded delivery radius, the same meal options can be offered across urban neighborhoods of varying socioeconomic status and increase overall availability [13], [21]. The results of our analysis show that most neighborhoods in Copenhagen and cities in general have access to the same FOs due to the overlapping delivery range. However, an existing study show that from rural to urban areas a significant difference in the amount of food outlets exists [14]. The results show that the use of delivery riders, a platform-to-consumer model, is mostly available in cities. Thus, FO in rural areas will in many cases have to administrate their own deliver riders, this might create a barrier for rural FOs to enter the MD apps. Therefore, for the few FOs operating in a rural area, they have a monopoly on the digital foodscape in that region. Thus, the extended availability that MD apps create will have a greater impact on the digital foodscape in areas with fewer FOs registered. This impact can potentially be good, however studies conclude that most food types available on OFD platforms, including MD apps are not considered healthy, with fast-food restaurants being the prevalent FO [13], [14].

Although there is a limited knowledge of nutritional content and quality of food sold on online platforms, MD apps seem to disproportionally increase availability of unhealthy foods. Eating out of home food has been associated with a negative impact on health, and thus MD app and the food options there [3]–[6]. A study from 2020 of the food out of the home consumption including delivery did not find it a driver for high BMI among adults in Scotland supporting that out of home food can exist without a health burden [22].

![Figure 11 Possible development of MD apps. The red arrows show development with negative impact on NCD.](image)

The results indicate that the MD apps decrease the significance of the physical placement of FOs. An important point to make here is that OFD platforms have the power to control what is on the menu and what restaurants are available from a certain user location. If only
one food category sells in a geographical area, the MD company could limit the offering there. Enhancement of unequal food environments through delivery or lack thereof is currently discussed in USA and should have continued attention to not create online ”food deserts” [23].

The results revealed lacking or little information about the FO and the purchasable meals. Without the usual sensory cues available when physically in a FO, the information provided in the digital foodscape is vital. Choosing a healthy meal and assessing portion size based on faulty or lacking online descriptions and pictures is the current scenario that consumers using MD apps make decisions in. The risk of misinformation on the MD apps is high. However, when considering solutions, the negative sides of overloading the consumer with information must also be considered [24]. Government regulations on consumer information should be upheld online and not only in physical FOs. Currently the FO has the responsibility of adhering to these [25]. However, as exemplified with McDonalds, FOs often use several MD apps making controlling all information and how it is presented on the consumer app a demanding job. The results show that regulations on allergen information and food safety reports are not adhered to on all platforms. In terms of policy, it is here relevant to consider whether this is because the MD app did not provide a place for the FO to enter the information or because the FO withheld from providing the information. Both cases create an environment where the consumer makes uninformed food choices.

Providing nutritional values for hot meals is not required in Denmark. However, a set of healthy guidelines for public-kitchens and canteens exists [26]. This could be made available for all FOs and be presented on the MD apps as a guideline or rating. This could further provide a needed verification of the “healthy” category present on four of the MD apps. The categories categorize the FOs and not individual meals; hence, it should be considered whether being in the “healthy” category is claiming that the whole online menu card of the FO is healthy.

The existing label contains guidelines for placement of e.g., sweetened beverages. In the digital foodscape the MD app company and the user interface determines placement in terms of menu order, add-on deals etc. Hence, considerations on how to translate physical guidelines into a healthy user interface should be made. One study suggests that physical guidelines of placing unhealthy items out of sight seem to not translate directly to placing unhealthy items low on an online menu [27]. However, studies on promoting healthy choices online are lacking.

The results furthermore identified a prescriptive user interface, that is built so the user follows a specific flow of ordering with recommendations and offers along the way. With a menu card a thousand times larger than the ones that are presented in physical FOs the consumer is likely to make choices based on the in-app recommendations, the top FOs, and promoted categories and menu items. Especially in the MD apps that did not provide sorting and filter options, the user is presented a list that is likely sorted after what FO paid for promotion or are selling well. An important note here is that since the MD apps have forced registration, they also have the possibility of using personalized recommendation algorithms to promote food that the user profile is likely to buy. In that case, vulnerable
population groups with unhealthy digital food patterns would be held in those patterns. On the other hand, population groups with healthy digital food patterns would keep being promoted healthy items. 

Driving usage and impacting user decisions through manipulative user interface is the reality on several digital platforms and has in turn created waves to redesign digital infrastructure [28]. Considering that some of these tactics may influence food choices and harm the public and individual health, there is a need for effective solutions to remove digital lawlessness. However, in a market with high competition these changes will need to be enforced by policy or consumer driven. An example of consumer driven change, however not health related, was seen when JustEat changed to opt-in instead of opt-out on plastic utensils. Suggestions of policies to create ethical consumer technology exists, and it is now vital to ensure that these encompass the sensitive aspects of nutritional health [29], [30].

The MD companies’ profit comes from the commission charged the FOs and the delivery fee charged the consumer. From a profit perspective, the intent for a purchase is thus to make the overall purchase cost high and to secure a return. The marketing strategies observed supports this. Add-ons, personalized deals, and campaigns work to increase purchase, this could implicitly encourage to overeating. Push notifications, high social media presence, and cashback systems work to make the user return or download the app. Digital food marketing has been shown to improve attitudes towards, enhance intention to use and current use of unhealthy products [31]. The marketing components identified are seamless as they pop up out of the MD app context and even appear in other apps such as social media. The use of social media influencers adds another level of pervasiveness, as it adds a peer-to-peer element of marketing. Further research could investigate to what extent the marketed items (meals, restaurants, partner products) on MD apps can be considered unhealthy commodities. The social media presence, the delivery riders dressed in logos, road advertising, stickers in restaurant windows, and online campaigns all provide indirect exposure of the FO present on the apps. This suggests that MD apps and their marketing should be effectively regulated as the built food environment to minimize the chance of an overall unhealthy food environment [32]. The MD apps are a semi-geographic dimension of food accessibility that should be included in the future characterizations of food environments. Such an approach would allow for a more multidimensional approach to mapping accessibility building on top of the existing studies that almost exclusively look at the built environment [33].

The demographics received by the 3 delivery apps supports existing data from the USA where intention to use was not affected by gender and from the UK where gender differences were insignificant [17], [34]. However, the same study found that males in Australia, Mexico, Canada, and USA have greater odds of using OFD [34]. The data from the MD app that provided age percentages also supports the general finding that OFD usage is inverse with age [34]. The digital foodscape, the MD apps and associated demographic could be unique for every country. Further the results show that though some MD apps operate on a multinational level the availability of MD apps in a specific country will be
unique. Hence extending the research is needed to ensure solutions that work across borders.

There is an ongoing trend towards usage of OFD and with it both dark and bright sides and whether the nature of the impact on health is hard to define [21], [35]. The task is not to stop this trend, but rather to support the healthy and sustainable development of the digital foodscape, and ensure current policy evolves with it to create a level playing field for all stakeholders.
6 Conclusion

The growing OFD market is a disrupter in the food system and poses both challenges and opportunities. MD apps central placement in the food system makes them powerful agents of change and allows them to reach and influence both FOs and consumers.

On the consumer side, it appears that the fast growth in the OFD segment may place a cost on consumers who navigate and make food decisions in unregulated and opaque waters. While evidence of the connection between MD apps and public health is extremely limited, there seems to be a bias towards unhealthy food options on these platforms. Without transparency and equal access to healthy options, consumer-eating behaviors that evolve out of the digital foodscape may ultimately place a burden on public health.

On the other side of the equation, FOs currently have the responsibility to adhere to policies in their physical establishments as well as online. MD apps, acting as an intermediary, muddle this possibility for policy adherence, since MD apps do not always facilitate or support the necessary functionality for adherence to take place.

This study finds that MD apps have the potential to influence consumer food choices and dietary behavior, as well as the information FOs can ultimately share with eaters. The study does not consider the existing MD app ecosystem’s impact as healthy given the disinformation, prescriptive user interfaces, and persuasive marketing tactics prevalent in MD apps. However, the study recognizes and applauds the opportunities MD apps present for facilitating healthy diets in modern, out-of-home food culture.
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8 References


9 Appendixes

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- Appendix B, Page 36-37: Stakeholders and demarcated system
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Appendix A

Skovgaard et al 2021: The Digital Foodscape and NCDs
Appendix B

The Digital Foodscape and NCDs

NCDs & Out of Home Food
THE SYSTEM