



# Towards social life cycle assessment of food delivery: findings from the Italian case study

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## Abstract

**Purpose** The growth of global food delivery (FD), which could reach a market value of 1510 billion dollars by 2027, could raise significant sustainability concerns, especially in terms of the social impact related to the expansion of the gig economy. This study, therefore, aims to analyze the social sustainability of the FD, taking Italy as a case study. The results could be a baseline to suggest practices that could promote a more socially responsible FD sector.

**Methods** Social life cycle assessment (S-LCA) was used, following the guidelines of the Product Social Impact Life Cycle Assessment (PSILCA) and considering four categories of stakeholders (workers, value chain actors, society, and local community), 11 risk categories, and 13 subcategories, mainly based on both the availability of data and their adherence to the objectives of the study and FD.

**Results and discussion** The main risks are associated with low wages, improper working hours, high accidentality, and approximation in food handling. Specifically, the wages of riders, 23% of whom are migrants, are just 14% above the poverty line in Italy and 67% below the median income. With 30-h work weeks, moreover, riders may face high risks of economic vulnerability. Stressful working conditions and the absence of mandatory protective equipment have resulted in 17 fatalities × 100,000 workers and 25 accidents × 1000 workers, which could generate a medium risk that violations of labor laws will occur. All this is also due to the low unionization in the Italian FD. Finally, results also show a flaw in food safety, as riders are not required to have HACCP and ATP attestation.

**Conclusions** Italian legislation and the business models of FD companies are still shown to be insufficient to guarantee the fairness of protections for riders, which are substantiated by low wages, high accident rates, poor union rights, and improper working hours. In addition, doubts are raised about the hygiene of containers carrying food during transport, as they could induce a potential microbiological health risk for consumers, especially related to food handling during transport.

**Keywords** Food delivery · Italy · Social life cycle assessment · Gig economy · Riders · Food safety

## 1 Introduction

In recent decades, the concept of meal delivery has evolved into a value-based service provided by restaurants, driven by changing consumer habits characterized by a desire for

time-saving options and a lack of culinary skills. This transformation has been further accelerated by the widespread adoption of digital technologies, which has reshaped the food delivery (FD) landscape by facilitating the rapid growth of online home food delivery platforms (Galati et al. 2020). The growing popularity of FD can be mainly attributed to the perceived convenience in terms of cost and time (Nigro et al. 2023), as well as, recently, the potential benefit of preventing the spread of diseases such as COVID-19 (Bonfanti et al. 2023). All this has propelled global FD to a market value of about \$1100 billion in 2022, with projections of \$1200 billion by the end of 2023 and \$1510 billion by 2027 (Statista 2023) (Fig. 1A).

In Italy, the trend is similar, with the FD market growing rapidly in value from €800 million in 2020 to €1.8 billion in 2022 (Statista 2023) and an annual growth rate (CAGR)

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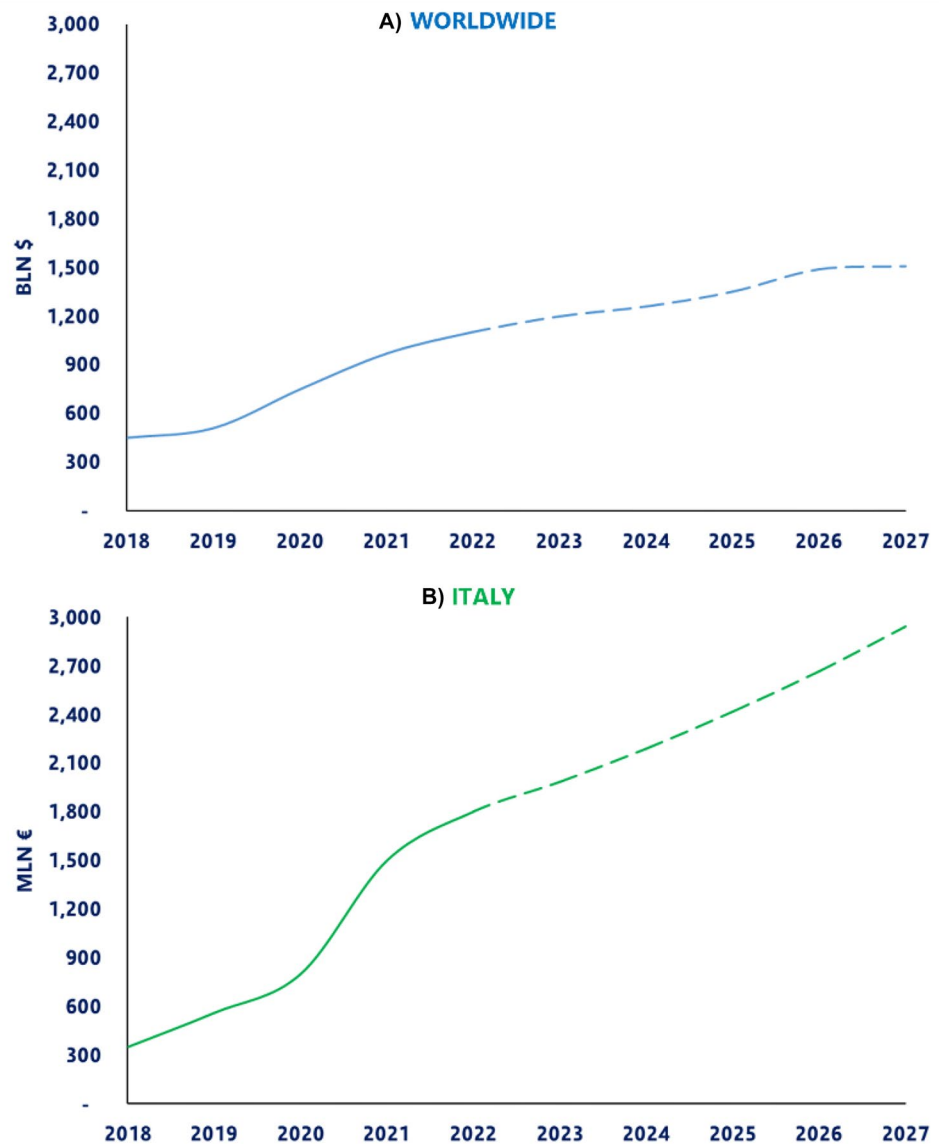
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of +10.3%, for a projected market volume of €3 billion by 2027 (Fig. 1B).

Thus, a strong present and future expansion of the sector emerges that could pose major sustainability challenges, which refers not to all processes in the food supply chain but only to the distribution phase (Galati et al. 2020). Recently, the sustainability of FD has been studied environmentally from the perspectives of packaging (Jang et al. 2023), reverse logistics (Weber et al. 2023), and transportation (Leyerer et al. 2020), but the growing demand for FD, could also have a significant social impact, particularly about the expansion of the gig economy. This term refers to an economic model characterized by on-call, casual, and temporary employment arrangements, rather than stable and continuous employment with greater contractual guarantees (Maffie 2023).

Related to this, one of the key issues to consider is precisely the nature of the concept itself. While the gig economy on the one hand offers flexibility and opportunities for additional or supplemental income, it may also raise concerns regarding job security, fair pay, and access to social protections. Indeed, gig workers (those who work in the FD are known in the public debate as “riders”) often lack the benefits and protections that come with traditional employment, such as health insurance, paid leave, or pension plans, affecting their financial stability, social welfare, and livelihoods. In addition, the algorithmic nature of platforms could determine their earnings based on factors such as delivery volume and distance, resulting in potential economic harm, and this aspect could further worsen the economic insecurity of workers, especially those who rely heavily on these platforms for their

**Fig. 1** The market value of FD globally (A) and in Italy (B), 2018–2027 (projections)



livelihoods, being treated as de facto “human drones” (Gupta and Gupta 2023). In addition, the consequences of the gig economy could also affect the dynamics of traditional employment and the availability of stable jobs. This is because the increase in casual work in the FD could impact the employment practices of restaurateurs, potentially leading to changes in labor demand and job opportunities within the industry.

In light of the above, this study aims to investigate social sustainability within the FD industry. To do so, the social life cycle assessment (S-LCA) (UNEP 2020) was used following the Product Social Impact Life Cycle Assessment (PSILCA) (Eisfeldt and Ciroth 2020), a professional database based on the UNEP framework, consisting of 87 indicators measuring social aspects in different stakeholder categories. Although the literature on FD and the socioeconomic impacts of the gig economy has gained attention in recent years, to the authors’ knowledge no previous study has explored the social dimension of FD using social life cycle assessment. Considering this approach, this research could therefore offer findings that recognize the importance of social sustainability in FD alongside environmental sustainability by considering a holistic and multi-stakeholder perspective. This could be important for multiple parties involved, such as policymakers who face these challenges and who could draw insights from the findings of this study both related to FD and more broadly on the gig economy, as well as consumers, who could make some reflections related to the foods they buy and their handling conditions during some stages of delivery. In addition, it is also important to consider how within the gig economy, the FD faces challenges related to the more general lack of data availability in the sector. Therefore, this study could also be useful in expanding the literature related to the social implications of the FD and the development of more just and equitable policies for the gig economy, through identifying some possible risks. Italy was chosen as the case study for two reasons: (i) it has experienced significant growth in food delivery, making it a potentially important market to examine; (ii) its renowned culinary tradition, with a rich and diverse food culture, could make it an interesting context to study. This case study, although not representative of the entire global industry, could still provide insights and lessons learned that may be valuable for other countries facing similar challenges and opportunities in food delivery.

## 2 Literature review

Currently, Italian FD has been analyzed by a limited number of studies, from which several key findings and gaps emerge. For example, relevant literature indicates that consumers perceive online FD as hurting the environment

and contributing to food waste (Varese et al. 2023) thus, highlighting the need for sustainable practices throughout the food delivery process. Muszyński et al. (2022), on the other hand, point out that delivery platforms in Italy rely heavily on algorithmic management to optimize costs, often employing workers on a casual or self-employed basis, and this could raise concerns about the working conditions and rights of delivery workers. In addition, regional platforms in Italy have formed coalitions with customers, local governments, and workers, leading to better working conditions and improved collaboration (Muszyński et al. 2022). This highlights the potential for positive change through cooperation and collective action. Analysis of digital labor exploitation in Italy, then, exemplified by *Uber Srl*, reveals instances where platforms may fail to comply with contractual conditions and working time regulations, taking advantage of vulnerable individuals (Inversi 2021). This emphasizes the need for legal frameworks to protect workers in the gig economy. However, studies also suggest that free delivery is not economically viable for food delivery platforms in Italy (Seghezzi and Mangiaracina 2021). Furthermore, the impact of increasing demand values on both positive and negative outcomes highlights the complexity of achieving profitability in the industry. Finally, the literature also points out how companies such as *Deliveroo Italy* are undertaking sustainability-oriented initiatives, including the use of sustainable and electric vehicles (Galati et al. 2020), however, encountering little support from institutions to create the infrastructural conditions that facilitate the widespread adoption of such vehicles. The literature indicates, however, that there are a limited number of studies focused specifically on the sustainability of the FD sector in Italy. This suggests the need for more comprehensive research to address various aspects of sustainability in this context. In addition, the literature reviewed focuses mainly on environmental and economic aspects, with limited exploration of the social dimensions. Therefore, although environmental and economic sustainability studies are useful for understanding some forms of FD emissions and impacts, the social dimension is often neglected. By expanding FD research with S-LCA, this study, therefore, aims to fill this possible research gap, and thus provide a more comprehensive assessment of the impacts of FD, thereby considering labor market dynamics, effects on local communities, and consumer welfare.

## 3 Materials and methods

For the social impacts analysis, social life cycle assessment (UNEP 2020) was used, a relatively recent methodology (the first methodological version was published in 2009) for which, unlike environmental LCA (E-LCA), there is

still no reference standard (ISO/AWI 14075 is under development) but only generic guidelines (Iofrida et al. 2018). However, since the basic assumption of S-LCA is to adapt LCA and its standards to the social dimension, the three mandatory steps required for E-LCA, namely *goal and scope definition*, *life cycle inventory (LCI)*, and *life cycle impact assessment (LCIA)*, were followed in this study and will be explained in detail in the following paragraphs. The literature proposes different methodologies for conducting social impact assessment. In particular, Richter et al. (2023), identified that the best-known approaches are the Social Footprint Method (SFM) (McElroy 2008), SeeBalance (Schmidt et al. 2004), and S-LCA (UNEP 2020), which covers about 80% of social sustainability studies internationally. Then there are a further plethora of approaches, including, just a few, contingent valuation method (CVM) (Nautiyal and Goel 2021), social return on investment (SROI) (De Leon 2021), most significant change (MSC) (Henry et al. 2022), labor process theory (LPT) (Braverman 1998) or multi-criteria decision analysis (MCDA). However, some reasons mainly related to practicality and applicability to the FD context, relevance to the study, and resources have led to the preference for S-LCA over these methodologies. For example, the SFM, which describes a context-based approach to measuring, managing, and reporting an organization's social sustainability performance, covers only a few issues, risking underestimating the problem. SeeBalance, on the other hand, covers just socio-efficiency, while not considering pure social sustainability. The CVM, being mostly based on interviews to determine willingness to pay to estimate the economic value of goods with no market value, could be susceptible to doubt and lead to wide variability in the quality of results, as also noted by Whitehead and Haab (2013). The S-ROI, an impact evaluation framework that measures the intangible social values used in both for-profit and nonprofit types of institutions, is sometimes found to be too subjective and judgmental (Gibbon and Dey 2011), difficult to quantify (Lowe 2013), as well as susceptible to risk in overlooking some context and process elements. MSC is a method used to integrate evaluations of the outcomes and impact of a given program through mini-narratives that contextualize the effect a program has on individuals. However, it was excluded because it was inconsistent with the objective of the study. LPT, on the other hand, is a Marxist approach in the study of production relations in industrial capitalism (Gandini 2019), in which managers seek to control the way work is organized, the pace and duration of work (because it is decisive for profitability), and could focus exclusively on the worker-employer relationship, while not considering the social implications along the entire value chain, thus excluding a broader group of stakeholders as in the case

of S-LCA. In fact, by using S-LCA, one could investigate not only the conditions of the workforce but also broader social ramifications thus ensuring a more inclusive evaluation than the relatively narrow focus of work process theory. Finally, MCDA methods are a collection of systematic approaches developed specifically to support the evaluation of alternatives in terms of multiple and often conflicting objectives (Krainyk et al. 2021), seeking to identify the choice whose consequences would imply greater social development value. Decision analysis theory is designed to help an individual or group in choosing among a set of pre-specified alternatives. While particularly useful when comparing different social, economic, and environmental indicators (Zanghelini et al. 2018), MCDA evaluation methods could consider many more subjective elements when evaluating different criteria (e.g., stakeholder opinions), as also confirmed by Myllyviita et al. (2017) and Torre et al. (2024).

In addition, the choice of S-LCA was also supported by additional, no less important reasons: First of all, since the objective of this research is to provide a broad assessment of the social dimensions of food delivery, S-LCA was deemed the most suitable methodology due to its systematic framework, which allows for a more structured analysis, encompassing various social aspects, reaching as far as consumer protection. Then the use of life-cycle approaches (LCA, LCC, and S-LCA) as a tool to promote the shift to sustainable patterns of production and consumption is increasingly recognized internationally. In particular, S-LCA currently has broad scientific consensus and is the most widely considered approach in the literature for assessing social sustainability, as also extensively documented by Tragnone et al. (2022) and Richter et al. (2023). This, then, could lead, for example, to easier comparability between similar studies. But also, because, in addition to being particularly useful in the broader range of CSR tools, the S-LCA framework is distinguished by its multiple connections with global initiatives (Agenda 2030, 10-Year Framework of Programs on Sustainable Consumption and Production, the International Labor Organization's Decent Work Agenda, Guiding Principles for Business and Human Rights) (UNEP 2020), thus aiding in their pursuit. Moreover, the above is also associated with the fact that recently, several research needs have been expressed, including the application of S-LCA in case studies (Ramos Huarachi et al. 2020), which further motivated this study. Finally, a concluding element that was particularly important in choosing S-LCA among the many social impact assessment methodologies was the possibility of being able to be guided by the PSILCA database (Eisfeldt and Ciroth 2020), which provided internationally recognized threshold values and guidelines that could then return results that were reproducible and as comparable as possible with other future studies, in other contexts, and for

other products or services. Thus, while recognizing the presence of various methodologies for assessing social impacts, the decision to use S-LCA was influenced primarily by the context and objective of the study (to provide an overview of the social sustainability of FD in Italy), its proven applicability in similar contexts, its ability to effectively integrate stakeholder perspectives according to a holistic view, as well as its robustness and acceptability in the international field, also under the forthcoming ISO 14067.

### 3.1 Goal and scope definition

The main purpose of S-LCA is to provide decision support, which can create an effect if decision-makers follow the outcome of the assessment and choose the alternative with the most favorable social consequences (Di Cesare et al. 2018). In the UNEP guidelines, social impacts are interpreted either as consequences due to specific behavior engaged in by one or more stakeholders, as a downstream effect of socioeconomic decisions, or concerning attributes possessed by an individual, group, or society. Therefore, consistent with UNEP, the S-LCA goal of this study is to consider the potential negative social impacts within the FD sector in Italy, to highlight the specific behavior of one or more stakeholders, and then present the results according to different levels of risk for different groups of stakeholders. In this way, the study could then help to measure the possibility of negative effects occurring in the FD sector and then avoid them through one or more preventive actions. As far as the functional unit (FU) is concerned, since social impacts are intangible, in S-LCA studies, they are not dependent on physical flows (Wei et al. 2022) and are not necessarily proportional to them, but reflect the influence of the sector's behavior toward various stakeholders (Zamagni et al. 2021). Therefore, although ideally, we could refer to a unit of food packaged and delivered in Italy, for a conceptual issue, i.e., both because the social impacts might not be related on a linear scale and because of the variability of the foods in FD, the FU is not defined. This choice is also consistent with other literature on S-LCA studies. These include, for example, Mulyasari et al. (2023), who in a study related to the social impacts of palm oil show that because it is difficult to relate intangible social impacts to physical flows, they do not consider a FU. Even Umair et al. (2015), who, in their study regarding the management of all ICT e-waste entering the informal recycling sector in Pakistan, using only qualitative data on social impacts, do not express impacts by FU, which only serves to specify the scope of the assessment. And finally, Macombe et al. (2018), call the introduction of functional units in S-LCA studies a “*stubborn insistence*.” This is because the very relationship between the quantity of FUs and the magnitude of impacts is purely linear, that is, the magnitude of impacts caused by  $n$  FUs is  $n$  times the

magnitude of impacts caused by one FU. In contrast, on the other hand, for example, union freedom does not depend on the number of shoes sold. Regarding system boundaries, the S-LCA, being still evolving, shows some methodological weaknesses and shortcomings, including difficulties in defining system boundaries in detail, as also pointed out by recent literature studies (Tragnone et al. 2022). Indeed, since this is a sectoral study and not a product study, it might be difficult to enclose FD in a well-delineated boundary. Veri-similarly, the geographical boundaries of the sector include the Italian state since the study is about FD in Italy. From a process perspective, ideally, the study could be *gate-to-gate*, as it considers the social impacts of workers during the transport phase (so when the product leaves the restaurant or point of sale, excluding the food preparation phase) until the moment of consumption, excluding end-of-life.

### 3.2 Social life cycle inventory

The data used are mainly quantitative and to a lesser extent qualitative and are collected from various fully public secondary sources. In particular, the following were considered as follows:

1. The first national collective bargaining agreement related to the rider category, signed by *AssoDelivery*, an association representative of the Italian food delivery industry, which includes *Deliveroo*, *Glovo*, *Just Eat*, *Social Food*, *Uber Eats*, and the “Unione Generale del Lavoro (UGL)” (AssoDelivery and UGL 2020). It contains data on hours worked by riders as well as their hourly pay.
2. The “Osservatorio nazionale incidenti rider food delivery,” is a report containing data on fatal and non-fatal accidents involving riders during food deliveries (ASAPS 2019). In this way, it was possible to find data on the number of accidents during deliveries and thus estimate workplace injuries, both fatal and non-fatal, evidence of violations of laws and employment regulations as well as violations of mandatory health and safety standards.
3. The websites of the four major players operating in Italy are *Deliveroo*, *Just Eat*, *Globo*, and *Uber Eats*. This is to find data on both the possibility of child labor occurring and the presence of mandatory worker protection measures.
4. ESG reports of the four companies mentioned above, to understand their codes of conduct toward workers and thus whether they participate in supply chain social responsibility initiatives, as well as the presence of gender wage gaps. In the latter case, only *Glovo*'s report (2021) showed data on their workers' wages.
5. The Bank of Italy's report regarding the food delivery sector in Italy, which analyzes the individual characteristics and work histories of rider working there (Giorgiantonio



and Rizzica 2018). This report was used to extrapolate data on the share of migrant workers in the Italian FD, since, to the authors' knowledge, it is currently the only one to quantify data on this issue.

6. Regulation (EC) No 852/2004 was enacted to legislate on food hygiene and introduce Hazard analysis and critical control points (HACCP) as the methodological tool needed to conduct hazard analysis, thus identifying the most effective food safety and prevention procedures. This regulation was read in full to ascertain whether Food Delivery needed HACCP certification, and thus, to extrapolate qualitative data (Yes/No).

However, because some of the necessary data were not readily available (particularly those related to trade unions and forced labor, due to the absence of specific databases), generic data were extracted from PSILCA (Eisfeldt and Ciroth 2020), which refers to national statistical agencies, intergovernmental organizations, etc. Specifically:

1. "Trade union density rate" data were extrapolated from the Ilostat database, whose most common sources for statistics on union membership and collective bargaining coverage are administrative records (kept by unions or government agencies).
2. For forced labor, data on modern slavery from the Global Slavery Index (2022), an annual index representing the level of slavery conditions in nations around the world (from Walk Free Foundation), were used.

Social inventory indicators were mostly defined by simple variables (e.g., hourly wages, hours per week, number of workplace injuries, etc.) to provide the current status of the delivery process in the FD. An overview of the various inventory data and their respective sources is available in the supplementary materials (Table S1).

### 3.3 Social life cycle impact assessment

Depending on the different objectives of those carrying out the study, from a methodological point of view, in S-LCA studies, there are two families of social life cycle impact assessment approaches: One assessment with respect to a reference scale, called reference scale assessment (RS S-LCIA), also known as Type I and another assessment that considers a cause-and-effect relationship called impact pathway assessment (IP S-LCIA), also known as Type II (Sureau et al. 2020). The latter estimates the implications of different pathways to an endpoint, thus enabling the assessment of long-term impacts through various correlations (Orola et al. 2022). However, IP S-LCIA is more difficult to apply, mainly because of the obstacles associated with defining cause-and-effect mechanisms in the social context, turning

out to be in fact scarcely used, as also confirmed by literature studies (Tragnone et al. 2022; Zafar et al. 2024). The Type I approach, on the other hand, relies on data, information, or judgments and provides an immediate assessment of performance and risks (e.g., at the inventory indicator level) and not the further propagation of effects, effectively not establishing a link between activity and long-term impacts. Instead, based on available information, it estimates the likely magnitude and importance of potential social impacts. For this reason, the collected data are compared with performance reference points (PRPs) (e.g., the number of hours per week worked by the individual worker is compared with the 40 h per week defined by the convention of the International Labor Organization). Therefore, RS S-LCIA provides for the development of a reference scale with explicitly defined levels for each inventory indicator, collected in the LCI phase (UNEP 2020). The reference scales can be represented in three main ways: (1) in non-numeric terms (colors, letters, tick marks); (2) with linear scores, where each level of the scale corresponds to a value above the previous one and thus to better performance; and (3) with non-linear scores, where each level of the scale is assigned, a customized value based on the gap to be defined between two levels of the scale. Within this study, the method chosen to convert the inventory collected in the previous stage into potential social impacts is the Type I approach. The reasons for this choice are as follows: First, it is considered the most current and widely used approach in case study applications (Mármol et al. 2023), as well as being a particularly straightforward measure. This is consistent with the aim of the research, which is not to delve into the long-term effects of FD in Italy, but to focus, on the basis of readily available data, on the social risks related to the behavior of the actors and organizations involved in FD, providing an overview of the state of the art in the relevant context. Secondly, S-LCIA Type I has a close link to social reporting approaches, such as corporate social responsibility standards (Sureau et al. 2020). This could be particularly important in the food delivery sector, where companies are expected to report on their social responsibilities, especially when a poorly protected category, such as riders, is involved. This could be further true, especially considering aspects such as the fair treatment of riders, their rights and wages, as well as safety standards and other social implications related to their operations. This connection could then serve as a basis for assessing and improving the social sustainability of FD. In addition, RS-LCIA is in line with major S-LCA databases (Bouillass et al. 2021), such as PSILCA, which is an important support for this study.

Finally, since the Type I approach allows for the evaluation of all stakeholder groups and their subcategories, it is more consistent with the multi-actor perspective discussed in this paper. At this point, for the evaluation of the collected

data, PRPs were defined for all quantitative indicators to estimate social risk compared to some international standards, local legislations, labor laws, etc. Specifically, the PRPs considered in this research are the same as those proposed by PSILCA, and they vary according to the various indicators, with maximum and minimum values, with ranges divided into five equal parts leading to linear scores and a scale composed of six social risks (Eisfeldt and Ciroth 2020): no risk, very low risk, low risk, medium risk, high risk, and very high risk. These different levels of risk were then represented through a speedometer chart in which each risk corresponds to a different color (respectively: dark green, light green, orange/yellow, red, dark red). As an example, in the case of the subcategory “children in employment,” which defines the category “child labor,” the indicator is the percentage of children aged 7–14 years involved in employment and the PRPs are as follows: 0 (no risk),  $0 < y < 2.5\%$  (very low risk),  $2.5\% \leq y < 5\%$  (low risk),  $5\% \leq y < 10\%$  (medium risk),  $10\% \leq y < 20\%$  (high risk), and  $20\% \leq y$  (very high risk), as well as no data (Eisfeldt and Ciroth 2020). So, for example, if a value should be 3%, then it falls within the PRP 2.5–5%, indicates a low-risk (light green), and so on for each indicator. After that, consistent with UNEP guidelines that propose a point scale (one to five), each risk was given a numerical score from 0 to 5. Specifically: 0 = no risk; very low risk = 1; low risk = 2, medium risk = 3; high risk = 4, very high risk = 5, and the results were finally expressed through a radar chart, also in agreement with other studies, such as Tokede et al. (2020) and Gompf et al. (2022). A more complete overview of reference scales and PRPs can be found in the supplementary materials (Table S2). Regarding stakeholder categories, i.e., groups of people involved in the value chain of the product system (Bouillass et al. 2021), four were considered, consistent with UNEP guidelines. Specifically: workers, value chain actors, society, and local community. Eleven risk categories were then chosen: child labor, forced labor, fair salary, working time, discrimination, health and safety, social benefits, legal issues, workers’ rights, promoting social responsibility, health and safety, and migration. Finally, the subcategories chosen are 13 (Children in employment, frequency of forced labor, sector average wage per month, hours of work per employee per week, gender wage gap, fatal accident at workplace, provision of protection for employees, evidence of violations of laws and employment regulations, trade union density, membership in an initiative that promotes social responsibility along the supply chain, violations of mandatory health and safety standards, presence of management measures to protect consumer health and safety, migrant workers in food delivery), each of which in turn is expressed by indicators. The reason behind the choice of these categories is twofold and can be attributed to both the availability of the data and their fit with the food delivery industry and the various impact

categories. The stakeholders, risk categories, and subcategories, as well as the various indicators, are described in the following paragraphs.

### 3.3.1 Workers

**i) Child labor** This category includes children in employment within the FD sector, thus referring to the percentage of children aged 7–14 years involved in economic activities for at least 1 h in the survey reference week (World Bank 2023). Of course, this is a very broad definition that does not consider either the severity or hazardousness of the work or whether children are deprived of the opportunity to attend school. Furthermore, cultural beliefs or local laws that allow a certain amount and type of child labor are not considered. Data on child labor should be collected at the sector level, but due to the lack of quantitative data, the regulations for accessing the four most popular delivery platforms in Italy (Deliveroo 2023a; Glovo 2023; Just Eat 2023a; Uber Eats 2023a) and becoming riders were considered.

**ii) Forced labor** Forced labor is defined as “any work or service which is required of a person under the threat of punishment and for which that person has not volunteered” (ILO 1930). Currently, it is still very difficult to identify due to the lack of reliable national estimates based on specialized data collection tools. As a result, it is difficult to obtain quantitative data on the frequency of forced labor in different sectors and countries. However, in this study, the frequency of forced labor (cases per 1000 population) was considered according to the Global Slavery Index (2022) and compared with literature data.

**iii) Fair salary** In September 2020, AssoDelivery (the association representing the Italian food delivery industry to which the main platforms adhere) and the “Unione Generale del Lavoro (UGL)” Rider signed the first National Collective Labor Agreement (*Contratto collettivo nazionale del lavoro, CCNL*) for riders, which classifies them within the scope of self-employment. This CCNL shows how, theoretically, the hourly wage should be 10€ gross per hour, which net is about 7€, although there is an algorithm that classifies riders based on parameters (speed, means of transportation, etc.) and defines their deliveries (Lin et al. 2020). Therefore, based on this and following PSILCA guidance, the “average monthly sector wage” was analyzed, which expresses the risk that the wage is too low to allow for a decent living and is expressed as a score calculated based on the average industry wage divided by the living wage or minimum wage in the same country for the year 2022. Average monthly wages in the FD sector in Italy (AssoDelivery and UGL 2020) were considered for the calculation, and since there is no minimum wage law yet, they were related to the living wage (Wageindicator.org 2019), as expressed by PSILCA guidelines.

**iv) Working time** Weekly hours per employee were considered to assess whether the actual number of hours worked by employees in the FD complies with International Labor Organization (ILO) standards and national regulations on working hours (ILOSTAT). Excessive working hours prevent a sustainable work-life balance, while too few working hours limit a satisfying professional life. Therefore, the indicators chosen for this subcategory are weekly working hours per employee (AssoDelivery and UGL 2020).

**v) Discrimination** In this case, the gender wage gap was examined. The Organization for Economic Co-operation and Development (OECD) defines the gender wage gap as “the difference between median earnings of men and women relative to median earnings of men if wages of men are higher. Otherwise, it is the difference between median earnings of men and women relative to median earnings of women” (OECD 2023). Since there are no data on wage values in Italy in the FD sector, only data reported by one of the four largest FD players in Italy (Glovo 2021) were considered (e.g., the only one to show their salaries in their sustainability reports), and the gender wage gap was calculated according to Eq. (1) if wages of men ( $M_w$ ) are higher than wages of women ( $F_w$ ), and according to Eq. (2) if it was the other way around.

$$\frac{M_w - F_w}{M_w} \times 100 \quad (1)$$

$$\frac{M_w - F_w}{F_w} \times -100 \quad (2)$$

**vi) Health and safety** Workplace fatalities were considered for this category (cases  $\times$  100,000 workers). Data for this indicator were taken from the statistics of the Rider Food Delivery Observatory (*Osservatorio nazionale incidenti rider food delivery*) (ASAPS 2019), which compiles and analyzes road traffic accidents involving FD riders, either by motorcycle or velocipede. The data are for the period January 1, 2019–October 25, 2019. These data are the most recent available and refer to cases of violations that resulted in injury, hospitalization, or death of employees. Therefore, the risk assessment scheme is based on the distribution of deaths per 100,000 employees, and to obtain this, the number of riders (22,500) in the same year was considered (AssoDelivery 2019), according to Eq. (3).

$$C_x = \frac{D_x \times 100,000}{R_x} \quad (3)$$

where

- $C_x$  is the number of cases  $\times$  100,000 employees
- $D_x$  is the number of fatal accidents (2019)
- $R_x$  is the number of total riders (2019).

**vii) Social benefits, legal issues** Evidence of violations of laws and employment regulations was considered in this case, as they are a threat to employee welfare and therefore a potential social impact. Occupational health and safety depend primarily on the hazards and risks to which employees are directly exposed in their work environment, which can be limited by appropriate measures taken by employers. The primary intention is to promote and ensure occupational safety and health and reduce deaths, injuries, and illnesses in the workplace. The information on these violations is an extension of the previous risk categories, which, instead of considering only deaths, also examines serious hospitalizations and injuries, per 1000 workers (ASAPS 2019). Thus, the risk assessment scheme is based on the distribution of total violations per 1000 employees, according to Eq. (4).

$$K_x = \frac{V_x \times 100,000}{R_x} \quad (4)$$

where

- $K_x$  is the number of cases  $\times$  100,000 employees
- $V_x$  is the number of violations (claims, hospitalizations, or deaths)
- $R_x$  is the number of total riders (2019).

**viii) Workers' right** To analyze this category, trade union density was taken as a reference, which is used to assess the exercise of the right to organize freely and measure the risk of workers not organizing into unions. Since the right to organize into trade unions is essential to collectively defend workers' interests and rights, higher density rates (tending toward 100%) are considered an indication of better or more liberal associational conditions. In the case of our analysis, since no industry-level data are available, the indicator “trade union density rate” in Italy was considered, but not specific to FD (ILOSTAT 2022). Therefore, risks were assessed based on the possibility that, for example, FD occurs according to a certain behavioral pattern typical of the reference country. This is because it might still be useful to consider the social effects that might affect the generic category of workers, within which those of FD are included.

### 3.3.2 Value chain actors

**i) Promoting social responsibility** Social responsibility is understood as the obligation of a company to operate in a way that considers the interests and needs of all its stakeholders, i.e., employees, customers, community, and society. For this indicator, therefore, the Environmental, Social, and Governance (ESG) Reports of the four major FD companies operating in Italy (Deliveroo 2023b; Glovo 2021; Just Eat 2023b; Uber 2023b)



were considered, and the presence or absence of activities in support of workers and for their well-being was assessed.

Then the data were normalized by considering whether in the ESG the company treats the topic thoroughly (there is no risk of unsustainable business practices) or superficially or poorly (there is the risk of unsustainable business practices). S-LCA does not provide in an industry-wide manner the ability to provide quantitative estimates to assess the extent to which social responsibility is taken seriously and ensured by companies within specific industries, but it might be useful to implement a qualitative approach.

### 3.3.3 Society

**i) Health and safety** Two indicators have been chosen for this category: (i) Violations of mandatory health and safety standards; (ii) the presence of management measures to assess consumer health and safety.

- i. The first can be used to measure a country's overall compliance with mandatory health and safety standards and indicates occupational health and safety conditions that may reflect poor/good worker health protection in a country. The risk assessment was based on the number of cases per country (ASAPS 2019) about the available workforce (ISTAT 2019). The more cases of violation relative to the total number of workers, the more likely the risk of injury, but this indicator could also indicate insufficient precautionary measures in the industry.
- ii. Furthermore, as for the presence of management measures to assess consumer health and safety, the European regulations on serving food were considered, based on the food safety standards defined by European legislation, namely Regulation 178/2002, on the general principles and requirements of food law, and Regulation 852/2004 on the hygiene of foodstuffs, transposed at the national level by Legislative Decree 193 of 2007. These regulations mandate the use of the Hazard Analysis and Critical Control Point (HACCP) system, a preventive approach that aims to reduce hazards in the food production process and services, including food delivery. A qualitative scale (yes = low risk, no = high risk) was used for this indicator to consider whether or not businesses, riders, and restaurants implement measures to protect consumer hygiene.

### 3.3.4 Local community

**i) Migration** Finally, for this category of stakeholders, the share of migrants in the sector was chosen based on data from the Italian Central Bank in 2018 for the period

2012–2017 (Giorgiantonio and Rizzica 2018), which is the only study currently available on the distribution of riders in Italy.

## 4 Results and discussions

From the results of the study, shown in Table 1 and Fig. 1 (normalized results), the potential social performance of FD in Italy could be inferred and understood. However, it might be useful to clarify two aspects:

- 1) Social performance is expressed in terms of risk. This is because if information on social effects is not available at the product level, social effects cannot be attributed with certainty, and therefore risks are considered (Sala et al. 2015). If it is not possible to know with certainty the social impact of producing a specific good or service (at least for policy purposes) it may be sufficient to know the probability that a product or service is associated with an externality (Traverso et al. 2018). From an analytical point of view, the use of the notion of risk has the advantage that risks so conceived can easily be used as explanatory factors in policy analysis. Social risks can undermine growth prospects or jeopardize other key policy objectives, and thus perceived risks (rather than actual risk realization) could prompt actors to change their behavior.
- 2) Although, among other shortcomings, no clear methodology for impact assessment is provided in the guidelines (Gompf et al. 2020), the risks defined by a social impact assessment, as the UNEP guidelines also explain, are potential risks and not probable risks (which does not mean they will necessarily occur), as well as the result of interpretations.

### 4.1 Workers

#### 4.1.1 Child labor

In considering this category, we tried to subscribe to the top four FD players operating in Italy (Deliveroo 2023a; Glovo 2023; Just Eat 2023a; Uber Eats 2023a), from which it emerges that to become a rider, the basic requirement is to be 18 years of age or older, with the requirement to attach an ID. Therefore, since companies are prohibited from hiring children under the age of 18, it could be argued that there is no risk of FD inducing or worsening child labor in Italy (Fig. 2A), although school closures and family job loss caused by the pandemic could push children more into FD work (Rodriguez and Burke 2023), as poverty and economic hardship faced by families could

**Table 1** Results of the S-LCA for the Italian FD

STAKEHOLDERS	CATEGORIES	SUBCATEGORIES	INDICATORS	VALUE	SOURCE
<b>WORKERS</b>	Child labor	Children in employment	% of children in employment ages 7–14	0	Deliveroo 2023a; Glovo 2023; Just Eat 2023a; Uber Eats 2023a
	Forced labor	Frequency of forced labor	Cases of forced labor × 1000 employees	2.43	Global Slavery Index 2022
	Fair salary	Sector average wage per month	Score	1.14	AssoDelivery and UGL 2020 Wageindicator.org (2019)
	Working time	Hours of work per employee, per week	h	30	AssoDelivery and UGL 2020
	Discrimination	Gender wage gap	%	24.05	Glovo 2021
	Health and Safety	Fatal accident at the workplace	Cases × 100,000 employees	17	ASAPS 2019 AssoDelivery 2019
			Provision of protection for employees	Y/N	N
	Social benefits, legal issues	Evidence of violations of laws and employment regulations	Cases of injuries × 1000 employees	1.1	ASAPS 2019 AssoDelivery 2019
	Workers right	Trade union density	%	32.5	ILOSTAT 2022
	<b>VALUE CHAIN ACTORS</b>	Promoting social responsibility	Membership in an initiative that promotes social responsibility along the supply chain	Y/N	Y
<b>SOCIETY</b>	Health and Safety	Violations of mandatory health and safety standards	Cases of violation relative to the labor force	0.000001	ASAPS 2019 ISTAT 2019
		Presence of management measures to protect consumer health and safety	Y/N	N	Regulation (EC) No 852/2004
<b>LOCAL COMMUNITY</b>	Migration	Migrant workers in food delivery	% of total workers in the sector	23%	Giorgiantonio and Rizzica 2018

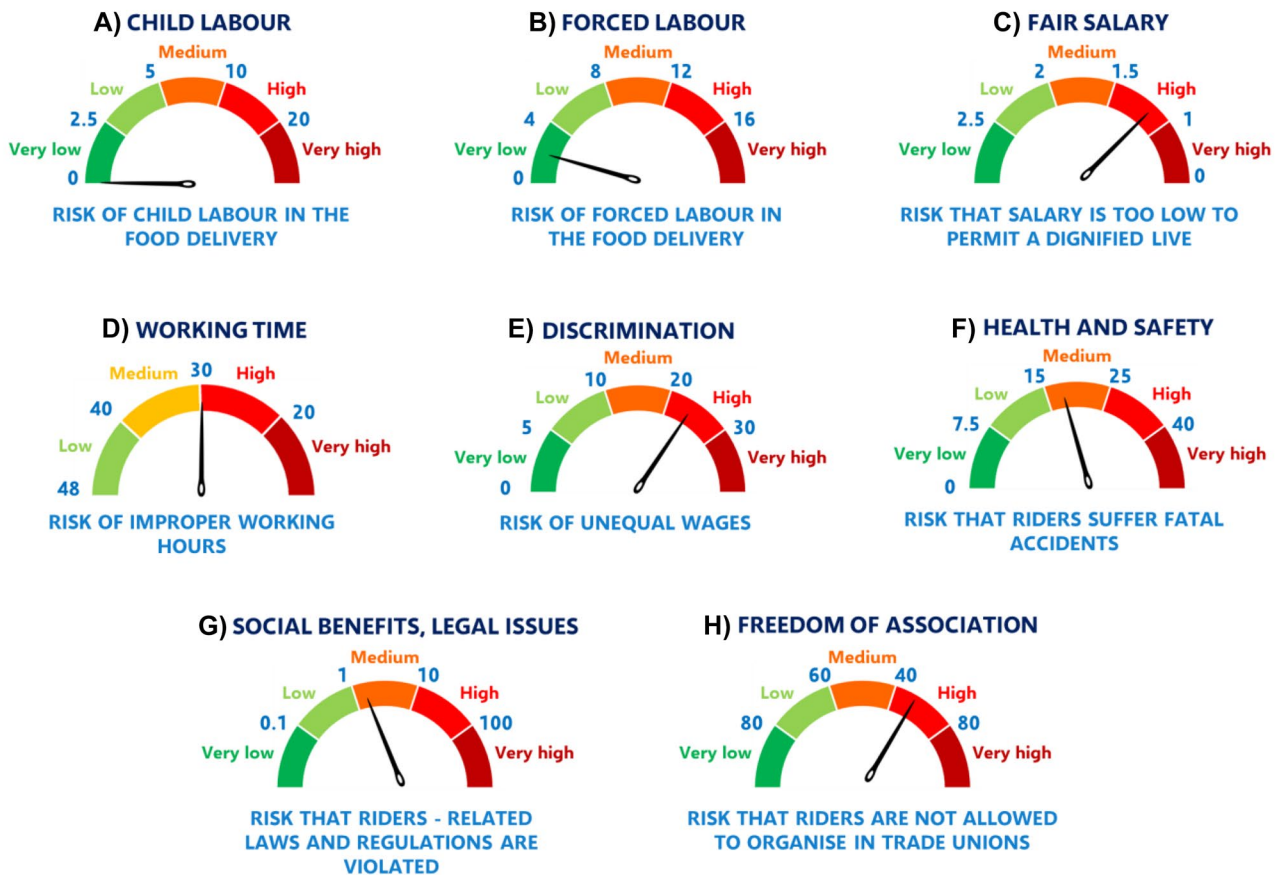
induce vulnerable situations where children are forced to contribute to family income. In reality, while it is true that in any case children might attempt to circumvent the age of majority requirement by using data and documents from their parents and siblings, it cannot be ruled out a priori, and it is still important to consider the current situation and available data. In fact, to date, no cases of child exploitation specifically related to FD work have been reported in Italy (although Child labor is notoriously difficult to document especially because abuse often goes unreported). Therefore, in Italy, there may be no risk of child labor in the FD sector (Fig. 2A). However, in light of the above, it is also important to remain vigilant and monitor some potential changes in the future. To ensure and prevent potential child labor in FD, synergy between delivery companies and regulatory bodies is important so that the enforcement of the age limit is carefully

and continuously monitored, while still considering the dynamics of the FD industry and its potential impact on vulnerable populations.

#### 4.1.2 Forced labor

Considering the Global Slavery Index (2022), one of the two main international references related to forced labor in S-LCA studies, it is interesting to note that Italy shows a very low risk of forced labor. In detail, forced labor cases are 2.43 cases per 1000 people, indicating a very low risk of forced labor (Fig. 2B). In this regard, it is important to mention a specific case that shows the commitment of Italian authorities to combat forced labor in the FD. In 2021, Milan prosecutors uncovered a subcontracting system that led to labor exploitation and *caporalato* (a recruitment system based on exploitation often associated

## WORKERS



**Fig. 2** Results of S-LCA normalized for workers' stakeholder category

with forced and bonded labor) (Scaturro 2021) within the Italian FD industry (Procura of Milan 2020). Indeed, it was found that a delivery company was exploiting migrant workers through an intimidating system of threats, wage withholding, illegal tax provisions, and other exploitative practices (Inversi 2021). Specifically, the riders, hired on casual self-employment contracts, were forced to work grueling shifts, sanctioned in case of behaviors undesirable to the principal, and endangered in their mental and physical integrity. Moreover, the riders were largely foreigners, international protection seekers, and residents of shelters and thus particularly fragile individuals, making them particularly vulnerable and susceptible to exploitation due to their precarious legal status in the country. However, while the chronicle (Procura of Milan 2020) and the existing literature (Inversi 2021; Iazzolino and Varesio 2023) suggest the existence of risks related to forced labor in the Italian FD sector, it remains difficult to quantify the exact extent of the problem due to the absence of complete

and specific data in the sector, although the current available data show a very low risk, which is comforted by the prompt response of Italian institutions.

### 4.1.3 Fair salary

Each rider, being classified as self-employed, works according to demand (Melián-González 2022). However, in FD it is useful to exclude time slots when there is no demand (such as, for example, from 3 to 6 p.m.), and thus, considering 4–6 h of work a rider could earn approximately 720€ net per day (Assodelivery and UGL 2020). Relating this value to the subsistence wage in Italy, which is 630€/month (Wageindicator.org 2019) yields a value of 1.14, which means that there may be a high risk that riders' wages are too low to allow the worker a decent living (Fig. 2C). Examining these data in the broader national economic context, an average monthly wage of €720/month is –67% compared to the median income in Italy (€1918 net per

month) and – 50% compared to the minimum wage in the service sector (€1260/month) (ISTAT 2022) (Fig. 3).

Such data, in addition to classifying riders into the category of *low-wage workers* (i.e., employees whose hourly wages are less than two-thirds of the national median value), could set up a stagnant wage situation and a prime cause of poverty. Therefore, these findings could raise concerns about the income inequality of riders and their ability to achieve a fair standard of living also because such an income does not even allow for livelihood, housing, and the right to a decent life. Moreover, such wages could not only impact their financial well-being but also have broader implications for their social equality and general well-being. And indeed, FD companies have been criticized and sanctioned because of the kind of employment they promote (Schor 2016; Belanche et al. 2021).

#### 4.1.4 Working time

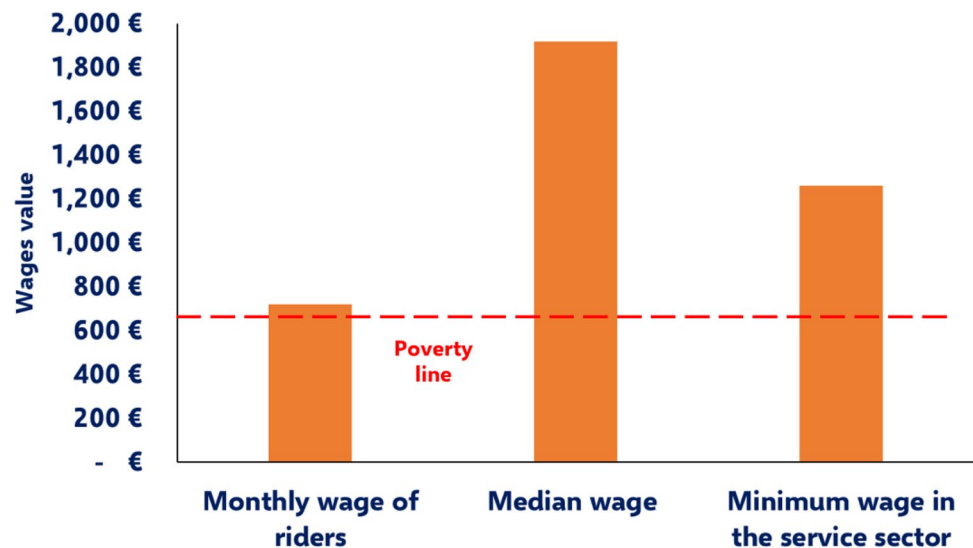
Riders do not have a set weekly schedule, but considering peak demand time slots (12–14, 19–22) and high turnover (Melián-González 2022), the employee could work for about 4–6 h per day, which weekly corresponds to 24–36 h, for an average of 30 h per week. The risk that could occur in this category is based on ILO Convention No. 1 (1919) and 47 (1935), which regulate optimal working hours as 8 h per day for 40–48 h per week. All extra hours worked configure an improper work risk, but even hours worked less are still considered improper because they may not allow the worker to achieve their professional goals. Thus, considering the value of 30 average hours per week, it lies in a borderline range between medium and high risk that riders will incur improper work hours (Fig. 2D) and thus be unable to fulfill their professional ambitions and goals. A few hours of work

could induce low earnings, confirming the point made in Sect. 4.1.3, as they could limit opportunities for personal development as well as to pursue other personal interests, hindering their ability to realize their aspirations and establish a good career path. However, these findings should also be put into context. Studies show that oftentimes riders could also be people who want to earn short-term money for a given time (e.g., students) (Goods et al. 2019). Therefore, while FD in Italy could provide opportunities to support oneself during periods of study when conceived as a main work activity, riders who are unable to work sufficient hours to provide them with a stable income may find themselves in precarious work situations, generating economic vulnerability, limited social mobility and a growing gap with the rest of society.

#### 4.1.5 Discrimination

Although specific data on pay differences in the FD sector in Italy are not readily available, it might still be useful to address the potential risk of pay disparity, which has been observed in some contexts within the sector. For this reason, the only available data regarding the difference between operator wages in FD were considered, namely general data for one of the four largest FD companies (Glovo 2021). Considering 2021 data, female workers (staff) received on average gross, €37,000 versus €28,000 for male workers, a gender gap of 24%. This case is not relative to Italy, and it is not representative of the category as a whole, but it could be indicative of a behavioral pattern that could spill over into the industry, including Italy, and that could lead to a high risk that there are unequal wages between men and women (Fig. 2E). This gender gap, however, should not necessarily be viewed negatively, as higher pay for the female sex, could

**Fig. 3** Riders' monthly income, median wage, and minimum wage in the service sector in Italy (ISTAT 2022)



be a way of coping with combating biases, stereotypes, and structural barriers to women's advancement and equality in the workplace, and could be indicative of a positive pattern, as opposed to other sectors where men are favored instead. Based on these considerations, by addressing the risk of gender gaps, the Italian FD sector could still create a more equitable and supportive work environment, helping to foster a culture of respect, dignity, and fairness in the FD sector by attracting a diverse and talented workforce, benefiting sustainability and success in the FD sector.

#### 4.1.6 Health and safety

Fatal accidents in the workplace were considered in this impact category. In 2019, there were 17 cases of fatal injuries per 100,000 workers in Italy (ASAPS 2019), implying a medium risk that workers may suffer fatal accidents (Fig. 2F).

#### 4.1.7 Social benefits, legal issues

In 2019, there were 25 cases of accidents (fatal, serious hospitalizations and injuries) in Italy, resulting in 1.1 cases  $\times$  1000 workers of violations of labor laws and regulations (ASAPS 2019), generating a medium risk that worker-related and employment regulations are violated (Fig. 2G). A significant factor that could contribute to both categories of risk is the lack of adequate safety measures and support provided by the major delivery platforms in Italy. While riders are generally equipped with reflective vests and food boxes, likely, the provision of additional safety devices is often insufficient. Many delivery workers predominantly use bicycles or electric scooters (*velocipedes*), which do not include compulsory helmets, and this could lead to seriously dangerous situations, especially in congested, car-dominated metropolises such as Rome or Milan (Tomassetti et al. 2020). This could significantly increase the risk to their safety, making the category of riders, a particularly vulnerable category. Literature studies report how, in general, the rate of road accidents in FD could depend on various factors, such as work burnout (Quy Nguyen-Phuoc et al. 2023), lack of rest (Oviedo-Trespacios et al. 2022). Therefore, Italian riders face several challenges mainly related to poor working conditions, absence of safety, and lack of regulation. This situation is also consistent with working conditions in other countries, such as China (Shepherd 2017) and Malaysia (Bernama 2021), which makes the sustainability of the FD model quite questionable and not aligned with the Sustainable Development Goals, which emphasize the role of fair labor and improved health and well-being.

#### 4.1.8 Workers' right

The analysis conducted shows how there is a high risk that FD sector workers in Italy will not organize into unions

(Fig. 2H). The average unionization rate in Italy stands at 32.5% (ILOSTAT 2022), indicating a significant challenge in effectively establishing union representation within the sector. The low level of unionization is further underscored by the limited recognition of union rights highlighted in the CCNL rider, thus fueling some doubts about the agreement's ability to meet the collective interest, as well as raising concerns about the fraudulent use of this type of work, which could be carried out under extremely weak conditions. Indeed, the limited extent to which union rights have been recognized in this context suggests that riders are not considered to require the same collective protections as traditionally employed workers. This is even though the lack of continuity in their employment often stems from contractual choices made by hiring platforms rather than reflecting the actual work patterns of the riders themselves. Uncertainty about the qualification of riders may also make it difficult to understand what the path might be for making union protections effective in the workplace. Also, notable was the struggle faced by Italian riders in their efforts to initiate collective bargaining and challenge the algorithmic control imposed by platforms (Cini 2023), with strikes and flash mobs, particularly in the city of Bologna, forming part of the union struggle (Quondamatteo 2021). These actions aimed to raise awareness and pressure platforms to recognize workers' rights and engage in negotiations. As a result, a path to rethinking the rhetoric of the sharing economy emerged from these efforts, leading to the development and signing of a charter of basic rights for digital work in urban contexts. The charter represents a commitment by companies to recognize and uphold a minimum standard of protection for workers. It also paved the way for the convening of a negotiating table at the Ministry, involving key stakeholders such as major platforms, confederal trade unions, and business representative associations. Expanding these initiatives and further engaging all stakeholders could help advance rider rights and protections in the FD sector.

## 4.2 Value chain actors

### 4.2.1 Promoting social responsibility

Examining and reading internally the ESG reports of the four major FD players in Italy (Deliveroo 2023b; Glovo 2021; Just Eat 2023b; Uber 2023b), it emerges how the treatment of the rider category lacks depth and comprehensiveness. While one company claims to enforce international labor standards and support during important events in workers' lives, there emerges a general lack of detailed information regarding contractual protections, safety measures, training opportunities, and economic stability for riders. In addition, future commitments are vague and do not sufficiently address social sustainability related to rider welfare. Another company



emphasizes its support for health workers and the provision of food to vulnerable populations globally. However, similar to the previous case, commitments to riders are generic and the focus seems to be more on environmental sustainability rather than social sustainability. Finally, the other two show how social sustainability and workers' conditions are treated rather superficially. This limited emphasis on worker conditions and social sustainability is in line with the findings of Galati et al. (2020), Lord et al. (2023), and Vieira (2023), who suggest that the treatment of social sustainability and worker welfare by delivery platforms is often superficial. In particular, Galati et al. (2020) interviewed managers of one of the four delivery companies in Italy, showing how the company is engaging mainly on the environmental sustainability front (plastic-free campaigns, fleet electrification), while not mentioning rider welfare in any way. Overall, then, it emerges how in the ESGs of the four major delivery platforms in Italy, there is a main focus on reducing emissions and not on the social sustainability of deliveries, and it is, therefore, reasonable to think about how there may be a risk of unsustainable business practices (Fig. 4A).

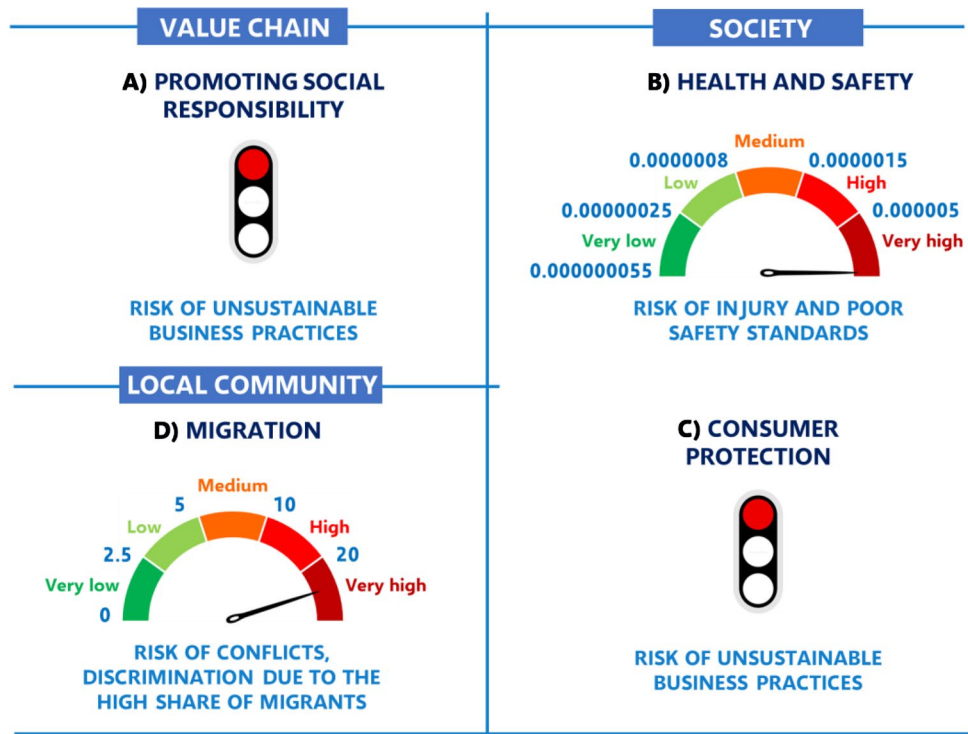
there were 25 million 941 thousand Italians who were part of the workforce (43%) (ISTAT 2019). Considering then, again the cases of workplace injuries (ASAPS 2019) result in a value of 0.000001%. However, it is important to note that these data are not very recent, and more up-to-date information may be needed to provide a more accurate assessment. In any case, they can still serve as a preliminary basis for comparison with future results from other countries and to make an initial risk assessment. These results highlight how it is reasonable to think that there is a very high level of injury on the work site and poor safety standards (Fig. 4B). Although national or local surveys of work or travel patterns are not properly adequate (Aguilera et al. 2022), the data from our study are consistent both with other risk assessments that have been carried out in this research, related to other categories, such as work-related fatalities, violations of employment laws and regulations, and promoting social responsibility, and with other literature studies related to other countries. For example, Christie and Ward (2023), show how even in the UK there is no risk oversight for app-based food delivery workers. Or Lachapelle et al. (2021) point out that employers' promotion of safe practices are key protective factors. And finally, Defossez (2022) points out how even in France, although the legislature has adopted two articles to provide certain minimum social rights to workers, these rights have been poorly enforced, especially concerning employment insurance coverage. Further comparison

### 4.3 Society

#### 4.3.1 Health and safety

In 2019 (the reference year of the only available data on rider accidents), out of 59 million 236 thousand residents

**Fig. 4** Results of S-LCA normalized for stakeholder category value chain actors, society, and local community



of our results with additional FD accident data in other countries, however, may be difficult, given the absence of specific data.

Regarding, on the other hand, the presence of management measures to assess consumer health and safety, according to HACCP procedures, cooked perishable foods to be consumed hot must be transported from 60 to 65 °C, while perishable foods to be consumed cold must be at a temperature no higher than 10 °C (European Parliament 2004). Restaurateurs are required to maintain HACCP documentation for employees and contractors and to provide training (Muszyński et al. 2022). However, this obligation does not apply to riders, who need not have obtained the HACCP certificate, although one of the four FD platforms noted that it provides training on food handling and storage. Furthermore, to comply with the cold chain, food would have to be transported in vehicles equipped with *Accord Transport Perissable* (ATP) certified containers that cannot be transported by scooters or bicycles, thus contrasting sustainability and safety takeover: on the one hand, companies could emphasize their sustainability through the use of bicycles, on the other hand, bicycles are not appropriate to support the most suitable tools to comply with safety protocols such as the cold chain. A similar argument can be made with cardboard containers, which are more sustainable but at the same time more prone to contamination because they are less airtight. This creates a loophole in the FD industry concerning food safety and the hygiene of the containers where food is stored during transport. This is also demonstrated by a recent analysis carried out in Italy, and now being published, where bags used by riders to transport food are analyzed in the laboratory and found to be contaminated with a high bacterial load. The above gap then, could induce a high health risk to consumers (Fig. 4C), related to the lack of prevention and approximation in food handling, which in turn could increase the risk to health and food toxins.

## 4.4 Local community

### 4.4.1 Migration

At the state of the art, there is a lack of official data on the share of migrant workers in the FD in Italy. However, available data from the only census conducted by the Italian Central Bank (Giorgiontonio and Rizzica 2018) show that migrant workers, in the period 2012–2018, accounted for about 23% of the total workforce in the FD sector. This suggests a substantial presence of migrant workers, which could potentially lead to a very high risk of conflict, discrimination, and other related problems (Fig. 4D). However, it is important to note that the actual percentage of migrant workers in the sector could be even higher and significantly underestimated (Iazzolino and Varesio 2023), further amplifying potential risks. In this context, it is relevant to

highlight the possibility of cases of *caporalato* within the sector involving irregular migrants and asylum seekers, mainly from African countries such as Algeria, Ivory Coast, and Mali, as well as Asian countries such as Pakistan and Bangladesh. Most notably, these, rent riders' accounts, make deliveries for them, and pay them a portion of what they earn (Inversi 2021; Mendonça et al. 2023; Iazzolino and Varesio 2023). The existence of a high share of migrant workers in FD in Italy also seems to be consistent with trends in European countries, where migrant workers are overrepresented in this sector (Heiland 2021; Popan and Anaya-Boig 2021) and paint a picture in which more often than not, the platforms' workforce is made up of a majority of migrant workers (Altenried 2021; Gebrial 2022). Some FD companies, such as Glovo and Deliveroo, only suspend the account but do not denounce it. Notably, the companies' press offices inform that zero-tolerance approaches on the topic, but as to how many and what measures this zero-tolerance has generated there is no information.

## 4.5 Comparison with other studies

Providing a comparison between the results of our study and those of similar studies appears difficult to date, given the complete absence of FD S-LCA literature studies both regionally and globally. Entering the keywords “social life cycle assessment AND food delivery” and “social life cycle assessment AND gig economy” on the Scopus database there are 0 similar results as of November 2023. Building on this research gap, the innovativeness of the study lies precisely in its ability to expand the literature and narrative on the social impacts of FD and the gig economy more generally from an S-LCA perspective. However, it is still possible to contextualize the results of our study by comparing them with some interesting insights related to social impacts more broadly. For example, Maimaiti et al. (2020) show how consumers often purchase unhealthy food options such as fast food online, thus promoting a nutritional imbalance. The results of our study, on the other hand, also expand the concept from the supply side, placing the focus on consumer health not so much from a purely nutritional point of view but more from a food safety and wholesomeness point of view, precisely emphasizing the absence of mandatory HACCP attestation for riders. Zhang et al. (2020), on the other hand, show how because many online platforms have a commission and management system, couriers are often in a race against time to obtain higher commissions, exacerbating the risk of violating traffic regulations and leading to possible traffic accidents. The results of our study are consistent with this and point out that the fact that there is no mandatory protective equipment, at least in Italy, may lead to a medium to high risk of fatal accidents, and it will therefore be necessary to intervene in this. Or also Graham and Anwar (2019) in studies of other countries in the global South show that FD

workers experience low wages, control, and discrimination due to power asymmetries that favor platforms, consistent with the findings of this study in Italy, where even wages are just above the poverty line. But the increasing reliance on subcontracting may also facilitate abuse and foster job insecurity, greater uncertainty, atypical contract forms, low bargaining power, and job insecurity, consistent with the findings of Stefoni et al. (2017) and Stecher and Sisto (2019).

To combat this, in the gig economy in general, few countries have adopted specific legislative responses for algorithmic work and FD, and although many platforms operate internationally, labor law is determined nationally and there are important differences between countries. Therefore, while lacking quantitative comparison data from other literature studies, the results of our study could still be useful at least for policy purposes, so as to make known the likelihood and various risks with which food delivery is associated with a given negative externality, and thus, represent a good starting point for mitigating inequalities within this sector. The difficulty in verifying the results with other literature studies underscores how to date, the methodology still presents methodological challenges, compounded by the not insignificant problem of data quality, which is often either missing or not properly representative. In fact, as also in this study, the absence of comprehensive inventories of social data leads to the exclusion and inadequate consideration of certain categories of stakeholders, effectively underestimating the extent of the problem. Hence, from this point of view, an increase in the amount of quantitative social indices would be desirable that can expand the effectiveness and objectivity of S-LCA as well as the transparency and social awareness in FD, so as to also allow future comparisons between different studies. In addition, a noteworthy problem is also the lack of global agreement on the methodology for evaluating social life cycle effects. As also noted by Lucchetti et al. (2018) and Backes and Traverso (2021), the absence of uniform criteria, particularly in the area of social culture, further complicates the creation and application of a cohesive approach and, consequently, the possibility of comparing results across similar studies. These difficulties, although also present in other areas (Ayassamy and Pellerin 2023), underscore the need for continued study and standardization in the field of social life cycle assessment and call attention to how intricate and multidimensional social life cycle assessment is.

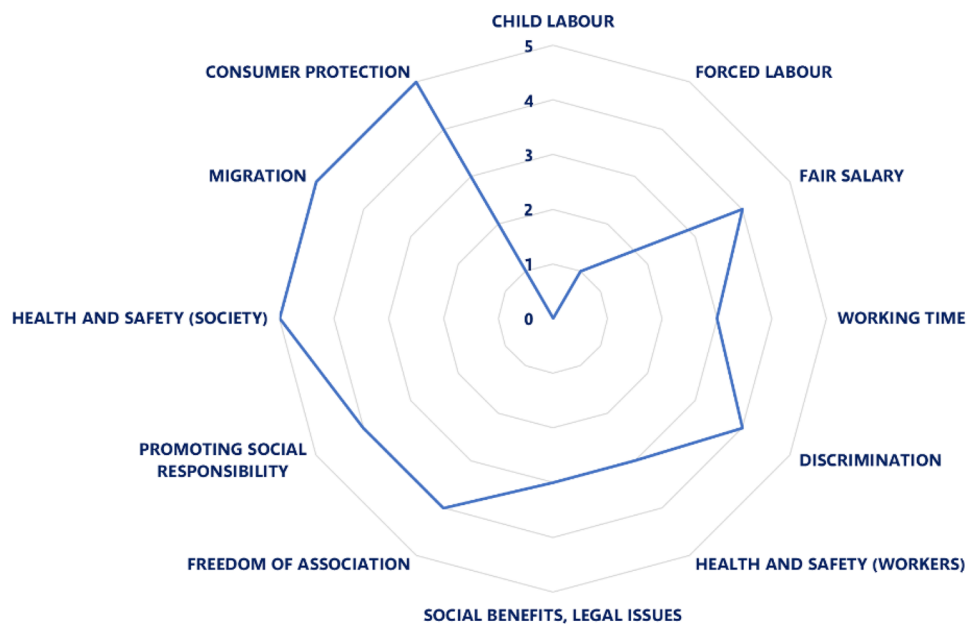
## 5 Main findings

Each risk has been given a numerical score from 0 to 5 so that it can be compared (Fig. 5) (0 = no risk; 1 = very low risk; 2 = low risk; 3 = medium risk; 4 = high risk; 5 = very high risk).

In general, the main findings of this article are as follows:

- In the Italian FD, there may not be any potential risk of child labor, considering the absence of case reports and the obligation to attach an identity document when registering the platform. However, child labor in the FD is not excluded a priori, as children may use their relatives' documents. In this regard, a useful tool for companies could be the use of facial recognition whenever you unlock the application.
- Italy may show a very low potential risk of forced labor in the FD. Cases have been reported in Turin and Milan, also considering situations of vulnerability by migrant workers, but these cases were promptly sanctioned by the authorities. In this situation, however, the absence of reliable data also weighs.
- Italian riders could earn little above the poverty line in Italy and less than half the minimum wage in the service sector. In particular, from the CCNL reference seems that the riders are remunerated for piecework, although the second paragraph of art. 47 c of Law 128/2019 provides for the prohibition of this form of remuneration. This contract could therefore present doubts of legitimacy, which could put riders in a situation of greater vulnerability, to the detriment of companies, as well as bringing with it the acknowledgment that collective bargaining is not always able to guarantee remuneration by a decent standard of living.
- The activity of riders is sometimes carried out as a form of livelihood by students or by those who want an additional income. If, on the other hand, considered as a main activity, it could induce cases of economic vulnerability and impediment to reaching their professional objectives. Here, too, the types of contracts for riders could pose some doubts about the gap they could create with the rest of society.
- In the rider category, there is a medium–high risk of accidents, especially because of the insufficient supply of protective equipment by FD companies (such as helmets), both for the haste to deliver as quickly as possible, taking them riders for example to drive the wrong way or cut the road to cars. On the one hand, therefore, government authorities could introduce more protections for riders, for example through the obligation of a helmet for both bicycles and scooters, as well as insurance protections. The FD companies, however, could also, in addition, improve the working conditions of riders, for example, by providing free water bottles and sachets containing supplements (magnesium and mineral salts, especially for periods too hot) and other safety devices.
- Food delivery in Italy is still characterized by a low unionization rate: to date, it seems that only the total number of riders can be roughly estimated, while there is

**Fig. 5** Summary of the social impacts for the FD in Italy. 0=no risk; 1=very low risk; 2=Low risk; 3=average risk; 4=high risk; 5=very high risk



still no data or research on the unionization rate. Further studies, therefore, could focus both on the census of riders and their union adherence.

- The main FD players operating in Italy deal internally and in their ESG narratives with the category of riders and their well-being in a rather superficial way, placing little emphasis on the real conditions of workers, but mainly focusing on environmental sustainability and the reduction of emissions, rather than on the well-being of the riders.
- There could be a risk to the health of consumers, linked above all to the potential presence of bacteria in transport bags and the handling of food by riders, which could create a hole in terms of food safety during deliveries. To date, a future research area could be to analyze the riders' bags to evaluate the bacteria content, and therefore, to implement the strictest HACCP self-control procedures also for the riders.

## 6 Conclusions

In light of the present and future growth of the FD market in Italy, with a projected revenue of 3 billion by 2027, this study sought to analyze the social sustainability of the FD sector by attempting to identify and where possible quantify its impacts, through social life cycle assessment.

The results confirm how, although some recent steps forward by the rider category, Italian legislation and the business models of FD companies are still shown to be insufficient to guarantee them fairness of protections, which are substantiated by low wages, high accident

rates, poor union rights, improper working hours. Here, on the one hand, it emerges how the authority should act by improving the legal status of riders. Specifically, if a rider is registered on a digital platform, and is waiting for orders to make pickups and deliveries, he should be considered an employee. His activity is subordinate and not self-employed, and as such he should be paid, so that riders can be equated with service workers. On the other hand, major FD players should dwell more carefully on the working, physical, and mental well-being of riders, putting into practice models of social sustainability and providing them with more protections, including incentives, rewards, mandatory safety devices even for scooters and bicycles, psychological support, to reduce accidentality. In addition, an interesting cue for companies could be the implementation of facial recognition via smartphones to completely eradicate any potential forms of forced or child labor.

The results also show a flaw in FD food safety, as riders are not required to have HACCP and ATP attestation, posing doubts about the hygiene of containers carrying food during transport and inducing a potential microbiological health risk for consumers, especially related to food handling during transport. In this regard, an area for future research could be to expand the body of literature related to the study of microbiological analysis on riders' bags, as well as to narrow the scope of HACCP and ATP regulations to them.

This study, although it stands as a more accurate national survey in the Italian FD sector, nevertheless suffers from some limitations. For example, the only data on the number of riders and their incident rates are from 2019, when COVID-19 had not yet exploded. Moreover, the only surveys



conducted on the generic category of riders were from 2018, in addition to the fact that there is a lack of comparison data with other countries. Therefore, although this study provides an initial knowledge base, there is a need for more comprehensive and updated data, both nationally and internationally. In this regard, another possible future opportunity could be, for example, the creation of a national registry of riders, so that they can be surveyed and distributed by gender, age, and nationality so that any social risks related to a certainly vulnerable category can be acted upon. Therefore, in conclusion, this study could provide a counter-narrative to the use of riders in the gig economy as a sustainable logistics intervention, and then consider how this might affect the broader sustainability of the entire system while waiting for the sector to be brought under the aegis of fair, equitable, and safe regulation.

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**Conflict of interest** The authors declare no competing interests.

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