Farm safety: A study of young farmers' awareness, attitudes and behaviours

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Abstract

Agriculture in the United Kingdom (UK) continues to be one of the most dangerous occupations, accounting for around a fifth of fatal workplace injuries and many other injuries, both major and minor. This study examines young farmers' awareness of, attitude to and behaviours around safety practices on-farm. A survey was undertaken amongst a group of young farmers aged sixteen and over who were actively engaged in farming in Northern Ireland, focusing on attitudes and behaviours towards safety on-farm. Drawing on previous literature, this study examined whether younger farmers demonstrate a higher degree of risk tolerance and are more likely to engage in risk taking behaviour when undertaking routine farming practices leading to potential injuries and lost working days. The young farmers surveyed were classified into three groups and differences in risk perception examined. The results indicate that statistically farmer age, intensity of farming alongside the level of farming experience contribute to accident occurrence. Our results indicate a need for attitudinal and behavioural change particularly around risk-taking behaviours which ultimately result in farm accidents; impacting on both the performance of the farm business and individual farmer well-being. Policies aimed at addressing perception and acceptance of risks among farmers are recommended.

Keywords Farm safety, young farmers, risk awareness, attitudes, behaviours and practices

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Section 1: Introduction

Globally, in terms of work-related injuries and fatalities, agriculture is one of the most dangerous industries to work in (Pouliakas and Theodossiou, 2013). According to the Health and Safety Executive (HSE), agriculture in the United Kingdom (UK) has the highest rate of worker fatalities (per 100,000) across all sectors: 20 times higher than the overall average rate (HSE, 2021).

Northern Ireland agriculture makes a higher contribution to GVA and more of the labour force is employed in agriculture compared to other UK regions. The majority of the 25,000 farms are small family operated businesses specialising in livestock production namely beef, sheep, and dairy (Department of Agricultural and Rural Affairs, DAERA, 2021a). In NI, the agriculture sector continues to persistently account for the majority of workplace injuries and fatalities, (HSENI, 2021). A survey undertaken of Northern Ireland farmers in 2019, indicated that in the previous 12 months, 5 percent of just over the 3600 respondents had experienced a farm related injury which required some form of medical intervention (DAERA 2020b). Beyond minor and major farming related accidents, while on average over time, the trend in farm fatality rates have been falling, relative to other UK regions NI fatality rates are higher. For example, over the period 2005-2017 the fatality rate was 1.16 per agriculture worker in NI compared to 1.14 for Great Britain (GB) (HSE, 2021). In 2018, in NI, eight farming related fatalities were recorded (HSENI, 2021).

In term of the seriousness of non-fatal, farming related accidents, this is normally measured by the number of working days lost in order to recover from the injury which has been incurred. In terms of workdays lost in Northern Ireland, the estimated aggregate value stands at more than 18,000 work days lost every year (Angioloni, *et al.*, 2022). Moreover, agricultural workers often experience near misses defined as 'serious accidents that were narrowly avoided' and it has been shown that the causal path for such near misses is similar to those of accident occurrences (Wright, *et al.*, 2004). Although they do not result in injury, incidences of near misses are shown to be highly correlated with more serious accidents and injuries (Low *et al.* 1996, Caffaro *et al.* 2018; Angioloni, *et al.*, 2022). This suggests that near misses are a good indication of future accidents and that farmers who experience a less serious incidents and/or accidents and near misses may be engaging regularly and repeatedly in unsafe practices that eventually will result in an accident.

Given all of this, over the last number of years a range of government and industry backed initiatives in NI have been introduced to help reduce accident occurrences and improve safety on farm. These have included advertising campaigns such as 'Stop and Think Safe' and

'Making it Safer' (HSENI 2020). Moreover, online self-assessments around farm safety called Farm Safety Action Plans (FSAP) were made mandatory for all farmers planning to participate in government funded schemes. However despite such investments in accident prevention initiatives and associated schemes, accident occurrences both major and minor are still persistent within the Northern Ireland farming sector, therefore there is a need to examine further on-farm attitudes and practices around farm safety.

Limiting the risks of both farmers and farm family members of being exposed to farming related accidents is an important area for industry and government to address and give attention to. While a number of studies have been undertaken in NI in relation to the overall farming population there has been limited focus on the attitudes of younger farmers and new entrant farmers, those next generation farmers, coming into the industry. This study aims to examine the attitudes and behaviours of younger farmers towards farm safety and to identify how safety at the farm level can be improved. The remaining sections of this paper are organised as follows: Section 2 provides a review of the farm safety literature focusing on specifically on previous research relating to younger farmers. Sections 3 and 4, respectively outline the methodology and results. Finally, the discussion and conclusions are reported in Section 5.

Section 2: Younger Farmers and farm safety: A review of the literature

Farming is different from other business sectors due to the nature of it being a family business with farms normally providing both a workplace and a family home. For this reason, young people who grow up on farms can be exposed to a higher level of risks from an early age compared to their non- farming cohorts (Lehtola *et al*. 2008, Nilsson, 2016). Furthermore, young people growing up on a farm tend to be socialised into farming and participate in farming activities often from an early age, for example, feeding and handling animals and/or operating machinery. Although this can bring positive benefits it also has the potential, if their exposure to dangers or risks are not managed properly, to impact on physical and mental welfare, (DeBarr *et al.*, 1998, Hendricks and Hendricks, 2010).

Young and inexperienced agricultural workers have been shown to be at a greater risk of experiencing injury (Zhou and Roseman, 1994, Low *et al*. 1996, Jadhav *et al*. 2016). In Austria, farmers under 40 years old form over two thirds of agricultural accidents (Kogler *et al*. 2016) and in Michigan, U.S. workers under 35 years old accounted for 39% of hospitalisations from agricultural accidents (Kica and Rosenman, 2020). Both lack of knowledge and a lack of situational awareness are often listed as reasons why younger farmers exhibit risky behaviour,

make rash decisions and are involved in more accidents when compared to middle aged farmers.

Other factors have been shown to also influence younger farmers' injury rates such as their behaviours and approaches to safety (Deary *et al.* 1997). While inexperience may lead to complacency and hurrying when undertaking farming tasks it has also been shown that higher levels of risk tolerance are predictors of accidents and associated injury (Van Winsen et al., 2016)). Younger individuals have been seen to exhibit behaviours where they are observed to think and act with an "optimistic bias" towards accidents; taking the view that trauma and injury won't occur to them. This reflects an apparent belief in their own invulnerability which increases risk taking which has been shown to result in agricultural accidents and injuries (Hodne *et al.*, 1999.). Beyond attitudes and behaviours in relation to good farm safety practices it has also been shown that younger farmers or early stage farmers may not have adequate levels of resources to purchase safety related equipment or to implement safety changes and practices Athanasiov *et al.*, 2005).

In addition to age, many factors play a role in determining attitudes towards risk, including time pressures throughout the day, tiredness, gender, social norms and stress (Brennan, 2015; Deary *et al.*, 1997). Particularly in relation to younger farmers, it has been shown that the views and behaviours of family, friends and peers influence individual attitudes to risk. An individual's perception of social norms around farm safety practices is an important predictor of farmers' behaviours, especially when it comes to risk taking (Petrea, 2001, Shortall *et al.*, 2019). Continual exposure to family member's or peer's risky behaviours, such as an unwillingness or resistance to use of safety equipment (for example, including seatbelts, roll over systems or PTO covers) or the omission of undertaking safety checks before using machinery can directly impact on an individual's attitude to risks. When these attitudes and behaviours become 'normalised' at the farm level then those working on the farm are more likely to develop similar attitudes and practices around farm safety practices and take similar risks in their own work. A recent study in the United States proposed that there is learned behaviour between inter-generations of farm families that results in young farmers continuing to display unsafe behaviours while working. In this particular study, the young farmers surveyed followed the same practices of the previous generation with 78% choosing not to wear a seatbelt while 46% indicated that they would go ahead and use a tractor if it had no roll over protection (Rudolphi *et al.*, 2017).

In summary, research evidence indicates that central to bringing about improved farm safety practices amongst the younger farming population is the need to identify current attitudes,

behaviours and approaches to safe working practices on the farm and to gain a better understanding the types and frequency of accidents that are occurring amongst younger farmers and their impact.

Section 3: Methodology

The study involved undertaking a survey of young farmers in Northern Ireland in the area of farm safety. A regionally based young farmers' organisation, namely the Young Farmers Club of Ulster, Northern Ireland, was identified as a potentially suitable cohort of individuals who were aged over 16 years of age and actively farming. Discussions with representatives of the YFCU indicated that the population relating to this cohort within this sample group would be around 800 individuals. An online survey was conducted between January and February 2021. The total number of respondents was 219, giving a response rate of 27%. While this sample group is not statistically representative of the overall younger farming population in Northern Ireland, it provided a useful data source for the study. In addition, as the survey was administered through the YFCU it was independent of DAERA and the HSENI and on this basis there was a perception that respondents may be more open and honest in their responses in relation to their experiences of safety on the farm.

The questionnaire consisted of five sections which focused around the individual's current level of involvement in farming, the concept of and attitudes towards safety on the farm, their farm safety training, the farm business and the individual. An important focus was to assess individuals' concept of and attitudes towards safety on the farm and a set of questions were included around participant's attitudes toward risk.

Based on the types of farm work undertaken, individuals evaluated when they thought they were most likely at risk of being involved in an accident, for instance when handling animals, when using large or small equipment or machinery, general farming activities or when working with a quad bike, slurry or at height. Participants were also asked to evaluate the frequency of potentially unsafe farming activities that they had recently engaged in. Their responses were used to estimate their risk tolerance. In addition, questions were also included to assess and evaluate their working practices; for example, taking time to make sure things were done safely, the importance of work-life balance importance and assessing dangerous situation. The section also focused on accidents and near misses, workdays lost, causes and type of medical attention required for both the participant as well as accidents involving other family members.

Participants were then divided into three groups; those who had experienced a major injury in the previous 12 months, respondents who had a minor injury and those who had no accident with the end goal of assessing whether people with major accidents displayed a higher tolerance to risk. Major injury was defined as an accident that occurred in the past 12 months and required medical attention that resulted in a visit to a hospital or GP /nurse treatment. Only one option could be picked for the cause of the major injury, which was not the case for the minor injuries. For minor injuries the respondents could select if more than one minor injury had occurred. Minor injury was defined as an accident that occurred in the past 12 months and had not required medical treatment at a hospital or GP surgery.

The study used qualitative methods to explore attitudes based on participants' responses to a number of behavioural questions were used. To this end, the section included questions to assess the level of risk tolerance of the respondents who were then split into groups depending on the type of injury sustained or lack thereof. Results were analysed to evaluate the behaviours associated with greater risk acceptance and in what ways these behaviours can be addressed in order to avoid a higher accident rate associated with younger farmers.

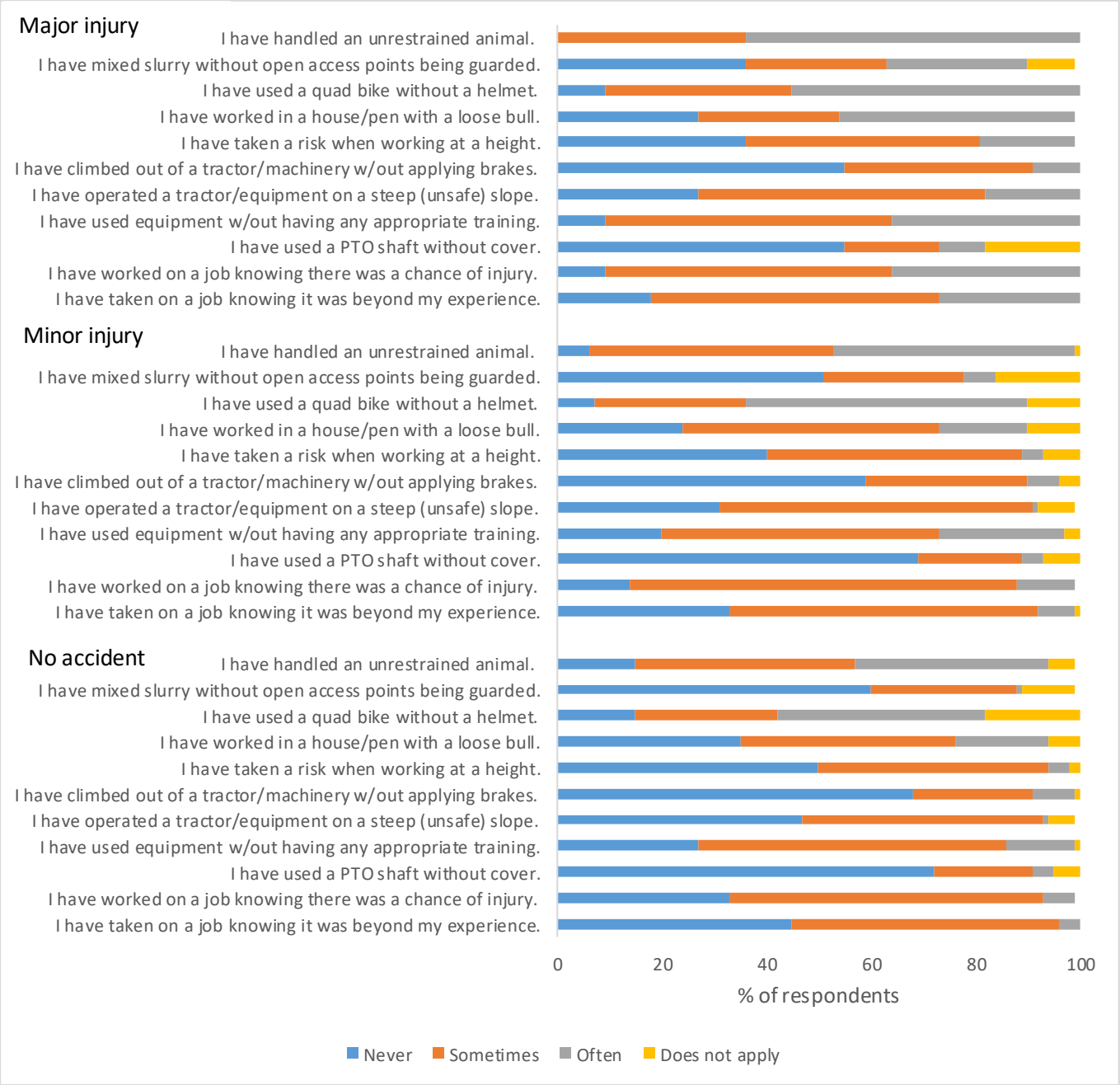
Section 4: Results

Eighty percent of respondents were in the under 30 age bracket, 8% were aged between 30-35 years and the remainder were above 35 years of age. Seventy-eight percent of respondents lived in households which comprised of between one and five household members. Overall, 56% of the survey respondents were female and 44% male. Seventy two percent of respondents were living with their parents and 22% lived with their spouse or partner. The majority of those surveyed did not have children (85%). The majority (72%) were working on farms officially designated as a disadvantaged land area and 21% worked in lowland, non-disadvantaged land areas. The main farm types dairying (37%), beef (32%), sheep (21%) and other (11%).

The results indicated that 10% (22) of the respondents reported experiencing a major injury, 47% (102) had a minor injury and 39% (95) had a no accident over the previous 12 months. The majority of accidents occurred on dairy farms, on which 45% of the major injuries and 37% for the minor injuries were recorded, followed by beef farms (18% major injuries and 35% minor injuries). In terms of main causes of accident, animal handling incidents occurred most frequently causing 27% of accidents. Using a quad bike, getting injured when using a hand tool and operating equipment, mainly tractors and larger machinery accounted equally for 14% of the accidents. A slip or fall to the ground and lifting heavy objects both accounted for 9% of accidents.

Figure 1 outlines how often respondents undertook certain routine activities on their farm, which may exposure them to the risk of injury, grouped by accident type. The underlying hypothesis is that people belonging to the major injury group are more accepting of risk and undertake activities that could lead to a higher chance of injury compared to the other two groups. Moreover, it might be expected that the minor injury group is more risk prone to the non-accident one.

Figure 1. Farming work practices by frequency and type of accident.



To illustrate this, all the respondents that experienced a major injury reported they either often or sometimes had handled an unrestrained animal. The same was valid for 93% of the minor injury group and 79% of the no accident group. Similar patterns can be seen when it came to taking a risk while working at a height, with 36% of the major injury group indicating they had never done this compared to 43% of the minor injury and 51% of the no accident group. Most results are in line with the assumption that major injury participants are more tolerant of risk. However, in relation to using a PTO shaft without a cover, 55% of the major injury group said they had never used it without a cover, compared to 69% from the minor injury group and 72% of the no accident group. The majority of respondents in all three groups reported they had used a quad bike without a helmet either often or sometimes.

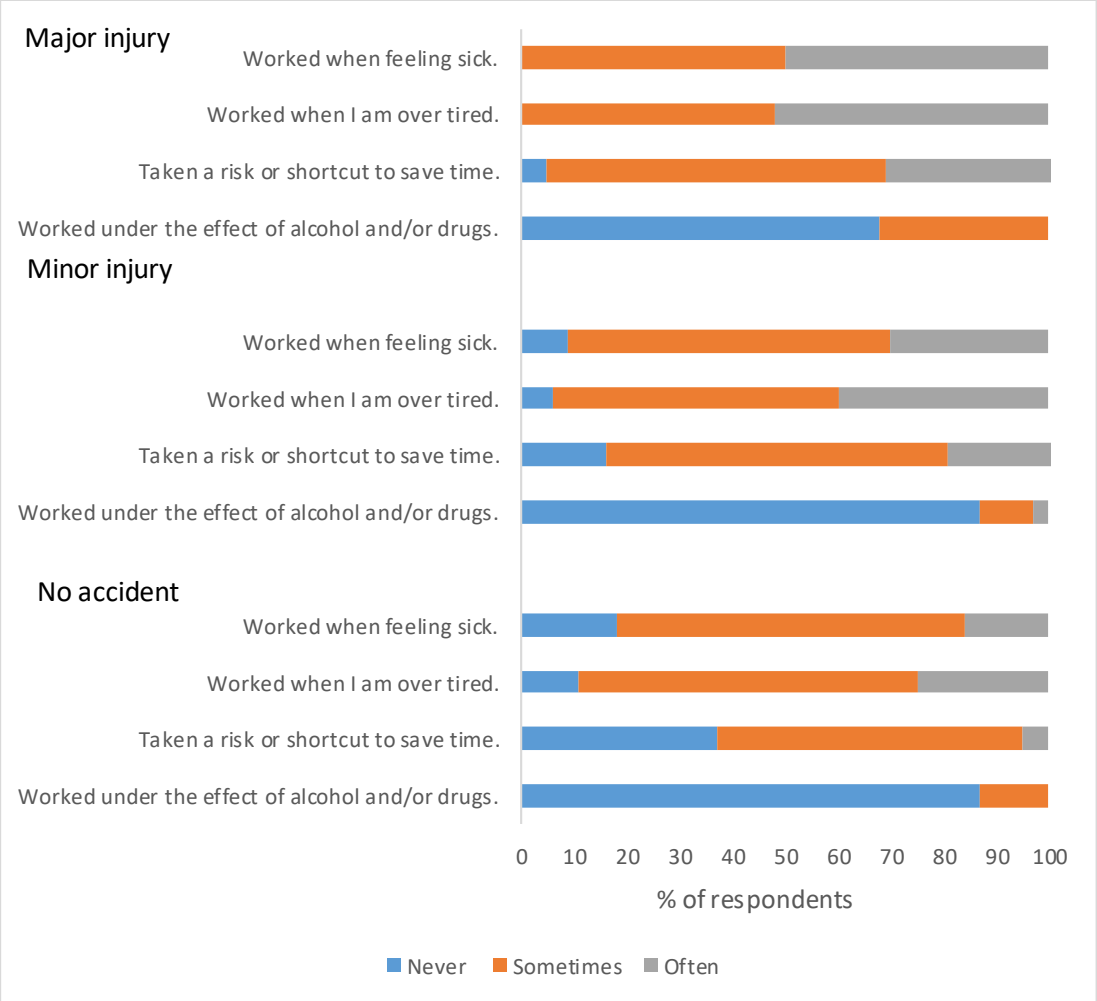
Similar behaviour and attitude analysis to the type of injury were conducted by farm type and gender. Farming enterprise types were split into dairy, sheep, beef and other. Results indicate that the majority of major injuries occurred on dairying farms where respondents in most cases also displayed higher tolerance for risky activities. When it came to gender, female respondents seemed to be more risk averse and aware of the dangers compared to their male counterparts, yet both groups displayed a degree of risk tolerance.

Subjective working conditions were then explored further by asking respondents if they had worked on the farm while feeling sick; feeling tired; taken shortcuts to save time and worked under the influence of drugs and/or alcohol. Figure 2 outlines the three groups reported frequency of engaging in activities that increased the risk of an accident occurring. For instance, all respondents who reported a major injury in the past 12 months indicated that they had either sometimes or often worked when feeling sick compared to 91% of those in the minor injury group and 82% of the no accident group. The majority of responses in the major injury group indicated that they had taken a risk or a shortcut to save time compared to 16% of those in the minor injury group and 37% of those in the no accident group.

Male participants were more likely to often or sometimes work when feeling sick (98%) compared to female ones (81%). Both males and females reported similar responses when it came to working when being overly tired (95% male and 92% female). More males (84%) than females (70%) indicated that they had sometimes or often taken a risk or shortcut to save time. When participants were divided by farm type, similar patterns as in Figure 1 emerged where dairying and beef enterprises took more risks than the other two groups. For instance, 90% of the dairying group said they had sometimes or often worked when feeling sick. The numbers were comparable across beef (88%), sheep (91%) and, less so, the other farm enterprises (74%). In contrast, only 16% of dairying and 20% of beef respondents said they had never taken a risk

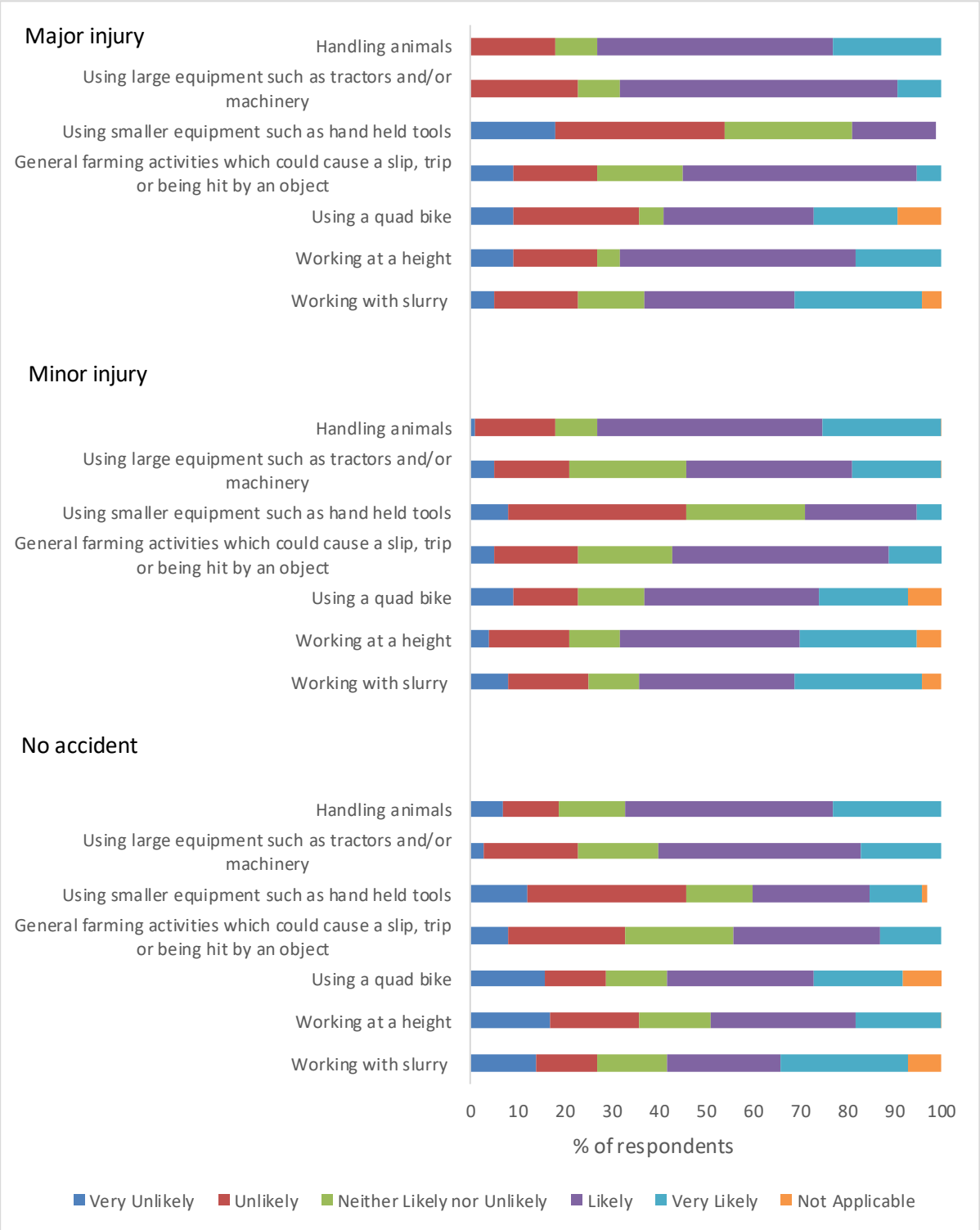
or shortcut to save time. The number stood at 34% for sheep and 39% for other farming enterprises.

Figure 2. Frequency of subjective working conditions.



For the three groups, Figure 3 outlines the overall responses to the question '*Thinking about the types of farm work you do, when do you think that you are most likely at risk of being involved in an accident*?' Interestingly, both major and minor injury groups perceived handling animals as an activity involving a high risk of an accident at 73% compared to 68% of the no accident group. The potential to sustain an injury when using large equipment such as a tractor and/or heavy machinery was also considered to be more likely for those who were in the major injury group with 68% identifying it as very likely or likely – a percentage higher than minor injuries (54%) and no accident (60%) groups.

Figure 3. Perceived risk of being involved in an accident by type of accident.



Working at a height and working with slurry were the activities which individuals thought placed them at the highest risk of an accident. Sixty-eight percent of the major injury group found it either likely or very likely that an accident might occur when working at a height; with 63% of the minor injury group and 49% of the no accident group also identifying this. In the majority of instances, major injury respondents demonstrated they were aware of the risk, even

more so than the other two groups, but their behaviours and actions did not always reflect this or mitigate against those risks as demonstrated in Figures 1 and 2.

Looking at differences in male and female responses, the latter seemed to be more aware of the dangers attached to the activities below, especially when it came to handling animals or using large equipment. When participants were divided by farm type, handling animals was intuitively perceived to be a greater risk for dairying and beef farms. In general, dairying farms appreciated the risks that using or operating equipment carried, however they seemed to accept that these activities could result in an accident or an injury.

Figure 4. Frequency of risk-attitudes by type of injury.

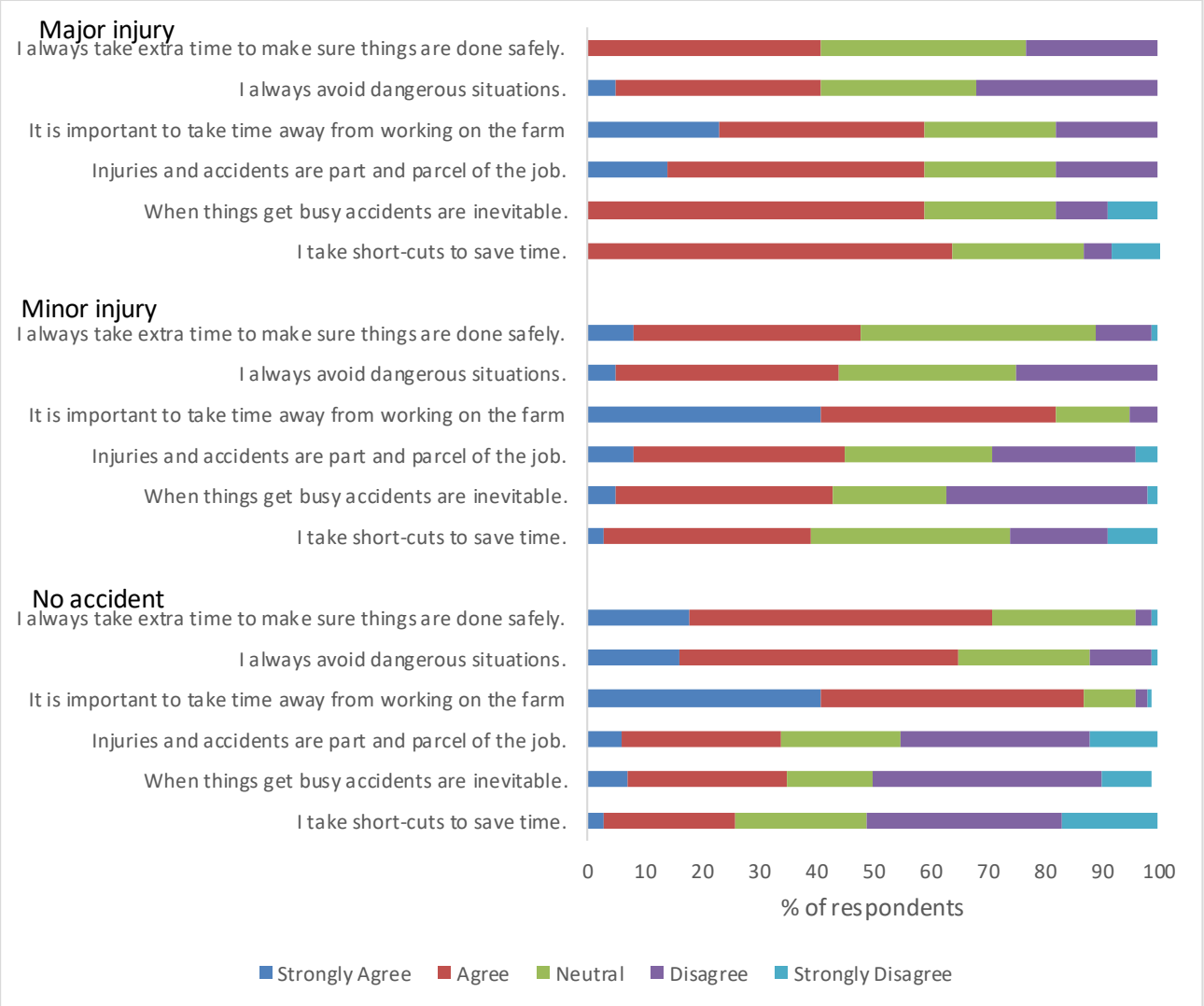


Figure 4 further illustrates the trend that respondents with a major injury displayed higher risk acceptance. For instance, nearly 60% of the major injury group agreed or strongly agreed that injuries and accidents are part of the job compared to 45% minor injuries and 34% of no accident instances. When participants were divided by gender, 49% of men and 64% of women

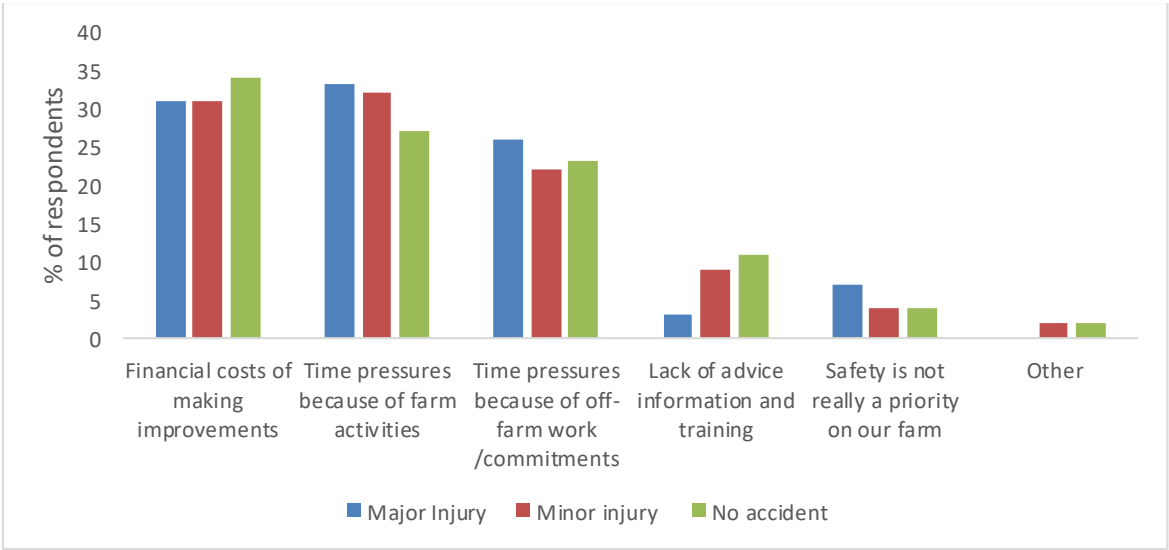
agreed or strongly agreed that they always take extra time to make sure things were done safely. The majority of respondents from both groups agreed it was important to take time away from farm work. However, male respondents compared to female ones were less likely to agree with the statement 'when things get busy accidents were inevitable'.

In this case dairying, farmers also displayed somewhat higher tendency towards risk taking than the other three farm types. In general, a higher percentage agreed that accidents are part and parcel of the job with nearly half accepting that as a fact while the number was 40% or lower for beef, sheep and other farms. Despite being somewhat more risk prone, dairying and beef farmers also accepted that risky situations are a part of the job and displayed a high level of risk awareness.

When it came to hours worked on the farm, 63% of those who had experienced a major injury worked between 0-30 hours on the farm. The major injury group had a higher percentage of individuals working more than 30 hours a week on the farm compared to the minor injury group and the no accident group.

When respondents were asked to consider who they think is most likely to be involved in a farm accident, just under a third of respondents identified young children as the most likely group of people to be involved in a farming-related accident followed by farmers over 65 (28%).

Figure 5. Main barriers to improving farm safety.



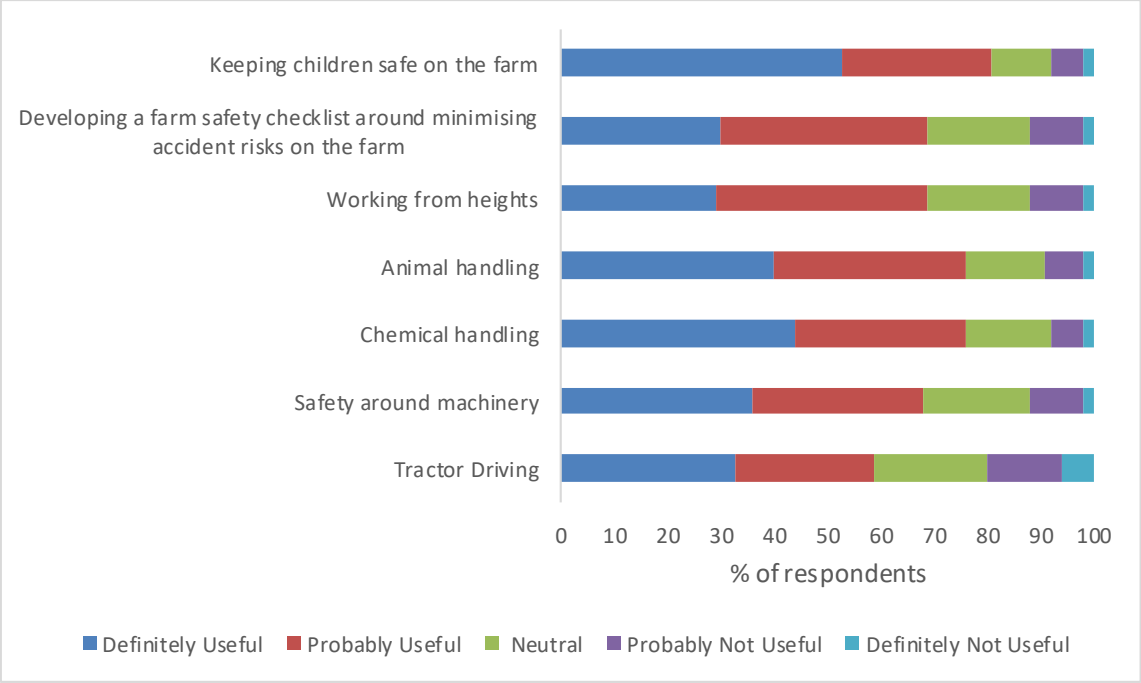
As highlighted in Figure 5, the main barriers to improving farm safety were the financial costs of making improvements and time pressures because of farm activities as well as having working commitments off-farm. Amongst all the respondents, financial barriers, time constraints from farming and off-farm work are close to 30% across type of accident. Only a

small percentage of respondents found that safety was not really a priority with the number notably highest in the major injury group at 7%.

In terms of factors viewed as having the potential to make the biggest difference in improving health and safety on farm, 34% of respondents indicated that the most helpful factor would be financial help, through a grant scheme followed by training and other courses (26%). Awareness advertising and a good social media presence as well as health and safety standards and checks were each considered important by approximately 17% of the respondents.

Figure 6 outlines what respondents considered to be the most useful training areas to focus on in relation to the whole area of health and safety on farm. Keeping children safe on the farm was a high priority. The other most useful areas for training to focus on were animal handling (40% definitely useful and 36% probably useful) and chemical handling (44% definitely useful and 32% probably useful). Overall, all subjects were rated as useful from the majority of the participants (at least 60% or more).

Figure 6. Preferred training subjects to improve farm safety.



In relation to how health and safety messages and advice is communicated, respondents strongly preferred digital media: i.e. Facebook, Twitter, You Tube, Mobile Apps, online interactive tools (60% finding it definitely useful), followed a combination of Traditional and Digital medium (54% finding it definitely useful and 35% probably useful).

Section 5: Discussion and Conclusions

Previous studies have shown that younger farmers are more likely than other age group to have a farming accident (Missikpode *et al.*, (2015); Angioloni *et al.*, 2022). While a range of factors contribute to this, a higher tolerance to risk amongst younger farmers is an important factor. In this study, the findings indicate that younger farmers displayed a higher acceptance of risk. On this basis, in general, our results indicate that there is a need to change attitudes and behaviours around implementing and embedding farm safety practices amongst younger farmers across a wide range of routine farming activities.

Animal handling activities were the main cause of accidents for both major and minor injuries, followed by accidents associated with the use of larger equipment, such as tractors and machinery. Dairy farming on average carried a higher risk of an accident compared to other enterprise types. This is in line with other studies, such as Watson *et al.*, (2017), who found that younger dairy farmers displayed a higher levels of risk taking. However a higher risk tolerance is not the sole contributors to injuries. Other factors, such as stress and tiredness, are also important factors for consideration increasing the probability of getting injured across all farmer age groups (Deary *et al.*, 1997).

In our analysis, the major injury group spent more time working on the farm. Those who work longer hours on the farm face an increased risk of accident and injury. Previous research has observed, when after controlling for the number of hours worked, different groups can have similar risk exposure to accidents (Stallone and Beseler, 2003)). A pattern of working long hours on the farm may instil the perception that these risks are just "part of the job" and that accidents will happen; i.e. that the farming profession conditions younger farmers to the idea that accidents are just 'part and parcel' of farm work; this seems a persistent view and is something that needs to be challenged from a policy and industry perspective.

The level of risk awareness amongst those surveyed who had experienced an accident compared to those who had not, is much less transparent. That is, their level of awareness in relation to undertaking routine farming activities as opposed to being aware of the risks but continuing to engage in risk taking behaviours. For example, male respondents demonstrate a lower awareness of risk in the majority of cases. For those females surveyed, their responses exhibited better knowledge and understanding of risk awareness, however their behaviours around routine farm practices still exhibited risk taking. This finding is supported by previous research with Stave *et al.*, (2007) identifying that in research with Swedish farmers, while they exhibited an awareness of hazards, there was a divergence between their awareness of risks and what they actually did in their everyday farming practices. Furthermore, a Scottish based

study showed that females took risks, often to "prove" themselves and their abilities to their male peers (Shortall et al. 2019). Therefore if younger farmers are aware of risks but consider taking risks are justified in some way, either through time pressures or just to get the job done or to prove themselves, then interventions which seek to raise risk awareness may have a limited effect.

The attitude of other family members towards risk (the farm business and household's social norms) also impact on the ability to implement improved farm safety practices on farm. In this survey, the vast majority of respondents were working on the farm, living with their parents and indicated that they looked to other family members for advice on farm safety. The attitude and influence of other family members does impact on whether or not good farm safety practices are adopted. Therefore a collective approach is required when aiming to implement improvements in farm safety practices on farm; that is, everyone involved in and working on the farm needs to be involved. For example, encouraging the establishment of a farm safety plan/checklists and maintaining a record of minor injuries and near misses which can be reviewed and from which lessons can be learned. Moreover, it is important that awareness and safety campaigns are focused towards all those working on the farm and the wider farm family household to address misconceptions around farm safety. For example, close to two thirds of respondents perceived that young children and farmers over the age of 65 were the most likely groups to be involved in a farming-related accidents. However, recent research undertaken in NI shows that those actively working on-farm and aged between 16 and 40 are the most likely cohort group to be involved in a farming related accident (Angioloni *et al.*, 2022).

Preferred training options were for on-the-job training and visits to demonstration farm which should incorporate farm safety best practice. Respondents expressed a preference for the use of digital communication .i.e. Twitter, Facebook. YouTube for the communication and delivery health and safety advice.

The young farmers surveyed as part of this study viewed the farming environment itself as a barrier to improving farm safety. Financial pressures and time pressures were identified as the main causes of stress and ultimately they associated these with stress-induced accidents and injuries. The perception that financial pressures are linked to accidents was consistent across all respondents. Younger farmers were clearly associating, from their perspective, working conditions as important contributors to accident occurrences and injuries. As a group of individuals who are and will be the next generation of farmers they acknowledged that operating within tight financial margins, working very long hours, often alone and in periods of high levels of work intensity, under the backdrop of policy uncertainty all created situations

of additional working stress and increased the potential for accidents to occur. This creates challenges for policy and responsibilities for the wider agri-food industry and retail sector. Farm accident occurrences impact not only on the profitability of farm businesses but also often have a major impact on the well-being of individual farmers and their households. Given that the agriculture sector in NI has the highest rate of fatal injury in the UK, and on average, a higher level of accident occurrences, a much more integrated and holistic approach amongst the key stakeholders is required along the food supply chain in order to deliver safer operating practice at the farm level.

References:

Angioloni, S., Jack, C., McCarry, R. (2022) 'Occupational Injury and Workdays Lost in Northern Ireland's Farming Sector', Journal of Agricultural and Resource Economics, 47(1), pp. 57-76.

Athanasiov, A., Gupta, M. L. and Fragar, L. J. (2005) 'An Insight into the Grain Auger Injury problem in Queensland, Australia', *Journal of Agricultural Safety and Health*, 12(1), pp. 29-42.

Brennan, C. (2015) 'Exploring the Impact of a Farm Safety Intervention Programme in Ireland: Examining Farmer's Behaviour towards Farm Safety - A Study of the Farm Safety Mentor Programme', np.

DAERA. 2020. "Norther Ireland Agri-Food Sector Key Statistics July 2020." Belfast, Northern Ireland: UK. Department of Agriculture and Rural Affairs. Available online at: https://www.daera-ni.gov.uk/publications/key-statistics-2007-onward, [Accessed 1st March 2022].

DAERA 2020b Results of the Northern Ireland Farm safety partnership survey 2019 Northern Ireland Farm Safety Partnership survey 2019 (hseni.gov.uk)

Deary, I., Willock, J. and McGregor, M. (1997) 'Stress in Farming', *Stress Medicine*, 13(1), pp. 131-136.

DeBarr, K., Ritzel, D., Wright, W. R. and Kittleson, M. (1998) 'Friends and family: implications for youth tractor safety', *Journal of Safety Research*, 29(2), pp. 87-95.

DeWit, Y., Pickett, W., Lawson, J., Dosman, J., The Saskatchewan Farm Injury Cohort Team, (2015) 'Farm Activities and Agricultural Injuries in Youth and Young Adult Workers', Journal of Agromedicine, 20(3), pp. 318-326.

Douphrate, D., Stallones, L., Kolstrup, C. L., Nonnemann, M. Pinzke, S., Hagevoort, R., Lundqvist, P., Jakob, M., Xiang, H., Xue, L., Jarvie, P., McCurdy, S., Reed, S. and Lower, T. (2013) 'Work-related injuries and fatalities on dairy farm operations—a global perspective', *Journal of Agromedicine*, 18(3), pp. 256-264.

Health and Safety Executive (2020) 'Workplace fatal injuries in Great Britain, 2021. Annual Statistics, Health and Safety Authority.'

Health and Safety Executive (2021) "Index of Data Tables – May 2021." London, UK: Health and Safety Authority. Available online at: Statistics - Index of tables (hse.gov.uk), [Accessed 1 March, 2022].

Health and Safety Executive Northern Ireland (2021) 'Farm Safety Action Plan April 2020 - March 2023.'

Hendricks, K. and Adekoya, N. (2001) 'Non-fatal animal related injuries to youth occurring on farms in the United States, 1998', *Injury Prevention*, 7(4), pp. 307-311

Hendricks, K. and Hendricks, S. (2010) 'Changing farm injury trends by sex for youth living on US farms, 1998-2006', *The Journal of Rural Health*, 26(1), pp. 182-188.

Hodne, C. J., Thu, K., Donham, K. J., Watson, D. and Roy, N. (1999) 'Development of the farm safety and health beliefs scale', *Journal of Agricultural Safety and Health*, 5(4), pp. 395-406.

Irwin, A. and Poots, J. (2018) 'Investigation of UK farmer Go/No-Go decisions in response to tractor-based risk scenarios', *Journal of Agromedicine*, 23(2), pp. 154-165.

Jadhav, R., Achutan, C., Haynatzki, G., Rajaram, S. and Rautiainen, R. (2016) 'Review and meta-analysis of emerging risk factors for agricultural injury', *Journal of Agromedicine*, 21(3), pp. 284-297

Lehtola, M. M., Rautiainen, R. H., Schonstein, E., Day, L. M., Suutarinen, J., Salminen, S. and Verbeek, J. H. (2008) 'Effectiveness of interventions in preventing injuries in agriculture—a systematic review and meta-analysis', *Scandinavian Journal of Work, Environment and Health*, 34(5), pp. 327–336.

Kica, J. and Rosenman., K. D. (2020) 'Multisource surveillance for non-fatal workrelated agricultural injuries', *Journal of Agromedicine*, 25(1), pp. 86-95.
Kogler, R., Quendler, E. and Boxberger, J. (2016) 'Occupational accidents with agricultural machinery in Austria', *Journal of Agromedicine*, 21(1), pp. 61-70.
Low, J. M., Griffith, G. R. and Alston, C. L. (1996) 'Australian farm work injuries: Incidence, diversity and personal risk factors', *The Australian Journal of Rural Health*, 4(3), pp. 179-189.
Missikpode, C., Peek-Asa, C., Young, T., Swanton, A., Leinenkugel, K. and Torner, J., 2015. Trends in non-fatal agricultural injuries requiring trauma care. Injury epidemiology, 2(1), pp.1-9.
Petrea, R. (2001) 'The theory of planned behaviour: Use and application in targeting agricultural safety and health interventions', Journal of Agricultural Safety and Health, 7(1), pp. 7-20.
Pouliakas, K. and I. Theodossiou. (2013). "The Economics of Health and Safety at Work: an Interdisciplinary Review of the Theory and Policy." Journal of Economic Surveys 27: 167-208. doi: 10.1111/j.1467-6419.2011.00699.x.
Rudolphi, J., Campo, S., Gerr, F. and Rohlman, D. (2017) 'Social and individual influences on tractor operating practices of young adult agricultural workers', *Journal of Adolescent Health*, 62(1), pp. 605-611.
Stallones L, Beseler C. (2003) 'Farm work practices and farm injuries in Colorado.' Inj Prev., 9(3), pp. 241-4.
Stave, C., Törner, M., Eklöf, M., (2007) 'An intervention method for occupational safety in farming — evaluation of the effect and process', Applied Ergonomics, 38(3), pp. 357-368.
Shortall, S., McKee, A. and Sutherland, L. A. (2019) 'Why do farm accidents persist? Normalising danger on the farm within the farm family', *Sociology of Health and Illness*, 41(3), pp. 470-483.
Van Winsen, F., de May, Y., Lauwers, L., Van Passel, S., Vancauteren, M. and Wauters, E. (2016) 'Determinants of risk behaviour: effects of perceived risks and risk attitude on farmer's adoption of risk management strategies', *Journal of Risk Research*, 19(1), pp. 56-78.
Watson, D., Kenny, O., Maître, B. and Russell, H. (2017) Risk taking and accidents on Irish farms: An analysis of the 2013 health and safety authority survey. Research Series Dublin: Economic & Social Research Institute.
Wright, L. and van der Schaaf, T. (2004) 'Accident versus near miss causation: a critical review of the literature, an empirical test in the UK railway domain, and their implications for other sectors', *Journal of Hazardous Materials*, 111(1), pp. 105-110.
Zhou, C. and Roseman, J. (1994) 'Agricultural injuries among a population-based sample of farm operators in Alabama', *American Journal of Industrial Medicine*, 25(1), pp. 385-402.