

Women in Agriculture: Risks for Occupational Injury within the Context of Gendered Role

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Abstract

Women continue to make significant contributions to farming. Not only do women participate in the traditional roles of homemaker, caregiver, and wife, they also work side-by-side with their spouses in keeping the farm viable. More daughters are entering the farming business, either as partners with other family members or as independent operators. Each year since the United States Department of Agriculture began including gender in the Census of Agriculture, the percentage of women engaged in agriculture has increased, and women's participation in agriculture is increasing faster than in other business segments.

This article examines the role of women in agriculture and how sociocultural, economic, and physical factors may affect women's exposure to injury-producing events and their knowledge and beliefs about injury prevention. To date, few studies have examined work-related unintentional injuries among farm women. Even less is known about the extent to which occupational risks are recognized when women seek medical care. Differences in size and stature, increased physical strain, and low maximal oxygen uptake may predispose women to ergonomic-related injuries. Limitations of current research and recommendations for future analyses are discussed.

Keywords. Gendered role, Agriculture, Women, Injury.

Gender affects the type and extent of women's involvement in farming (Saito and Spurling, 1992). Studies have demonstrated that what is considered an appropriate division of labor, and thus exposure to farm tasks, varies from region to region, from group to group, and even from family to family (Adams, 1994). Each farm family has its own set of values that is influenced by the family's ethnicity, socioeconomic status, level of education, and cultural traditions (Weinert and Burman, 1994). These values influence the division of labor on farms and women's

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potential exposure to multiple roles—factors contributing to occupational illness, stress, fatigue, and agricultural injuries. This article examines the role of women in agriculture and how sociocultural, economic, and physical factors may affect women's exposure to injury-producing events and their knowledge and beliefs about injury prevention.

Invisible Farmers

To date, few studies have examined work-related unintentional injuries among farm women. Two major factors may contribute to this lack of research. The first factor is the invisibility of farm women's work (Reed et al., 1999; Sachs, 1996; Walter and Wilson, 1996; Whitener et al., 1985). The second factor is the gendered division of labor on farms (Bokemeir and Garkovich, 1987; Feldman and Welsh, 1995; Hardesty and Harmon, 1994; Rosenfeld, 1986). Until the late 1970s, women in agriculture were virtually ignored by both the government and rural scholars (Walter and Wilson, 1996). More recently, however, increased emphasis has been placed on women's work roles within agriculture (Rickson, 1997).

Over the past 20 years, studies by sociologists have been critical in drawing attention to, and illustrating, women's work on farms and in describing how integral women's work is for sustaining the farm's productivity, holding down costs, and managing farm operations. Several studies have documented the wide variety of tasks in which farm women participate. Activities most frequently cited include taking care of the vegetable garden and animals (including milking), bookkeeping, running farm errands, and helping with harvesting. Tasks less commonly performed were plowing and other fieldwork with machines, making major purchases, supervising hired hands, and marketing products. Women were least likely to help apply herbicides, fertilizers, or insecticides (Bokemeier and Garkovich, 1987; Hardesty and Harmon, 1994; Reed et al., 1999; Reimer, 1986; Rosenfeld, 1986).

A growing number of farm women are participating in the farming operation as managers by marketing farm products, maintaining computer records, making purchases, and helping with long-term planning (Taylor, 1997). In recent years, a trend toward larger farms and smaller families has resulted in more daughters entering the farming business, either as partners with other family members or as independent operators (Henderson, 2000). However, findings from a 1997 poll of a random sample of 964 farm women from the *Farm Journal* publication database suggested that traditional roles were still the norm (Taylor, 1997). Forty-one percent continued to describe themselves as their husbands' assistants on the farm, and 34% described themselves as silent partners. Farm women spent an average of 21 hours per week working off the farm, 22 hours per week working on the farm, and 35 hours per week engaged in household and family duties. These findings raise the issue of occupational exposure risk for farm women. For example, farm women who spend most of their time in farm management duties have different exposures to injury-producing agents than farm women who participate in traditional farm work.

Role Identity and Farm Involvement

According to Bokemeir and Garkovich (1987), gender division of labor and authority in farm households is conditioned by individual self-identified role.

Women who see themselves as agricultural partners and producers are more integrally involved in farm tasks. Perceived self-efficacy (belief in ability to do the work) also plays a key role in determining women's attitudes toward farm work and their participation in farm tasks (Alston, 1995; Bandura, 1991; Keating and Little, 1994; Pearson, 1979). Perceived vulnerability to injury (Beyth-Marom et al., 1993; Slovic, 1987; Zuckerman, 1994) affects the types of tasks performed and thus exposure to potential agents of injury.

Recently, Reed et al. (1999) examined the role of farm women in Kentucky and Texas. The authors reported that although 46% of women in both states characterized themselves as farm homemakers, they regularly engaged in farm work. Reported farm tasks included work with animals, tobacco-related chores, field irrigation, farm equipment operation, and farm management. The authors concluded that "role definition may influence a woman's perception of risk on the farm, preclude participation in farm safety programs, and prevent an accurate occupational medical history" (p. 317). For example, farm women who describe themselves as farm wives and who also work off the farm in other physically strenuous jobs may not be asked about farm-related exposures when they present to their doctor with back pain. Women who describe themselves as homemakers may not perceive themselves at risk for farm-related injuries because they may not see themselves as exposed to farm tasks on a regular basis. For example, helping with tobacco by riding on the back of a tobacco setter may not seem to be risky behavior; however, risk of poisoning occurs when women inhale carbon monoxide from defective tractor exhaust systems as they ride behind the tractor (Struttman et al., 1997).

Other factors sociologists have identified that may affect the extent to which women are exposed to agricultural work-related hazards include the size of farm, farm commodity, marital status, control of land, children on the farm, husband's off-farm work, education, and experience in farming. Women who lived on smaller farms, controlled land (i.e., name on deed or lease), or were not married performed more farm tasks than women who lived on larger farms, did not control land, or were married. Having children, husband's off-farm work, higher level of education, and farming experiences were all associated with women participating in more farm tasks (Alston, 1995; Bokemeir and Garkovich, 1987; Buttel and Gillespie, 1984; Feldman and Welsh, 1995; Reimer, 1986; Rosenfeld, 1986; Reed et al., 1999). According to the latest census conducted by the U.S. Department of Agriculture in 1997 (USDA, 1999), farms operated by women are smaller than the national average of 487 acres (Effland et al., 1998). Almost 43% of female-operated farms are less than 50 acres, and 68.5% have sales of less than \$10,000 (USDA, 1999).

Farm Commodity

Role is associated with farm commodity because commodity affects both the amount of manual labor required and the tasks that need to be done on the farm and thus influences the division of labor. Traditionally, women have cared for animals (Sachs, 1996), and in a survey of 880 Kentucky farm women, Bokemeir and Garkovich (1987) reported that women who lived on farms with livestock operations routinely had higher levels of involvement in farm production than those who lived on farms with crop operations. Women who resided on diversified farms had the highest level of involvement.

Large animals have been identified as vectors of injury for farm women (Browning et al., 1998; Carruth et al., 2001; Gerberich et al., 1994; McCoy, 2000; Myers et al., 1999; Stueland et al., 1997). Women on dairy farms spend a considerable amount of time involved in farm tasks (Wilkening and Ahrens, 1979; Sander, 1986; Sachs, 1996), and women who work in dairy farming may be at special risk for occupational injury. Nordstrom et al. (1995) reported that dairy farmers were 2.5 times more likely to be injured than residents of other types of farms. Boyle et al. (1997), in a case control study of dairy farmers, found that milking and feeding caused most injuries. In that study, 52% of the injuries occurred among women. Many injuries were reported to have occurred in barns or while carrying out tasks such as feeding or milking (Boyle et al., 1997; Nordstrom et al., 1995; Pickett et al., 1995; Reed et al., 1999; Stueland et al., 1997).

All of the studies cited above suggest that women are at risk for injury from large animals. Xiang et al. (1998) reported that subjects in their study were more likely to be injured by small farm animals. However, it is unclear from the data whether the exposures were different for the participants in the Xiang et al. study compared to the exposures for the participants in the other studies because the women took on different roles on the farm.

Role and the Farm Economy

Restructuring of the farm economy also has an effect on farm women's roles. In the past, during times of economic crisis, farm women increased participation in alternative agricultural enterprises, such as chicken and egg production, to provide additional income. However, off-farm employment now offers the most common diversification strategy for U.S. farmers (Ollenburger et al., 1989; Rosenfeld, 1985), and an escalating number of farm women have off-farm employment. Yet many women continue regular farm and household tasks in addition to outside employment (Alston, 1995; Garkovich et al., 1995; Lee, 1995; Sachs, 1996). Gallagher and Delworth (1993) refer to the "third shift" phenomenon, in which farm women attempt to balance home, employment away from the farm, and farm work. Women in rural communities are often sandwiched between caring for children and elderly family members. This was emphasized in a study in which farm caregivers of elderly family members were found to spend more time in household-related activities compared to rural non-farm and urban counterparts (Horwitz and Rosenthal, 1994).

These added responsibilities can lead to role overload and increased stress. "Whatever additional roles they assume, most farm wives are still expected to do 'the little of everything all at once' that keeps the farm business and family life running smoothly" (Delworth et al., 1988, p. 424). Added economic stresses, along with role overload, are consistent with the Farm Family Stress and Injury Model and recent psychological reports (Kidd et al., 1996; Mulder et al., 2000). The added pressure of multiple roles, including concurrent on-farm and off-farm employment, was recently cited as contributing to depression in rural and farm women (Gallagher and Delworth, 1993; Mulder et al., 2000). Stallones et al. (1995) reported a higher prevalence of depression among female farmers than among male farmers in Colorado, and Xiang et al. (1998) reported an association between depression and increased risk for injury among female farmers in Colorado. Although male farmers also take off-farm jobs, women have the added burden of household responsibilities and may feel stress

because they are not able maintain the household in the way that they would like (Garkovich et al., 1995).

Physical Factors Associated with Role

Age and Role

The average female farm operator was 58 years old in 1997, compared to an average age of 54 years among male farm operators (USDA, 1999). According to Keating and Little (1994), women's roles change through the life cycle, and thus exposure to injury-producing events may change with age. Few studies reported ages of injured women farmers. When age was reported in studies that included both male and female farmers, age was not stratified by gender. Average ages of injured farm women in studies have ranged from the thirties to the late forties (Cogbill et al., 1991; Lewis et al., 1998; Xiang et al., 1998). Myers and Hard (1995), reporting on a review of 6,727 fatal agricultural injuries between 1980 and 1989, found that only 1.5% of the deaths were women, and many of these were older women. Myers et al. (1999) reported that the death rate of female farm workers age 55 and older was twice that for females under age 55. Although many older adults are healthy, as women age they are more susceptible to age-related changes and chronic illnesses that can affect their ability to avoid as well as recover from injury (Archbold, 1999). Older farm women also may have reduced immunity to tetanus following injury (Gergen et al., 1995; Schatz et al., 1998).

Physical Stature and Role

Women have anatomical and physiological differences that may place them at risk for farm injuries (Engberg, 1993). Females are, on average, shorter than men and have more adipose tissue. Females also have narrower shoulders, wider hips, and proportionally shorter legs and arms than their male counterparts (Mackay and Bishop, 1984). On average, upper body strength is 40% to 75% less in females than in males, while lower body strength is 5% to 30% less in females (Falkel et al., 1986). The higher prevalence of shoulder-neck disorders among women in industry has been associated with weaker muscle strength in the upper body (Kilbom and Broberg, 1988). However, other literature reports that both strength and endurance were similar for men and women when body composition and size were controlled (Falkel et al., 1985; Hosler and Morrow, 1982). Whole-body vibration affects women more than men because of anatomic and physiologic characteristics. Circulatory changes in the pelvic organs were found in a study of female tractor drivers; vascular tone decreased and venous stasis occurred at times, depending on the intensity and duration of the vibration (Engberg, 1993). Excessive physical strain has been associated with injury events in women (Pickett et al., 1995; McCoy, 2000). Ahonen et al. (1990) reported the physical strain of dairy farming to be high in women because of heavy work tasks and relatively low maximal oxygen uptake (VO_{2max}).

Women may also be more susceptible to some specific types of injury. For example, entrapment of the median nerve in the proximal forearm (pronator syndrome) is more common in women and has been identified in Swedish female milkers using milking machines (Stål et al., 1998). Research also has demonstrated that falls are a common mechanism of injury among farm women. Nordstrom et al. (1996) reported that although the crude rate for falls was higher for men, the rate based

on hours worked was higher for women. Among a case series of 154 injured farm women, 26% of injuries resulted from falls (McCoy, 2000). A study among farm women in Texas and Louisiana found falls to be the second leading external cause of injury (Carruth et al., 2001). Examples of hazards in the physical environment that may increase the risk of falls include loose boards, uneven or cluttered floors, and wet slippery floors from water, cleaning agents, urine, manure, or hay. Temperature extremes result in icy conditions or risk of heat-related injury. For example, women who feed small calves in the winter may have to carry milk across icy ground to another building. The same women may be exposed to caustic cleaning solutions used to clean milking equipment, or to high environmental temperatures in the summer.

Role and Disability

Women farmers may also be at higher risk for musculoskeletal disability. Xiang et al. (1998) reported a common risk factor for injury was farmstead material handling. Leigh and Fries (1992) examined subsamples of men and women from the National Health and Nutrition Examination Survey (NHANES I) Epidemiological Follow-up (NHEFS) conducted from 1982 to 1984 ($N = 6,096$). Farming was the longest-held occupation with the highest disability for women.

Cooper et al. (1993) examined data obtained from the National Center for Health Statistics' 1980 National Health Interview Survey, the first survey to collect data on longest-held occupation and industry employment. Women age 65 and over were more likely than younger women to report farm labor or farm foreman work as their longest-held occupation. In those less than 65 years old, a greater percentage of female (26.0%) than male (15.2%) farm laborers and farm foremen reported some limitation of activity. In addition, nearly 32% of the women farmers and farm managers reported limitations of activity, compared to 17.2% of the male farmers and farm managers. Women in farming, including farm management and farm labor, reported over a month of restricted activity days per person per year. However, the reasons for restriction were not reported. For example, it is not clear to what extent disability contributes to restriction of work or the risk of injury.

Knowledge and Beliefs about Safety

Knowledge about Safety

Knowledge about safety and use of personal protective equipment, and beliefs about preventing injuries, may affect safety behavior (Dewar, 1996; Lexau et al., 1993; Long, 1993). Additionally, farm women's definition of injury, and their health-seeking behavior, may affect recovery after the injury event. The literature suggests that farm women do not have the same access to transfer of knowledge in the farming culture as do male farmers. Leckie (1996) interviewed 32 female farmers from southern Ontario and reported that the division of labor by gender constrains the information passed on to farm women. According to Leckie, "parents as definers or interpreters of farming skills, combined with hands-on work experience, are key elements in the intra-family transfer of agricultural information . . . parents construct and maintain various social limitations on the amount and type of agricultural information that their daughters are potentially able to gain" (p. 317). A major constraining factor for transfer of knowledge was the attitude parents held about what

is acceptable farm work for girls. Additionally, current farm-related agricultural extension services are geared toward male farmers (Saito and Spurling, 1992).

Zeuli and Levins (1995) reported that among women farmers in Minnesota, lack of farming knowledge was a major issue. They reported that sons were given more opportunities to learn about farming than daughters were because sons were considered the future farmers. One farm woman related that it was only after she took over the family farm that her father taught her how to farm. Others have reported that daughters were less likely to be taught about tractors (Kidd et al., 1997) and were less familiar with rollover protection (Schulman et al., 1997). Jones-Webb and Nickols (1984) identified care and operation of large equipment among the educational needs of farm women. Xiang et al. (1998), who reported that women with more than 30 years of farm experience had more injuries, suggest that the reason for this finding may be because knowledge obtained in the past is not relevant to the current situation. An alternative explanation may be that women who worked in agriculture for 30 years have different roles than younger women, thus providing different exposures.

Case reports of significant equipment-related injuries among women have been reported in the literature. Four cases of scalping among women farmers baling hay in New York (Roerig et al., 1992; Roerig, 1993) illustrate this point. The incidents occurred when the farmers dismounted tractors and approached hay balers with the power take-off unit (a rapidly rotating shaft) still engaged. While adjusting the baler, they placed their heads in close proximity to the exposed unit to reach adjusting levers, and their hair became entangled in a secondary driveline on the balers used to power a bale thrower. These women suffered severe injuries and months of despondence, disfigurement, loss of body image, and inability to return to work on the farm. Several factors present in these women, not necessarily present in a male counterpart, might have placed women at higher risk for injury than men. These factors include long hair, shorter stature, and less body mass and strength than men (Mital and Kumar, 1998). However, it is also possible that a knowledge deficit about equipment safety principles contributed to these injuries.

Beliefs about Safety

A widely held belief is that farm women are more concerned with safety on the farm than men. This difference is difficult to assess from the literature due to the differences in the measurement of variables. In an attempt to compare priorities among men and women, Dewar (1996) determined that women were most concerned with farm health (breathing, trauma, skin disease, hearing loss, chemical exposure, and occupational cancer) and the need for screening (dosimetry, spirometry, and pesticide exposure), while men were most concerned with counseling services provided to address accidents. However, in a random sample of farm operators in Kentucky, researchers found no significant sex differences in tractor safety perceptions and behavior (Cole et al., 2000). This raises an interesting question: Are men just as likely as women to be concerned with safety, or are women just as likely as men to give in to economic/environmental pressures?

Limitations of Current Research

Injury control includes identifying a problem, designing and implementing programs and interventions to address that problem, and evaluating the results (Kidd et al., 1996). Researchers are beginning to establish that some agents (vectors),

such as animals, are associated with injury in farm women to a greater extent than other agents (Pickett et al., 1995; Stueland et al., 1997). Studies also indicate that certain types of injuries, particularly sprains/strains, fractures, bruises, and wounds are more common than other types of injuries (e.g., poisoning and burns) in farm women (Hopkins, 1989; Stueland et al., 1990; Stueland et al., 1997).

National studies of fatal and nonfatal agricultural-related injuries among women have rarely been reported. Most research has been descriptive in nature, reporting only the incidence of a particular injury and the percentage of injuries associated with a particular agent. Some studies reported very low incidence of injury in women compared to men, other studies found similar incidence, and still others studies found a higher incidence of injury in women. In a study in New York, the injury rate among women was one-third that of men (Pratt et al., 1992). To et al. (1993) reported a higher percentage of injuries to spouses (63.3%) in a Canadian study; however, spouse was not identified by gender. One study demonstrated different patterns of injury within a single age group of men and women (Pickett et al., 1995), suggesting possible differences in exposure. However, the type of injury studied (i.e., mechanical, tractor operations) and status of the farmer (farm operator) might have resulted in selection bias, particularly if women were not considered farm operators or were engaged in different tasks than their male counterparts. Unfortunately, it is difficult to compare studies because they used different populations, different methods to collect data, and different definitions of injury.

Although researchers are beginning to address issues related to women in agriculture, many limitations are evident. For example, Stueland et al. (1997) addressed only injuries that required medical care, and the study was limited to one geographic region within one state where dairies were the primary farming operation. Reed et al. (1999) suggested that role may be a factor in injury risk but did not compare farm tasks performed by homemakers to farm tasks performed by other farm women. In addition, rather than conducting separate analysis of data by gender, gender was treated as a confounder in some studies (Boyle et al., 1997).

Another limitation of current studies is the type of data collected. Most studies have focused on the injury event using quantitative data. The USDA collected narrative data along with quantitative data during its 1993–1995 Traumatic Injury Surveillance of Farmers (TISF) survey project but did not link the data (McCoy, 2000). Yet within the narrative data were descriptions of how women were injured while working with animals or helping their husbands that provided information about the events leading up to the injury (McCoy, 2000).

Recommendations for the Future

Although studies to date suggest that farm women may be at risk for injury, studies have not included role as a variable when examining injuries among farm women. Failure to include role excludes an important variable that needs to be addressed if targeted injury-prevention programs are to be developed for women. Little is known about pre-injury exposures in farm women, yet preventive measures used in the pre-injury phase have the greatest potential to reduce injury (Baker and Haddon, 1974). In addition, it is unclear how the changing social and cultural environment affects women's roles and exposures associated with farm work. Studies should examine how changes in women's roles within agriculture affect women's risk for occupational injury. Future studies should also examine age-specific rates of injury

among farm women. For example, are age-specific injury rates different for female farm operators, partners, helpers, homemakers, or employees?

More research is needed to explore the relationships between injury to farm women and the social, cultural, and economic aspects of the work environment. For example, do men and women differ in risk perception and risk-taking behavior? How do women's roles affect the transfer of safety knowledge to females in the farm household?

Little is known about specifics of exposure to injury agents among farm women. Studies are needed that examine dose-response relationships between exposure and injury outcome. Are women being injured while performing farm tasks they do every day or during farm tasks in which they only occasionally participate or complete? In a study that was not stratified by gender, Nordstrom et al. (1995) reported that when injury rates were adjusted for hours worked, the injury rate was highest among persons working the fewest hours and lowest among those working the most hours. What aspects of work with animals contribute to the most injuries? Except in one study (Xiang et al., 1999), back injury (the most common source of disability in the non-agricultural workplace) has not been addressed for farm women. Carruth et al. (2001) examined chronic conditions as risk factors and reported that farm women who reported recurrent back pain in the preceding 12 months were two times more likely to sustain a nonfatal farm injury. Women who reported weakness had a four-fold risk for nonfatal farm injury.

Engineering research should be conducted to design machinery and equipment that is ergonomically appropriate for smaller body frames. Within the physical environment, research is needed to identify what aspects of the physical environment contribute to the most injuries in women. For example, are stanchion barns particularly dangerous? Little is known about musculoskeletal disorders in farm women, yet both NIOSH and OSHA recommend ergonomic improvements in industry to combat the high incidence and prevalence of musculoskeletal disorders. Research is needed to evaluate how working both on and off the farm affects the incidence of musculoskeletal disorders in farm women. It is reasonable to assume that a synergistic effect may exist, placing farm women who hold multiple jobs at even greater risk for musculoskeletal disorders and subsequent disability.

Researchers should include both quantitative and qualitative design components and link these data. Qualitative research provides a fuller and richer description of the injury circumstances across the pre-injury event, time of injury, and post-injury phases (Reed, 1996). Qualitative methods are most useful when little is known about the phenomena under study (Strauss and Corbin, 1990). For example, quantitative data may only report one mechanism of injury (kicked by a cow), yet both a direct and indirect mechanism might be involved and actually increase the severity of injury, (e.g., knocked down by an unrestrained cow while engaged in breeding procedure). Triangulation of research methods can provide a more complete understanding of farm injury. Qualitative data also allows the injury event to be analyzed within the context of the work situation. These types of complementary methods of inquiry may yield a more complete understanding of women's farm injury.

Summary

The 1997 Census of Agriculture demonstrated a continued increase in the number of female farm operators. There has been an increased interest in women farmers by

the USDA (Effland et al., 1998), and farm women are becoming more organized, as evidenced by the greater visibility of the Women in Agriculture organization. A recent study conducted for *Top Producer* (Taylor, 1997) reported that one out of every four women view themselves as a manager in the farm family business, actively partnering on their own or with their husbands in the farm operation.

A trend to both larger farms and smaller families is allowing women to pursue farming aspirations once reserved for sons. The National Foundation for Women Business Owners (NFWBO) reported that women-owned agricultural firms increased nearly 60% over the past seven years, compared with less than a 40% increase in traditional industries like services and retail. Many women are taking over management aspects of the farm rather than participating in traditional farm tasks, while others are tackling traditional male roles (Henderson, 2000).

It is evident that women will be an increasing force in agriculture. It is also evident that women in agriculture have many roles and that these differing roles place women at risk for different types of injuries. The inclusion of qualitative methods will enrich the research base and aid in the identification of both direct and indirect mechanisms of injury. Results from these studies can be used to identify intervention foci for injury prevention.

The invisible farmers of the past are no longer invisible. Each year since the United States Department of Agriculture began including gender in the Census of Agriculture, the percentage of women engaged in agriculture has increased, and women's participation in agriculture is increasing faster than in other business segments. Changing social and economic conditions have affected the roles of women on farms. Roles are becoming more varied, and in many cases women are taking on multiple roles. It is imperative that role be considered as a variable when examining risk factors for injury among farm women and when developing targeted educational programs for farm women.

References

- Adams, J. 1994. *The Transformation of Rural Life: Southern Illinois, 1890–1990*. Chapel Hill, N.C.: The University of North Carolina Press.
- Ahonen, E., J. M. Venäläinen, U. Könönen, and T. Klen. 1990. The physical strain of dairy farming. *Ergonomics* 33(12): 1549–1555.
- Alston, M. 1995. Women and their work on Australian farms. *Rural Sociology* 60(3): 521–532.
- Archbold, P. G. 1999. Older adults' health and illness issues. In *Handbook of Clinical Nursing Research*, 561–562. A. E. Hinshaw, S. L. Feetham, and J. L. F. Shaver, eds. Thousand Oaks, Cal.: Sage.
- Baker, S. P., and W. Haddon. 1974. Reducing injuries and their results: The scientific approach. *Milbank Memorial Fund Quarterly / Health and Society* 52(4): 377–389.
- Bandura, A. 1991. Social cognitive theory of self-regulation. *Organizational Behavior and Human Decision Processes* 50(2): 248–287.
- Beyth-Marom, R., L. Austin, B. Fischhoff, C. Palmgren, and M. Jacobs-Quadrel. 1993. Perceived consequences of risky behaviors: Adults and adolescents. *Developmental Psychology* 29(3): 549–563.
- Bokemeir, J., and L. Garkovich. 1987. Assessing the influence of farm women's self-identify on task allocation and decision making. *Rural Sociology* 52(1): 13–36.
- Boyle, D., S. G. Gerberich, R. W. Gibson, G. Maldonado, R. A. Robinson, F. Martin, C. Renier, and H. Amandus. 1997. Injury from dairy cattle activities. *Epidemiology* 8(1): 37–41.

- Browning, S. R., H. Truszczynska, D. Reed, and R. McKnight. 1998. Agricultural injuries among older Kentucky farmers: The farm family health and hazard surveillance study. *American J. Industrial Medicine* 33(4): 341–353.
- Buttel, F. H., and G. W. Gillespie. 1984. The sexual division of farm household labor: An exploratory study of the structure of on-farm and off-farm labor allocation among farm men and women. *Rural Sociology* 49(2): 183–209.
- Carruth, A. K., L. Skarke, B. Moffett, and C. Prestholdt. 2001. Women in agriculture: Risk and injury experiences on family farms. *J. American Medical Women's Assoc.* 56(1): 1–4.
- Cogbill, T. H., E. S. Steenlage, J. Landercasper, and P. J. Strutt. 1991. Death and disability from agricultural injuries in Wisconsin: A 12-year experience with 739 patients. *J. Trauma* 31(12): 1632–1637.
- Cole, H. P., S. C. Westneat, S. R. Browning, L. R. Piercy, and T. Struttmann. 2000. Sex differences in principal farm operators' tractor driving safety beliefs and behaviors. *J. American Medical Women's Association* 55(2): 93–95.
- Cooper, S. P., P. A. Buffler, and D. K. Wagener. 1993. Gender differences in health indicators by longest-held occupation and industry of longest employment. *Annals of Epidemiology* 3(4): 367–374.
- Delworth, U., S. D. Veach, and L. Grohe. 1988. Clinical issues with farmwomen. *Innovations in Clinical Practice* 7: 423–432.
- Dewar, D. M. 1996. Farm health safety issues: Do men and women differ in their perceptions? *AAOHN J.* 44(8): 391–401.
- Effland, A. B., R. A. Hoppe, and P. R. Cook. 1998. Minority and women farmers in the U.S. *Agricultural Outlook* 251: 16–21.
- Engberg, L. 1993. Women and agricultural work. *Occupational Medicine* 8(4): 869–882.
- Falkel, J. E., M. N. Sawka, L. Levine, and K. B. Pandolf. 1985. Upper to lower body muscular strength and endurance ratios for women and men. *Ergonomics* 28(12): 1661–1670.
- Falkel, J. E., M. N. Sawka, L. Levine, N. A. Pimental, and K. B. Pandolf. 1986. Upper-body exercise performance: Comparison between women and men. *Ergonomics* 29(1): 145–154.
- Feldman, S., and R. Welsh. 1995. Feminist knowledge claims, local knowledge, and gender divisions of agricultural labor: Constructing a successor science. *Rural Sociology* 60(1): 23–43.
- Gallagher, E., and U. Delworth. 1993. The third shift: Juggling employment, family, and the farm. *J. Rural Community Psychology* 12(2): 21–36.
- Garkovich, L., J. L. Bokemeier, and B. Foote. 1995. *Harvest of Hope: Family Farming/Farming Families*. Lexington, Ky.: The University Press of Kentucky.
- Gerberich, S. G., R. W. Gibson, P. D. Gunderson, L. R. French, F. Martin, J. A. True, J. Shutske, C. M. Renier, and W. P. Carr. 1994. Regional rural injury study (RRIS): A population based effort. In *Supplement to Agricultural Health and Safety: Workplace, Environment, Sustainability*, 195–200. H. H. McDuffie, J. A. Dosman, K. M. Semchuk, S. A. Olenchock, and A. Senthilselvan, eds. Saskatoon, Saskatchewan, Canada: University of Saskatchewan.
- Gergen, P. J., G. M. McQuillan, M. Kielly, T. M. Ezzati-Rice, R. W. Sutter, and G. Virella. 1995. A population-based serologic survey of immunity to tetanus in the United States. *New England J. Medicine* 332(12): 761–766.
- Hardesty, C., and M. P. Harmon. 1994. Division of labor on family farms: A life course analysis. *Sociological Spectrum* 14(4): 351–370.
- Henderson, P. 2000. The farmer's daughter. *Top Producer* 17(4): 28–30.
- Hopkins, R. S. 1989. Farm equipment injuries in a rural county, 1980 through 1985: The emergency department as a source of data for prevention. *Annals of Emergency Medicine* 18(7): 758–762.
- Horwitz, M. E., and T. Rosenthal. 1994. The impact of informal caregiving on labor force participation by rural farming and nonfarming families (1994). *J. Rural Health* 10(4): 266–272.
- Hosler, W. W., and J. R. Morrow. 1982. Arm and leg strength compared between young women and men after allowing for differences in body size and composition. *Ergonomics* 25(4): 309–313.

- Jones–Webb, J., and S. Nickols. 1984. Programming for modern farm women. *J. Extension* 22(May–June): 16–22.
- Keating, N. C., and H. M. Little. 1994. Getting into it: Farm roles and careers of New Zealand women. *Rural Sociology* 59(4): 720–736.
- Kidd, P., T. Scharf, and M. Veazie. 1996. Linking stress and injury in the farming environment: A secondary analysis of qualitative data. *Health Education Quarterly* 23(2): 224–237.
- Kidd, P., K. Townley, H. Cole, R. McKnight, and L. Piercy. 1997. The process of chore teaching: Implications for farm youth injury. *Family and Community Health* 19(4): 78–89.
- Kilbom, A., and E. Broberg. 1988. Health hazards related to ergonomic work conditions. *Women and Health* 13(3/4): 81–93.
- Leckie, G. J. 1996. ‘They never trusted me to drive’: Farm girls and the gender relations of agricultural information transfer. *Gender, Place, and Culture* 3(3): 309–325.
- Lee, B. C. S. 1995. Factors influencing protection of children from agricultural hazards. PhD diss. UMI No. 95–32475. Milwaukee, Wisc.: University of Wisconsin.
- Leigh, J. P., and J. F. Fries. 1992. Disability in occupations in a national sample. *American J. Public Health* 82(11): 1517–1524.
- Lewis, M. Q., N. C. Sprince, L. F. Burmeister, P. S. Whitten, J. C. Torner, and C. Zwerling. 1998. Work–related injuries among Iowa farm operators: An analysis of the Iowa Farm Family Health and Hazard Surveillance Project. *American J. Industrial Medicine* 33(5): 510–517.
- Lexau, C., L. Kingsbury, B. Lenz, C. Nelson, and S. Voehl. 1993. Building coalitions: A community–wide approach for promoting farming and health and safety. *AAOHN J.* 41(9): 440–449.
- Long, K. A. 1993. The concept of health: Rural perspectives. *Nursing Clinics of North America* 28(1): 123–130.
- Mackay, C. J., and C. M. Bishop. 1984. Occupational health of women at work: Some human–factors considerations. *Ergonomics* 27(5): 489–498.
- McCoy, C. A. 2000. Risks for occupational injury in farm women. Unpublished PhD diss. Lexington, Ky.: University of Kentucky.
- Mital, A., and S. Kumar. 1998. Human muscle strength definitions, measurement, and usage: Part II. The scientific basis (knowledge base) for the guide. *International J. Industrial Ergonomics* 22(1): 123–144.
- Myers, J. R., and D. L. Hard. 1995. Work–related fatalities in the agricultural production and services sectors, 1980–1989. *American J. Industrial Medicine* 27(1): 51–63.
- Myers, J. R., D. L. Hard, K. A. Snyder, V. J. Casini, R. Cianfrocco, J. Fields, and L. Morton. 1999. Risks of fatal injuries to farm workers 55 years of age and older. *American J. Industrial Medicine* 32(Sept: Supp. 1): 29–30.
- Mulder, P. L., M. B. Kenkel, S. Shellenberger, M. G. Constantine, R. Streigel, S. E. Sears, P. Jumper–Thurman, et al. 2000. The behavioral health care needs of rural women. The Rural Women’s Work Group of the Rural Task Force of the American Psychological Association and the American Psychological Association’s Committee on Rural Health. Available at: <http://apa.org/rural/ruralwomen.pdf>.
- Nordstrom, D., P. Layde, K. Olson, D. Stueland, L. Brand, and M. Follen. 1995. Incidence of farm–work–related acute injury in a defined population. *American J. Industrial Medicine* 28(4): 551–564.
- Nordstrom, D., P. Layde, K. Olson, D. Stueland, M. Follen and L. Brand. 1996. Fall–related occupational injuries on farms. *American J. Industrial Medicine* 29(5): 509–515.
- Ollenburger, J. C., S. J. Grana, and H. A. Moore. 1989. Labor force participation of rural farm, rural nonfarm, and urban women: A panel update. *Rural Sociology* 54(4): 533–550.
- Pearson, J. 1979. Note on female farmers. *Rural Sociology* 44(1): 189–200.
- Pickett, W., R. J. Brison, H. Niezgoda, and M. L. Chipman. 1995. Nonfatal farm injuries in Ontario: A population–based survey. *Accident Analysis and Prevention* 27(4): 425–433.
- Pratt, D., L. Marvel, D. Darrow L. Stallones, J. May, and P. Jenkins. 1992. The dangers of dairy farming: The injury experience of 600 workers followed for two years. *American J. Industrial Medicine* 21(5): 637–650.

- Reed, D. B. 1996. Occupational rehabilitation of farmers with upper extremity amputations. Unpublished PhD diss. Lexington, Ky.: University of Kentucky.
- Reed, D. B., S. C. Westneat, S. R. Browning, and L. Skarke. 1999. The hidden work of the farm homemaker. *J. Agric. Safety and Health* 5(3): 317–327.
- Reimer, B. 1986. Women and farm labor. *Rural Sociology* 51(2): 143–155.
- Rickson, S. T. 1997. Outstanding in their field: Women in agriculture. *Current Sociology* 45(2): 91–133.
- Roerig, S., J. Melius, and G. Casey. 1992. Scalping incidents involving hay balers: New York. *Morbidity and Mortality Weekly Reports* 41(27): 489–491.
- Roerig, S. 1993. Scalping accidents with shielded PTO units. *AAOHN J.* 41(9): 437–439.
- Rosenfeld, R. 1985. *Farm Women: Work, Farm, and Family in the United States*. Chapel Hill: University of North Carolina Press.
- _____. 1986. U.S. farm women: Their part in farm work and decision making. *Work and Occupations: An International Sociological Journal* 13(2): 179–202.
- Sachs, C. 1996. *Gendered Fields: Rural Women, Agriculture, and Environment*. Boulder, Colo.: Westview Press.
- Saito, K. A., and D. Spurling. 1992. Developing agricultural extension for women farmers. World Bank Discussion Paper No. 156. Washington, D.C.: The World Bank.
- Sander, W. 1986. Farm women and work. *Home Economics Research J.* 15(1): 14–20.
- Schatz, D., T. Ellis, E. Ottendorfer, E. Jodoin, D. Barrett, and M. Atkinson. 1998. Aging and the immune response to tetanus toxoid: Diminished frequency and level of cellular immune reactivity to antigenic stimulation. *Clinical and Diagnostic Laboratory Immunology* 5(6): 894–896.
- Schulman, M. D., C. T. Evensen, C. W. Runyan, L. R. Cohen, and K. A. Dunn. 1997. Farm work is dangerous for teens: Agricultural hazards and injuries among North Carolina teens. *J. Rural Health* 13(4): 295–305.
- Slovic, P. 1987. Perception of risk. *Science* 236(4799): 280–285.
- Stål, M., C. G. Hagert, and U. Moritz. 1998. Upper extremity nerve involvement in Swedish female machine milkers. *American J. Industrial Medicine* 33(6): 551–559.
- Stallones, L., M. Leff, C. Garrett, L. Criswell, and T. Gillan. 1995. Depressive symptoms among Colorado farmers. *J. Agric. Safety and Health* 1(1): 37–43.
- Strauss, A., and J. Corbin. 1990. *Basics of Qualitative Research*. Beverly Hills, Cal.: Sage.
- Struttman, T. W., V. Brandt, and A. Scheerer. 1997. Outdoor carbon monoxide poisoning attributed to tractor exhaust: Kentucky, 1997. *Morbidity and Mortality Weekly Reports* 46(51): 1224–1227.
- Stueland, D., T. Zoch, P. Stamas, Jr., G. Krieg, and W. Boulet. 1990. The spectrum of emergency care of agricultural trauma in central Wisconsin. *American J. Emergency Medicine* 8(6): 528–530.
- Stueland, D., B. Lee, D. Nordstrom, P. Layde, L. Wittman, and P. Gunderson. 1997. Case–control study of agricultural injuries to women in central Wisconsin. *Women and Health* 25(4): 91–103.
- Taylor, M. 1997. Women’s work: Modern women rewrite a farm wife’s job description. *Top Producer* 14(4): 8–13, 33.
- To, T., K. Wacker, and J. A. Dosman. 1993. A pilot study of farm accidental injuries in Aberdeen, Saskatchewan. *Canadian J. Public Health* 84(3): 153–154.
- USDA. 1999. 1997 Census of Agriculture. NASS AC 97–A–51. Washington, D.C.: U.S. Government Printing Office.
- Walter, G., and S. Wilson. 1996. Silent partners: Women in farm magazine success stories, 1934–1991. *Rural Sociology* 61(2): 227–248.
- Weinert, C., and M. E. Burman. 1994. Rural health and health seeking behaviors. In *Annual Review of Nursing Research* 12, 65–72. J. J. Fitzpatrick and J. S. Stevenson, eds. New York, N.Y.: Springer.
- Whitener, L., C. Sachs, P. J. Ross, J. Z. Kalbacher, and P. Salant. 1985. Farmwomen’s contribution to agriculture and the rural economy. *Rural Development Perspectives* 1(2): 20–26.

- Wilkening, E. A., and N. Ahrens. 1979. Involvement of wives in farm tasks as related to characteristics of the farm, the family, and work off the farm. Paper presented at the Rural Sociological Society Meeting, Burlington, Vt. ERIC Document Reproduction Service No. ED 178251.
- Xiang, H., L. Stallones, Y. Chiu, and A. Epperson. 1998. Non-fatal agricultural injuries and risk factors among Colorado female farmers. *J. Agromedicine* 5(4): 21–33.
- Xiang, H., L. Stallones, S. Hariri, A. Darragh, Y. Chiu, and J. Gibbs-Long. 1999. Back pain among persons working on small or family farms: Eight Colorado counties, 1993–1996. *Morbidity and Mortality Weekly Reports* 48(15): 301–304.
- Zeuli, K. A., and R. A. Levins. 1995. Women who farm: Wider attention to a growing subgroup. *Minnesota Agricultural Economist* 682(Fall): 1–3.
- Zuckerman, M. 1994. *Behavioral Expressions and Biosocial Bases of Sensation Seeking*. Cambridge, U.K.: Cambridge University Press.