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Farming Activities and Carrying and Lifting: The Agricultural Health Study

Elizabeth F. Racine, DrPH, RD,

Assistant Professor of Public Health, Dept. of Public Health Sciences, University of North Carolina at Charlotte, University City Blvd., Charlotte, NC 28223, Phone: 704-687-8979, Fax: 704-687-6122

Sarah B. Laditka, PhD,

Associate Professor and Master of Health Administration Program Director, Department of Public Health Sciences, University of North Carolina at Charlotte, University City Blvd., Charlotte, NC 28223

Jacek Dmochowski, PhD,

Associate Professor of Mathematics, Department of Mathematics and Statistics, University of North Carolina at Charlotte, University City Blvd., Charlotte, NC 28223

Michael Alavanja, DrPH,

Senior Investigator, Division of Cancer Epidemiology and Genetics, National Cancer Institute, National Institutes of Health, Department of Health and Human Services, Executive Plaza South, Room 8000, Bethesda, Maryland 20892-7335

Duck-chul Lee, PhD, and

Department of Exercise Science, University of South Carolina, 514 Main St, Columbia, SC 29208-4102

Jane A. Hoppin, ScD

Epidemiology Branch, National Institute of Environmental Health Sciences, National Institutes of Health, Department of Health and Human Services, Research Triangle Park, NC 27709

Elizabeth F. Racine: efracine@uncc.edu

Abstract

Background—Heavy carrying and lifting (HCL) is a common activity among farmers that may be related to health. The aim of this study was to examine HCL as a proxy for occupational physical activity (PA) among farm residents. The secondary objective was to evaluate PA based on HCL.

Methods—Data from 21,296 farmers and 30,951 spouses in the Agricultural Health Study examined the relationship between HCL and farm activities and individual/farm characteristics. HCL was categorized as 1 or <1 hours per day. The association between HCL and farm activities (15 for farmers; 16 for spouses) and individual/farm characteristics was examined using adjusted logistic regression. To evaluate PA, we created a PA activity index using metabolic equivalents for HCL, and compared PA weekly averages with national guidelines.

Results—In adjusted results, most farm activities were significantly associated with HCL. Based on HCL, farmers had a median of 1.5 hours and spouses 0.5 hours of vigorous or muscle-

Correspondence to: Elizabeth F. Racine, efracine@uncc.edu.

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strengthening PA per day. Most farmers (94%) and about 60% of spouses meet or exceed 2008 national guidelines for vigorous or muscle-strengthening PA.

Conclusion—Findings suggest the HCL measure may be useful as a PA metric in future studies of occupational PA among farm residents.

Keywords

Occupational Physical Activity; Muscle Strengthening; Resistance Exercise

Introduction

A number of researchers suggest that farmers have a higher rate of physical activity (PA) than those in other professions.^{1–3} Occupational status has often been used in the literature as a proxy for PA where farm work is categorized as highly physical.^{4–8} All-cause mortality among Agricultural Health Study (AHS) participants, a cohort of farmers and spouses, was significantly lower than the general population; lower rates were also seen for cancer, cardiovascular disease, diabetes, and chronic obstructive pulmonary disease.⁹ The researchers suggested that the lower mortality rates may be due, in part, to the PA associated with farming.⁹

Greater occupational PA has been associated with lower rates of cancer,² chronic disease,¹⁰ cardiovascular disease,¹¹ cardiovascular mortality,¹² stroke,¹³ and diabetes.¹⁴ The relationship between occupational PA and body mass index has been inconsistent. Chiriboga and colleagues found an inverse relationship between occupational PA and body weight among men;¹⁵ Kaleta and colleagues found no association between that occupational activity and body mass index.¹⁶

Characterizing occupational PA is difficult. Most objective measures of PA are costly to collect and challenging to implement on a large scale; questionnaire-based metrics have been difficult to identify and characterize.¹⁷ Farming involves manual labor; however, the amount of labor has decreased in recent history as a result of mechanization. One metric that has not been widely evaluated in farming or other occupational settings is hours spent carrying and lifting heavy objects.¹⁸ The metabolic equivalents (METs) associated with heavy carrying and lifting is 8.¹⁹ Thus, heavy carrying and lifting is considered as vigorous PA (METs >6).¹⁹ Assigned MET intensities for some farm activities range from 1.5 for milking by machine to 11.0 for carrying logs; however, not all farming activities have been evaluated for their MET intensity.¹⁹ Carrying and lifting heavy objects is also a muscle-strengthening activity.²⁰ Although farming requires a wide array of activities that vary by day and by season, the time spent carrying and lifting heavy objects may provide a useful summary measure of PA performed throughout the work day.

The AHS, the largest and most comprehensive study of agricultural exposure and health outcomes ever conducted in the United States, tracks the health of 52,395 farmers, 4,916 commercial pesticide applicators, and 32,346 spouses of farmers. Occupational PA was not objectively measured. Using the heavy carrying and lifting measure, the primary objective of this study was to assess whether it can be used as a proxy for occupational PA by examining its relationship with farm activities and farm characteristics. The relationship between heavy carrying and lifting and personal characteristics such as age, health status, and leisure PA are also examined. The secondary objective was to evaluate PA among farmers and spouses. To address this objective, we developed a PA index assigning METs to weekly averages of heavy carrying and lifting and compared weekly PA averages with the Centers for Disease Control and Prevention (CDC) 2008 guidelines for vigorous and muscle-strengthening PA.²⁰

Methods

We conducted a cross-sectional analysis using the AHS enrollment data collected in 1993–1997.²¹ Farmers were recruited when they applied for a restricted-use pesticide license. Farmers were asked to complete an enrollment questionnaire, which included questions about pesticide use, health behaviors, health information, and farming activities. Farmers who completed the enrollment questionnaire were provided additional questionnaires to be completed at home by themselves and their spouse and to return by mail: the Farmer Applicator questionnaire and Spouse questionnaire (www.aghealth.org/questionnaires.html). The Farmer Applicator and Spouse questionnaires include in-depth questions about health behaviors, work practices, leisure PA, occupational history, medical history, and health status. Participants provided information about the number of hours of heavy carrying and lifting per day during the growing season. This analysis is limited to the 21,296 male farmers and 30,589 female spouses who completed the heavy carrying and lifting question on the Farmer Applicator and Spouse questionnaires. The AHS was approved by the Institutional Review Boards of the National Institutes of Health and its contractors.

Heavy carrying and lifting (hereafter carrying and lifting) was defined based on the question “During a typical day in the growing season, about how many hours per day do you spend lifting or carrying heavy objects (for example, hay bales, logs, fertilizer or feed bags)?” Participants selected from a list of six categories: none, less than 1 hour, 1–2 hours, 3–5 hours, 6–10 hours, more than 10 hours. To estimate median hours of carrying and lifting per day for the PA index, the six carrying and lifting categories were recoded as a continuous variable, where the midpoint value was selected as the score for the four categories just described as follows: 30 minutes, 1.5 hours, 4 hours, or 8 hours per day; for >10, 11 hours per day was assigned. Responses for carrying and lifting were also grouped into two categories: <1 hour per day, 1 hour per day. These categories were defined so that each level would include at least 25% of participant responses.

Demographic and physical characteristics include: age (<50, 50); body mass index (BMI), under or normal weight (BMI <25), overweight (BMI 25–29.9), and obese (BMI ≥ 30); race (White, other races); marital status (currently married, not married); education (high school degree, > high school degree); and currently smokes (yes/no). Time spent engaging in leisure PA per week was classified as: <45, 45 to 180, or >180 minutes for farmers and as 30, 31–135, >135 minutes for spouses; leisure PA was coded differently by gender so 20% or more of the sample falls within each category. Time spent in the sun per day for farmers and spouses was up to 3, 3–5, and >5 hours. Years lived on a farm was categorized as 10, 11–30, and >30 years. Employment off the farm was classified among farmers as ever working off the farm (yes/no).

Two summary variables were created based on self-reported medical history information to indicate if a farmer/spouse had a history of cancer (Hodgkin’s disease, leukemia, melanoma, non-Hodgkin’s disease, or another cancer) or a history of a chronic disease. The summary cancer history variable indicates if the farmer/spouse responded yes to at least one question. Farmers/spouses were asked if they had been diagnosed with one or more of 27 chronic diseases, listed in Table 1. The summary chronic disease variable indicates if the farmer/spouse responded yes to at least one question.

Farmers and spouses provided information about the frequency of performing a number of different farm activities during the growing season. Responses were dichotomized, and indicate farmers who performed the activity at least weekly. For farmers, activities evaluated were: driving combines, planting, applying natural fertilizer, applying chemical fertilizer, hand picking crops, milking cows, driving trucks, driving diesel tractors, driving gasoline

tractors, welding, repairing engines, grinding metal, grinding animal feed, tilling the soil and painting. Spouses were also asked about these activities. Responses were also dichotomized for spouses, and indicate those who performed the activity at least once a month or at least once during the last growing season. For spouses, “ever worked in the fields during the last growing season,” was also considered a farm activity. To examine the relationship between farm size and carrying and lifting, the number of acres planted in the past year was categorized as 0, 1–199, and 200.

Associations between carrying and lifting and demographic, health status, health behavior characteristics, farm activities, and farm characteristics were determined using logistic regression, stratified by farmer and spouse. All factors significantly associated with carrying and lifting in the unadjusted logistic regression models were included in a full model. The final model included all variables significantly associated with carrying and lifting in the full model ($p < 0.05$). To maximize sample size, participants with missing values were included in the analysis with a separate category for missing values. Multicollinearity diagnostics were performed using the variance inflation factor,²² which did not suggest any evidence of multicollinearity. We used the AHS Data Release PIREL0506.02 (www.aghealth.org); all analyses were conducted using SAS statistical software package version 9.1 (SAS Institute Inc., Cary, NC, USA).

To address the second objective, we developed a PA index. We used the MET classification for the carrying and lifting measure reported by Ainsworth and colleagues,¹⁹ where carrying heavy loads and baling hay are both classified as vigorous PA; each activity is equal to 8 METS. The PA index was calculated as the product of number of hours of carrying and lifting per day multiplied by seven to calculate a weekly index during the growing season.²³ Next, we compared the PA weekly index results to the CDC 2008 PA guidelines of 75 minutes or more of vigorous PA per week. Heaving carrying and lifting is also a muscle-strengthening activity based on the national PA guidelines; the national guidelines recommend engaging in muscle-strengthening activity twice per week; the length of time per session is not specified.²⁰ To estimate whether farmers and spouses meet or exceed the muscle-strengthening guidelines, we used one hour of carrying and lifting per week as a marker for meeting the CDC guidelines. Thus, farmers and spouses who exceed one hour per week exceed the muscle-strengthening guidelines.

Results

Association between Carrying and Lifting and Farm Characteristics/Activities

Table 1 reports descriptive statistics for demographic characteristics, health status, and farm factors, together with the unadjusted odds ratio (OR) and the 95% confidence interval (CI) of carrying and lifting for each characteristic stratified by farmers and spouses. The majority of farmers and spouses were White, had lived on a farm for more than 30 years, and did not have a history of cancer or chronic disease. About two-thirds of farmers and spouses lived in Iowa. About half of farmers and 60% of spouses were under age 50. About 60% of farmers and 26% of spouses reported carrying and lifting 1 hour per day. High levels of leisure PA was associated with carrying and lifting among farmers (OR=1.97; 95% CI 1.82, 2.13) and spouses (OR=2.19; 95% CI 2.03, 2.35). Characteristics associated with higher odds of carrying and lifting 1 hours per day for farmers and spouses were: being White, being younger than 50, having less education, living in Iowa, spending more time in the sun, having no history of cancer, having no history of a chronic disease, and living on a farm more than 10 years.

Table 2 shows unadjusted ORs for 1 hour of carrying and lifting and farm activities separately for farmers and spouses. All farm activities were significantly associated with

carrying and lifting ≥ 1 hour/day in unadjusted models. For farmers, unadjusted OR ranged from 1.44 (95% CI 1.32, 1.57) for hand picking crops to 2.58 for milking cows (95% CI 2.22, 2.99). Among spouses, the OR of carrying and lifting ≥ 1 hours per day ranged from 1.88 (95% CI 1.78, 1.99) for hand picking crops to 6.99 (95% CI 5.61, 8.71) for repairing engines. More carrying and lifting was significantly associated with planting more acres in the past year among farmers; this relationship was less pronounced among spouses.

The adjusted results for farmers and spouses are shown in Table 3. History of chronic disease was not significantly associated with carrying and lifting among farmers or spouses. History of cancer was not significantly associated with carrying and lifting among farmers. Among spouses, a history of cancer was inversely associated with carrying and lifting ≥ 1 hour per day.

In the final model for farmers, all farm activities were positively associated with carrying and lifting ≥ 1 hour per day. Farmers who milked cows were the most likely to report carrying and lifting ≥ 1 hour per day (OR=1.77; 95% CI 1.51, 2.08); however, only 5% of farmers reported this activity. Painting (OR=1.48; 95% CI 1.14, 1.92) and repairing engines (OR=1.40; 95% CI 1.22, 1.61) were also associated with more carrying and lifting. In contrast with the unadjusted results, planting fewer acres was associated with carrying and lifting ≥ 1 hour per day compared to planting more acres.

In the final model for spouses (Table 3), 13 of 16 farm activities were positively associated with carrying and lifting ≥ 1 hour per day. Working in the fields at least once in the growing season was the most commonly reported farm activity among spouses (51%), and was associated with more carrying and lifting (OR=1.99; 95% CI 1.85, 2.14). Consistent with the results for farmers, milking cows was associated with more carrying and lifting (OR=1.92; 95% CI 1.64, 2.25).

PA Weekly Index among Farmers and Spouses and Comparison with 2008 National PA Guidelines

Results of the PA index are reported in Table 4. A median of 1.5 hours of carrying and lifting per day during the growing season was reported for farmers. Comparing the PA weekly index results to the CDC 2008 PA guidelines for vigorous and muscle-strengthening physical activity, 94% met or exceed the recommendations and 58% met or exceeded the guidelines by 5 times, respectively.

A median of 0.5 hours of carrying and lifting per day during the growing season was reported for spouses. When compared to the CDC PA guidelines, 58% met or exceeded guidelines and 26% met or exceeded guidelines by 5 times, respectively.

Discussion

This is the first study to examine the relationship between carrying and lifting and farming activities and a number of characteristics of farmers and spouses, using a comprehensive study of agricultural health outcomes in the U.S. Almost all farm activities were associated with carrying and lifting among farmers and spouses. Farm activities that resulted in the greatest odds of carrying and lifting ≥ 1 hour per day among farmers were milking cows, repairing engines, and painting. Farmers on smaller farms had higher odds of carrying and lifting ≥ 1 hour per day compared with farmers on larger farms; this results is likely due to the fact that on smaller farms, farmers are more likely to complete work themselves rather than hire workers.²⁴ Larger farms may also have more mechanical equipment requiring less PA by the farmer. Among spouses, farm activities with the greatest odds of increased carrying and lifting were working in the fields, milking cows, grinding animal feed, and

repairing engines. Taken as a whole, for farmers and spouses, the findings indicate that carrying and lifting is significantly associated with almost all farming activities, suggesting that carrying and lifting may be a useful measure of occupational PA.

We also used the carrying and lifting measure and the METs classification¹⁹ to evaluate duration of vigorous PA among farmers and spouses during the growing season. The PA weekly index findings indicate that the majority of farmers and spouses meet or exceed the 2008 national PA guidelines for vigorous and muscle-strengthening activity during the growing season. This is an encouraging finding; however, there were also a number of farmers and spouses who exceed the recommendation by 5 times. The health implications of these high levels of physical activity are unclear, and suggest the need for further study.

Several study limitations are acknowledged. There have been few objective measures of occupational PA among farmers. Thus, we are not able to validate whether carrying and lifting is an adequate measure of occupational PA in farmers. In addition, as occupational PA was not the focus of the AHS there were limited occupational PA related questions. Only about 40% of farmers in the AHS cohort were represented in our sample; this is due to the fact that not all farmers completed the Farmer Applicator Questionnaire. However, farming and medical history characteristics did not differ between farmers who did and those that did not complete the Farmer Applicator Questions.²⁵

Factors associated with PA have seldom been described in farmers. Nonetheless, our findings for carrying and lifting are consistent with observations from other populations. Older farmers and spouses were less likely to report carrying and lifting 1 hour per day, consistent with lower PA among older people.^{11, 26} Also, less education was associated with higher levels of carrying and lifting, which was reported in previous studies examining PA and education.^{11, 26} In contrast to farmers, spouses with a higher BMI were more likely to engage in carrying and lifting. More leisure PA was also associated with higher odds of carrying and lifting; this finding is consistent with some studies^{26, 27} and inconsistent with others.²⁸⁻³⁰ It may be that general fitness achieved through farming promotes participation in leisure PA, as suggested in several studies^{27, 26} A history of chronic disease was not associated with carrying and lifting in the final model. We lacked power to evaluate individual diseases and the current severity of the disease was not known. Given a growing literature on the impact of health status on occupational activities,¹⁰⁻¹⁴ examining the relationship between chronic disease and carrying and lifting would be a useful area for future research.

Our findings suggest that further research is needed to develop ways to assess occupational PA in farm environments, as farming activities vary by season and by calendar year. Ideally, it would be preferable to collect detailed daily diary information about a number of farming activities conducted during the growing season, with participants wearing measurement devices such as accelerometers. Data collection of this type is not possible in large cohort studies. A more feasible option would be to conduct a detailed study among a subset of participants, collecting information about bouts, intensity, and frequency of PA as well as other measures of occupational PA that may differ among subgroups such as farmers and spouses. This detailed information could be used to identify key contributors which would be collected in a larger survey such as the AHS.

Conclusion

Carrying and lifting was associated with almost all farm activities and many individual characteristics. The PA weekly index showed that carrying and lifting results in a high level of vigorous and muscle-strengthening PA among farmers and spouses. In sum, findings

suggest that the carrying and lifting measure may be useful as a PA measure to classify individuals with regard to occupational PA. Results indicate carrying and lifting may be useful as an exposure metric in future studies of occupational PA among farm residents, and in research that examines populations engaging in manual labor.

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Table 1

Unadjusted Odds of Carrying and Lifting for Farmers and Spouses in the Agricultural Health Study, 1993–1997, Demographic, Farm Characteristics, Health Behavior, and Health Status Factors

Characteristic ^{a,d}	Farmers (n=21,296)				Spouses (n=30,591)			
	n (%)	Odds of CL	1 hr per day	95% CI	n (%)	Odds of CL	1 hr per day	95% CI
Carrying/Lifting								
< 1 hour per day	8876 (42)	---	---	---	22674 (74)	---	---	---
1 hours per day	12420 (58)	---	---	---	7917 (26)	---	---	---
Race								
White	20370 (98)	1.00		Referent	30039 (98)	1.00		Referent
Non-white	354 (2)	0.68		0.55–0.84	508 (2)	0.60		0.47–0.75
Education								
High School Degree or less	11716 (58)	1.11		1.05–1.17	12476 (46)	1.27		1.20–1.34
Greater than High School Degree	8678 (43)	1.00		Referent	14938 (55)	1.00		Referent
Years spent on farms								
0–10 years	656 (3)	0.64		0.54–0.74	4275 (14)	0.64		0.59–0.70
11–30 years	4270 (20)	1.19		1.11–1.28	10433 (34)	0.99		0.93–1.04
> 30 years	16032 (77)	1.00		Referent	15528 (51)	1.00		Referent
Age								
< 50	11179 (53)	1.00		Referent	18267 (60)	1.00		Referent
50	10116 (47)	0.46		0.44–0.49	12322 (40)	0.59		0.56–0.63
Marital Status^b								
Not Married	3282 (15)	1.00		Referent	-----	-----		-----
Married or living as married	17926 (85)	0.77		0.72–0.84	-----	-----		-----
Ever Employed off the Farm								
Yes	13766 (65)	0.93		0.88–0.99	-----	-----		-----
No	7433 (35)	1.00		Referent	-----	-----		-----
Body Mass Index Categories^c								
Under or Normal Weight	4892 (26)	1.00		Referent	10795 (50)	1.00		Referent
Overweight	9369 (51)	0.92		0.86–0.99	6769 (32)	1.15		1.07–1.23
Obese	4305 (23)	0.98		0.91–1.07	3926 (18)	1.14		1.05–1.24

Characteristic ^d	Farmers (n=21,296)				Spouses (n=30,591)			
	n (%)	Odds of CL	1 hr per day	95% CI	n (%)	Odds of CL	1 hr per day	95% CI
State of Residence								
Iowa	14135 (66)	1.19		1.12–1.26	21039 (69)	1.53		1.44–1.62
North Carolina	7161 (34)	1.00		Referent	9552 (31)	1.00		Referent
History of Chronic Disease Diagnosis								
Yes ^d	8250 (41)	0.77		0.73–0.82	10878 (36)	0.87		0.83–0.92
No	11817 (59)	1.00		Referent	19713 (64)	1.00		Referent
History of Cancer Diagnosis								
Yes	1269 (6)	0.67		0.60–0.75	1680 (6)	0.74		0.66–0.83
No	18621 (94)	1.00		Referent	28514 (94)	1.00		Referent
Leisure PA (tertile) ^{c,e}								
Low ^c	9053 (44)	1.00		Referent	8716 (39)	1.00		Referent
Moderate	7381 (36)	1.33		1.25–1.41	7503 (33)	1.34		1.25–1.45
High	4256 (21)	1.97		1.82–2.13	6307 (28)	2.19		2.03–2.35
Hours spent in the sun per day ^c								
Up to 3 hours	2097 (10)	0.43		0.39–0.48	13358 (59)	0.58		0.54–0.62
3–5 hours	5878 (28)	1.00		Referent	6389 (28)	1.00		Referent
> 5 hours	13116 (62)	1.84		1.73–1.96	2762 (12)	2.26		2.06–2.47
Currently smoke								
Yes	2662 (13)	1.28		1.18–1.39	3080 (10)	1.27		1.17–1.37
No	17950 (87)	1.00		Referent	26784 (90)	1.00		Referent

Notes: “–” indicates variables that were not included in the model. “CI” is Confidence Interval

^a n (% of those who responded) presented

^d Missing observations ranged from 0–10% depending on the variable unless otherwise noted

^b Marital status not asked among women

^c Missing observations greater than 10% of sample for spouses: Body Mass Index Categories (missing=9101, 30% of sample), Leisure PA (missing=8065, 26.4% of sample, and hours spent in the sun per day (missing=8082, 26.4% of sample)

^dChronic disease is an aggregate variable includes ever being diagnosed with one or more of the following conditions: angina, arrhythmia, asthma, nephritis, bronchitis, chronic lung disease, chronic kidney infection, diabetes, emphysema, epilepsy, heart disease, hypertension, kidney disease, kidney failure, other kidney disease, lupus, multiple sclerosis, myocardial infarction, nervous disorder, Parkinson's, rheumatoid arthritis, stroke, thyrotoxicosis, thyroid disease, ulcerative colitis or Crohn's Disease

^eMen: Low: less than 45 minutes/wk, Moderate: 45 minutes-3 hours/wk, High: More than 3 hours/wk

Women: Low: less than 30 minutes/wk, Moderate: 30 minutes = 2.25 hours/week, High: More than 2.25 minutes/week

Unadjusted Odds of Carrying and Lifting (CL) for Farmers and Spouses in the Agricultural Health Study, 1993–1997, Farm Activities^a

Table 2

Farm Activities ^b	Farmers (n=21,295)				Spouses (n=30,591)			
	n(%)	Odds of CL	1 hr per day	95% CI	n(%)	Odds of CL	1 hr per day	95% CI
Apply chemical fertilizer ^{c,d}	7835 (38)	1.79	1.69–1.90	3420 (11)	2.25	2.09–2.43		
Apply natural fertilizer ^{c,d}	8391 (41)	1.89	1.79–2.01	3527 (12)	3.22	3.00–3.46		
Drive combines ^{c,d}	12506 (60)	1.59	1.50–1.68	3244 (11)	3.06	2.84–3.30		
Drive diesel tractors ^{e,f}	18057 (86)	2.44	2.25–2.65	9590 (32)	3.87	3.66–4.08		
Drive gasoline tractors ^{e,f}	9743 (47)	1.53	1.45–1.62	7459 (25)	3.28	3.10–3.47		
Drive trucks ^{e,f}	10293 (50)	1.55	1.46–1.64	11435 (38)	2.77	2.62–2.92		
Grind animal feed ^{e,f,g}	4934 (31)	1.89	1.76–2.02	1549 (5)	5.84	5.24–6.50		
Grind metal ^{e,f}	4252 (20)	1.51	1.40–1.62	354 (1)	6.64	5.29–8.33		
Hand pick crops ^{c,d}	2611 (13)	1.44	1.32–1.57	7772 (26)	1.88	1.78–1.99		
Milk cows ^{e,f}	1039 (5)	2.58	2.22–2.99	816 (3)	3.83	3.35–4.39		
Paint ^{e,f}	328 (2)	1.80	1.41–2.28	9051 (30)	2.15	2.03–2.26		
Plant ^{c,d}	13725 (66)	1.77	1.67–1.88	7346 (24)	2.20	2.08–2.33		
Repair engines ^{e,f}	1320 (6)	2.02	1.78–2.29	387 (1)	6.99	5.61–8.71		
Till the soil ^{c,d}	14639 (70)	1.81	1.71–1.93	7285 (24)	3.38	3.20–3.58		
Weld ^{e,f}	4295 (21)	1.55	1.45–1.67	291 (1)	5.27	4.14–6.71		
Work in the fields ^{c,h}	---	-----	-----	15541 (51)	4.42	4.17–4.69		
Acres Planted in the Past Year ^g								
0	620 (3)	0.40	0.33–0.47	843 (3)	0.57	0.47–0.69		
1–199	6233 (32)	1.00	Referent	8106 (29)	1.00	Referent		
200	12693 (65)	1.11	1.05–1.19	19182 (68)	1.07	1.01–1.14		

Notes: “-” indicates variables that were not included in the model. “CI” is Confidence Interval

^aThe referent for each activity is “not” doing the activity

^bFor farm activities, missing observations ranged from 0–4% depending on the variable

- ^cFarmers-performed more than 5 days in the growing season
- ^dSpouse-farm activities performed in last growing season
- ^eFarmers-farm activities performed more than once per week
- ^fSpouses-farm activities performed at least once a month
- ^gMissing observations greater than 4% of the sample; Acres Planted in the Past Year (missing=1750, 8% of sample) and grind animal feed (missing=5137, 24% of sample)
- ^hThe amount of time working in the fields was not asked for farmers

Table 3

Odds of Carrying and Lifting One or More Hours per Day Adjusted for Demographic, Health Status, Health Behavior, and Farm Activities, Agricultural Health Study, 1993–1997^a

Characteristic	Farmers (n=21,295)			Spouses (n=30,591)		
	Odds of CL	1 hr per day	95% CI	Odds of CL	1 hr per day	95% CI
Education						
High School Degree or less	1.21		1.13–1.29	1.25		1.17–1.34
Greater than High School Degree	1.00		Referent	1.00		Referent
Race						
White	1.00		Referent	^^^		^^^
Non-white	0.61		0.48–0.77	^^^		^^^
Years spent on farms						
>10years	0.79		0.66–0.95	1.00		Referent
11–30 years	1.07		0.99–1.16	0.80		0.72–0.88
> 30 years	1.00		Referent	0.94		0.87–1.00
Age						
< 50	1.00		Referent	1.00		Referent
50	0.52		0.49–0.55	0.60		0.56–0.64
Ever Employed off the Farm						
Yes	1.09		1.02–1.17	-----		-----
No	1.00		Referent	-----		-----
History of Cancer Diagnosis						
Yes	^^^		^^^	0.84		0.73–0.96
No	^^^		^^^	1.00		Referent
Body Mass Index Categories						
Under or Normal Weight	^^^		^^^	1.00		Referent
Overweight	^^^		^^^	1.13		1.04–1.23
Obese	^^^		^^^	1.18		1.07–1.30
Leisure PA (tertile)						
Low	1.00		Referent	1.00		Referent
Moderate	1.35		1.26–1.44	1.21		1.11–1.31
High	1.84		1.69–2.00	1.64		1.50–1.79
Hours spent in the sun per day						
Up to 3 hours	0.54		0.48–0.60	0.44		0.41–0.48
3–5 hours	1.00		Referent	1.00		Referent
> 5 hours	1.58		1.48–1.69	1.60		1.45–1.77
Currently Smokes						
Yes	1.18		1.07–1.29	1.33		1.21–1.46
No	1.00		Referent	1.00		Referent
Apply chemical fertilizer ^{b,c}	1.20		1.12–1.28	1.18		1.06–1.30
Apply natural fertilizer ^{b,c}	1.30		1.21–1.40	1.30		1.18–1.43

Characteristic	Farmers (n=21,295)			Spouses (n=30,591)		
	Odds of CL	1 hr per day	95% CI	Odds of CL	1 hr per day	95% CI
Drive combines ^{b,c}	1.08		1.00–1.17	^^^		^^^
Drive diesel tractors ^{d,e}	1.36		1.23–1.50	1.30		1.20–1.41
Drive gasoline tractors ^{c, b}	1.17		1.10–1.24	1.26		1.17–1.36
Drive trucks ^{d,e}	1.30		1.22–1.38	1.51		1.42–1.61
Grind animal feed ^{d,e}	1.31		1.20–1.43	1.86		1.64–2.11
Grind metal ^{d,e}	1.10		1.01–1.21	^^^		^^^
Hand pick crops ^{b,c}	1.32		1.19–1.46	1.15		1.06–1.25
Milk cows ^{d,e}	1.77		1.51–2.08	1.92		1.64–2.25
Paint ^{d,e}	1.48		1.14–1.92	1.26		1.18–1.34
Plant ^{b,c}	1.24		1.15–1.34	1.42		1.29–1.55
Repair engines ^{d,e}	1.40		1.22–1.61	1.66		1.27–2.17
Till the soil ^{b,c}	1.14		1.06–1.23	1.08		1.00–1.17
Welding ^{d,e}	1.09		1.00–1.20	0.79		0.58–1.08
Work in the fields ^{c,f}	-----		-----	1.99		1.85–2.14
Acres Planted in the Past Year						
0	0.69		0.57–0.83	^^^		^^^
1–199	1.00		Referent	^^^		^^^
200	0.79		0.73–0.85	^^^		^^^

Notes: “-----” indicates variables that were available for one group (farmers or spouses) and not the other.

“^^^” indicates variable was insignificant in full model and therefore not included in the final model.

“CI” is Confidence Interval

^aThe following variables were not significantly associated with CL in the full model and therefore not included in this final model: marital status, state of residency and history of chronic disease.

^bFarmers-performed more than 5 days in the growing season

^cSpouses-farm activities performed at least once a growing season

^dFarmers-farm activities performed more than once per week

^eSpouses- farm activities performed at least once a month

^fThe amount of time working in the fields was not asked for farmers

Table 4

Physical Activity Based on Reported Carrying and Lifting among Farmers and Spouses, Agricultural Health Study, 1993–1997; Comparison with CDC 2008 Guidelines²⁰

	Farmers N=21296	Spouses N=30591
Median (IQR)		
Hours of CL per day	1.5 (0.5, 4.0)	0.5 (0.0, 1.5)
n(%)		
Vigorous Activity CDC 2008 PA Guidelines		
Meet or exceed ^a	20003 (93.9)	17828 (58.3)
Meet or exceed 5 times ^b	12420 (58.3)	7917 (25.9)
Meet or exceed 10 times ^c	5561 (26.1)	3142 (10.3)
Muscle-Strengthening Activity CDC 2008 PA Guidelines ^d		
Meet or exceed ^e	20003 (93.9)	17828 (58.3)
Meet or exceed 5 times ^f	12420 (58.3)	7917 (25.9)
Meet or exceed 10 times ^g	12420 (58.3)	7917 (25.9)

IQR=interquartile range

CL=carrying and lifting

CDC=U.S. Centers for Disease Control and Prevention

PA=physical activity

^a75 minutes or more of vigorous activity per week

^b375 minutes or more of vigorous activity per week

^c750 minutes or more of vigorous activity per week

^dTwo times per week; assuming participants carry and lift 30 minutes per day twice per week (60 minutes per week)

^e120 or more minutes per week

^f300 or more minutes per week

^g600 or more minutes per week