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Seminal characteristics following exposure to pesticides among agricultural workers

by Solveig B Larsen, MD,[1] Aleksander Giwercman, MD,[2] Marcello Spanò, BSc,[3] Jens Peter E Bonde, MD,[1] Asclepios[4]

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Background and objectives

Few pesticides are known to damage human testicular function, but animal data and epidemiologic studies have indicated male reproductive toxicity on the part of several other compounds (1, 2). As part of the European Asclepios project on occupational hazards to male reproductive function we conducted an explorative study among agricultural workers in order to examine whether exposure to pesticides during a spraying season affects seminal characteristics. We analyzed the within-person changes in semen quality and reproductive hormones across a spraying season in groups of agricultural workers using and not using pesticides.

Materials and methods

Among 789 eligible Danish men, 248 (31.4%) provided 2 semen samples. Information on spillage, fever >38°C, and sexual abstinence period was recorded for each sample, each having been analyzed in a mobile laboratory by 2 trained technicians and 1 physician. The men were instructed to collect the sample within 1 hour before the arrival of the mobile laboratory. The first semen sample was provided before the spraying season started or, at the latest, a few weeks after its start. The second semen sample was collected at least 12 weeks after the first sample and — if spraying — 12 to 18 weeks after the first spraying day. Information on reproductive, medical, and occupational history and life-style habits was collected by self-administered questionnaires. The men were divided into 2 groups according to the use of pesticides between the 2 samples (ie, spraying or not spraying pesticides). The semen samples were examined according to the Asclepios protocol. The paired differences between the second and first sample were computed, and median values of the differences between the 2 groups were calculated for various sperm parameters. Multiple linear regression (SAS procedure GLM) was used to compare the paired differences between the 2 groups. To ensure that the underlying assumptions (normality of residuals and homogeneity of variances) were satisfied, some of the sperm parameters were transformed before the differences were computed. Several potential confounders were included, for example, the differences in spillage between the first and second sample, fever, period of abstinence, delay from sampling to analysis (motility parameters), and time of day of the blood sampling (reproductive

1 Department of Occupational Medicine, Aarhus University Hospital, Aarhus, Denmark.
2 Department of Growth and Reproduction, Rigshospitalet, Copenhagen, Denmark.
3 Section of Toxicology and Biomedical Sciences, ENEA CR Casaccia, Rome, Italy.
4 The Asclepios project on occupational hazards to male reproductive capability is a biomedical research project of the European Union that was carried out in 14 European centers in 1993—1998. The project was coordinated by The Steno Institute of Public Health, University of Aarhus Denmark, and it included the following researchers: Belgium, Gent (P Kiss, A Mahmoud, M Vanhoorne, H Verstraelen); Denmark, Aarhus (A Abell, JP Bonde, SB Larsen, G Danscher, E Ernst, H Kolstad), Copenhagen (A Giwercman); England, London (A Dale, M Joffe, N Shah); Finland, Helsinki (M-L Lindbohm, H Taskinen, M Sallmen), Turku (J Lähdetie); France, Paris (P Jouannet, P Thonneau), Strasbourg (A Clavert); Germany, Erlangen (KH Schaller, W Zschiesche); Italy, Brescia (P Apostoli, S Porru), Milano (L Bisanti), Pietrasanta (L Lastrucci), Rome (M Spanò); The Netherlands, Nijmegen (N Roeleveld, H Thuis, GA Zielhuis), Zeist (W de Kort); Poland, Lodz (K Sitarek).

Correspondence to: SB Larsen, Department of Occupational Medicine, Aarhus University Hospital, Nørrebrogade 44, building 2C, DK-8000 Århus C, Denmark.

Table 1. Seminal characteristics across a summer for men spraying and men not spraying pesticides. (%COMPαT = percentage of cells with abnormal chromatin)

	Men spraying pesticides						Men not spraying pesticides					
	Before (N=161)		After (N=161)		Paired differences[a]		Before (N=87)		After (N=87)		Paired differences[a]	
	Median	25—75 percentile	Median	25—75 percentile	Median	25—75 percentile	Median	25—75 percentile	Median	25—75 percentile	Median	25—75 percentile
Concentration (million/ml)	59	35—102	54	25—101	−10	−27—15	64	29—115	52	26—90	−6	−29—8
Total count[b] million	223	110—407	178	81—361	−30	−119—66	197	86—352	153	78—306	−32	−83—21
Sperm chromatin structure assay (mean-αt)	218	209—230	216	209—228	−1.7	−11—6	219	210—235	220	213—238	2.5	−5—12
%COMPαT	12.1	8.2—17.8	11.5	7.4—17.2	−0.8	−4.3—2.9	13.1	8.4—20.3	12.2	8.6—19.9	−0.07	−2.5—2.2

[a] Paired differences are results from second sample minus results from first sample.
[b] Samples with spillage were excluded from the analyses

hormones). The preliminary results of the analyses are given in this report.

Results

The median sperm concentration declined significantly from the first to the second sample for the men spraying pesticides and the men not spraying pesticides (table 1), but there was no statistical difference in the decline between the 2 groups, even after adjustment for several potential confounders. Only minor changes were found in the sperm morphology, vitality, motility, sperm chromatin denaturation (SCSA), and reproductive hormones, and the differences in the changes between the 2 groups were not significant or were in the opposite direction to the expected.

Discussion and concluding remarks

The preliminary findings reported indicate that semen quality does not change across a spraying season because of occupational exposure to pesticides. Sprayers and nonsprayers had an equal decline in sperm concentration from the first (collected from February to June) to the second (collected from July to October) semen samples. Seasonal changes in sperm concentration have been described in many nonequatorial countries in the northern hemisphere, with the lowest values in the 3 summer months (3). The decline in the sperm concentration of sprayers was not likely caused by pesticide exposure, but rather by seasonal variation or other unknown factors. The lack of association in our study could be real or due to a lack of sufficient exposure contrast. A limitation of our study was the lack of exact exposure measurements, and it was only possible to relate the changes in sperm parameters to exposure variables that are supposed to indicate the exposure level and not to exposure variables with known strong relationships to the internal pesticide exposure level. The number of spraying days and the placement of the days in relation to the 2 samples varied among the farmers. The interval between the first exposure date and the second semen sample was 14.6 weeks (median), which was acceptable for detecting effects on the early stages of spermatogeneses. However transient effects would not have been detected with a design such as ours. If the toxicologic effect is cumulative, which means that an effect will only be detectable after a long period of exposure, the interval was too short. In conclusion, we found no overall differences in semen quality in Danish agricultural workers across a pesticide-spraying season. Additional analyses are in progress on detailed exposure characteristics and biological monitoring data.

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