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The Partial Attributable Risk: An Illustration With Personal and Occupational Risk Factors of Carpal Tunnel Syndrome

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Background:

The population attributable risk (PAR) is a measure of the burden of a disease (eg: carpal tunnel syndrome, CTS) in the population, associated with a particular exposure (eg: work exposure). Only crude work-related PARs of CTS are reported in the literature despite the multifactorial nature of this disorder[1]. A more consistent assessment of the proportion of cases of CTS attributable to work needs to take into account the main potential confounders (e.g.: gender, age, diabetes and obesity).

Bruzzi[2], and Eide and Gefeller[3] have proposed a method to compute n-dimensional average PARs, adjusted of potential confounders. This method is available in general statistical softwares (as R®, SAS® or Stata®) only for dichotomous variables. The lack of use of adjusted PARs can be explained by the absence of software allowing the estimation of average PARs for quantitative or qualitative polytomous exposures.

The aim of our study was to estimate adjusted PARs of CTS with the average PAR methodology and to compare this method with other classical computation methods. Additionally, we developed a macro for the Stata® software allowing to compute average PARs for dichotomous, polytomous or quantitative exposures.

Method:

The data from the Surveillance Program of CTS in the Pays de la Loire Region (France)[4] were used and five exposure factors were studied: work (proxy: occupational category, OC), obesity (BMI>30kg/m²), diabetes mellitus (DM), gender and age. We compared three different estimators of PARs: (i) the unadjusted PAR (crude PAR); (ii) the adjusted sequential PAR, with sequential removal of risk factors (two different removal sequences were proposed: (sequence I) age, DM, OC, obesity, sex; (sequence II) OC, sex, DM, age, obesity), and (iii) the adjusted average AR.

As the crude PAR can only be estimated for dichotomous exposures, age and OC had been dichotomized into two classes to allow the comparison of the different methodologies. Two groups of age were defined: less than 40 years vs. 40 years and over. Similarly, two groups of OC were defined: a OC class with high risk of CTS (blue collar workers and low grade white collar workers) and a OC class with low risk of CTS (higher occupational categories).

Results:

Between 2002 and 2003, 1107 individuals in employment and aged from 20 to 59 years old have benefited from a carpal tunnel release surgery on at least one of their wrists in the Maine et Loire region (351 men and 756 women). All information regarding gender, OC, obesity, DM and age were collected for 697 (63%) of them. The average age was 37.1 (SD: 10.1) for the Maine et Loire population, and 43.5 (SD: 8.5) for the operated CTS cases. The estimated incidence of operated CTS among the residents of the Maine et Loire department, in employment and aged 20 to 59ans was 0.56% (table I).

		Entire Maine et Loire population		Operated CTS cases	
		Sample size	%	Sample size	%
gender	male	156,317	55.1	183	26.3
	female	127,481	44.9	514	73.7
OC	farmers	13,092	4.6	24	3.4
	craftsmen, shopkeepers, business leaders	16,768	5.9	20	2.9
	executives, higher intellectual professions	25,906	9.1	28	4.0
	intermediate occupations	59,992	21.2	91	13.1
	low grade white collar workers	74,427	26.2	249	35.7
	blue collar workers	93,613	33.0	285	40.9
obesity	yes	26,960	9.5	113	16.2
	no	256,838	90.5	584	83.8
DM	yes	7,663	2.7	29	4.2
	no	276,135	97.3	668	95.8

Table I: Distribution of the different exposures for carpal tunnel syndrome among the Maine et Loire residents, employed and ranging in age from 20 to 59 years old between 2002 and 2003.

Attributable risks.

• *All the exposures considered as dichotomous variables.*

The PARs estimated for exposures considered as dichotomous variables are presented in Table II.

	crude AR		sequential AR n°I	
	AR	95% CI	AR	95% CI
gender	0.537	0.489 - 0.584	0.118	0.082 - 0.148
DM	0.009	-0.002 - 0.020	-0.002	-0.007 - 0.004
Obesity	0.067	0.042 - 0.091	0.023	0.002 - 0.046
OC (high risk vs. low risk)	0.459	0.391 - 0.527	0.211	0.166 - 0.268
Age (<40 vs. ≥40)	0.551	0.496 - 0.598	0.548	0.509 - 0.618

	sequential AR n°II		average AR	
	AR	95% CI	AR	95% CI
gender	0.295	0.236 - 0.319	0.300	0.261 - 0.339
DM	0.004	-0.001 - 0.009	0.001	-0.006 - 0.007
Obesity	0.011	0.001 - 0.025	0.025	0.011 - 0.040
OC (high risk vs. low risk)	0.442	0.372 - 0.502	0.244	0.200 - 0.286
Age (<40 vs. ≥40)	0.146	0.105 - 0.166	0.327	0.287 - 0.369

Table II: Attributable risks for exposures considered as dichotomous variables, depending on the attributable risk estimation method.

• *Exposure considered as dichotomous, polytomous or quantitative variables.*

The average PARs estimated for risk factors considered as dichotomous, polytomous or quantitative variables are presented in Table III.

	average AR	
	AR	95% AR
sexe	0.236	0.205 - 0.268
DM	0.000	-0.007 - 0.003
obesity	0.015	0.005 - 0.027
OC (6 categories)	0.242	0.168 - 0.308
age (continuous)	0.501	0.442 - 0.562

Table III: Average AR estimated for the operated Carpal Tunnel Syndrome for exposures possibly considered as polytomous or quantitative variables.

Discussion:

The PARs were highly dependent on the method applied for their estimation. The crude PARs were overestimated: their sum (equal to 162%) was higher than the possible maximum 100%.

The sequential PARs estimations were dependent on the order of removal of the risk factors: the sequential PARs associated with the first removed risk factors were overvalued, and the sequential PARs associated with the last removed risk factors were undervalued.

The average PARs were not depend on any sequence of exposure removal, and their sum was less than 100%. Thus, the average PARs seemed to provide the best estimates of the examined methods.

Conclusion:

The average population attributable risk method should be widely used in public health and epidemiological studies for estimating the population attributable risks of CTS to quantify the proportion of cases in the population that can be ascribed to certain exposures.

We hope that the Stata® macro developed for this study facilitates the estimation of such average PARs*.

*Please contact the author for more informations about the Stata® macro.
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