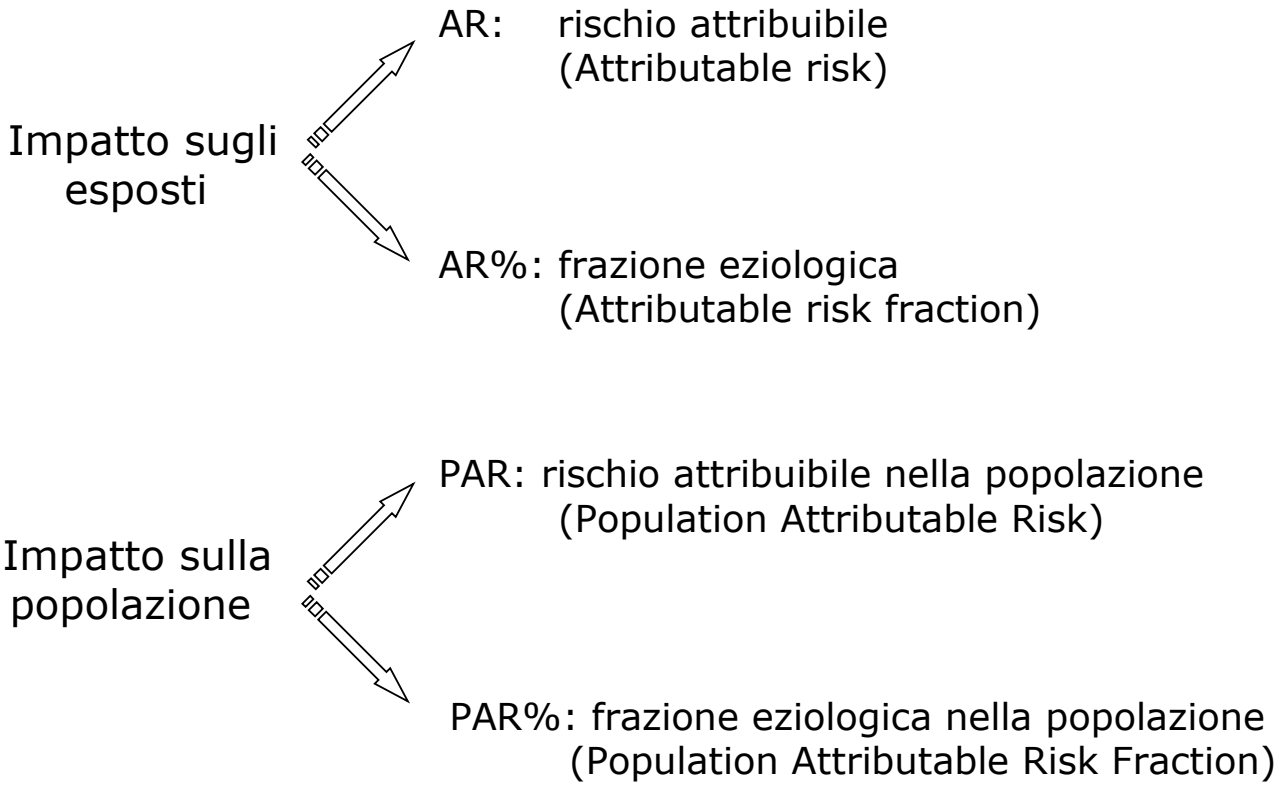
Misure di impatto sulla salute pubblica

- Misure teoriche utili a valutare l'impatto di un programma sanitario sulla salute di una collettività
- Assumono che l'associazione tra la malattia e l'esposizione sia causale (non hanno senso altrimenti)
- Basate in genere su misure di Incidenza

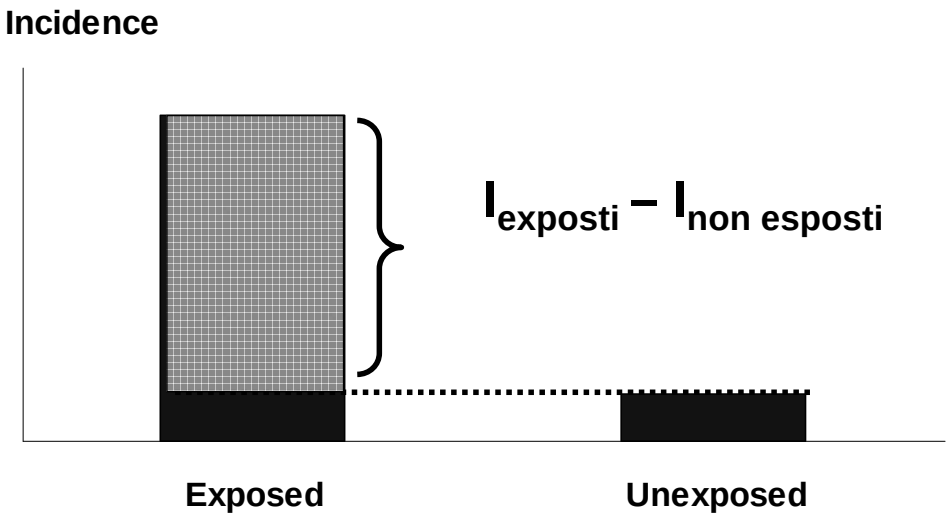
Tipi di Misure



Rischio Attribuibile (AR)

$$I_1 - I_0$$

Qual'è il rischio (incidenza) di malattia attribuibile all'esposizione ??
Qual'è l'eccesso di rischio dovuto all'esposizione ??

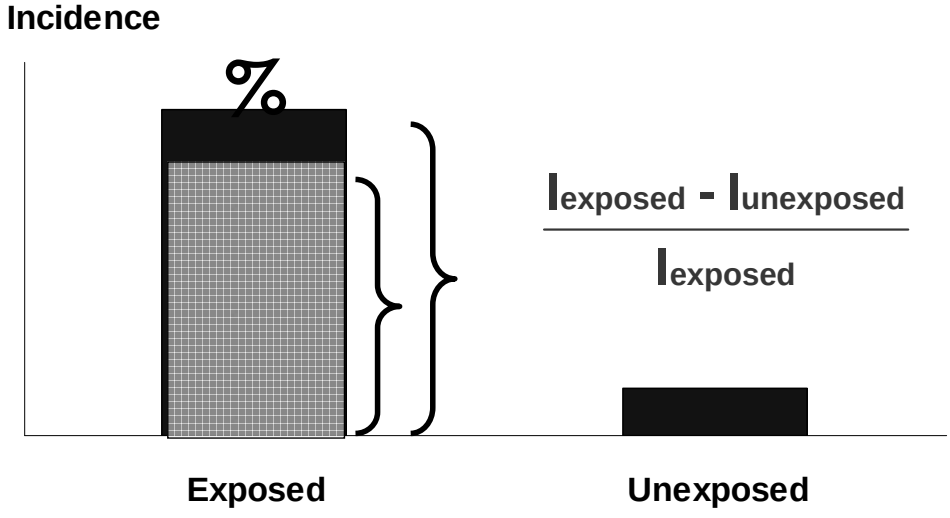


Rischio Attribuibile % (AR%) o Frazione Eziologica

$$(I_1 - I_0) / I_0$$

Qual'è la proporzione di malattia tra gli esposti che puo:

- essere attribuita all'esposizione??
- essere evitata se l'esposizione venisse eliminata



- You are in charge of health prevention
- Want to reduce automobile-related deaths
- Limited budget
  but want to have the greatest impact
  on reducing deaths
- Cohort study to examine causes
  for automobile-related deaths:

	RR	AR	AR%
Fast driving	**5.0**	**0.04**	**80%**
Drunk driving	**10.7**	**0.136**	**91%**

Relazione tra AR% e RR

Essendo: $I_1 = I_0 * RR$

$$AR\% = \frac{I_0\,RR - I_0}{I_0\,RR} = \frac{\cancel{I_0}\,(RR - 1)}{\cancel{I_0}\,RR} = \frac{(RR - 1)}{RR}$$

I tribunali americani attribuiscono un evento a un esposizione, se risulta che l'evento ha almeno una probabilità del 50% di essere dovuto all'esposizione.

Es: Operaio esposto a cromo esavalente e affetto da cancro al polmone.

Cromo $\Rightarrow$ K polmone : RR=2.1

$$AR\% = \frac{2.1 - 1}{2.1} = 52.3\%$$

Stima della probabilità che K al polmone sia dovuto all'esposizione

Prevented fraction

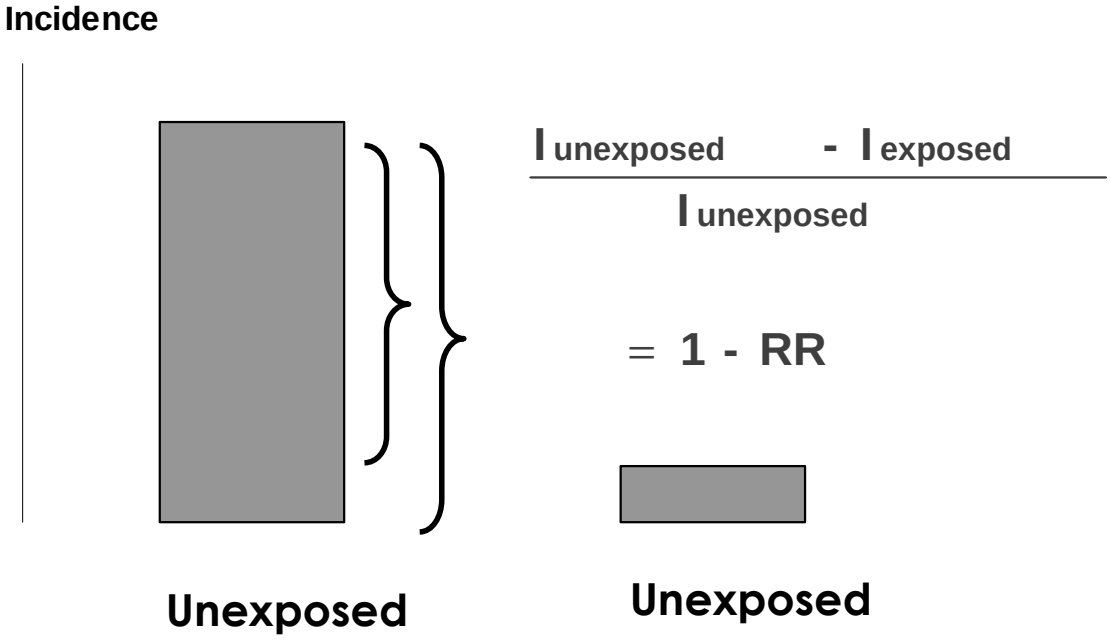
Prevented Fraction (PF)

For exposures associated with decreased risk

- If relative risk <1
  - exposure is protective

- Proportion of potential cases
  - which would have occurred if the exposure had been absent
  - prevented by the exposure

Prevented fraction



PF: Vaccine efficacy

	Pop.	Cases	Cases/1000	RR
Vaccinated	**301,545**	**150**	**0.49**	**0.28**
Unvaccinated	**298,655**	**515**	**1.72**	**Ref.**
Total	**600,200**	**665**	**1.11**	

$$\frac{I_{unexposed} - I_{exposed}}{I_{unexposed}} \qquad PF = \frac{1.72 - 0.49}{1.72} = 0.72$$

$$= 1 - 0.28 \qquad = 0.72$$

	Pop.	Cases	Cases/1000	RR
Vaccinated	**301,545**	**150**	**0.49**	**0.28**
Unvaccinated	**298,655**	**515**	**1.72**	**Ref.**
Total	**600,200**	**665**	**1.11**	

Expected number of cases among vaccinated if unvaccinated

$$\frac{301,545}{1,000} \times 1.72 = \quad 519$$

Observed number of cases **150**

Estimated number of cases prevented **369 (72%)**

AR e AR% ci informano sull'incidenza o proporzione di malattia nel gruppo esposto dovuta all'esposizione..

Ma:

Qual è l'eccesso di rischio nella popolazione totale dovuto all'esposizione ???

o

Qual è la percentuale o il numero di casi che potrebbero essere evitati nella popolazione generale se fosse rimossa l'esposizione ???

Per rispondere alle precedenti domande è necessario conoscere la % di esposti della popolazione!!

PAR e PAR%

PAR: Incidenza della malattia nella popolazione che può essere attribuita all'esposizione.

$$I_p - I_0 \quad == \quad p(I_1 - I_0)$$

PAR%: Proporzione della malattia nella popolazione che può essere attribuita all'esposizione.

$$\frac{I_p - I_0}{I_p}$$

I_p = incidenza nella popolazione generale = $p(I_1)+(1-p)(I_0)$

P= % di esposti

Relazione tra PAR% e RR

$$PAR\% = \frac{p\,(RR-1)}{p\,(RR-1)+1}$$

p = percentuale di soggetti esposti nella popolazione

P= % di esposti

Cont. Esempio

- **Fast drivers** >>>> 20% of the total population
- **Drunk drivers**>>> 3%of the total population

Fast driving

	Dead	Not dead		Risk
Fast	100	1900	2000	0.050
Slow	80	7920	8000	0.010
	180	9820	10000	0.018

$$PAR = 0.018 - 0.010 = 0.008$$

$$PAR\% = \frac{0.018 - 0.010}{0.018} \times 100 = 44\%$$

PAR%: Drunk driving

	Dead	Not dead		Risk
Drunk	45	255	300	0.150
Not d.	135	9565	9700	0.014
	180	9820	10000	0.018

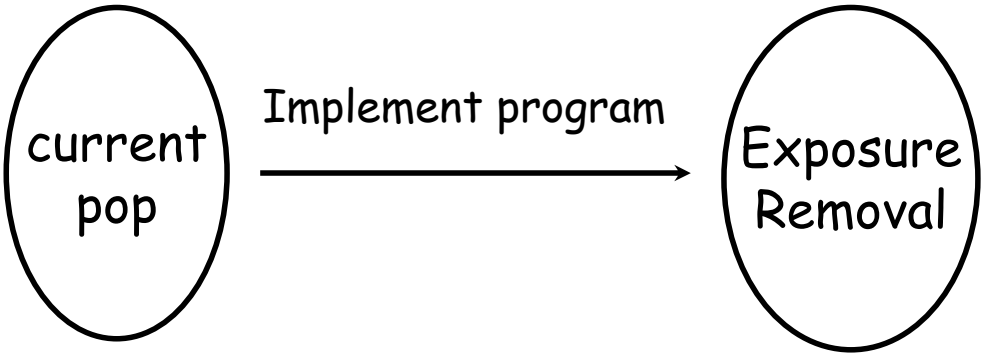
$$PAR = 0.018 - 0.014 = 0.004$$

$$PAR\% = \frac{0.018 - 0.014}{0.018} \times 100 = 22\%$$

Conclude

- Driving related deaths in population
  - 44% presumably due to fast driving
  - 22% presumably due to drunk driving

PAR - How to calculate it?



Disease X
100 cases per 10,000 p-y

Disease X
60 cases per 10,000 p-y

PAR = (100-60) cases per 10.000 p-y
40 cases per 10.000 p-y are due to physical inactivity

$$PAR\% = \frac{(100-60)/10.000}{100/10.000} \times 100\% = 40\%$$

40% of Disease X in this population is due to physical inactivity

Esempio

I consumatori abituali di carni rosse hanno un RR=2 di sviluppare cancro al colon.

Il 25% della popolazione è abituale consumatore di carni rosse.

L'incidenza di cancro al colon nella popolazione generale e 50/100.000/anno.

- Quanti casi su 100.000 persone sono dovuti al consumo di carni rosse?

- Quale percentuale della malattia può essere attribuita al consumo di carne.

Soluzioni Esempio:

I_p = (0.25)(100/100.000/year) + 0.75 (50/100.000/year)

= 62.5/100.000/year

PAR = I_p - I_0 = 62.5 - 50.0 = 12.5/100.000/year

PAR% = 12.5/62.5 = 20%

PAR - Limitations

- Theoretical concept
- Estimates of P_e vary, depending on which survey data are used
- Estimates of RR often come from different data source than that for P_e
- PAR% usually calculated assuming 2 levels only of risk factor, e.g., inactive versus active

Population attributable risk (PAR) for polichotomous exposure:

$$\frac{\sum P_{exp(i)} * (RR_i - 1) * 100}{1 + \sum P_{exp(i)} * (RR_i - 1)}$$

Walter 1976

Example: Smoke and cardiovascular disease

Risk ratio for CHD for non-smoking nurses exposed only at work:

Regular	1.91
Occasional	1.58
None	1.00

Percentage of exposure in the population

$p_{(regular)} = 16\%$ $p_{(occasional)} = 12\%$ $p_{(none)} = 72\%$

$$PAR\% : \frac{\sum P_{exp(i)} * (RR_i - 1) * 100}{1 + \sum P_{exp(i)} * (RR_i - 1)}$$

$$PAR\% : \frac{[.16*(1.91-1)]+[.12*(1.58-1)]}{1 + [.16*(1.91-1)]+[.12*(1.58-1)]} * 100 = 17.7\%$$

Kawachi, et al., Circulation 1997

The Big Risk Number

• You've calculated your relative risk and you've made it statistically significant. Is that enough? Can you just write up your results, get them published and start filling out those federal grant applications?

• You can, but you haven't yet maximized your chances for success. There's one last thing to do and it's easy as pie. You simply take the innocuous relative risk number and "morph" into a public health crisis.

Steven Milloy, The Risky Business of Public Health Research, SCIENCE WITHOUT SENSE

The Big Risk Number

• You need to calculate a risk estimate for some population, preferably a large population, preferably a large population or, better yet, all 250 million Americans. If you can figure the number of cancer cases or premature deaths associated with your risk, you're sure to get instant national attention. But how do you do this? Simple. Tell you statisticians you want to calculate an attributable risk. They know how.

Steven Milloy, The Risky Business of Public Health Research,
SCIENCE WITHOUT SENSE

The Big Risk Number

• Attributable risk is intended to indicate what percentage of deaths in a population are caused by a risk. For example, saying that "16 percent of deaths are due to being overweight" is an attributable risk. You've attributed 16 percent of all deaths to obesity. All you need to do then is figure out how many deaths there are annually (about 2.2 million in the U.S., according to 1991 statistics), then multiply the number of annual deaths by the attributable risk (16 percent). *Voila!* A public health crisis is born!

Steven Milloy, The Risky Business of Public Health Research,
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Examples of Attributable Risk

Risk	Annual Deaths Attributable to Risk
Obesity	350.000 from all causes (Source: derived from 1995 Harvard University Study)
Smoking	390.000 from all causes (Source: U.S. Surgeon General)
Radon	40.000 from lung cancer (Source: U:S: EPA)
Chlorinated tap water	10.000 from bladder & rectal cancer (Source: Morris et al 1992)
Environmental tabacco smoke	3.000 from lung cancer (Source: U.S. EPA)

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Examples of Attributable Risk

STATISTISTICIAN'S WARING: ATTIRIBUTABLE RISK MAY NOT BE SCIENTIFICALLY JUSTIFIABLE. IT IS CALCULATED FROM VERY UNCERTAIN STATISTICAL ASSOCIATIONS. THESE ASSOCIATIONS MAY NOT REFLECT TRUE BIOLOGICAL CAUSE-AND-EFFECT. AT BEST, A STATISTICAL ASSOCIATION IS A REPRESENTATION OF WHAT WAS OBSERVED IN A PARTICULAR POPULATION STUDIED AND IS NOT APPLICABLE TO OTHER POPULATIONS NOT STUDIED.

You, of course, should ignore this warning.

Steven Milloy, The Risky Business of Public Health Research,
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