

## THEORY AND METHODS

## Meta-analysis of randomised trials of monetary incentives and response to mailed questionnaires

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*J Epidemiol Community Health* 2005;59:987–999. doi: 10.1136/jech.2005.034397

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Accepted for publication  
15 May 2005

**Study objective:** To quantify the increase in mailed questionnaire response attributable to a monetary incentive.

**Design:** A systematic search for randomised controlled trials of monetary incentives and mailed questionnaire response was conducted. For each trial identified, logistic regression was used to estimate the odds ratio for response per \$0.01 incentive increase. Odds ratios were pooled in a series of random effect meta-analyses stratified by the minimum and maximum amounts offered. Piecewise logistic regression was used to estimate the odds ratio for response per \$0.01 increase given in each of five incentive ranges.

**Setting:** Populations in several developed countries, predominantly the USA.

**Participants:** 85 671 randomised participants from 88 trials.

**Main results:** The pooled odds ratios for response per \$0.01 incentive decreased monotonically as the maximum amount of incentive offered increased. The piecewise logistic regression model estimated that for incentive amounts up to \$0.50, each additional \$0.01 increased the odds of response by about 1% (pooled OR = 1.012, 95%CI 1.007 to 1.016). The effects on response above \$0.50 were smaller and decreased monotonically in the ranges: \$0.50–0.99, \$1–1.99, \$2–4.99, \$5.00 and over, but remained statistically significant up to \$5.

**Conclusions:** This meta-analysis of the best available evidence shows that monetary incentives increase mailed questionnaire response. Researchers should include small amounts of money with mailed questionnaires rather than give no incentive at all.

Mailed questionnaires are often used for data collection. When collecting information from large, geographically dispersed populations, the mailed questionnaire may be the only practical and financially viable method available for researchers.<sup>1</sup> However, non-response to mailed questionnaires reduces the effective sample size and can introduce bias.<sup>2</sup> Strategies that can increase response to mailed questionnaires have been identified and include the use of monetary incentives.<sup>3</sup>

Several reviews and meta-analyses of studies of the effect of monetary incentives on questionnaire response have been published in the past 30 years,<sup>4–10</sup> but none has been based on a systematic search of the literature. We conducted a meta-analysis of the data obtained from a systematic search of the literature to quantify the increase in response attributable to a monetary incentive.

## METHODS

## Systematic review

A systematic search was initially made for all randomised controlled trials of any method to influence response to a mailed questionnaire.<sup>3</sup> We updated the systematic search for trials and included all trials published by February 2003. There was no restriction by language, questionnaire topic, or study population. We searched 14 electronic bibliographic databases, the reference lists of relevant trials, and all issues of two journals in which the largest number of eligible trials had been published (*American Journal of Epidemiology* and *Public Opinion Quarterly*). The reports of potentially relevant trials were obtained and two reviewers assessed each for its eligibility. We estimated the sensitivity of the combined search strategy (electronic searching and manual searches of reference lists) by comparing the trials identified with this strategy with those identified by manually

searching journals. The authors of eligible trials were contacted by mail or e-mail for any information required for the review that was missing from the published reports, and were also asked whether they knew of unpublished trials.

## Data extracted

Data were extracted from each study on: amount and currency of the monetary incentives used, whether incentives were mailed with questionnaires ("unconditional" incentives) or given to participants after questionnaires had been returned ("conditional" incentives); the year the study was conducted, the numbers of participants randomised, and the numbers who responded. When the years that studies were conducted were unknown they were estimated by subtracting from the year of publication the average delay between study year and publication year calculated from those studies for which this information was available. The amounts of monetary incentive were standardised by converting them to US dollars, and then updating them to present day values using the American Institute for Economic Research's *Cost of Living Calculator*.<sup>11</sup> To investigate whether pre-specified study characteristics modify the effect of an incentive on response, data were extracted from each report on: the number of pages used in each questionnaire and whether: the questionnaire topic was health related; participants were groups of professionals (for example, physicians); a non-monetary incentive was used in addition to the monetary incentive; the organisation conducting the study was an academic institution; a reply paid envelope was provided; participants were notified in advance of the questionnaire being sent; the questionnaires were sent by special delivery, and whether follow up reminders were sent to non-respondents.

**Table 1** Description of studies included in the meta-analysis

First author, year	Participants	Study topic	Interventions	Questionnaires returned/ sent
Asch 1998	1 000 primary care physicians identified through the American Medical Association Physician Master File (US).	Attitudes about cost containment in cancer screening.	1. \$2 sent with questionnaire 2. \$5 sent with questionnaire	221/500 (44.2%) 296/500 (59.2%)
Bellizzi 1986	200 people randomly selected from a city telephone directory, (US).	Shopping convenience and lifestyle.	1. No incentive 2. \$1 bill included with questionnaire	37/100 (37%) 54/100 (54%)
Berk 1993	315 physicians (allergists and otolaryngologists) in Project HOPE survey (US).	Tests and costs for diagnosing allergies.	1. \$10 with first mailing; follow up questionnaire and letter mentioning the incentive 2. No incentive with first mailing; Follow up questionnaire with \$10 and letter explaining the importance of the study 3. No mention of \$10 in either first or second mailing	79/125 (63.2%) 62/125 (49.6%)
Biner 1988	200 of the 77216 residents of a mid-western city, randomly sampled from a telephone directory (US).	Community needs assessment.	2×2 factorial design: No incentive v \$1 Reactance appeal v No reactance appeal	30/100 (30%) v 61/100 (61%)
Biner 1990	200 of the 120500 residents of a mid-western city, systematically sampled from a telephone directory (US).	Community needs assessment.	2×2 factorial design: \$1 v \$0.25 Obligated to reply v Given in appreciation	67/100 (67%) v 46/100 (46%)
Brennan 1991	900 people listed on one of the 57 electoral rolls representing the main urban centres (New Zealand).	Personal investments, banking and finance.	1. No incentive 2. 20c coin with first mailing 3. 50c coin with first mailing 4. \$1 with first mailing 5. 20c coin with second mailing 6. 50c coin with second mailing 7. \$1 with second mailing 8. Entry into prize draw for \$200 cash offered with each mail out 9. Entry into prize draw for \$200 gift voucher offered with each mail out	42/100 (42%) 46/100 (46%) 65/100 (65%) 49/100 (49%) 53/100 (53%) 45/100 (45%) 56/100 (56%) 45/100 (45%) 50/100 (50%)
Brennan 1992a	400 people listed on a financial service company's 'hot prospect' list (New Zealand).	Financial services.	1. No incentive 2. \$0.50	144/200 (72%) 162/200 (81%)
Brennan 1992b	400 people listed on the electoral roll (New Zealand).	Use of brands of fruit juice.	1. No incentive 2. \$0.50	112/200 (56%) 128/200 (64%)
Brennan 1992c	384 people listed on the electoral roll (New Zealand).	Shopping.	1. No incentive 2. \$0.50	123/192 (64.1%) 134/192 (69.8%)
Brennan 1993a	412 dairy and beef farmers (New Zealand).	Use of mineral supplements.	1. No incentive 2. \$0.50 coin with first mailing 3. \$1 coin with first mailing 4. \$1 lottery ticket with first mailing	50/101 (49.5%) 70/103 (68.0%) 66/100 (66.0%) 64/108 (59.3%)
Brennan 1993b	1 847 people listed on the electoral roll (New Zealand).	Attitudes toward social inequality.	1. No incentive 2. \$0.50 coin with first mailing 3. \$1 coin with first mailing 4. Promise that \$1 would be donated to a charity for each valid return (in each of three mailings)	230/452 (50.9%) 278/454 (61.2%) 307/463 (66.3%) 271/478 (56.7%)

**Table 1** Continued

First author, year	Participants	Study topic	Interventions	Questionnaires returned/ sent
Burns 1980	400 bank, savings and loan chief executive officers (US).		2 × 2 factorial design: No incentive v \$0.25 No follow up v Follow up postcard sent 10 days after initial mailing	54/200 (27.0%) v 89/200 (44.5%)
Camunas 1990	700 members of the New York State Nurses Association (US).	Nursing association activities.	1. No incentive 2. \$1 bill 3. Brochure	63/300 (21.0%) 97/200 (45.0%) 20/200 (13.5%)
Collins 2000	4280 members of the RAND adolescent and young adult panel study drawn from schools across the US (US).	Smoking and substance misuse.	1. \$20 cash with mailing 2. \$20 cash on return of questionnaire 3. \$25 cash on return of questionnaire	1047/1689 (62.0%) 1019/1734 (58.8%) 564/857 (65.8%)
Deehan 1997	3584 GPs who did not respond to two mailings of a questionnaire (UK).	Work with patients who misuse alcohol.	Third mailing: 1. No incentive 2. £5 charity donation 3. £10 charity donation 4. £5 5. £10 Fourth mailing to non-respondents in control group of third mailing: 1. £5 2. £10	101/1188 (8.5%) 57/607 (9.4%) 58/578 (10.0%) 105/613 (17.1%) 135/598 (22.6%)
Denton 1988	297 graduates from the Department of Educational Curriculum and Instruction at a large university in the south west (US).	Educational knowledge and skills.	2 × 2 factorial design: No incentive v \$0.25 No newsletter v newsletter	63/534 (11.8%) 85/536 (15.9%) 109/257 (42.4%) v 16/40 (40.0%)
Denton 1991	100 graduates from the Department of Educational Curriculum and Instruction at a large university in the south west: (US).	Educational knowledge and skills.	1. No incentive 2. \$0.25 3. \$0.50 4. \$1 5. Raffle	12/20 (60.0%) 13/20 (65.0%) 14/20 (70.0%) 14/20 (70.0%) 13/19 (68.4%)
Dommeyer 1980	352 people listed in the Cincinnati telephone directory (US).	Attitudes to mailed surveys.	No incentive v pre-paid \$0.25 in follow up	21/176 (11.9%) 30/176 (17.0%)
Dommeyer 1988	600 people listed in the Chicago and Phoenix telephone directory (US).	Morality and conscience.	1. No incentive 2. \$0.25 coin 3. \$0.25 cheque 4. \$0.25 money order 5. 'Early bird' — get a share in an incentive (\$25) if send questionnaire back quickly 6. Sweep stake (entered into sweepstake to win \$25 if return questionnaire by deadline)	37/100 (37%) 50/100 (50%) 37/100 (37%) 38/100 (38%) 33/100 (33%) 30/100 (30%)
Donaldson 1999	400 physicians randomly selected from a list of US physicians actively caring for at least one transplant patient (US).	Interest in an internet consulting service.	2 × 2 factorial design: No incentive v \$5 cheque with initial mailing No follow up call v follow up call to non-respondents 4 weeks after initial mailing	9/1/200 (4.5%) v 115/200 (57.5%)

Table 1 Continued

First author, year	Participants	Study topic	Interventions	Questionnaires returned/ sent
Doob 1971a	400 people listed in a phone book (Toronto and Ontario, Canada).	Lifestyle.	2×2 factorial design: No incentive v dime incentive No reactance v reactance ('reactance' was a request written to make participants feel an attempt was being made to limit their freedom)	60/200 (30.0%) v 93/200 (46.5%)
Doob 1971b	200 people listed in a phone book (Toronto and Ontario, Canada).	Lifestyle.	2×2 factorial design: No incentive v dime incentive No reactance v reactance	30/100 (30%) v 48/100 (48%)
Doob 1971c	200 people listed in a phone book (Toronto and Ontario, Canada).	Lifestyle.	2×2 factorial design: No incentive v \$0.20 incentive No reactance v reactance	36/100 (36%) v 53/100 (53%)
Doob 1973	804 people listed in a California telephone directory (US).	General.	1. No incentive 2. \$0.05 3. \$0.20	110/268 (41.0%) 159/268 (59.3%) 191/268 (71.3%)
Doody 2003a	1500 radiologist technologists who had not responded to two earlier mailings of a questionnaire (US).	Physician diagnosed cancers and risk factors.	1. No incentive 2. \$1 bill 3. \$2 bill 4. \$2 cheque 5. \$5 cheque	46/300 (15.3%) 74/300 (24.7%) 86/300 (28.7%) 63/300 (21.0%) 82/300 (27.3%)
Doody 2003b	1200 radiologist technologists who had not responded to two earlier mailings of a questionnaire (US).	Physician diagnosed cancers and risk factors.	1. No incentive 2. \$1 bill 3. \$2 bill 4. \$2 cheque	53/300 (17.7%) 71/300 (23.7%) 84/300 (28.0%) 66/300 (22.0%)
Fiset 1994	517 dentists insured by a major malpractices carrier in two western states (US).	Malpractices claims experience.	1. \$5 2. \$10	156/258 (60.5%) 163/259 (62.9%)
Friedman 1979	600 people listed in telephone directories of two suburban areas in the greater New York Metropolitan area (US).	Public attitudes toward ethnic groups.	2×2 factorial design: No incentive v \$0.25 Sponsor name suggests black race v white race	66/300 (22.0%) v 113/300 (37.7%)
Furse 1982	600 microwave oven owners listed in a major manufacturer's warranty registration records (US).	Microwave ovens.	3×2 factorial design: No incentive v \$0.50 enclosed v \$1 enclosed No charity incentive v charity incentive (promise of \$1 to charity of respondent's choice for returned questionnaire)	110/200 (55.0%) v 154/200 (77.0%)
Gajraj 1990	700 customers of a major public utility, comprising households in south western Ontario (Canada).	Energy conservation.	1. No incentive 2. \$0.50 included 3. Promise of \$0.50 on return of completed questionnaire 4. Pen included 5. Promise of pen on return of completed questionnaire 6. Inclusion in share of winning from five Super Lotto lottery tickets 7. Promise of inclusion in share of five Super Lotto lottery tickets on return of completed questionnaire	34/100 (34%) 62/100 (62%) 42/100 (42%) 41/100 (41%) 43/100 (43%) 55/100 (55%) 45/100 (45%)

**Table 1** Continued

First author, year	Participants	Study topic	Interventions	Questionnaires returned/ sent
Gendall 1998	1890 people on the electoral roll (New Zealand).	Role of government and attitudes to work orientation.	1. No incentive 2. Foil wrapped tea bag included 3. \$1 coin included	386/632 (61.1%) 388/631 (61.5%) 431/627 (68.7%)
Gibson 1999	1446 residents of Pierce County who had been clients of Medicaid and 797 residents who had been clients of Washington Basic Health Plan for more than 6 months (US).	Health and use of health services.	1. No incentive 2. \$1 3. \$2	209/412 (50.7%) 874/1467 (59.6%) 139/364 (38.2%)
Gillpatrick 1994	619 engineers identified from the subscriber list of a major trade journal (US).	Computer aided design workstations.	2×2 factorial design: No incentive v \$1 No pre-contact v pre-contact	41/213 (19.2%) v 178/406 (43.8%)
Glisan 1982	1512 farmers from six geographical regions (US).	Farm operations and crops.	3×3 factorial design: No incentive v \$0.25 v promised survey results Tan v blue v white questionnaire Regular stamp v commemorative stamp	73/504 (14.5%) v 122/504 (24.2%) v 98/504 (19.4%) 46/72 (63.9%) 57/77 (74.0%) 62/83 (74.7%)
Godwin 1979	232 people in 60 countries, including government ministers, senior academics and directors of relevant organisations.	Facts and opinions on politics of family planning programs.	1. No incentive 2. \$25 on return of questionnaire 3. \$50 on return of questionnaire	375/604 (62.1%) 451/604 (74.7%) 403/604 (66.7%)
Goodstadt 1977	2416 readers of <i>Addictions</i> magazine (US).	Evaluation of <i>Addictions</i> magazine.	1. No incentive 2. \$0.25 3. Free book incentive 4. Promise of free book on return of completed questionnaire	396/604 (65.6%)
Groeneman 1986	600 people listed in the telephone directories of Toronto, Montreal, Vancouver and Winnipeg selected using distinctive Jewish name sampling (Canada).	Travel experiences and attitudes toward possible future trips.	1. No incentive 2. \$1 enclosed	51/300 (17%) 102/300 (34%)
Hackler 1973	218 mothers of ninth or tenth grade students living in one neighbourhood of Edmonton (US).	Community cohesiveness.	1. No incentive 2. \$1 bill incentive	43/109 (39.4%) 77/109 (70.6%)
Halpern 2002	1,200 general internists and family practitioners randomly selected from the American Medical Association's master file of physicians (US).	The comparative merits of placebo controlled versus active controlled trials of novel antihypertensive drugs.	2×2×2 factorial design: \$5 v \$10 incentive Small v large outgoing envelope Peppermint candy v none	354/700 (50.6%) v 293/500 (58.6%)
Hancock 1940	6263 people listed on the personal tax records of the county assessors (US).	Attitudes toward chain and independent stores.	1. No incentive 2. \$0.25 included 3. Promise of \$0.25 on return of questionnaire 4. Personal interview	366/3726 (9.8%) 463/960 (48.2%) 204/1123 (18.2%) 388/454 (85.5%)
Hansen RA 1980	2496 industrial safety engineers employed by firms that require employees to wear safety hard hats (US).	Work related.	1. No incentive 2. \$0.25 3. Ballpoint pen worth \$0.25	114/832 (13.7%) 308/832 (37.0%) 177/832 (21.3%)
Hopkins 1988	507 professional school and public librarians (US).	Attitudes and practices toward holding books in Spanish.	1. No incentive 2. \$1 incentive	188/253 (74.3%) 218/254 (85.8%)
Hubbard 1988a	2,000 residents of a major mid-western metropolitan area (US).	Satisfaction with a range of banking and financial services.	1. No incentive 2. Promise of \$1 donation to charity of respondent's choice 3. \$0.25 enclosed 4. \$1 enclosed 5. Opportunity to win \$200 cash prize	162/400 (40.5%) 134/400 (33.5%) 227/400 (56.8%) 272/400 (68.0%) 207/400 (51.8%)

**Table 1** Continued

First author, year	Participants	Study topic	Interventions	Questionnaires returned/ sent
Hubbard 1988b	3150 residents of a major mid-western metropolitan area (US).	Satisfaction with a range of banking and financial services.	<ol style="list-style-type: none"> <li>No incentive</li> <li>Pre-paid \$0.25</li> <li>Pre-paid \$1</li> <li>Opportunity to win \$50</li> <li>Opportunity to win \$100</li> <li>Opportunity to win \$150</li> <li>Opportunity to win \$200</li> </ol>	<p>121/450 (26.9%) 182/450 (40.4%) 254/450 (56.4%) 133/450 (29.6%) 127/450 (28.2%) 129/450 (28.7%) 170/450 (37.8%)</p>
Huck 1974	200 students living in residence halls at the university of Tennessee (US).	A variation of the Rokeach Dogmatism Scale.	<ol style="list-style-type: none"> <li>First mailing with \$0.25</li> <li>Second mailing (to non-respondents) with \$0.25</li> <li>Third mailing (to non-respondents) with \$0.25</li> <li>First, second and third mailings without \$0.25</li> </ol>	<p>47/50 (94%) 46/50 (92%) 39/50 (78%) 36/50 (72%)</p>
James 1990	844 cable television subscribers in Fairfax County, Virginia (US).	Personal information.	<ol style="list-style-type: none"> <li>No incentive</li> <li>\$0.25</li> <li>\$0.5</li> <li>\$1</li> <li>\$2</li> </ol>	<p>148/168 (88.1%) 146/169 (86.4%) 145/168 (86.3%) 157/169 (92.9%) 163/170 (95.9%)</p>
James 1992	1200 members of a national trade association of owners of construction subcontracting companies who were not currently enrolled in the association's health insurance programme (US).	Personal information about employees.	<ol style="list-style-type: none"> <li>No incentive</li> <li>\$1 cash</li> <li>\$5 cash</li> <li>\$5 cheque</li> <li>\$10 cheque</li> <li>\$20 cheque</li> <li>\$40 cheque</li> <li>\$50 on return of completed questionnaire</li> </ol>	<p>78/150 (52.0%) 96/150 (64.0%) 107/150 (71.3%) 101/150 (67.3%) 100/150 (66.7%) 119/150 (79.3%) 104/150 (69.3%) 85/150 (56.7%)</p>
Jobber 1988	159 chief executives of building societies (UK).		<ol style="list-style-type: none"> <li>2x2 factorial design:</li> <li>No incentive v 20 pence</li> <li>No booklet v booklet explaining survey included</li> </ol>	<p>23/79 (29.1%) v 35/80 (43.8%)</p>
John 1994	7549 cosmetologists aged 22-36 years (US).	Recent health problems, pregnancy and childbirth.	<ol style="list-style-type: none"> <li>No incentive</li> <li>\$1 in first mailing</li> <li>\$1 in second mailing</li> </ol>	<p>327/443 (73.8%) 2257/2791 (80.9%) 3385/4315 (78.4%)</p>
Kasprzyk 2001	300 general internists listed on the American Medical Association files who spend time on direct patient care, dealing with STD diagnosis (US).	STD diagnosis, treatment and control practices.	<ol style="list-style-type: none"> <li>3x2 factorial design:</li> <li>No incentive v \$1.5 cash v \$25 cash</li> <li>First class mailing v FedEx mailing</li> </ol>	<p>25/100 (25%) v 67/100 (67%) v 66/100 (66%)</p>
Keown 1985a	100 business executives (Japan).	Attitudes to business risks.	<ol style="list-style-type: none"> <li>No incentive</li> <li>\$1</li> </ol>	<p>11/50 (22%) 24/50 (48%)</p>
Keown 1985b	100 business executives (Hong Kong).	Attitudes to business risks.	<ol style="list-style-type: none"> <li>No incentive</li> <li>\$1</li> </ol>	<p>6/50 (12%) 0/50 (0%)</p>
Kephart 1958	500 women who had passed their Pennsylvania State Nursing Board exams (US).	Attitudes to aspects of the nursing profession.	<ol style="list-style-type: none"> <li>No incentive</li> <li>Penny</li> <li>Nickel</li> <li>Dime</li> <li>Quarter</li> </ol>	<p>52/100 (52%) 55/100 (55%) 54/100 (54%) 57/100 (57%) 70/100 (70%)</p>

**Table 1** Continued

First author, year	Participants	Study topic	Interventions	Questionnaires returned/ sent
Leung 2002	4850 physicians randomly selected from the full and limited registration lists of the Hong Kong Medical Council (Hong Kong).	Computerisation of clinical and administrative tasks among physicians.	<ol style="list-style-type: none"> <li>1. No incentive</li> <li>2. HK\$10 cash</li> <li>3. HK\$20 cash</li> <li>4. HK\$40 cash</li> <li>5. Entry into HK\$1000 lottery</li> <li>6. Entry into HK\$2000 lottery</li> <li>7. Entry into HK\$4000 lottery</li> </ol>	<p>281/1700 (16.5%)                      9/50 (18.0%)                      15/50 (30.0%)                      17/50 (34.0%)                      175/1000 (17.5%)                      197/1000 (19.7%)                      203/1000 (20.3%)</p>
London 1990	1000 electronics design engineers (US).	Use of components.	<ol style="list-style-type: none"> <li>1. No incentive</li> <li>2. \$1</li> </ol>	<p>24/500 (4.8%)                      116/500 (23.2%)</p>
Martinson 2000	4200 adolescents aged 14–17 years in the Minneapolis/St Paul metropolitan area (US).	Behaviour and attitudes toward smoking.	<ol style="list-style-type: none"> <li>1. No incentive</li> <li>2. \$2 included with questionnaire</li> <li>3. \$15 on completion and return of questionnaire</li> <li>4. Promise of entry into ten drawings for \$200 cash prizes on completion and return of questionnaire</li> </ol>	<p>483/1050 (46.0%)                      650/1050 (61.9%)                      721/1050 (68.7%)                      589/1050 (56.1%)</p>
McConochie 1985	11057 men aged 18–34 (US).	Radio listening.	<ol style="list-style-type: none"> <li>1. \$0.50</li> <li>2. \$2</li> <li>3. \$5</li> </ol>	<p>2312/5249 (44.0%)                      1448/2874 (50.4%)                      1660/2934 (56.6%)</p>
Mizes 1984	200 physicians specialising in allergy, randomly selected from all physicians listed under allergy or allergy/immunology in the telephone directory yellow pages of major metropolitan areas (US).	The incidence, treatment and success of treatment of rhinitis medicamentosa.	<ol style="list-style-type: none"> <li>1. No incentive; Answer sheet on postcard</li> <li>2. \$1 cheque; answer sheet on postcard</li> <li>3. \$5 cheque; answer sheet on postcard</li> <li>4. \$1 cheque; answer on bank cheque</li> <li>5. \$5 cheque; answer on bank cheque</li> </ol>	<p>21/40 (52.5%)                      29/40 (72.5%)                      29/40 (72.5%)                      21/40 (52.5%)                      29/40 (72.5%)</p>
Paolillo 1984	400 business professionals from the mid-west (US).		<ol style="list-style-type: none"> <li>1. No incentive</li> <li>2. \$1 enclosed with questionnaire</li> <li>3. \$2 promised on return of questionnaire</li> <li>4. Entry into a lottery for a cash prize promised on return of questionnaire</li> </ol>	<p>36/100 (36.0%)                      657/100 (65.0%)                      41/100 (41.0%)                      33/100 (33.0%)</p>
Parke 2000	2561 adults aged 20–74 years who were controls in a Canadian case-control study of cancer (Canada).	Lifetime residential and occupational history, smoking, diet, physical activity and use of medication.	<ol style="list-style-type: none"> <li>1. No incentive</li> <li>2. \$2 sent with questionnaire</li> <li>3. \$5 sent with questionnaire</li> </ol>	<p>519/838 (61.9%)                      623/856 (72.8%)                      669/867 (77.2%)</p>
Peck 1981	5850 men and women who had been high school juniors in spring 1973 (US).	Work experience and career plans.	<ol style="list-style-type: none"> <li>1. No incentive</li> <li>2. Prepaid \$3</li> <li>3. \$3 on return of questionnaire</li> </ol>	<p>566/1462 (38.7%)                      1882/2918 (64.5%)                      773/1470 (52.6%)</p>
Perneger 1993	1235 young adults enrolled in various insurance plans (Geneva, Switzerland).	Health status.	<ol style="list-style-type: none"> <li>1. No incentive</li> <li>2. Reminder card</li> <li>3. Promise of 10 Swiss francs</li> <li>4. Reminder card and promise of 10 Swiss francs</li> </ol>	<p>243/311 (78.1%)                      252/309 (81.6)                      260/310 (83.9%)                      252/305 (82.6%)</p>
Pressley 1977	280 marketing research directors (US).		<ol style="list-style-type: none"> <li>2 × 2 × 4 factorial design:</li> <li>No incentive v Dime</li> <li>Cartoons v No cartoons</li> <li>Yellow v Blue v Green v White questionnaire</li> </ol>	<p>45/140 (32.1%)                      v                      61/140 (43.6%)</p>

**Table 1** Continued

First author, year	Participants	Study topic	Interventions	Questionnaires returned/ sent
Roberts 2000	1000 English women aged 40–65 years (UK).	Menopause services in the north west of England.	2 × 2 factorial design: No incentive v payment of £5 on response No lottery incentive v entry into lottery for £50 on response	420/750 (56.0%) v 169/250 (67.6%)
Robertson 1978	450 people systematically selected from the Denver Metropolitan area phone directory (US).		1. No incentive 2. Promise of \$1 cash on return of questionnaire 3. Promise of \$1 donation to charity on return of questionnaire	35/150 (23.3%) 39/150 (26.0%) 62/150 (41.3%)
Shackleton 1980	85 partially sighted school leavers aged 17–20 years who had left schools for the visually handicapped during the previous academic year (UK).	Occupational experiences during the first year after leaving school.	2 × 2 factorial design: No incentive v £1 offered No examination v Previous examination	38/42 (90.5%) v 40/43 (93.0%)
Shaw 2001	1800 HealthSystem Minnesota enrollees aged 20–80 years (US).	Quality of life, anxiety, depression, morbidity and health care utilisation.	1. \$2 2. \$5	590/900 (65.6%) 649/900 (72.1%)
Skinner 1984	300 marketing professors (Canada).	Needs of instructors for an introductory marketing text.	1. No incentive 2. \$1 pre-paid 3. \$1 on return of completed questionnaire; Respondent identified	23/60 (38.3%) 30/60 (50.0%) 20/60 (33.3%)
Spy 1989	3388 residences listed in the Haines Directory who had not responded to a questionnaire (San Diego, US).	Health and physical activity.	4. \$1 on return of completed questionnaire; respondent not identified 5. \$1 promised to charity	15/60 (25.0%) 16/60 (26.7%)
Tullar 1979	200 large manufacturing firms (US).	Product development.	1. No incentive 2. Promise of \$5 on return of completed questionnaire 3. Promise of \$1 on return of completed questionnaire 4. \$1 bill enclosed	323/3114 (10.4%) 21/96 (21.9%) 12/90 (13.3%) 11/88 (12.5%)
VanGeest 2001	873 physicians randomly selected from the American Medical Association's master file of all practising physicians (US).	Attitudes toward, and responses to, utilisation review pressures.	2 × 2 factorial design: No incentive v \$0,10 No follow-up v Follow-up	50/100 (50.0%) v 78/100 (78.0%)
Warriner 1996	3044 households listed in the Grand River Watershed region of south-western Ontario (Canada).	Environmental issues.	1. \$5 cash 2. \$10 cash 3. \$20 cash	176/292 (60.3%) 198/291 (68.0%) 189/290 (65.2%)
Welzien 1986	942 people who had terminated from mental health treatment centres (US).	Client satisfaction.	4 × 5 factorial design: No monetary incentive v Canadian \$2 v \$5 v \$10 No offer to make a charitable donation v \$2 offer v \$5 offer v \$10 offer v lottery (five prizes of Can\$200)	219/347 (63.1%) v 1441/2007 (71.8%) v 270/351 (76.9%) v 263/339 (77.6%)
Wiseman 1973	464 residents in a state-wide telephone listings, Massachusetts (US).	Attitudes and opinions toward the Massachusetts State lottery.	1. No incentive 2. \$0.02 2 × 2 × 2 factorial design No incentive v \$0.10 No follow-up v Postcard follow-up 3 days after initial mailing Stamped v Business reply return envelope No offer of survey results v offer of survey results	86/471 (18.3%) 115/471 (24.4%) 90/232 (38.8%) v 109/232 (47.0%)



**Table 1** Continued

First author, year	Participants	Study topic	Interventions	Questionnaires returned/ sent
Wotruba 1966	150 urban household residents (US).		1. No incentive 2. \$0.25 with questionnaire 3. \$0.50 promised on return of questionnaire	9/50 (18%) 20/50 (40%) 10/50 (20%)
Zusman 1987	371 undergraduate transfer students (US).		1. No incentive 2. \$1 sent with first mailing	74/171 (43.3%) 122/200 (61.0%)

**Statistical methods**

For each trial identified we used logistic regression to estimate the odds ratio for response per \$0.01 increase in the amount of incentive offered unconditionally and conditionally. Our a priori hypothesis was that there are diminishing marginal gains in response for each additional \$0.01 increase in incentive given. We pooled the logistic regression coefficients in a series of random effect meta-analyses stratified according to the minimum and maximum amount offered in each trial: \$0, \$0.01–0.49, \$0.50–0.99, \$1.00–1.99, \$2.00–4.99, \$5.00 and over, and by whether they were conditional or unconditional. Combined odds ratios were calculated within strata as a weighted average of the odds ratios from each trial, using standard errors as weights and incorporating an estimate of the between-study heterogeneity into the weights.<sup>12</sup> Heterogeneity among the trial coefficients was assessed with a  $\chi^2$  test using a 5% level for significance. In the absence of significant statistical heterogeneity, we assessed evidence for selection bias (for example, publication bias) using Egger’s weighted regression method and Begg’s rank correlation test and funnel plot.<sup>13</sup>

We used the Stata statistical software (StatCorp, College station, TX) to fit a piecewise logistic regression model to describe the relation between response rate and amount of incentive (see appendix available on line <http://www.jech.com/supplemental>). The regression coefficients in this model estimate the odds ratio for response for each \$0.01 increase in incentive in each of the ranges: \$0.00–0.49, \$0.50–0.99, \$1.00–1.99, \$2.00–4.99, and \$5.00 and over. Standard errors from the model were adjusted using the  $\chi^2$  goodness of fit statistic to allow for over-dispersion. The model was also extended to investigate interactions between the amount of money offered and the study characteristics, such as whether questionnaire topics were health related.

**RESULTS**

The systematic search for randomised controlled trials of methods to influence response to mailed questionnaires yielded a total of 28 994 records of potentially relevant reports. After screening records and obtaining copies of the reports considered being relevant for further inspection, 325 reports were found to contain one or more such trials. Of the 325 reports, 69 included trials of monetary incentives on response (table 1) where a total of 85 671 participants had been randomised. Contact was made with 22 authors and no unpublished trials were identified. Three reports contained the results of two trials and two reports contained the results of three trials and so there were 76 trials in total. Thirty three trials had evaluated two or more alternative amounts of money and the remainder had compared a single amount with no incentive. In addition, 10 trials had factorial designs combining investigation of a monetary incentive with one other factor (nine trials) or two other factors (one trial). In the following analyses each of these was considered as two (or four) separate smaller trials defined according to levels of the other factor(s), giving a total of 88 trials available for analysis. Among the 88 trials, 73 (83%) evaluated unconditional incentives only, six (7%) evaluated conditional incentives only, and nine (10%) evaluated both conditional and unconditional incentives. A total of 79 (90%) studies were conducted by academic institutions, 28 (32%) were known to have studied health related topics, 36 (41%) were known to have specifically targeted professional groups, 50 (57%) were known to have sent reminders to non-respondents, 51 (58%) were known to have included reply paid envelopes, and eight (9%) were known to have also used non-monetary incentives. The studies were published in a range of journals covering marketing, psychological, and medical research, and the average time between trials being

conducted and being published was three years. The earliest trial located was published in 1940 and the most recent in 2003. Present values of monetary incentives ranged from \$0.04 to \$161. There was significant heterogeneity among the odds ratios for response per \$0.01 increase in the amount of incentive offered derived from each trial ( $p < 0.00001$ ). Among the 82 trials that evaluated unconditional incentives, 80 (98%) found a positive effect on response, and among the 15 trials of conditional incentives, 14 (93%) found a positive effect.

### Stratified meta-analyses

Table 2 shows the combined odds ratios for response per \$0.01 incentive increase among the 82 trials that evaluated unconditional incentives, stratified by the minimum and maximum amounts given in each trial.

Figure 1 shows the results for the 74 trials in the five strata in which the minimum amount given was \$0. Among trials in which the maximum amount given was less than \$0.50 (fig 1(A)—15 trials) the odds of response per \$0.01 were increased by 1.2% (95% confidence interval (CI): 0.6% to 1.7%). In the remaining strata, the pooled effect sizes were progressively smaller as the maximum amount given increased. There was significant heterogeneity among the trial results within each of these five strata ( $p < 0.05$ ). Tests for selection bias were not conducted in the remaining strata, as there were too few trials.

There were 15 trials that had evaluated conditional incentives (not shown in the figure). When these trials were stratified by the minimum and maximum amount offered, two strata contained more than one trial. There were four trials in which the maximum incentive offered was between \$2 and \$4.99, and among these trials the odds of response per \$0.01 were increased by 0.1% (95% CI: 0.0% to 0.2%). There were eight trials in which the maximum incentive offered was \$5 or over, and among these trials the odds of response for each \$0.01 increase were almost unchanged (95% CI:

0.0% to 0.1%). There was significant heterogeneity among the trial results within both strata ( $p < 0.05$ ). In these two strata, the increases in the odds of response per \$0.01 were lower than those for unconditional incentives.

### Piecewise logistic regression

Using the 82 trials that evaluated unconditional incentives, the piecewise logistic regression model estimated the odds ratio associated with a \$0.01 increase in each of five incentive ranges. The fitted relation between odds of response and the amount of incentive given is shown in figure 2, with coefficients from the model shown in table 3. Between \$0.01 and \$0.49, the odds of response per \$0.01 were increased by 1.15% (95% CI: 0.72% to 1.58%). The effect of a \$0.01 increase above \$0.50 was smaller in each successive incentive range, with the effect of an increase between \$2 and \$5 still achieving statistical significance.

In an investigation of the extent to which the relation between amount of unconditional incentive and odds of response was dependent on trial characteristics, the only independently statistically significant effect modifier was whether or not a reminder was sent. A steeper relation was consistently seen if no reminder was sent, but the limited number of studies in different incentive ranges when split up by whether or not a reminder was sent meant that the exact form of the relation could not be reliably identified. We explored the possibility that the impact of a monetary incentive on questionnaire response may have diminished over time. When studies conducted after 1975 were considered separately, we found that for incentive amounts up to \$0.50 each additional \$0.01 increased the odds of response by about 2% ( $p = 0.002$ ). When health related trials were considered separately, the estimates for the effect of each \$0.01 on the odds of response were increased slightly for amounts up to \$1, and decreased slightly for amounts over \$1, however none remained statistically significant.

**Table 2** Odds ratios (95% confidence intervals) for response per \$0.01 increase in incentive in 82 trials that evaluated unconditional incentives, stratified by the minimum and maximum amounts given in each trial

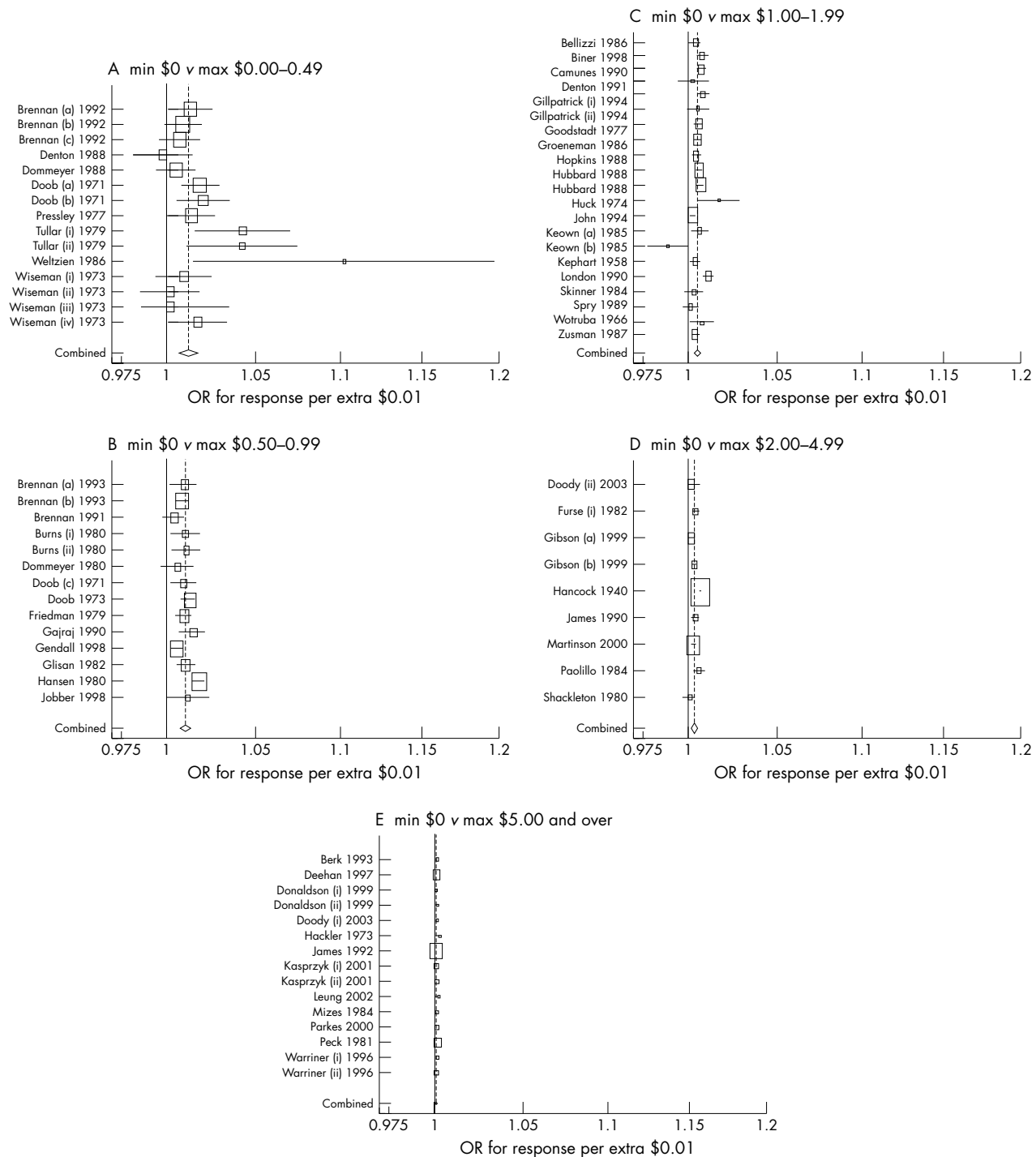
	Maximum amount				
	\$0.00–0.49	\$0.50–0.99	\$1.00–1.99	\$2.00–4.99	\$5.00 +
Minimum amount \$0	1.012 (1.006, 1.017) 15 trials $p = 0.037$ $I^2 = 76$	1.010 (1.008, 1.012) 14 trials $p < 0.001$ $I^2 = 100$	1.005 (1.004, 1.007) 21 trials $p < 0.001$ $I^2 = 100$	1.003 (1.002, 1.005) 9 trials $p < 0.001$ $I^2 = 100$	1.001 (1.001, 1.001) 15 trials $p < 0.001$ $I^2 = 100$
\$0.00–0.49		0 trials	1.007 (1.002, 1.012) 1 trial	0 trials	0 trials
\$0.50–0.99			0 trials	0 trials	1.001 (1.000, 1.001) 1 trial
\$1.00–1.99				1.003 (0.998, 1.008) 1 trial	0 trials
\$2.00–4.99					1.001 (1.001, 1.002) 2 trials $p = 0.099$ $I^2 = 100$
\$5.00 +					1.000 (1.000, 1.001) 3 trials $p = 0.112$ $I^2 = 100$

\*The  $p$  values shown are from the  $\chi^2$  test for heterogeneity among trial results within strata.

**DISCUSSION**

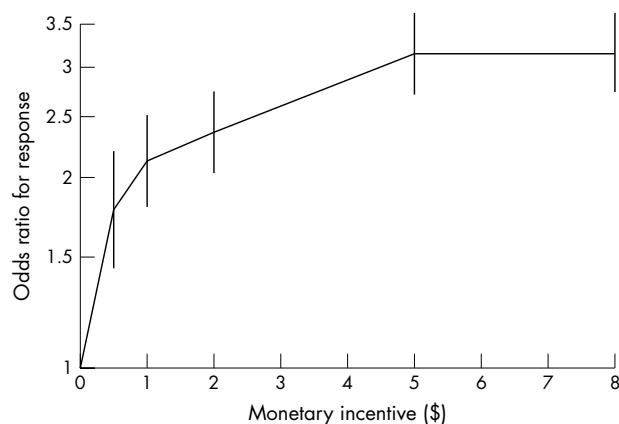
The results of our systematic review and meta-analysis of randomised controlled trials confirm that monetary incentives can increase response to mailed questionnaires. Our stratified meta-analysis and piecewise logistic regression model provide evidence for a non-linear relation between amount of money offered and response: we found that the marginal increase in response for each \$0.01 increase in incentive is highest for amounts up to \$0.50. The effect on response for each additional \$0.01 given above \$0.50 was

smaller and decreased monotonically, but was still statistically significant up to \$5. This suggests that a \$0.01 increase means a lot more to a study participant when offered \$0.25 (a 4% increase), than when offered \$2.50 (a 0.4% increase). We also found evidence that this relation is steeper when follow up reminders are not used and when incentives are given unconditionally. We found no evidence that the impact of monetary incentives on response has diminished over time. Before we consider the implications of these results for the design of mailed data collection strategies, several



**Figure 1** Odds ratios (with 95% confidence intervals shown on a log scale) for response per \$0.01 increase in incentive given unconditionally, stratified by the minimum and maximum amount given in each trial: (A) min \$0 v max \$0.00–0.49, (B) min \$0 v max \$0.50–0.99, (C) min \$0 v max \$1.00–1.99, (D) min \$0 v max \$2.00–4.99, (E) min \$0 v max \$5.00 and over.

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**Figure 2** Odds ratios for response according to amount of incentive given unconditionally, estimated from a piecewise linear logistic regression model (95% confidence intervals shown for incentive levels where the gradient of response is allowed to change).

methodological issues with a bearing on the validity of the results must be addressed.

### Strengths and weaknesses of the study

The most important step in the conduct of a systematic review and meta-analysis of randomised controlled trials is to identify and include all the relevant trials.<sup>14</sup> In our meta-analysis we estimate that our search strategy retrieved nearly all eligible trials (sensitivity 95%; CI: 84% to 99%) and that we missed very few relevant records during screening.<sup>15</sup> However, we excluded studies where we were unable to confirm with the authors that the participants had been randomly allocated to intervention or control groups. We did not examine whether the inclusion of these trials in our meta-analysis would have significantly changed our results. We were successful in contacting some of the authors of the included studies to ask about unpublished trials, but none was identified. We cannot rule out the possibility that other trials of monetary incentives have been conducted and remain unpublished, and that our results may therefore be biased. We did not conduct meta-analytic tests for selection bias because of significant statistical heterogeneity among the results of the included trials.<sup>13</sup>

The results of some of the included trials may be biased if the allocation of participants to intervention or control groups was inadequately concealed at the time of randomisation.<sup>16</sup> The methods of randomisation used to allocate participants were only described in nine reports, and we were unable to contact many authors of the other trials to obtain this information. We were therefore unable to investigate whether the exclusion of trials with inadequate allocation concealment would have significantly changed our results. Another potential source of bias in the included trials

### What is already known on this subject

- Mailed questionnaires are often used for data collection in epidemiological studies, but non-response reduces the effective sample size and can also introduce bias. Monetary incentives (cash or cheques) are one method known to increase response rates.
- Meta-analyses of the estimated effects of monetary incentives on questionnaire response have been published but have not been based on systematic searches of the literature.

is that attributable to losses to follow up. However, the outcome we analysed (whether or not a questionnaire was returned) is known for all participants in all the included trials.

Our study has considered the amount of response that can be gained by using a monetary incentive. We did not investigate any effects that incentives may have on the accuracy and validity of the data collected. We are therefore unable to say whether the use of monetary incentives affect the quality of response, only that they seem to increase the quantity of response. Also, the overwhelming majority of the studies included in our meta-analysis were conducted in the developed world. Whether our results about the effects of a monetary incentive on questionnaire response may be generalised to the developing world remains a matter for judgement.

### Strengths and weaknesses in relation to other studies

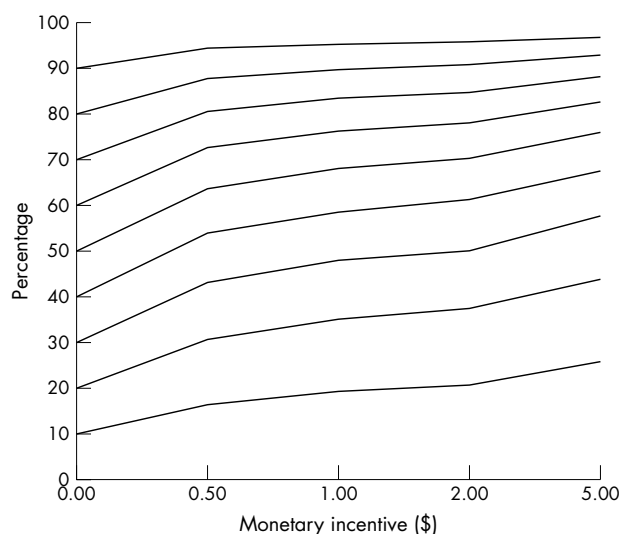
This is the first meta-analysis of studies of the effect of monetary incentives on questionnaire response to be based on a systematic search of the literature. Previous reviews and meta-analyses have only used some of the literature drawn from specific disciplines (for example, marketing).<sup>4-10</sup> One of these studies reached a similar conclusion regarding the relation between the amount of incentive and response.<sup>4</sup> Based on an un-weighted meta-analysis of the data from 17 studies of monetary incentives on response, the authors proposed a “rule of thumb” for a 1% decrease in non-response for each \$0.01 increase in incentive up to 40%. In a meta-analysis of data from 18 American studies of unconditional incentives, no relation was found between the size of the incentive and increases in response rates,<sup>8</sup> whereas another found that increases in monetary incentive bring decreasing marginal gains in response.<sup>7</sup> A meta-analysis of 38 randomised and quasi-randomised trials of monetary incentives concluded that unconditional incentives are the most effective, however, the relation between amount offered and response was not investigated.<sup>10</sup>

**Table 3** Odds ratios for response per \$0.01 increase in unconditional incentive in each of five incentive ranges, estimated from a piecewise linear logistic regression model

Incentive range	Odds ratio for response per \$0.01 increase in incentive	95% confidence intervals	p Value
\$0.01–\$0.49	1.0115	1.0072, 1.0158	0.001
\$0.50–\$0.99	1.0037	0.9979, 1.0095	0.21
\$1.00–\$1.99	1.0011	0.9990, 1.0031	0.31
\$2.00–\$4.99	1.0009	1.0003, 1.0016	0.004
\$5 and above	1.0000	0.9999, 1.0002	0.56

### Policy implications

- This study shows that researchers should include at least a small amount of money with questionnaires rather than give no incentive at all.
- Local research ethics committees, when considering study designs, should be aware that small payments to participants for completion of questionnaires can reduce non-response.



**Figure 3** Increases in response rates from different baseline values by amount of money given (estimates based on the results of a piecewise linear logistic regression model).

### Implications for the design of mailed data collection strategies

In research using mailed questionnaires to collect data, small monetary incentives may be effective in increasing response compared to offering no incentive at all. The response rates that may be expected at different amounts of incentive given unconditionally are shown in figure 3. Depending on the study resource, small amounts can be offered to participants as tokens of appreciation or larger amounts offered as compensation for their time. Although ethical considerations will need to be taken into account before payments to participants are included in the study design, such inducements should be acceptable if kept small, or when the amount of time and effort required of participants exceeds a certain threshold. Before deciding on the amount of incentive to use, other additional related costs need to be considered, such as the costs of printing, packing, and mailing the questionnaires. Larger incentives cost more than smaller ones, but in studies where reminders are sent to non-respondents, the cost may be offset by a corresponding reduction in the numbers of questionnaires that need to be printed, packed, and mailed for the reminders.

This study shows that monetary incentives can increase response to mailed questionnaires but the relation between the amount of money and response is not linear. For amounts up to \$0.50, each additional \$0.01 given with a questionnaire

### What this study adds

- This meta-analysis of the best available evidence quantifies the effect on response of giving varying amounts of monetary incentive.
- This study confirms that monetary incentives increase mailed questionnaire response and shows that the marginal benefits diminish as the amount of incentive offered increases.



The appendix containing details of the references to studies included in the meta-analysis and the piecewise logistic regression model used in the study is available on line <http://www.jech.com/supplemental>.

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Funding: none.

Conflicts of interest: none declared.

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