

**Table 1 (Supplementary): Included studies investigating dog bite prevention strategies**

Study, Design, Aims	Participants, Intervention	Outcomes measured	Findings	Quality
<b>LEGISLATION</b>				
<p><b>Häsler, B., 2014 [57]</b></p> <p><b>Design:</b> Observational retrospective cohort study</p> <p><b>Aim:</b> Investigate the economic value and effect on animal and human welfare of a rabies intervention programme</p>	<p><b>Participants:</b> 47 sub-districts in Colombo city, Sri Lanka (n=650,000) 2007 – 2011</p> <p><b>Intervention:</b> One Health approach:</p> <ul style="list-style-type: none"> <li>• Stopped mass culling roaming dogs</li> <li>• Public area dog control</li> <li>• Targeted sterilisation</li> <li>• Education public</li> <li>• Public education</li> <li>• Mass vaccination</li> </ul>	<p>4-year study period</p> <ul style="list-style-type: none"> <li>• Incidence dog bites from randomised household surveys in 2007 and 2011</li> <li>• Monthly number of hospital presentations for a dog bite</li> </ul>	<p>Dog bites:</p> <ul style="list-style-type: none"> <li>• Household Surveys (n=31/1,622): 34% non-significant reduction from 0.0216 per person (23/1,063) in 2007 to 0.0143 per person (8/559) in 2010 (p=0.31)</li> <li>• Presentations to hospital (n=291): Increase from 131 (11%) in 2006 to 160 (12%) in 2011</li> </ul>	<p><b>Study Quality:</b> Moderate</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• Use of hospital records and household survey</li> <li>• Incidence rates reported for survey</li> <li>• Comprehensive intervention</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>• Small sample size</li> <li>• Statistical analysis and method of incidence calculation not reported for hospital data</li> <li>• Unknown if increase in hospital presentations due to improved treatment seeking or an increase in dog bite injuries</li> <li>• Response bias in house-hold survey</li> <li>• Introduction of new intervention concurrently with ending mass culling stray dogs.</li> <li>• No control group</li> <li>• Did not study level of enforcement</li> </ul>
<p><b>Dhillon, J., et al, 2016 [65]</b></p> <p><b>Design:</b> No specific information given on study design</p> <p><b>Aim:</b> Investigate how a dog control program can be introduced into a small indigenous community</p>	<p><b>Participants:</b> Indigenous community in Canada, 2009-2013 (sample size not reported)</p> <p><b>Intervention:</b></p> <ul style="list-style-type: none"> <li>• Dog control officer visited every school, community group and household.</li> <li>• Addressed dog welfare</li> <li>• Built a shelter</li> </ul>	<p>5-year study period</p> <ul style="list-style-type: none"> <li>• Dog bites reported (did not specify who to)</li> <li>• Dog population data (not defined how they gained this)</li> </ul>	<p>Dog Bites (n=19)</p> <ul style="list-style-type: none"> <li>• Number of reported dog bites decreased from 6-10 per year to 1 per year for three years</li> <li>• Dog population reduced by 50%, and roaming dog population reduced by 90%</li> <li>• Elders and children reported feeling safer</li> <li>• Increase in dog population after termination of programme</li> </ul>	<p><b>Study Quality:</b> Low</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• Programme implemented in a small indigenous community</li> <li>• Used feelings of safety as an outcome</li> <li>• Reported effects of stopping intervention</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>• Unknown population size, small sample size</li> <li>• No control group</li> <li>• Unknown method of data collection</li> </ul>

	<ul style="list-style-type: none"> <li>• Ticketing or euthanasia for stray dogs</li> <li>• Sterilisation</li> <li>• Community patrols</li> <li>• Encouraged reporting of stray dogs</li> </ul>			
<p><b>Schurer, J.M., 2015 [74]</b></p> <p><b>Design:</b> Pre-post interventional study</p> <p><b>Aim:</b> To investigate the effect of a community based dog control programme on dog welfare and dog bites</p>	<p><b>Participants:</b> Two rural indigenous communities in Saskatchewan, Canada (n=1,050)</p> <p><b>Intervention:</b> One Health approach:</p> <ul style="list-style-type: none"> <li>• Dog control (including 32%, n=124/382 dogs rehomed outside the community)</li> <li>• Community discussions</li> <li>• Dog welfare (including deworming and vaccination)</li> <li>• Free sterilisation clinics</li> </ul>	<p>1-year study period</p> <ul style="list-style-type: none"> <li>• Dog bites presenting to medical attention</li> </ul>	<p>Dog Bites (n=11):</p> <ul style="list-style-type: none"> <li>• Nine dog bites in 2012 and two in 2013</li> <li>• Home-owners noticed children felt safer playing outside or walking to school.</li> </ul>	<p><b>Study Quality:</b> Low</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• Programme implemented in small indigenous communities</li> <li>• Culturally sensitive with strong community engagement</li> <li>• Also noted feelings of safety as outcome</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>• Small sample size</li> <li>• No control group</li> <li>• Substantial reduction in dogs during study</li> </ul>
<p><b>Riley, T., et al 2020 [45]</b></p> <p><b>Design:</b> Pre-post interventional study</p> <p><b>Aim:</b> To investigate the effect of a community animal welfare intervention on dog bite rates</p>	<p><b>Participants:</b> Remote Indigenous community in Wadeye, Northern Australia (n=approx. 2,280)</p> <p><b>Intervention:</b> One Health approach: Free Vet visits (259):</p> <ul style="list-style-type: none"> <li>• Sterilisation</li> <li>• Medication</li> <li>• Vaccination</li> <li>• Owner directed education on animal health (with translations)</li> </ul>	<p>4-year study period</p> <ul style="list-style-type: none"> <li>• Quarterly incidence of dog bites presenting to health clinics</li> </ul>	<p>Dog-bites:</p> <ul style="list-style-type: none"> <li>• No change in quarterly incidence of dog bites from 4.7 per 1,000 people in 2016 to 4.2 per 1,000 people in 2019</li> <li>• Small reduction in dog population (598-532)</li> </ul>	<p><b>Study Quality:</b> Low</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• Appropriate statistical analysis</li> <li>• Appropriate study period</li> <li>• Indigenous engagement</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>• Small sample size</li> <li>• No control group</li> </ul>
<p><b>Ma 2020 [44]</b></p> <p><b>Design:</b> Non-random interventional study</p>	<p><b>Participants:</b> Remote Indigenous communities in Northern Australia (n=approx. 4,000)</p>	<p>7-year study period</p> <ul style="list-style-type: none"> <li>• Council reported dog attacks (rushes at, attacks, bites, harasses or chases any person or</li> </ul>	<p>Dog-attacks:</p> <ul style="list-style-type: none"> <li>• 33-66% reduction in reported dog attacks from 2.5 per 1,000, 1.5 per 1,000 and 1.5 per 1,000 in the pre-intervention year of each community, to</li> </ul>	<p><b>Study Quality:</b> Moderate</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• Tailored interventions to indigenous communities with strong engagement</li> </ul>

<p><b>Aim:</b> Investigate effect of community intervention on dog bite rates</p>	<p><b>Intervention:</b> Free:</p> <ul style="list-style-type: none"> <li>• Sterilisation</li> <li>• Registration/Microchips</li> <li>• Vet visits (assistance w transport)</li> <li>• Unwanted dogs euthanized or rehomed</li> <li>• Education at local schools on dog safety/hygiene</li> </ul>	<p>animal, whether or not injury has occurred)</p>	<p>&lt;1 per 1000 for all three communities in 2018/19 (p=0.035)</p> <ul style="list-style-type: none"> <li>• No change in control community (4 per 1,000 in 2015/16 and 8.1 per 1,000 in 2018/19)</li> </ul>	<ul style="list-style-type: none"> <li>• Control group</li> <li>• Appropriate statistical analysis</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>• Small sample size</li> <li>• Many communities had unreported results</li> <li>• Dog population change not reported</li> <li>• Definition of dog attacks is likely to have greater variation than dog bites alone</li> </ul>
<p><b>Marsh, L., et al, 2004 [46]</b></p> <p><b>Design:</b> Observational retrospective cohort study</p> <p><b>Aim:</b> Describe the extent of dog bite injuries in New Zealand</p>	<p><b>Participants:</b> NZ population (n=3.7 million) 1989 - 2001</p> <p><b>Intervention:</b> Dog Control Act, 1996:</p> <ul style="list-style-type: none"> <li>• Ticketing</li> <li>• Registrations</li> <li>• Leash laws</li> <li>• Muzzling</li> <li>• Sterilisation</li> <li>• Prohibited owners</li> <li>• Euthanasia</li> <li>• Breed Specific Legislation (BSL)</li> </ul>	<p>12-year study period</p> <ul style="list-style-type: none"> <li>• Incidence dog bite hospitalisations</li> </ul>	<p>Dog Bites (n=3119)</p> <ul style="list-style-type: none"> <li>• Rising incidence prior to legislation (from graph) from 4 per 100,000 per year in 1989 to 7.5 per 100,000 in 1996</li> <li>• Rates dropped to 5.5 per 100,000 in 1999 after introduction of legislation</li> <li>• Rates returned to 6.8 per 100,000 in 2001</li> </ul>	<p><b>Study Quality:</b> Moderate</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• Study length</li> <li>• Reliable data source</li> <li>• Use of incidence rates</li> <li>• Use of hospitalisation data</li> <li>• Large sample size</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>• Changes to coding may have over-estimated rates before legislation was introduced</li> <li>• No statistical analysis</li> <li>• No control group</li> <li>• Did not study level of enforcement</li> </ul>
<p><b>The City of Calgary Animal &amp; Bylaw Services, 2006 [50,86]</b></p> <p><b>Design:</b> Observational retrospective cohort study</p> <p><b>Aim:</b> Investigate the effect of dog control legislation on the incidence of dog bites</p>	<p><b>Participants:</b> Calgary, Canada population (n=1,195,000) 1984 - 2014</p> <p><b>Intervention:</b> Pet Ownership bylaw 2006:</p> <ul style="list-style-type: none"> <li>• Strict leash laws</li> <li>• Directly returning strays</li> <li>• Reduced registration rates</li> <li>• Increased ticketing, muzzling, caging and sterilisation of dogs causing an injury to a person or animal</li> <li>• Education on the laws</li> </ul>	<p>30-year study period</p> <ul style="list-style-type: none"> <li>• Incidence dog bites reported to Animal Management</li> </ul>	<p>Dog Bites (n=4193)</p> <ul style="list-style-type: none"> <li>• 80% reduction in reported bite incidence from 99 per 100,000 per year in 1984 to 20 per 100,000 in 2014</li> </ul>	<p><b>Study Quality:</b> Moderate</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• Study length</li> <li>• Use of incidence rates</li> <li>• Large sample size</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>• Reported bites likely an underestimation</li> <li>• Changes to reporting guidelines within study period</li> <li>• No statistical analysis</li> <li>• No control group</li> </ul>

	<ul style="list-style-type: none"> <li>• No BSL</li> </ul>			<ul style="list-style-type: none"> <li>• Rates declining prior to legislation being introduced</li> <li>• Did not study level of enforcement</li> </ul>
<p><b>Clarke, N.M., et al, 2013 [84]</b></p> <p><b>Design:</b> Observational retrospective cohort study</p> <p><b>Aim:</b> Investigate the effect of dog control strategies on rates of reported dog bites</p>	<p><b>Participants:</b> 36 jurisdictions in British Columbia Canada (n=10.1 million) 2003 – 2005</p> <p><b>Interventions:</b></p> <ul style="list-style-type: none"> <li>• Ticketing</li> <li>• Licensing</li> <li>• Education</li> <li>• BSL</li> <li>• Financial investment into animal control</li> </ul>	<p>3-year study period</p> <ul style="list-style-type: none"> <li>• Incidence dog bites reported to animal management in different jurisdictions (per 100,000 people per year)</li> </ul>	<p>Dog Bites (n=not reported)</p> <p>Lower dog bite rates in areas with:</p> <ul style="list-style-type: none"> <li>• High ticketing rates (p&lt;0.01)</li> <li>• High licencing rates (p&lt;0.10)</li> </ul> <p>No difference in dog bite rates in areas with:</p> <ul style="list-style-type: none"> <li>• Higher budget allocation for dog control</li> <li>• Higher staffing allocation for dog control</li> <li>• More public education</li> <li>• BSL (170 vs 180 in Non-BSL areas)</li> </ul>	<p><b>Study Quality:</b> High</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• Excellent statistical analysis. Incidence rates used.</li> <li>• Described that dog ownership rates (per person) not substantially different by area</li> <li>• Assesses legislative strategies separately</li> <li>• Large sample size likely</li> <li>• Control groups</li> <li>• Accounts for the impact of ticketing and licensing on likelihood of reporting</li> <li>• Investigated levels of enforcement of legislation</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>• Reported bites likely an underestimation</li> <li>• Confounding bias: Likely other differences in policy, dogs, owners, victim or environment</li> <li>• Reporting bias (response rate 22/36 areas)</li> </ul>
<p><b>Glosser, J., et al, 1970 [75]</b></p> <p><b>Design:</b> Pre-post interventional study</p> <p><b>Aim:</b> Investigate the effect of a national dog control strategy, implemented as a response to a rabies epizootic</p>	<p><b>Participants:</b> Guam population (n=95,000)</p> <p><b>Intervention:</b> Mass poisoning of stray dogs and cats (&gt;15,000), the introduction of leash laws, and adult education</p>	<p>3-year study period</p> <ul style="list-style-type: none"> <li>• Number of animal encounters (predominantly dog bites or contact with saliva)</li> </ul>	<p>Animal encounters</p> <ul style="list-style-type: none"> <li>• 75% reduction in encounters from 995 in 1967 to 252 in 1969</li> </ul>	<p><b>Study Quality:</b> Moderate</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• Large sample size</li> <li>• Clear intervention: reduction in stray dog population</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>• Unclear method of data collection</li> <li>• Included all animals, not just dogs</li> <li>• No statistical analysis done</li> <li>• No incidence rates calculation</li> <li>• Unacceptable intervention in some societies</li> </ul>
<p><b>Villalbí, J.R., et al, 2010 [51]</b></p>	<p><b>Population:</b> Catalonia, Spain population (n=7.2 million) 1997-2008</p>	<p>11-year study period</p> <ul style="list-style-type: none"> <li>• Incidence dog bite hospitalisations</li> </ul>	<p>Dog Bites (n=1103)</p> <ul style="list-style-type: none"> <li>• 38% reduction from 1.80 per 100,000 (n=332, 95% CI 0.87, 1.36) in 1997-99, to</li> </ul>	<p><b>Study Quality:</b> Moderate</p> <p><b>Strengths:</b></p>

<p><b>Design:</b> Observational retrospective cohort study</p> <p><b>Aim:</b> Investigate the effect of dog control legislation on dog bite injuries</p>	<p><b>Intervention:</b> Dangerous Animals Act 1999 &amp; 2002</p> <ul style="list-style-type: none"> <li>• Restrictions for dangerous dogs (breed, behaviour, size and other physical characteristics)</li> <li>• Leash laws</li> <li>• Microchips</li> <li>• Owner licencing</li> </ul>		<p>1.11 per 100,000 (n=241, 95% CI 0.87, 1.36) in 2006-08</p>	<ul style="list-style-type: none"> <li>• Long study period</li> <li>• Large sample size</li> <li>• Incidence rates used</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>• No control group</li> <li>• No statistical analysis</li> <li>• Hospitalisation data only</li> <li>• Rates declining prior to intervention</li> <li>• Did not study level of enforcement</li> </ul>
<p><b>Klaassen, B., et al, 1996 [52]</b></p> <p><b>Design:</b> Observational retrospective cohort study</p> <p><b>Aim:</b> Investigate the effect of the Dangerous Dogs Act 1991 on dog bite injuries</p>	<p><b>Participants:</b> Aberdeen, Scotland population (n=200,000) 1991-1994</p> <p><b>Intervention:</b> Dangerous Dogs Act 1991</p> <ul style="list-style-type: none"> <li>• Ticketing</li> <li>• Registrations</li> <li>• Stray dog control</li> <li>• Leash laws</li> <li>• Restrictions for dangerous dogs (breed/behaviour)</li> </ul>	<p>4-year study period</p> <ul style="list-style-type: none"> <li>• Emergency department (ED) presentations of dog bite injuries over 3 months</li> </ul>	<p>Dog Bites (n=268)</p> <ul style="list-style-type: none"> <li>• No difference in dog bite presentations to ED pre and post legislation (134 in 1991 and 134 in 1994)</li> </ul>	<p><b>Study Quality:</b> Moderate</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• Allowed enough time (2 years) to see impact</li> <li>• Broad outcome measure (ED presentations)</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>• No incidence rate or statistical analysis reported</li> <li>• No control group</li> <li>• Moderate sample size</li> <li>• Does not show seasonal term effects</li> <li>• Did not study level of enforcement</li> </ul>
<p><b>Raghavan, M., et al, 2013 [83]</b></p> <p><b>Design:</b> Observational retrospective cohort study</p> <p><b>Aim:</b> Investigate the effect of banning pit-bull breeds on dog bite injuries</p>	<p><b>Population:</b> 19 jurisdictions in Manitoba, Canada (n= 26 million), 1984-2006</p> <p><b>Intervention:</b> Banning of Pit-bull breeds</p>	<p>23-year study period</p> <ul style="list-style-type: none"> <li>• Incidence of hospitalisations for dog bite injuries</li> </ul>	<p>Dog Bites (n=838)</p> <ul style="list-style-type: none"> <li>• Areas with BSL had 19% significantly less dog bite hospitalisations (2.92 per 100,000, 95% CI 2.66, 3.19) than non-BSL areas (3.62 per 100,000, 95% CI 3.25, 3.99, p=0.002)</li> <li>• Areas with BSL had a 9.6% non-significant reduction over time. 3.14 per 100,000 pre-BSL (n=144, 95% CI 2.65, 3.69), to 2.84 per 100,000 post-BSL (n=331, 95% CI 2.53, 3.15), p=0.319</li> </ul>	<p><b>Study Quality:</b> Moderate</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• Long study period</li> <li>• Includes controls without legislation</li> <li>• Uses incidence rates and statistical analysis</li> <li>• Focused intervention</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>• Likely many confounding factors</li> <li>• Hospitalisation data only</li> <li>• Did not study level of enforcement</li> <li>• Unclear outcomes: all areas versus two cities</li> <li>• Control areas had other forms of pit-bull legislation</li> </ul>

				<ul style="list-style-type: none"> <li>• Unclear time-periods compared between exposure and control</li> <li>• Non-BSL areas not studied over time</li> <li>• Two cities compared instead of all areas</li> <li>• Did not account for differences in dog-ownership rates between areas</li> </ul>
<p><b>Mariti, C., et al 2015 [49]</b></p> <p><b>Design:</b> Observational retrospective cohort study</p> <p><b>Aim:</b> Investigate the effects of breed-specific legislation on the trend of dog bites</p>	<p><b>Participants:</b> Florence, Italy population (n= 355,000)</p> <p><b>Intervention:</b> Breed Specific Legislation (banning 92 breeds) 2003-04</p>	<p>4-year study period</p> <ul style="list-style-type: none"> <li>• Aggregate of dog bites from three sources including ED presentations, reports to canine registry and observational reports for prophylaxis in Florence:</li> <li>-Pre-BSL: 2002-03</li> <li>-Short term: 2003-04</li> <li>-Long term: 2004-05</li> </ul>	<p>Dog Bites (n=556)</p> <ul style="list-style-type: none"> <li>• 17-18% reduction from 210 pre-BSL to 172 in short term, and 174 in long term</li> </ul>	<p><b>Study Quality:</b> Moderate</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• Focused intervention</li> <li>• Long study period</li> <li>• Large sample size</li> <li>• Broad outcome measure</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>• Three different data-sources used</li> <li>• Decreasing trend prior to study period (1986-2001)</li> <li>• No incidence or statistical analysis</li> <li>• Did not report increased rate of decline post-BSL</li> <li>• No control group</li> <li>• Moderate sample size</li> </ul>
<p><b>Nilson, F et al, 2018 [48]</b></p> <p><b>Design:</b> Observational retrospective cohort study</p> <p><b>Aim:</b> Investigate the effect of breed-specific legislation on the number of dog bite injuries</p>	<p><b>Participants:</b> Odense, Denmark population (n=188,000)</p> <p><b>Intervention:</b> Breed Specific Legislation 2010 (11 breeds banned and euthanised)</p>	<p>13-year study period</p> <ul style="list-style-type: none"> <li>• Average 6-monthly number of dog bites presenting to an ED:</li> <li>-Pre-BSL: 2002-10</li> <li>-Post-BSL: 2010-15</li> </ul>	<p>Dog Bites (n=2622)</p> <ul style="list-style-type: none"> <li>• Non-significant 15% reduction pre-BSL: 103 per six months (n=1748, 95% CI 98, 108) to 87 per six months post-BSL (n=874, 95% CI 82, 93)</li> <li>• Non-significant 14% reduction pre-post BSL, in private spaces: 75 per six months (n=1269, 95% CI 71, 79) to 61 per six months (n=610, 95% CI 56, 66), or 7% reduction in public spaces: 28 per six months (n=480, 95% CI 26, 31) to 26 per six months (n=264, 95% CI, 56, 66)</li> </ul>	<p><b>Study Quality:</b> Moderate</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• Investigated private and public spaces separately</li> <li>• Long study period</li> <li>• Large sample size</li> <li>• Statistical analysis appropriate</li> <li>• Broad outcome measure (ED presentations)</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>• Decreasing trend prior to intervention</li> <li>• 6-monthly rates do not account for seasonal variation</li> <li>• No control group</li> <li>• No incidence calculated</li> </ul>

				<ul style="list-style-type: none"> <li>• Two breeds already banned in 1991</li> </ul>
<p><b>Rosado, B. et al, 2007 [47]</b></p> <p><b>Design:</b> Observational retrospective cohort study</p> <p><b>Aim:</b> Investigate the effect of the Dangerous Animals Act on the incidence of dog bites</p>	<p><b>Participants:</b> Aragón, Spain population (n=1,204,215)</p> <p><b>Intervention:</b> Dangerous Animals Act 1999 (non-BSL) and BSL 2002</p>	<p>9-year study period</p> <ul style="list-style-type: none"> <li>• Mean incidence of dog bites recorded in Public Health Department:</li> </ul> <p>-Pre non-BSL: 1995-99 -Post non-BSL: 2000-01 -Post BSL: 2003-04</p>	<p>Dog Bites (n=4186)</p> <ul style="list-style-type: none"> <li>• No difference in dog bite incidence pre-post BSL (total rates not reported)</li> <li>• Low-populated area: 1.7% significant increase: 71.8 per 100,000 (SE 3.8) before and 73.0 per 100,000 (SE 3.3) after</li> <li>• High-populated area: 50% significant reduction: 18.6 per 100,000 (SE 3.9) before and 9.3 per 100,000 (SE 3.0)</li> </ul>	<p><b>Study Quality:</b> Moderate</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• Investigates low-populated vs high-populated areas separately</li> <li>• Long study period</li> <li>• Large sample size</li> <li>• Incidence calculated</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>• Reported bites likely an underestimation</li> <li>• Limited statistical analysis</li> <li>• Confounding likely</li> <li>• No control group</li> </ul>
<b>STERILISATION</b>				
<p><b>Byrnes, H., et al, 2017[58]</b></p> <p><b>Study design:</b> Observational retrospective cohort study</p> <p><b>Aim:</b> Investigate the effect of a One health rabies prevention programme</p>	<p><b>Participants:</b> Sikkim, India population (n=610,000)</p> <p><b>Intervention:</b> SARA (One Health) rabies prevention programme 2006:</p> <ul style="list-style-type: none"> <li>• Stray dog sterilisation, medical care, and return to owners if known</li> <li>• Animal welfare education</li> </ul>	<p>13-year study period</p> <ul style="list-style-type: none"> <li>• Number of bites provided by Dept of Health. Unknown method data collection</li> </ul>	<p>Dog Bites</p> <ul style="list-style-type: none"> <li>• Increased from 853 in 2005/06 to 3,315 in 2012/13</li> <li>• Bi-annual increases during breeding seasons</li> </ul>	<p><b>Study Quality:</b> Low</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• Long study period</li> <li>• Large sample size</li> <li>• Culturally sensitive interventions</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>• Unknown data collection, missing data</li> <li>• No statistical analysis</li> <li>• Multiple interventions</li> <li>• No control group</li> <li>• Primarily rabies prevention</li> <li>• Intervention aimed to increase presentations of animal bites to medical care</li> </ul>
<p><b>Kamoltham, T., et al, 2003 [82]</b></p> <p><b>Design:</b> Pre-post interventional study</p> <p><b>Aim:</b> Investigate the effect of sterilisation as part of a</p>	<p><b>Participants:</b> Phetchabun, Thailand population (n=1.04 million)</p> <p><b>Intervention:</b> Rabies prevention:</p> <ul style="list-style-type: none"> <li>• Public education for rabies prevention</li> </ul>	<p>5-year study period</p> <ul style="list-style-type: none"> <li>• Number of Animal bites from potentially rabid animals reported to Health Office</li> </ul>	<p>Animal Bites (93% dog bites):</p> <ul style="list-style-type: none"> <li>• 66% increase in presentations of bites in intervention years, from 1,692 in 1996 to 2,816 in 2000, with a drop to pre-intervention levels of 1,693 in 2001</li> <li>• Increase in total dog population from 91,190 in 1996 to 105,272 in 2001</li> </ul>	<p><b>Study Quality:</b> Low</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• Long study period</li> <li>• Large sample size</li> </ul> <p><b>Limitations:</b></p>

rabies prevention programme	<ul style="list-style-type: none"> <li>• Sterilisation of dogs, particularly targeting strays around temples or schools 1997-2001</li> </ul>			<ul style="list-style-type: none"> <li>• Intervention aimed to increase presentations of animal bites to medical care</li> <li>• Bites only included if potentially from rabid animal, and only if reported to public health</li> <li>• No control group</li> <li>• No statistical analysis</li> <li>• Large annual variability in rate – percentage rate change over time not reported</li> <li>• Primarily rabies prevention</li> </ul>
<p><b>Reece, J.F., et al, 2013 [64]</b></p> <p><b>Design:</b> Pre-post Interventional study</p> <p><b>Aim:</b> Determine if a relationship exists between canine reproductive behaviour and human dog bites, through sterilisation of stray dogs</p>	<p><b>Participants:</b> Jaipur, India population (n=3 million)</p> <p><b>Intervention:</b> Surgical sterilisation and release of stray dogs from 2003 – 2011</p>	<p>8-year study period</p> <ul style="list-style-type: none"> <li>• Annual number of dog bite injuries presenting to the dog bite unit of the city hospital</li> </ul>	<p>Dog Bites (n=167,000, approx)</p> <ul style="list-style-type: none"> <li>• 48% reduction in dog bites injuries from 11,500 in 2003 to 6,000 in 2011</li> <li>• Increase in bites 3 months after a peak in canine pregnancies in January, possibly due to protecting young</li> </ul>	<p><b>Study Quality:</b> Moderate</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• Broad outcome measure (unit presentations)</li> <li>• Large sample size</li> <li>• Long study period</li> <li>• Investigated seasonal variation</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>• No control group</li> <li>• Likely confounding</li> <li>• No incidence rates or statistical analysis</li> </ul>
<p><b>Garde, E., et al, 2016 [81]</b></p> <p><b>Design:</b> Randomised Controlled Trial</p> <p><b>Aim:</b> Investigate changes in behaviour following sterilization in a free-roaming male dog population</p>	<p><b>Participants:</b> Free roaming dogs in Chile (n = 119)</p> <p><b>Intervention:</b> Randomly assigned to either surgical (n=39) or chemical sterilisation (n=36) or control (no treatment, n=44)</p>	<p>6-month study period:</p> <ul style="list-style-type: none"> <li>• Independent scale of aggression from videos of dogs in a session</li> </ul>	<p>Dog aggression:</p> <ul style="list-style-type: none"> <li>• An increase in aggressive behaviour in chemically sterilised dogs (p = 0.001)</li> <li>• No change in aggressive behaviour in dogs that were surgically sterilised or control group.</li> </ul>	<p><b>Study Quality:</b> High</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• Mostly randomised (3 dogs changed groups)</li> <li>• Adequate sample size</li> <li>• Control group</li> <li>• Independent blinded aggression scores</li> <li>• Well defined and described aggression scores</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>• 14% loss to follow up (17/119)</li> <li>• Aggression testing done in different seasons</li> <li>• Does not report dog bites</li> <li>• Behaviours had varying degrees of aggressiveness</li> <li>• Limited to free-roaming dogs only.</li> </ul>
<p><b>Neilson, J.C., et al, 1997 [63]</b></p>	<p><b>Participants:</b> Male household dogs in</p>	<p>Unknown study period</p>	<p>Dog Aggression:</p>	<p><b>Study Quality:</b> Low</p>



<p><b>Design:</b> Pre-post interventional study</p> <p><b>Aim:</b> Determine whether surgical sterilisation can reduce problem behaviours in adult male dogs</p>	<p>California, USA, aged 2-7yrs with a behavioural issue (n = 57)</p> <p><b>Intervention:</b> Surgical sterilisation</p>	<ul style="list-style-type: none"> <li>Percentage improvement in dog behaviours based on report by owners (aggressive or non-aggressive)</li> </ul>	<ul style="list-style-type: none"> <li>20-25% of dogs showing aggression toward other dogs or family members had a 90% improvement</li> <li>10-15% of dogs who showed aggressive behaviours toward unfamiliar dogs or human intruders had a 90% improvement</li> </ul>	<p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>Follow up questions to owner made by a Vet</li> <li>Some statistical analysis</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>Small sample size</li> <li>No control group</li> <li>Young dogs and females not included</li> <li>Confounding likely</li> <li>Owner reported aggression scores</li> <li>Non-validated measures of behaviour problems</li> <li>Likely more motivated dog owners in study</li> </ul>
<p><b>Maarschalkerweerd, R.J., 1997 [59]</b></p> <p><b>Design:</b> Observational retrospective cohort study</p> <p><b>Aim:</b> Investigate the effect of orchiectomy on dog behaviour</p>	<p><b>Participants:</b> 23 male dogs with aggression problems, castrated 6-12 months prior to study, Netherlands</p> <p><b>Intervention:</b> Surgical sterilisation</p>	<p>12-month study period</p> <ul style="list-style-type: none"> <li>Percentage of owners reporting an improvement in dog aggression</li> </ul>	<p>Dog aggression:</p> <ul style="list-style-type: none"> <li>26% (6/23) dogs decreased aggressive behaviour inside the house, and 52% (12/23) outside the house</li> </ul>	<p><b>Study Quality:</b> Low</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>Dogs with a number of behavioural issues</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>Small sample size</li> <li>No control group</li> <li>Owner reported aggression improvement</li> <li>Non-specific measures aggression</li> <li>No appropriate statistical analysis</li> <li>Likely motivated dog owners in study</li> </ul>
<b>ALCOHOL REDUCTION</b>				
<p><b>West, C., et al, 2019 [43]</b></p> <p><b>Design:</b> Pre-post interventional study</p> <p><b>Aim:</b> Investigate the effect of alcohol restrictions on the incidence of dog bites and other types of injury</p>	<p><b>Participants:</b> Three remote indigenous communities in Far North Queensland, Australia, 2006-2011 (n=2,262)</p> <p><b>Intervention:</b> Community Alcohol Management Plans:</p> <ul style="list-style-type: none"> <li>Community A (n = 1,063) and C (n = 621) strict alcohol zero carriage restrictions</li> </ul>	<p>5-year study period</p> <ul style="list-style-type: none"> <li>Incidence of dog bites presenting to primary care clinics</li> </ul>	<p>Dog-bites (n=229):</p> <ul style="list-style-type: none"> <li>Community A: 61% significant reduction from 12.4 per 1,000 people in 2006/08 to 4.8 per 1,000 in 2009/11 (IRR 0.4, 95% CI 0.2, 0.7, p=0.001)</li> <li>Community C: 30% significant reduction in community C from 40.0 per 1,000 to 27.9 per 1,000 (IRR 0.7, 95% CI 0.5, 1.0, p=0.033)</li> <li>Community B: 29% non-significant reduction, from 12.90 per 1,000 to 9.20 per 1,000 (p = 0.317)</li> </ul>	<p><b>Study Quality:</b> High</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>Good sample size</li> <li>Control group with partial intervention</li> <li>Community based intervention</li> <li>Broad outcome measure (primary care)</li> <li>Incidence rates calculated</li> <li>Appropriate statistical analyses</li> <li>Other injury outcomes also measured</li> <li>Strategy directed towards an indigenous population</li> </ul>

	<ul style="list-style-type: none"> <li>Community B (n = 578) restricted to limited personal alcohol consumption</li> </ul>		All communities: 0.6 times (60%) less likely to occur in 2011 (95% CI 0.4, 0.9, p=0.024) compared with 2006	<p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>Unknown relationship between alcohol and dog-bites</li> <li>Controversial intervention, with potentially poor long-term engagement</li> </ul>
<b>GENERAL PUBLIC EDUCATION</b>				
<p><b>Masthi, R.N.R., et al, 2014 [77]</b></p> <p><b>Design:</b> Non-random interventional study</p> <p><b>Aim:</b> Estimate the incidence of rabies and animal bites, investigate the efficacy of a rabies prevention programme, and assess the safety of vaccination</p>	<p><b>Participants:</b> 6 rural villages in South India (n=16,243):</p> <ul style="list-style-type: none"> <li>3 received intervention (n=10,220)</li> <li>3 controls (n=6,023)</li> </ul> <p><b>Intervention:</b> One Health approach:</p> <ul style="list-style-type: none"> <li>Intensive Public Adult Education on rabies prevention, including responsible pet ownership and how to avoid animal and dog bites</li> </ul>	<p>2-year study period:</p> <ul style="list-style-type: none"> <li>Incidence of dog bites measured through random survey of 20% of the village populations, at the start of the study, and at one year</li> </ul>	<p>Animal Bites (n=138/1735):</p> <ul style="list-style-type: none"> <li>30% reduction in animal bites in intervention villages from 2.7% (47/1,735, all dogs) to 1.9% (33/1,735: 27 dogs and 6 cows), p = 0.0398</li> <li>No significant change in all animal bites in control villages, from 2.8% (31/1,080) to 2.5% (27/1,080, p=0.5501). Proportion caused by dogs not reported</li> </ul>	<p><b>Study Quality:</b> High</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>Comprehensive and culturally sensitive community-based education</li> <li>Control group</li> <li>Statistical analysis</li> <li>Broad outcome measure (Household Survey)</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>Small sample size</li> <li>Education may increase reporting of bites</li> <li>In context of rabies prevention</li> <li>Proportion of animal bites caused by dogs not reported for the control group</li> </ul>
<p><b>Cleaveland, S., et al, 2003 [79]</b></p> <p><b>Design:</b> Non-random interventional study</p> <p><b>Aim:</b> Investigate the effect of a rabies prevention programme on number of dog bites from potentially rabid dogs</p>	<p><b>Participants:</b> Rural Tanzanian Communities. Intervention: Serengeti District. Control: Two Neighbouring Districts (n=unknown)</p> <p><b>Intervention:</b> Public education on rabies prevention and dog-vaccination 1996 – 2001</p>	<p>5-year study period</p> <ul style="list-style-type: none"> <li>Annual incidence of dog bites from potentially rabid dogs, presenting to district hospitals</li> </ul>	<p>Dog-bite incidence:</p> <ul style="list-style-type: none"> <li>79% significant decrease in bites within intervention areas, from 28.8 per 100,000 people per year (95% CI 20.7, 39.1) pre-intervention, to 6.02 per 100,000 post-intervention (p&lt;0.001)</li> <li>60% non-significant increase in bites within control areas from 11.7 per 100,000 people per year (95% CI 8.6, 15.5) pre-intervention period to 29.4 per 100,000 (95% CI not reported) post-intervention period (p=0.06)</li> </ul>	<p><b>Study Quality:</b> High</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>Rural communities studied</li> <li>Long study period</li> <li>Monthly incidence calculated</li> <li>Excellent statistical analysis</li> <li>Appropriate control group</li> <li>Demographics compared between intervention and control areas through random household sampling, including number of household dogs and people</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>Used bites from potentially rabid dogs (uncertain if only non-vaccinated)</li> <li>Rabies prevention and vaccination dogs</li> </ul>

<p><b>Mpolya, E.A., et al, 2017 [71]</b></p> <p><b>Design:</b> Pre-post interventional study</p> <p><b>Aim:</b> Investigate the effect of a rabies prevention programme on dog bite incidence</p>	<p><b>Participants:</b> Southern Tanzania population (n=unknown)</p> <p><b>Intervention:</b> Public education on rabies prevention and dog vaccination from 2010 to 2015</p>	<p>5-year study period</p> <ul style="list-style-type: none"> <li>• Incidence of dog bites reported to researchers by livestock field officers and health care workers</li> </ul>	<p>Dog-bite incidence</p> <ul style="list-style-type: none"> <li>• An initial increase in bite incidence from 1.8 per 100,000 per quarter (n=1,600) in 2011 to 2.8 per 100,000 (n=2,700) in 2012. Then, with monthly fluctuations there was a general decline to zero by 2016.</li> </ul>	<p><b>Study Quality:</b> Moderate</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• Monthly and annual incidence calculated</li> <li>• Broad data collection method</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>• No control group</li> <li>• High variability in data collection method</li> <li>• No statistical analysis</li> <li>• Did not investigate pre-intervention rates</li> <li>• In context of rabies prevention</li> </ul>
<p><b>Mudoga, E., et al, 2014 [69]</b></p> <p><b>Design:</b> Pre-post interventional study</p> <p><b>Aim:</b> Investigate the effect of a rabies prevention programme on dog bites</p>	<p><b>Participants:</b> Unguja, Zanzibar population (n=900,000)</p> <p><b>Intervention:</b> Rabies prevention 2009 to 2013:</p> <ul style="list-style-type: none"> <li>• Intensive adult education, including vets, local leaders and dog-owners</li> </ul>	<p>5-year study period</p> <ul style="list-style-type: none"> <li>• Dog bites presenting for medical attention (unknown data collection method)</li> </ul>	<p>Number dog-bites:</p> <ul style="list-style-type: none"> <li>• Reduced by almost 65% from 2009 to 2013</li> </ul>	<p>Study Quality: Low</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• Developing country, not often studied</li> <li>• Appropriate outcome measure</li> <li>• Large sample size</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>• No control group</li> <li>• Data collection methods limited in Zanzibar</li> <li>• No statistical analysis, numbers not reported</li> <li>• Did not investigate pre-intervention rates</li> <li>• In context of rabies prevention</li> </ul>
<p><b>Valenzuela, L.M., et al, 2017 [70]</b></p> <p><b>Design:</b> Pre-post interventional study</p> <p><b>Aim:</b> Investigate the effect of a rabies prevention programme on dog bites</p>	<p><b>Participants:</b> Ilocos Norte, Philippines (n=593,081)</p> <p><b>Intervention:</b> Rabies prevention 2012 to 2016:</p> <ul style="list-style-type: none"> <li>• Community education to adults and children</li> <li>• Vaccination of dogs</li> </ul>	<p>8-year study period</p> <ul style="list-style-type: none"> <li>• Animal bite consultations from eight animal bite treatment centres</li> </ul>	<p>Number of Animal bites:</p> <ul style="list-style-type: none"> <li>• Animal bite consultations (83-89% by dogs) increased from 2,015 in 2011 (pre-intervention) to a peak of 5,908 in 2014 (post-intervention), then fell to 5,520 in 2015</li> </ul>	<p>Study Quality: Low</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• Broad data collection method</li> <li>• Large sample size</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>• No control group</li> <li>• No statistical analysis</li> <li>• Numbers were increasing pre-intervention</li> <li>• In context of rabies</li> </ul>
<b>EDUCATION OF CHILDREN</b>				
<p><b>Deray, R., et al, 2018 [62]</b></p>	<p><b>Participants:</b> Children aged 5-14 years (n = 5,764) in 27</p>	<p>2-year study period</p>	<p>Dog bites to children aged 5-14yrs:</p>	<p><b>Study Quality:</b> High</p>

<p><b>Design:</b> Pre-post interventional study</p> <p><b>Aim:</b> Evaluate the impact and economics of education and pre-exposure prophylaxis on rabies and animal bite incidence in school children</p>	<p>Public Elementary schools in El Nido, Philippines</p> <p><b>Intervention:</b> Rabies prevention: • Education on dog-bite prevention 2012-2013</p>	<p>• Incidence of dog bites in children aged 5-14 years: • Follow up interviews every 3 months over 18 months (per 1,000) • Presentations to bite centre at local hospital</p>	<p>• Interviews: No significant difference from 26.4 per 1,000 (124/4,700) in 2011 to 24.7 per 1,000 (114/4,700) in 2012 (p=0.46) • Hospital Presentations: No significant difference in presentations to hospital from 8.6 per 1,000 (79/9,211) in 2011 to 7.5 per 1,000 (69/9,211) in 2012 (p=0.65) • Decrease in the proportion of Category III bites, (11% of bites in 2011 to 3% in 2012 (p&lt;0.05))</p>	<p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• Single intervention - education children</li> <li>• Dog bite rates measured in the same population</li> <li>• Broad outcome measure (interviews and hospitalisations)</li> <li>• Recall bias reduced by surveying at regular intervals</li> <li>• Large sample size</li> <li>• Statistical analysis appropriate</li> <li>• Investigated wound depth</li> <li>• Appropriate study length</li> <li>• Low loss to follow up (3.5%)</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>• No control group</li> <li>• Lower response rate for urban areas</li> <li>• Children at-risk not included in study (37% of children are not enrolled in a school)</li> </ul>
<b>EDUCATION OF DOG OWNERS</b>				
<p><b>Gazzano, A., et al, 2008 [78]</b></p> <p><b>Design:</b> Non-random interventional study</p> <p><b>Aim:</b> Assess the effect of educating owners early in puppy management for the prevention of undesirable behaviours in adult dogs</p>	<p><b>Participants:</b> Puppy owners, Pisa, Italy (n=89)</p> <p><b>Intervention:</b> Advice on the importance of early socialisation, and positive behavioural techniques, from a veterinary behaviourist during first vet visit Non-randomly assigned: • 46 received intervention • 43 control</p>	<p>1-year follow up: • Owner reported dog behaviour</p>	<p><b>Dog Aggression:</b> • Dogs in the intervention group were significantly less likely than controls to show aggressive behaviour toward unknown people and dogs (2% vs 16%, p&lt;0.05), with a non-significant difference in aggression toward known people (0% vs 9%, p=0.051)</p>	<p><b>Study Quality:</b> Low</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• Appropriate follow up time</li> <li>• Control group</li> <li>• Balanced characteristics of owners and dogs</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>• Small sample size</li> <li>• Owner reported aggression scores</li> <li>• Non-validated and unclear measures of undesirable behaviour</li> <li>• Degree to which advice was implemented unknown</li> <li>• Loss to follow-up not reported</li> <li>• Aggression may not occur until a later age</li> </ul>
<b>DOG TRAINING</b>				

<p><b>Hutson, H.R., et al, 1997 [53]</b></p> <p><b>Design:</b> Observational retrospective cohort study</p> <p><b>Aim:</b> Investigate how a change in K9 police training method influences police dog bites</p>	<p><b>Participants:</b> Police dogs in Los Angeles from 1988-1995 (n=unknown)</p> <p><b>Intervention:</b> Dog training method, changed in 1992 from “Bite and Hold” to “Find and Bark”</p>	<p>8-year study period:</p> <ul style="list-style-type: none"> <li>Number of dog bites (and severity) to incarcerated patients in the jail ward ED (<math>\geq 16</math> years age)</li> </ul> <p>-Pre: 1988-91 -Post: 1992-95</p>	<p>Dog bites (n=705)</p> <ul style="list-style-type: none"> <li>90% decrease in number of bites from 639 ‘Pre’ to 66 ‘Post’ (no p-value)</li> </ul> <p>Bite severity:</p> <ul style="list-style-type: none"> <li>Decrease in people with <math>\geq 3</math> bites (Pre:58.4% to Post:45.5%; OR 1.68, 95% CI 0.98, 2.89, p=0.04)</li> <li>Decrease in fractures (Pre:2.4% to Post:0%), vascular complications (Pre:7.5% to Post:1.6%), hospitalizations (Pre:52.0% to Post:33.8%)</li> <li>No difference in overall complication rate (Pre:19.7% vs Post:15.6%; OR 1.32, 95% CI 0.64, 2.99, p=0.4)</li> </ul>	<p><b>Study Quality:</b> Moderate</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>Investigates severity of bites</li> <li>Long study period</li> <li>Relevant training methods</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>Size of police dog population unknown</li> <li>No incidence rate (proportion of prison population)</li> <li>No statistical analysis on primary outcome</li> <li>Dogs likely already trained in old method prior to new method implemented</li> <li>No control group</li> <li>Potential bias of referrals of injured inmates to ED</li> <li>Unknown adherence to training</li> <li>Police dogs not representative of general dog population</li> <li>Loss to follow-up (10.8%)</li> </ul>
<p><b>Mesloh, C., 2006 [54]</b></p> <p><b>Design:</b> Observational retrospective cohort study</p> <p><b>Aim:</b> Investigate the impact of a new police dog training method on police dog bites (2001)</p>	<p><b>Participants:</b> Police dogs in Florida, USA (n = 181)</p> <p><b>Intervention:</b> New ‘bark and hold’ method</p> <ul style="list-style-type: none"> <li>45 received intervention</li> <li>135 control (standard ‘bite and hold’ method)</li> </ul>	<p>1-year study period</p> <ul style="list-style-type: none"> <li>‘Bite ratio’ (% of arrests where a bite was involved), measured by a survey (2002) to police dog handlers</li> </ul>	<p>Bite-Ratio:</p> <ul style="list-style-type: none"> <li>New method had higher mean bite ratios than the standard method (22.4% vs 15.7%, no p-value)</li> </ul>	<p><b>Study Quality:</b> Low</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>Adequate sample size</li> <li>Control group</li> <li>Relevant training methods</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>Inadequate statistical analysis reported</li> <li>No allocation to each group, retrospective study</li> <li>Dogs likely already trained in old method prior to new method implemented</li> <li>Dog trainers (white males) and police dogs not representative of general population</li> <li>Unknown adherence to training</li> <li>Response bias (48% did not return survey)</li> </ul>

				<ul style="list-style-type: none"> <li>• Short study period</li> </ul>
<p><b>Tortora, D.F., 1983 [76]</b></p> <p><b>Design:</b> Non-random interventional study</p> <p><b>Aim:</b> Investigate behavioural characteristics and efficacy of treatment of avoidance aggression in dogs</p>	<p><b>Participants:</b> Household dogs in New Jersey, USA, referred to a vet with signs of aggression (n = 36)</p> <p><b>Intervention:</b> Dog training programme (over 2.5 years) reinforced with an electric dog collar. Non-random assignment:</p> <ul style="list-style-type: none"> <li>• 36 received intervention</li> <li>• Controls (waiting list, n=not specified)</li> </ul>	<p>4.5-year study period:</p> <ul style="list-style-type: none"> <li>• Trainer reported measure: frequency of biting attempts within sessions</li> </ul>	<p>Bite Attempts:</p> <ul style="list-style-type: none"> <li>• Significant decrease in bite attempts with training (<math>p &lt; 0.001</math>), remaining at zero at a two-year follow-up</li> <li>• No change for controls (<math>p &gt; 0.05</math>)</li> </ul>	<p><b>Study Quality:</b> High</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• Variety of dog breeds included</li> <li>• Control group</li> <li>• Two people independently measuring outcome</li> <li>• Good follow up period (2.5 years)</li> <li>• Statistical analysis</li> <li>• Focused outcome</li> <li>• Detailed description of intervention</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>• Intervention requires high-input/cost</li> <li>• Electric dog collars are considered to be unethical by some</li> <li>• Did not report size of control group, or if loss to follow-up</li> <li>• Follow-up data collected via survey/owner videos</li> </ul>
<p><b>Dodman, N.H., et al, 1996 [85]</b></p> <p><b>Design:</b> Pre-post interventional study</p> <p><b>Aim:</b> Investigate the effect of positive training methods to treat dogs with dominance aggression</p>	<p><b>Participants:</b> House-hold dogs with a history of owner-directed aggression (n = 10), Massachusetts, USA</p> <p><b>Intervention:</b> A 1.5hr behavioural consultation followed by an individualised 8-week non-confrontational behaviour modification programme</p>	<p>8-week study period:</p> <ul style="list-style-type: none"> <li>• Owner reported dog aggression</li> </ul>	<p>Dog aggression:</p> <ul style="list-style-type: none"> <li>• 9/10 aggressive dogs experienced a decrease in aggressive responses (<math>p &lt; 0.05</math>)</li> </ul>	<p><b>Study Quality:</b> Low</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• Use of non-aversive technique an acceptable strategy to many people</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>• Very small sample size</li> <li>• No control group</li> <li>• Short study period, no further follow-up</li> <li>• Measures of aggression not validated</li> <li>• Inconsistent intervention (altered for individual dogs)</li> <li>• Owner reported aggression scores</li> <li>• Intervention requires high-input/cost</li> <li>• Unknown adherence to training</li> </ul>
<p><b>Knol, B.W., 1987 [60]</b></p>	<p><b>Participants:</b> House-hold dogs with behavioural</p>	<p>Study period unknown</p>	<p>Dog aggression:</p>	<p><b>Study Design:</b> Low</p>

<p><b>Design:</b> Pre-post interventional study</p> <p><b>Aim:</b> Summarise information on behavioural problems and the efficacy of treatment options</p>	<p>problems (n = 133), Netherlands</p> <p><b>Intervention:</b> Owner-implemented successive approximation training (mixed rewards and leash/collar punishment system)</p>	<p>• Owner satisfaction with the programme in changing dog behaviour (aggressive and non-aggressive): Good, Fair, Moderate, Bad</p>	<p>• Owner reported satisfaction with the programme to change dog behaviour as 'good' or 'fair' in 42% of cases, moderate in 11% and bad in 41%</p>	<p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• Adequate sample size</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>• 5 dogs also received medications (methyl-progesterone and methyl-testosterone)</li> <li>• No control group</li> <li>• Different strategies for different behavioural problems</li> <li>• Mixed aversive and non-aversive training</li> <li>• Unknown time-period of intervention / follow-up</li> <li>• Owner satisfaction a proxy measure of dog behavioural change</li> <li>• Intervention requires high-input/cost</li> <li>• Unknown adherence to training</li> <li>• No statistical analysis on outcome</li> </ul>
<p><b>Dinwoodie, I.R., et al, 2021 [55]</b></p> <p><b>Design:</b> Observational retrospective cohort study</p> <p><b>Aim:</b> To investigate the proportion of dog owners seeking help for behavioural issues, who they sought help from, which treatment plan worked best (behavioural or medication strategies), and the effect of treatments</p>	<p><b>Participants:</b> House-hold dogs with at least one form of aggressive behaviour (n = 963), Connecticut USA</p> <p><b>Intervention:</b> Owner-implemented behavioural modification (19 different types) or medication</p>	<p>Study period up to 2yrs</p> <ul style="list-style-type: none"> <li>• Owner-reported improvements in aggression</li> </ul>	<p>Interventions accessed:</p> <ul style="list-style-type: none"> <li>• 98% (943) engaged in behaviour training</li> <li>• 56% (542) sought help from professional trainer</li> <li>• 21% (202) received at least one of 11 kinds of medication</li> </ul> <p>Dog Aggression:</p> <ul style="list-style-type: none"> <li>• 82% (790/963) of owners reported an improvement in aggression</li> <li>• 25% (245/963) reported an improvement of at least 75%</li> <li>• No medication or alternative treatment improved aggression</li> <li>• Behavioural techniques associated with improvements were: communication technique, habituation, relaxation, and the use of short, frequent training sessions</li> </ul>	<p><b>Study Quality:</b> Low</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• Variety of dog breeds included</li> <li>• Statistical analysis</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>• Low sample size medication groups</li> <li>• No control groups</li> <li>• 91% of dogs were neutered</li> <li>• Owners asked retrospectively</li> <li>• Owners initiated a heterogenous group of interventions</li> <li>• Owner-reported improvements, and non-validated measures</li> <li>• Interventions likely require motivated owners, were not standardised or well defined, and were of unknown duration</li> <li>• Unknown adherence to interventions</li> </ul>
<p><b>Line S, et al 1986 [72]</b></p> <p><b>Design:</b> Pre-post interventional study</p>	<p><b>Participants:</b> House-hold dogs with owner directed aggression (n=24), USA</p>	<p>Study period: 12 months</p>	<p>Dog aggression:</p> <p>4/24 had &gt;90% improvement 6/24 had 70-90% improvement 5/24 had 50-70% improvement</p>	<p><b>Study Quality:</b> Low</p> <p><b>Strengths:</b></p>

<p><b>Aim:</b> To investigate the effect of strategies to treat dog aggression</p>	<p><b>Intervention:</b> Behavioural techniques, progestin, and surgical or chemical sterilisation</p>	<ul style="list-style-type: none"> <li>• Owner-reported improvements in aggression</li> </ul>	<p>4/19 had &lt;50% improvement 2/19 euthanised due to aggression, 2/19 died of other causes and 5 were lost to follow-up</p>	<ul style="list-style-type: none"> <li>• House hold dogs with aggression</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>• Low sample size</li> <li>• No control group</li> <li>• Multiple different interventions</li> <li>• Owner-reported improvements</li> <li>• Interventions likely require motivated owners</li> <li>• Unknown adherence to behavioural interventions</li> <li>• No intention to treat analysis</li> <li>• High loss to follow-up</li> </ul>
<p><b>Uchida Y, et al, 1997 [73]</b></p> <p><b>Design:</b> Pre-post interventional study</p> <p><b>Aim:</b> Investigate the effect of a behavioural modification programme on dogs with dominance aggression</p>	<p><b>Participants:</b> House-hold dogs with dominance aggression, presenting to a behaviour clinic (n=20), USA</p> <p><b>Intervention:</b> Non-confrontational behaviour management advice</p>	<p>8-week study period:</p> <ul style="list-style-type: none"> <li>• Owner-reported response to treatment</li> </ul>	<p>Dog aggression:</p> <ul style="list-style-type: none"> <li>• 20% (n=4) 'cured'</li> <li>• 35% (n=7) marked or moderate improvement</li> <li>• 15% (n=3) slight improvement</li> <li>• 30% (n=6) no improvement</li> </ul>	<p><b>Study Quality:</b> Low</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• House hold dogs with aggression</li> <li>• Non-aversive training techniques</li> <li>• No concurrent medication use</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>• Low sample size</li> <li>• No control group</li> <li>• Owner-reported improvements</li> <li>• Interventions likely require motivated owners</li> <li>• Unknown adherence to behavioural interventions</li> </ul>
<b>MEDICATION AND DIET</b>				
<p><b>Chutter, M., et al, 2019 [67]</b></p> <p><b>Design:</b> Pre-post interventional study</p> <p><b>Aim:</b> Assess the effect of fluoxetine and behavioural modification therapy in the treatment of canine behavioural disorders</p>	<p><b>Participants:</b> House-hold dogs with behavioural issues including aggression, presenting to a behaviour clinic (n=88), USA</p> <p><b>Intervention:</b> Fluoxetine with a behaviour modification plan at some point in a 4-year period</p>	<p>4-year study period:</p> <ul style="list-style-type: none"> <li>• Owner-reported response to treatment (positive, neutral, or negative)</li> </ul>	<p>Dog aggression:</p> <ul style="list-style-type: none"> <li>• Response to treatment: 55%, 32% neutral, 13% negative</li> </ul>	<p><b>Study Quality:</b> Low</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• Range of doses used</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>• Small sample size</li> <li>• No control</li> <li>• Other medications also prescribed</li> <li>• Duration of treatment not reported</li> <li>• Intervention likely requires motivated owners</li> <li>• Owner-reported improvements</li> </ul>



				<ul style="list-style-type: none"> <li>• High loss to follow up (n=41/134). Potentially treatment failure/non-compliance</li> </ul>
<p><b>Virga, V., et al, 2001 [80]</b></p> <p><b>Design:</b> Cross-over interventional study</p> <p><b>Aim:</b> Investigate the effect of amitriptyline to assist behavioural modification in the management of aggressive behaviours in dogs</p>	<p><b>Participants:</b> House-hold dogs with chronic aggression, USA (n=39)</p> <p><b>Intervention:</b> Amitriptyline with behaviour modification plan</p> <ul style="list-style-type: none"> <li>• 12 randomly assigned (prospectively) to either: -4wks drug then 4wks none</li> <li>• -4wks none then 4wks drug</li> <li>• 27 had drug for 4 weeks (retrospectively)</li> </ul>	<p>8-week study period:</p> <ul style="list-style-type: none"> <li>• Owner-reported improvement in dog aggression</li> </ul>	<p>Dog aggression:</p> <ul style="list-style-type: none"> <li>• No difference in owner-reported improvement between weeks of receiving amitriptyline: 83% (95% CI 51, 97), and weeks receiving Placebo: 75% (95% CI: 44, 94, p=1.0)</li> <li>• No difference in owner-reported improvement between dogs receiving Amitriptyline in retrospective phase 70% (95% CI 50, 86), and weeks when prospectively treated dogs were receiving placebo 75% (95% CI 44, 94) (p=1.0)</li> </ul>	<p><b>Study Quality:</b> Low</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• Double blinded, placebo control, cross-over</li> <li>• Statistical analysis</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>• Small sample size</li> <li>• 12/24 prospective participants excluded</li> <li>• Unknown compliance with medication or behaviour modification plan</li> <li>• Unknown effect of behaviour techniques</li> <li>• No washout period</li> <li>• Owner-reported measures of improvement</li> </ul>
<p><b>Odore, R., et al, 2020 [68]</b></p> <p><b>Design:</b> Pre-post interventional study</p> <p><b>Aim:</b> Investigate the behavioural effects of Fluoxetine in dogs affected by dominance aggression</p>	<p><b>Participants:</b> Dogs referred due to owner-directed aggression (n = 8), Italy</p> <p><b>Intervention:</b> Fluoxetine and positive behavioural techniques for 6 months</p>	<p>6-month study period</p> <ul style="list-style-type: none"> <li>• Owner-reported dog-aggression scale</li> </ul>	<p>Dog aggression:</p> <ul style="list-style-type: none"> <li>• Aggressive behaviour decreased from pre-intervention to 6 months</li> </ul>	<p><b>Study Quality:</b> Low</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• Valid treatment</li> <li>• Focused outcome</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>• Very small sample size</li> <li>• No control group</li> <li>• Unknown compliance with medication or behaviour modification plan</li> <li>• Unknown effect of behaviour techniques</li> <li>• Owner-reported measure of aggression</li> </ul>
<p><b>Dodman, N.H., et al, 1996 [61]</b></p> <p><b>Design:</b> Cross-over interventional study</p> <p><b>Aim:</b> Investigate the use of fluoxetine for the treatment of dominance aggression in dogs</p>	<p><b>Participants:</b> House-hold dogs with owner-directed dominance aggression (n = 9), USA</p> <p><b>Intervention:</b> Fluoxetine: 1 week of placebo, followed by 4 weeks of medication</p>	<p>5-week study period:</p> <ul style="list-style-type: none"> <li>• Owner-reported aggression score: (growling, lip curling, snapping, biting)</li> </ul>	<p>Dog aggression:</p> <ul style="list-style-type: none"> <li>• Significant reduction in aggression score (p = 0.01), but not in any specific behaviour</li> <li>• 8/9 owners reported some level of improvement</li> </ul>	<p><b>Study Quality:</b> Low</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• Cross over design</li> <li>• Partial blinding (week of placebo unknown to owners)</li> <li>• Use of an aggression score</li> <li>• Compliance to medication was checked</li> </ul> <p><b>Limitations:</b></p>

				<ul style="list-style-type: none"> <li>• Very small sample size</li> <li>• Owner-reported measure aggression</li> <li>• Non-validated measure aggression</li> <li>• Uses continuation of medication as a measure of success</li> <li>• Post-study analysis uncertain accuracy</li> </ul>
<p><b>Rosado, B., et al, 2010 [66]</b></p> <p><b>Design:</b> Pre-post interventional study</p> <p><b>Aim:</b> Investigate the effect of fluoxetine on aggressive behaviour and biochemical markers</p>	<p><b>Participants:</b> House-hold dogs with behavioural aggression, Valencia, Spain (n = 22)</p> <p><b>Intervention:</b> Fluoxetine for 30 days</p> <ul style="list-style-type: none"> <li>• 22 received intervention</li> <li>• 9 non-aggressive dogs also received intervention</li> </ul>	<p>30-day study period</p> <ul style="list-style-type: none"> <li>• Owner-reported aggressive behaviour</li> </ul>	<p>Dog aggression</p> <ul style="list-style-type: none"> <li>• All owners reported an improvement in aggressive episodes (authors did not specify by how much, or which group)</li> </ul>	<p><b>Study Quality:</b> Low</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• Also investigates biochemical markers</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>• Small sample size</li> <li>• No appropriate control group</li> <li>• Owner-reported measure of aggression</li> <li>• Non-validated measure of aggression</li> <li>• Main objective of study was to measure biochemical markers</li> </ul>
<p><b>DeNapoli, J.S., et al, 2000 [56]</b></p> <p><b>Design:</b> Crossover interventional study</p> <p><b>Aim:</b> Investigate the effect of protein or tryptophan diet on dog aggression and biochemical markers</p>	<p><b>Participants:</b> House-hold dogs with aggression, Boston, USA (n=33). Grouped by aggression type: dominance, territorial, hyperactivity</p> <p><b>Intervention:</b> Four diets: high or low protein, with or without tryptophan. Random allocation to 1 week of each</p>	<p>4-week study period</p> <ul style="list-style-type: none"> <li>• Owner-reported aggression (average score)</li> </ul>	<p>Dog aggression:</p> <ul style="list-style-type: none"> <li>• No significant improvement in behaviour with any groups for any diet</li> <li>• Dogs with dominance aggression fed a high-protein + Tryptophan diet had higher aggression scores</li> </ul>	<p><b>Study Quality:</b> Moderate</p> <p><b>Strengths:</b></p> <ul style="list-style-type: none"> <li>• 3-day washout period between diets</li> <li>• Exclusion of recent medications</li> <li>• Randomisation and blinding of diet weeks</li> <li>• Well defined measure of aggression</li> <li>• Appropriate statistical analysis</li> </ul> <p><b>Limitations:</b></p> <ul style="list-style-type: none"> <li>• Potential conflict of interest with Pet-Food company sponsorship</li> <li>• Exclusion of pregnancy or severe aggression</li> <li>• Small sample size</li> <li>• 5 dogs lost to follow-up</li> <li>• Owner-reported aggression score</li> <li>• Further analysis done on whole sample (no crossover/randomisation)</li> </ul>