Hip and Elbow Dysplasia in Golden Retrievers: A Comprehensive Review

Introduction

Hip dysplasia (HD) and elbow dysplasia (ED) are developmental orthopedic disorders that commonly affect Golden Retrievers, leading to joint laxity, arthritis, pain, and lameness. Both genetic and environmental factors contribute to these conditions. Responsible breeders and veterinarians have long implemented screening programs to reduce the incidence of HD and ED. This review examines the scientific literature of the past ~25 years on HD and ED specifically in Golden Retrievers, including prevalence rates, typical ages at diagnosis, the impact of hereditary vs. age-related joint disease, the effectiveness of screening/certification programs (OFA, PennHIP, BVA/KC), and the biases and gaps in current research. Our aim is to present an accessible yet in-depth "white paper" summary for families, breeders, and veterinary professionals.

Prevalence of Hip and Elbow Dysplasia in Golden Retrievers

Hip Dysplasia Prevalence: Reported prevalence rates of hip dysplasia in Golden Retrievers vary widely across studies and contexts. In general, early studies and unbiased screenings showed very high rates, while recent reports from selective breeding programs show much lower rates:

- **Unbiased Population Samples:** A landmark U.S. study in 2005 (Paster et al.) examined hip radiographs of pet Golden Retrievers 2–5 years old with no pre-selection. It found 53% of Goldens had hip dysplasia under a standard scoring system, and up to 73% were dysplastic when even minor osteoarthritic changes were counted. This suggests true prevalence in the general Golden Retriever population (without selective breeding) can exceed 50–70% – far higher than often reported. The same study revealed a strong voluntary submission bias: owners were 8.2 times more likely to submit X-rays to the Orthopedic Foundation for Animals (OFA) if the hips appeared normal. In other words, many dysplastic dogs "fly under the radar," leading to underestimation in voluntary registries.
- **General Reported Rates (OFA Data):** In contrast to the above, the OFA's registry – which relies on voluntary submissions, usually of breeding prospects – historically reported much lower dysplasia rates. OFA data (through ~2019) indicate roughly 19–20% of Golden Retrievers have dysplastic hips. For example, out of over 170,000 Goldens evaluated by OFA, about 19.7% were rated as having abnormal (dysplastic) hips. This ~20% figure is often cited but is clearly a low-end estimate given the voluntary nature of OFA screening (many affected dogs are never submitted). It does, however, show that among *screened* dogs, about one in five still had hip dysplasia. Notably, even this OFA rate is

significant – hip dysplasia remains one of the most common orthopedic problems in the breed.

- **International and Improved Programs:** Breeding selection programs have achieved substantial reductions in HD prevalence. In Switzerland, where breeding dysplastic dogs has been prohibited for decades, the prevalence of hip dysplasia in Goldens dropped from ~25% in the late 1990s to about 9.4% by 2010–2016. Earlier (1991–1995) Swiss data even showed a prevalence of ~51%, so the long-term selective breeding efforts have dramatically lowered that number to single digits. The UK's Kennel Club/BVA hip scoring scheme (voluntary but widely used) has also led to gradual improvement: studies of six UK breeds including Goldens show a steady decline in average hip scores over the past 30 years, indicating fewer dogs with severe HD. In one analysis of UK Goldens, the median hip score and the proportion of high-score (bad-hip) dogs have significantly decreased with each generation.

Elbow Dysplasia Prevalence: Published rates of elbow dysplasia in Golden Retrievers also vary, though generally ED is less frequent than hip dysplasia in this breed. As with hips, results differ between registry data and broader samples:

- **OFA vs. BVA Data:** According to OFA records, roughly 11–12% of evaluated Golden Retrievers have elbow dysplasia (as of early 2000s). For example, among 9,630 Goldens in the OFA database through 2003, about 11.6% were rated dysplastic in elbows. By contrast, the British Veterinary Association (BVA) elbow scheme (which may capture a more complete cross-section of the breed in the UK) reported about 25% of Goldens with elbow dysplasia. This stark difference (25% vs 12%) again underscores how sampling bias and criteria affect reported prevalence. The true rate of ED in the overall Golden population likely lies somewhere in between. It's worth noting that Goldens are not the worst breed for ED – (for instance, Rottweilers often show ~40% ED) – but 10–25% is still considerable.
- **Trends:** Like hip dysplasia, elbow dysplasia rates have seen modest improvement with selection, but progress has been slower. The UK data show only a slight decline in mean elbow scores over time. Part of the challenge is that ED has a lower heritability (more below), making it harder to breed out quickly. Still, even voluntary testing helps: a recent study noted increased participation in elbow screening of Golden breeders in the UK and corresponding slight reductions in ED severity over the years. In Switzerland, elbow dysplasia is monitored but the focus has been more on hips; global data suggest Golden Retrievers have a moderate risk of ED relative to other large breeds.

Visualizing Prevalence: The chart below compares hip dysplasia rates in Golden Retrievers across different contexts – from an unbiased sample to typical OFA data to a strictly selected population. It highlights how selection and screening can make a huge difference in reported prevalence:

Figure 1: Reported hip dysplasia prevalence in Golden Retrievers under different sampling conditions. "Unbiased US (2005)" represents a research study of pet Goldens with no selection (finding ~60% dysplastic, with up to 73% in one analysis). "Voluntary US (OFA)" represents OFA registry data (~19–20% dysplastic). "Strict Selection (Switzerland)" represents a population where only dogs with healthy hips are bred (~9% dysplastic by 2010–2016).

Takeaway: Prevalence estimates range widely – from under 10% to over 50% – depending on the breeding and sampling strategy. In general, around 20% of screened Golden Retrievers in the U.S. have hip dysplasia, but the true population incidence could be much higher (over half) if one includes all pet Goldens without selection. Conversely, rigorous breeding selection can reduce the rate to around 10% or less over time.

Diagnostic Age Ranges and Hereditary vs. Geriatric Onset

When are Goldens Diagnosed with Dysplasia? Different studies and screening programs use varying age ranges for evaluation, but it's crucial to distinguish *developmental dysplasia* (a hereditary condition that manifests in youth) from purely *age-related degenerative joint disease*. Key points on diagnostic age include:

- **Early Development vs. Late Arthritis:** Hip and elbow dysplasia are fundamentally developmental, beginning in puppyhood as abnormally loose joints. Clinical signs of hip dysplasia can emerge at two life stages: during skeletal growth (as early as 4–12 months old), or later in middle-age to senior years (4–8+ years) when chronic arthritis from the dysplasia causes pain. Many young dysplastic dogs show hind-limb lameness or gait abnormalities by 6–14 months of age due to joint laxity. Others may not show obvious problems as pups but go on to develop osteoarthritis in the dysplastic joints and become symptomatic in adulthood. As one source notes, *"for some dogs, signs of hip dysplasia will develop while they are <1 year old; for others, signs can develop at any age after maturity"*. Once arthritic changes set in, the condition persists for life.
- **Typical Screening Ages:** To get a standardized comparison, most screening programs evaluate dogs around skeletal maturity (1–2 years old). OFA, for example, only issues final hip/elbow certifications at ≥24 months of age (though they offer preliminary assessments earlier). The BVA/KC schemes in the UK

accept dogs for hip/elbow scoring at ≥12 months old. The rationale is that by 1–2 years, any genetic dysplasia is usually radiographically evident – the joints have developed (or malformed) enough to see. However, some dogs with mild dysplasia might not show obvious arthritis until later in life. Research studies sometimes extend the age range to capture these – e.g., the Paster et al. study intentionally screened Goldens up to 5 years old to catch those whose dysplasia might only be confirmed via early arthritic signs.

- **PennHIP Early Evaluation:** Unlike traditional methods, the PennHIP technique can be performed as early as 16 weeks (4 months) of age. It measures hip laxity in puppies to predict their risk of developing HD later. PennHIP's early-age evaluation is valuable for breeders who want to make decisions before investing in a dog's training or breeding – a dog with very loose hips at 4–6 months is highly likely to have dysplasia as an adult. Studies show that by 6 months, 90–95% of dysplastic dogs can be identified on radiographs. (A small fraction might appear normal at 1 year but develop osteoarthritis by say age 2–3 – often these are cases that were borderline dysplastic initially.)
- **Hereditary vs. "Acquired" Joint Disease:** True hip/elbow dysplasia is considered heritable and developmental – dogs are born with a genetic predisposition that causes the joints to form improperly. This is distinct from purely "wear-and-tear" arthritis in an otherwise normal joint. In older dogs, it can be tricky to differentiate the two without previous films. A Golden Retriever diagnosed with hip arthritis at 8 years old, for example, *likely* had unrecognized mild dysplasia earlier in life that only now has become clinical. Primary osteoarthritis in a dog with perfectly congruent hips is rare. Thus, most scientific studies focus on heritable dysplasia and evaluate dogs at a younger adult age to classify them as dysplastic or not. If a study includes geriatric dogs, it generally still requires radiographic evidence of dysplasia (e.g. shallow sockets, joint remodeling) to count it as HD, not just age-related changes.
  That said, some veterinary surveys (like primary-care vet record analyses) may label an older dog as "hip dysplastic" based on arthritis consistent with HD, even if no films were taken earlier. This can blur the line. For clarity: dysplasia originates in youth – it's a malformation of the joint – whereas arthritis can accumulate with age. Most rigorous studies ensure dogs are evaluated at a standard age (often 1–2 years) to compare hereditary dysplasia rates, rather than counting every senior dog with arthritis. In summary, a Golden Retriever with joint issues in old age almost always either *had dysplasia all along* or has another specific cause (e.g. injury) – spontaneous late-life hip joint degeneration without underlying dysplasia is uncommon in this breed.

- **Important Caveat – Early vs. Late Diagnoses:** Because of the above, reported prevalence can depend on the age at diagnosis. If you x-ray all 8-year-old Goldens, you might find more arthritic hips than if you screen at 1–2 years (since some mild cases progress by 8). Conversely, some severely dysplastic dogs won't even make it to old age or would have been treated surgically, etc. Thus, standardizing age in studies is important. Most breeding programs consider the dog's hip/elbow status at ~1–2 years as the definitive assessment of hereditary dysplasia. Any joint problems arising *much* later are often excluded from genetic prevalence calculations to avoid confusion with other geriatric issues.

Screening and Certification Programs (OFA, PennHIP, BVA)

Several orthopedic screening programs are used worldwide to identify and certify dogs free of dysplasia, or to quantify their risk. In Golden Retrievers, the main ones are the Orthopedic Foundation for Animals (OFA) scheme (widely used in the US and Canada), PennHIP (Pennsylvania Hip Improvement Program), and the British Veterinary Association (BVA) Hip/Elbow schemes (used in the UK, with similar protocols in many other countries). Each program has its own methods and scoring system. The table below summarizes key features:

Program & Admin. (Region)	**Minimum Age for Evaluation**	**Methodology and Measurements**	**Scoring/Outcome**	**Usage & Effectiveness**
OFA – Orthopedic Foundation for Animals (USA) *Also CHIC database (jointly with AKC)*	24 months for final certification (preliminary eval at ≥4 months).	**Hip:** Standard ventrodorsal (VD) hip-extended radiograph. No stress maneuver. Films are evaluated by multiple radiologists. **Elbow:** Flexed elbow radiograph (both legs).	**Hip:** Rated Excellent, Good, Fair (these are considered passing/normal); Borderline; or Dysplastic (Mild, Moderate, Severe). **Elbow:** Rated Normal (0) or Dysplastic grades 1 (mild arthrosis)	**Voluntary participation:** Common in U.S. Golden breeders. Dogs with passing grades often get OFA certificates. **Effectiveness:** OFA has helped reduce grossly affected dogs in breeding pools (e.g., encouraging breeders to use

			through 3 (severe).	only Fair/Good/Excellent hips). However, progress has been **slow** when used alone. A recent study in a breeding colony found no improvement in hip quality over 14 years using OFA selection alone. The OFA database is also subject to submission bias (many dysplastic dogs are simply not submitted). Nonetheless, OFA reports show gradual improvement in hip ratings over decades in Goldens, especially among conscientious breeders.
PennHIP – University of Pennsylvania Hip Improvement Program (USA/International)	16 weeks (4 months) or older (no upper age – can assess	**Hip:** Three radiographs under heavy sedation or anesthesia: a standard extended view and two special views with a distraction	**Hip:** Provides a DI value for each hip (e.g. DI = 0.50). Also reports if radiographic osteoarthritis is present. There is	**Voluntary participation:** Growing in popularity. PennHIP requires special training and fees, so fewer vets/dogs

	even older dogs).	device. The device applies lateral force to the hip to measure laxity. The key output is the **Distraction Index (DI)**, a number from 0 (tight) to 1 (very loose) indicating the fraction of femoral head displacement. Also notes any osteoarthritis on films. No separate elbow protocol (PennHIP is hips-only).	no simple pass/fail – instead, the dog's hips are ranked against breed norms. For example, a DI of 0.30 in a Golden is considered quite tight (better than most Goldens), whereas the breed average DI is ~0.53. Breeders are advised to select dogs with DI better (lower) than breed average to improve hips over time.	are in this database (e.g., ~24,000 Goldens to date). **Effectiveness:** PennHIP's early evaluations allow breeders to make selection decisions sooner. Research shows PennHIP is more sensitive in detecting laxity and can predict future arthritis risk . In a controlled breeding colony, using PennHIP (DI ≤0.30 as a cutoff) achieved significant improvement in hip quality, whereas relying on OFA scores alone had little effect. Some breeds (German Shepherds vs. Goldens) show different arthritis outcomes at a given DI, but in general, PennHIP has been a valuable tool for genetic progress.

BVA/KC Hip & Elbow Schemes – British Veterinary Association & Kennel Club (UK) *(FCI and other national schemes are similar in principle)*	12 months or older (for both hips and elbows).	**Hip:** Standard hip-extended radiograph under sedation/anesthesia. A panel of BVA expert radiologists assigns a numeric score for each hip based on specific anatomical points (e.g. Norberg angle, subluxation, acetabular rim, etc). The points are summed to a total score per hip (0 = best, 106 = worst combined score). **Elbow:** Standard flexed elbow X-rays. Graded 0 (clear) to 3 (severe arthrosis) per the International Elbow Working Group criteria ofa.org.	**Hip:** Each hip receives 0–53 points; the two are often summed (0–106). Lower scores = tighter, healthier hips. In UK Goldens, the breed median score is often used as a threshold – e.g. breed median ~10; dogs scoring well below that are ideal for breeding. There is no hard "pass/fail"; all scores are recorded. **Elbow:** Grades 0, 1, 2, 3 (with 0 and 1 sometimes considered "low grade"). UK recommends breeding only 0-grade elbows if possible.	**Voluntary but strongly encouraged:** A large proportion of UK Golden Retrievers are hip and elbow scored (≈70% of registered Goldens had hip scores in recent years). **Effectiveness:** The BVA/KC data show significant genetic improvement over time. Between 1990 and 2017, the average hip scores in Golden Retrievers improved, with fewer dogs in the high-score ranges. Estimated Breeding Values (EBVs) introduced by the Kennel Club further enhance selection by accounting for relatives' scores, accelerating progress. Elbow dysplasia rates

				have also modestly declined, but less dramatically. In essence, the UK program has been a qualified success – not eliminating the problem, but reducing its severity and frequency in the breed.

Note: In the U.S., the **Canine Health Information Center (CHIC)**, co-sponsored by OFA and the AKC, serves as a centralized database. Goldens that have required health tests (including OFA or PennHIP evaluations for hips and elbows) receive a CHIC number. This encourages breeders to perform and publicly record dysplasia screenings as part of a comprehensive health profile. However, CHIC itself doesn't evaluate the X-rays – it relies on the results from OFA, PennHIP, etc..

Effectiveness of Screening and Breeding Programs

The ultimate goal of these programs is to reduce the incidence of HD/ED by guiding breeding decisions. The literature offers a mixed but overall encouraging picture of their success:

- **Hip Dysplasia Reduction:** Long-term data across many breeds (including Goldens) demonstrate that phenotypic selection does work over time. A 2017 study analyzing 1 million+ OFA hip records found a measurable downward trend in dysplasia prevalence in most breeds, including Golden Retrievers. Golden Retrievers showed improvement, though slow, in hip joint conformation over the 45-year span of OFA data. The genetic trend in Goldens indicated subtle but steady improvement – fewer dogs with severe scores and a lower overall genetic liability to HD. This aligns with the anecdotal reports from breeders: compared to decades ago, it's now rarer to see *severely* dysplastic (crippling) hips in well-bred Goldens, though mild cases are still not uncommon.
  However, the pace of improvement under traditional programs can be slow (because HD is polygenic). The introduction of **Estimated Breeding Values (EBVs)**, which use relatives' data to more accurately select breeders, has been a

significant advance in places like the UK. EBVs for hips/elbows in Goldens allow selection of dogs that are not just phenotypically normal but also genetically superior, even if some of their relatives had issues. This could accelerate progress beyond what simple phenotypic selection can do. The UK's implementation of EBVs in recent years is expected to further drive down dysplasia rates.

One notable finding is that PennHIP adds effectiveness when combined with traditional selection. The 2020 detection-dog breeding study (Haney et al.) showed that using an aggressive PennHIP threshold alongside OFA criteria markedly improved offspring hip quality, whereas OFA criteria alone, applied in the same colony, had not made significant progress. This suggests that in Golden Retrievers (and retrievers in general), selecting for quantitatively tighter hips (low DI) is more effective than relying on the coarse OFA categories that might not distinguish mild laxity. In practice, many progressive breeders now use both: e.g. require an OFA Good or Excellent AND seek a PennHIP DI in the top 50th percentile or better for the breed. The GRCA's Code of Ethics actually permits using PennHIP in lieu of OFA for hip clearance, reflecting its value.

- **Elbow Dysplasia Reduction:** Elbow programs have also helped, but their success rates are more modest. In Goldens, ED has a lower genetic component (heritability ~0.2–0.3 vs ~0.6 for hips), meaning environment or random factors play a larger role, which makes genetic progress slower. The UK data showed only a slight decrease in average elbow scores over time. One reason is that many breeders historically focused on hips first, sometimes neglecting elbows. In fact, even today fewer Golden Retrievers get elbow screened than hip screened – in the UK, only ~46–48% of breeding Goldens had elbow grades recorded, versus ~70% for hips. This discrepancy, also seen in the US, means dysplastic elbows could slip through into the gene pool more often.

  Nonetheless, avoiding breeding dogs with known elbow dysplasia (especially bilateral or grade 2–3 changes) is believed to reduce ED incidence. The heritability is lower, but still significant. Data from the OFA database illustrate this: if both parents have normal elbows, offspring ED risk is ~12%. If one parent has elbow dysplasia, offspring risk jumps to ~26–31%, and if both parents are dysplastic, offspring risk is **~41%**. This shows a clear genetic influence. Thus, screening out affected elbows can meaningfully dent the odds, even if not eliminate the problem entirely.

  Many kennel clubs now strongly recommend breeding only dogs with elbow grade 0 (normal). Some will allow a mating if one parent is grade 1 (mild) *provided* the other is 0, to maintain genetic diversity, but discourage two grade-1 dogs being bred. Over generations, this should reduce the frequency of alleles contributing to ED. Countries like Sweden and Finland, which mandated elbow

scoring earlier, have reported improvements (though detailed Golden-specific numbers are scarce).

- **Maintenance of Genetic Diversity:** A consideration in *any* strict selection program is the breed's gene pool. Golden Retrievers are a large-population breed, so culling dysplastic dogs (not breeding them) is feasible without severely bottlenecking genetic diversity. Programs like Switzerland's ban on dysplastic breeders worked largely because there were still enough healthy dogs to breed from. In breeds with extremely high prevalence, there is debate about breeding mild cases to avoid shrinking the gene pool drastically. In Goldens, this isn't as much of a bottleneck issue – enough dogs have normal hips/elbows that one can find quality breeding stock without using affected individuals. Thus, the consensus in the literature and breed clubs is to select only normal or near-normal dogs for breeding to continue the downward trend in dysplasia.

In summary, screening and certification programs have been essential in managing HD/ED in Golden Retrievers. They are not foolproof or instant solutions – the polygenic nature means progress takes time – but studies confirm that generations of testing and selection have significantly lowered the prevalence and severity of these diseases. Goldens in 2025, especially those from health-conscious breeders, are in a much better place orthopedically than those in, say, 1970, thanks to these efforts.

However, the literature also warns that improper use or interpretation of screening can limit effectiveness. If breeders only do tests for certification and then ignore the results (or only publish the good results), the impact is blunted. Participation needs to be high and results used honestly. The UK experience shows that when >70% of breeders comply, measurable breed-wide improvement occurs. In contrast, in populations with low testing uptake, dysplasia can remain high. For example, if nearly half of Golden Retriever dams or sires aren't elbow-scored (as in UK data), those unscreened dogs could be a reservoir for perpetuating ED genes. Increasing compliance and perhaps making such health tests a de facto requirement for breeding is a continuing goal of breed organizations worldwide.

Biases and Limitations in Dysplasia Studies

When interpreting the scientific literature on HD/ED in Golden Retrievers, it's important to recognize several potential biases and sources of error that can affect study results:

- **Voluntary Submission Bias:** As discussed, studies drawing from registries like OFA inherently *underestimate* dysplasia rates. Owners/breeders are less likely to submit X-rays of dogs they suspect (or know) to be dysplastic. Paster et al. quantified this: only **53%** of the dogs they offered OFA evaluations for actually had their films submitted by the owners, and the vast majority of those submitted

were the ones with normal hips. Radiographs showing dysplasia were often kept "hidden." This self-selection dramatically skews data. Any prevalence figures from such databases must be taken as minimum estimates. Researchers try to adjust for this by doing independent screenings (as in that study) or by statistical modeling, but it remains a key limitation in retrospective analyses of registry data.

- **Sample Demographics:** Many studies focus on particular subpopulations of Goldens that may not represent the breed at large. For instance, some research uses guide dogs, service dogs, or military dogs (which might have their own breeding programs and perhaps lower dysplasia due to selection), or show/hobby breeders' dogs (often carefully bred). Results from such groups can paint a rosier picture than reality. Conversely, studies from referral orthopedic clinics might overrepresent severe cases (since mild cases don't always get referred). The ideal epidemiological study – a random sampling of the pet Golden Retriever population – is rarely done due to cost and logistics. One partial example was a UK primary-care vet dataset (VetCompass) that found about 0.72% of all dogs (all breeds) had a diagnosis of HD, but that relies on diagnoses made (often later in life) and isn't specific to Goldens. Breed-specific health surveys sometimes help but often rely on owner reports. Thus, who was studied (and at what age) can greatly influence findings.
- **Diagnostic Criteria & Reader Variability:** There is some subjectivity in how dysplasia is scored. Different countries and organizations have slightly different criteria (e.g. what counts as "borderline" vs "mild"). Even within OFA, three radiologists independently score – they have mechanisms to average scores, but a borderline case might be rated normal by one and mild by another. The inter-observer variability can introduce noise. A study on inter-reader agreement in hip scoring (comparing FCI, OFA, BVA methods) found generally good consensus on clear-cut cases, but discrepancies on mild cases. Similarly, inclusion of certain radiographic signs (like the Morgan line, a subtle osteophyte in hips) can change a diagnosis from normal to dysplastic. Paster et al. demonstrated that adding one osteoarthritic criterion raised prevalence from 53% to 73% in their sample. So, how dysplasia is defined matters. Most modern studies explicitly state their criteria (e.g. "we considered any sign of OA as affected"). When comparing studies, one must ensure they're using comparable thresholds.
- **Funding or Institutional Biases:** It's worth noting who performs or funds the research. For example, OFA-associated researchers (like those on the OFA's scientific board) have published data showing improvements, and PennHIP developers have published data highlighting the importance of laxity and earlier selection. This doesn't invalidate the findings – in fact those studies are high-quality – but authors might emphasize certain points. We mitigated this by

drawing from a broad range of sources (academic journals, independent studies, international data). Fortunately, in this field, the major players (OFA, PennHIP, BVA, etc.) all share the goal of reducing dysplasia, and their findings often complement each other. If a study is directly funded by a dog food company, a pharmaceutical, or a kennel club, we check if that could bias results (e.g. a food company might study nutritional intervention results). For this review, most references are peer-reviewed and not overtly influenced by commercial interests, aside from methodology preferences.

- **Small Sample Sizes & Study Design:** Some reports, especially older ones or those focusing on a single lineage, may involve relatively few dogs. Conclusions from a study of 50–100 dogs should be viewed with caution compared to those from databases of thousands. Additionally, cross-sectional studies (looking at one point in time) can't fully capture progression, whereas longitudinal studies (following the same dogs over years) are rare but more informative about outcomes. A good example of a longitudinal component is the Purina Lifelong Study which followed paired littermates on different diets for life – it gave insight into when arthritis developed in dysplastic dogs under different feeding regimes. We have limited such longitudinal data in Goldens specifically, aside from diet and neutering studies. The lack of long-term follow-up in most dysplasia research means we often infer long-term outcome from radiographic grades (assuming a dog with severe HD at 2 will have arthritis by 6, which is usually true).
- **Confounding Factors:** Many environmental factors (diet, exercise, weight, neuter status) can affect the manifestation of dysplasia and thus complicate comparisons. For example, if one study's cohort had a majority of neutered Goldens and another did not, their HD rates might differ due to neutering effects (early neuter has been linked to increased HD risk in Goldens). Similarly, a population that is largely pet dogs allowed free feeding might show more severe dysplasia than a population of lean working dogs, purely due to weight and conditioning differences. One classic study showed that restricted feeding (maintaining a lean body condition) cut hip dysplasia incidence and delayed onset of arthritis in Labradors – this likely applies to Goldens too. If a dysplasia study doesn't account for weight/exercise, results could be skewed. Some modern studies include weight or body condition score as a variable when analyzing risk. Where relevant, we've noted such factors.

In evaluating the literature, we have tried to account for these biases. For example, we give greater weight to studies that used broad, unbiased samples or that corrected for known biases. Nonetheless, readers should understand that numbers can differ widely between studies – not necessarily because one is "wrong," but because they examined

different subsets or used different definitions. We've cited multiple sources to provide context for any statistics presented.

Gaps and Needs in the Research

While a great deal is known about hip and elbow dysplasia in Golden Retrievers, there are still important gaps and open questions in the literature:

- **Unbiased, Large-Scale Epidemiological Data:** Outside of targeted studies like Paster et al. (2005), we lack recent large-scale random sampling of the Golden Retriever population for HD/ED. Most data come from registries (biased) or specific groups. A nationwide study that, for instance, randomly X-rays a few hundred pet Goldens (including those from non-breeding homes) at 2 years old would be extremely useful to gauge current true prevalence in 2025. This could reveal how much progress has been made outside the circle of reputable breeders. Similarly, more data from countries with mandatory screening (e.g. parts of Europe) could be analyzed to see the ceiling of improvement (how low can prevalence realistically go?). The Swiss study was one example, and it would be helpful to replicate such analyses in other countries or update them.
- **Longitudinal Studies and Clinical Outcomes:** We need more research following dysplastic vs. non-dysplastic Goldens through their lifespans. For example, among Goldens rated with mild HD at 2 years, what percentage show clinical pain by age 5, 7, 10? Does every dysplastic dog inevitably develop lameness, or do some never show signs? While it's generally assumed dysplasia leads to arthritis, the timeline and variability are not fully charted in Goldens. Long-term prospective studies – like the Golden Retriever Lifetime Study (a 3,000-dog cohort) – could potentially provide data on orthopedic outcomes if radiographs are taken or if owners report mobility issues over time. Knowing the natural history would help vets advise pet owners on prognosis and management (e.g., some mildly dysplastic dogs may live to 12 with minimal issues, while others might need surgery at 4).
- **Genetic Research and Markers:** Despite the high heritability of hip dysplasia in Goldens, specific gene markers or mutations have been elusive. It's a polygenic condition, meaning many genes of small effect. A 2021 across-breed genome study identified some markers associated with HD, but none with deterministic power. For Golden Retrievers, no commercially available genetic test can predict dysplasia risk. Developing polygenic risk scores or genomic EBVs could greatly enhance selection, but that requires large DNA datasets with phenotypes. So far, most genetic studies pool multiple breeds to gain power. A gap remains in having Golden-specific genetic insights. The literature calls for more DNA collection from both affected and unaffected Goldens. If certain genetic combinations are found

to confer protection or risk, breeders could use that information alongside radiographs. This area is a frontier – bridging the gap between the observed heritability and the ability to select on genetic code.

- **Elbow Dysplasia Complexity:** ED is an umbrella term (it can involve different specific lesions like fragmented coronoid process, ununited anconeal process, OCD of the humeral condyle, etc.). The distribution of these lesions in Golden Retrievers isn't well documented in literature. For instance, it's known that in Labs and Goldens the most common form of ED is fragmentation of the medial coronoid (FCP), but exact percentages or any unique breed aspects (do Goldens get more bilateral ED? are they prone to a particular type of lesion?) are not clearly reported. Also, some evidence suggests that what is called "elbow dysplasia" might be multiple syndromes with different inherited components. Golden Retrievers could benefit from more elbow-focused research – e.g., advanced imaging (CT/MRI) studies to see how often mild radiographic ED corresponds to actual cartilage damage. One study using CT on seemingly normal-elbow dogs found some had unrecognized issues. More such work could refine how we screen elbows (perhaps in the future, CT or arthroscopy might become the gold standard, as radiographs can miss subtleties). In short, the elbow needs further study, as progress in reducing ED has lagged behind HD.
- **Environmental Modifiers:** Another gap is understanding how to optimally manage growing puppies to minimize dysplasia expression. We know from classic studies that keeping puppies lean greatly reduces the severity of hip dysplasia and delays arthritis. We also have data that early neutering (especially before 6 months) may *increase* the risk of HD and cruciate ligament tears in Goldens, likely due to altered growth plate closure and hormonal effects. But beyond weight and neuter timing, other factors are debated: e.g. exercise – should puppy exercise be restricted? Some believe excessive running or high-impact activity in a pup predisposed to HD could worsen the outcome, but concrete evidence is limited. A Swedish study on German Shepherds showed a correlation between certain exercise routines in puppyhood and HD, but we don't have breed-specific guidance for Goldens. Similarly, is there any nutritional supplement (e.g. glucosamine) that helps in development? Unlikely to make a big difference, but not thoroughly studied. Filling this gap with solid research would help owners do everything possible (environmentally) to prevent dysplasia in their Golden Retriever puppies.
- **Clinical Treatment Outcomes:** While this review excluded treatment-focused studies, it's worth noting a related gap: for dogs that *do* have dysplasia, especially elbow dysplasia, the best management strategies are still being investigated. For breeders and owners, prevention via selection is the priority, but

inevitably some Goldens will have HD/ED. Long-term studies comparing outcomes of different interventions (surgery vs. conservative management, etc.) in Goldens could feed back into how we approach early diagnosis. For example, if a certain surgical intervention in a puppy with elbow OCD yields a near-normal adult, that might influence recommendations for screening puppies. Currently, however, treatment studies often include all breeds and may not break out results by breed. Goldens might respond differently in some cases (due to temperament or anatomy). This remains an area for veterinary clinical research.

In summary, the literature would benefit from more Golden-specific data in unbiased scenarios, more genetic dissection, and more follow-up of affected dogs over time. Collaboration between researchers, breed clubs, and owners (for data sharing) will be key to closing these gaps.

Conclusion

Hip and elbow dysplasia have been recognized in Golden Retrievers for decades, and intensive efforts have been made to reduce their impact. This review has shown that:

- The **prevalence** of hip dysplasia in Goldens has ranged from alarmingly high (50%+ in unselected groups) to impressively low (~9% in strictly health-tested lines), with current OFA statistics around 20% and elbow dysplasia around 10–15% (higher in some datasets). Clearly, improvement is possible – Golden Retrievers today are in a better place orthopedically than in the past, though dysplasia is far from “solved.”
- **Diagnosis** typically occurs by 1–2 years of age for hereditary dysplasia (which is the focus of studies), but owners should be aware that some dysplastic Goldens won’t show pain until later in life. Distinguishing genetic dysplasia from age-related arthritis is important: nearly all true dysplasia is rooted in genetics and youth, even if it only becomes obvious at an older age. Thus, screening at a young age (while not catching every single case) is an effective way to identify at-risk dogs early and make breeding or management decisions accordingly.
- **Screening programs** (OFA, PennHIP, BVA, etc.) have been invaluable. Each has pros and cons: OFA is widespread and simple but can miss subtle laxity; PennHIP quantifies laxity early but requires heavy sedation and special training; BVA scoring gives granular data and has driven improvement in the UK. Using these tools, breeders have reduced dysplasia rates – especially when they use them rigorously (not just as a formality). The programs’ success varies, with studies showing faster genetic gains when more stringent selection criteria (e.g. PennHIP) are applied. For elbows, progress has been slower, reminding us that ongoing vigilance is needed. One common theme is the need for high

participation – the more dogs screened and made part of the record, the better the overall breed outcomes.

- **Study biases** can affect reported results, and we highlighted the importance of understanding those biases. A family reading about “9% dysplasia” vs “73% dysplasia” in Goldens might be confused – context is everything. Realistically, a well-bred Golden from health-tested parents has a much lower chance of severe HD/ED than an untested one. But even well-bred Goldens can develop orthopedic issues, so it remains a critical area of focus for breeders.
- Several gaps in knowledge persist, from genetic mechanisms to the fine details of elbow pathology in Goldens. For breeders and researchers, these gaps point to future directions – e.g., participate in studies or submit DNA to help find those genes; encourage complete reporting to get better data; and perhaps consider new technologies (like advanced imaging or genetic testing when available) to complement traditional x-rays.

In conclusion, hip and elbow dysplasia in Golden Retrievers are challenges that can be managed through diligent screening, selective breeding, and informed care. The last 20+ years of research and data show encouraging trends: with sustained effort, the breed can continue to see lower prevalence and milder cases of these joint disorders. Golden Retrievers bring so much joy to families; reducing the burden of dysplasia ensures they enjoy the active, pain-free lives we envision for them. Ongoing research, combined with breeder and owner commitment, is the path to further successes in the years to come.

Sources: This review drew on peer-reviewed studies, veterinary journals, and reports from OFA, GRCA, and international researchers. Key references include Paster et al. 2005, which exposed biases in prevalence data; Ohlerth et al. 2019 (Swiss study); Oberbauer et al. 2017 (analysis of 60 breeds); James et al. 2019 (UK trends); and others detailing heritability, environmental influences, and screening outcomes. These are cited throughout for readers who wish to explore the original data and analyses

