

Prevalence of Gastrointestinal Helminths in Free-Range Backyard Poultry

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ABSTRACT

Free-range backyard chickens scavenge for much of their feed, and in doing so they meet the eggs and intermediate hosts of the gut helminths that circulate in village and household flocks. Surveys from many countries report that roundworms, caecal worms, capillarids and tapeworms are common in such birds, yet the figures they give are rarely comparable. This narrative review sets out what is known about the main helminth groups of scavenging poultry, how they are transmitted, and how prevalence has been measured, and it reports no new data. The central difficulty is that a prevalence figure folds together the age and season of sampling, the management of the flock, the parasites that were looked for and, above all, the diagnostic method: a faecal egg count and a necropsy answer different questions and miss different infections. Evidence on production losses is real but patchy, and it is hard to separate the effect of worms from poor nutrition and concurrent disease. The review concludes that helminths are widespread in free-range flocks but that their true frequency and cost remain poorly defined, and it proposes a short list of items that future surveys should report so that results can be set side by side.

Keywords: Free-range poultry; Backyard chickens; Helminths; *Ascaridia galli*; *Heterakis gallinarum*; Prevalence; Diagnostic methods; Narrative review

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1. Introduction

Village and backyard flocks are numerically the largest part of poultry keeping in many low-income regions, and they supply eggs, meat and a small but dependable household income [1, 2]. The birds are usually left to scavenge, with little supplementary feed and little or no veterinary attention. A chicken that spends its day picking through soil, litter and household waste eats a varied diet, and it also swallows whatever infective stages of parasites are lying there. Gastrointestinal helminths are therefore a

constant background feature of such flocks.

Surveys of these parasites are plentiful. Reports from Africa, Asia and Europe describe roundworms, caecal worms, capillarids and tapeworms in free-range chickens, and many give a prevalence for each group. What is less clear is how far those numbers can be compared, and what they say about the health and productivity of the birds. A single figure for the proportion of chickens infected depends on who sampled which birds, when, and with what test. The question this review asks is not simply how common helminths

are in free-range backyard poultry, but how much weight the published prevalence figures can bear. The aim is a fair account of what is known and what is simply repeated.

The article is a narrative review. It draws on published work on helminth biology, on surveys of scavenging and free-range flocks, and on the methods used to detect and count worms, and it reports no new data. Where a point depends on a number we could not check against its source, we have left the number out and described the pattern instead.

2. Literature Review

2.1 The Helminths of Scavenging Chickens

Four groups account for most of what is reported (Table 1). The large roundworm *Ascaridia galli* lives in the small intestine and has a direct life cycle: eggs passed in droppings develop in the environment and become infective, and a bird is infected when it swallows them [3, 4]. The caecal worm *Heterakis gallinarum* also has a direct cycle, but its eggs are notably persistent in soil, and the worm matters as much for what it carries as for what it does, because it transmits *Histomonas meleagridis*, the agent of histomonosis [5, 6]. Earthworms can carry the eggs and larvae of several nematodes and so extend the time they remain a threat in a yard.

Table 1. Main gastrointestinal helminth groups of scavenging chickens.

Group	Usual site	Route of infection
<i>Ascaridia galli</i> (roundworm)	Small intestine	Direct: embryonated eggs swallowed from soil, litter or water [3, 4]
<i>Heterakis gallinarum</i> (caecal worm)	Caeca	Direct; eggs persist in soil; carries the agent of histomonosis [5, 6]
<i>Capillaria</i> spp. (capillarids)	Crop, oesophagus or intestine, by species	Direct or through earthworms, depending on species [3]
Tapeworms (for example <i>Raillietina</i>)	Small intestine	Indirect: beetles, ants or other invertebrates eaten by the bird [3, 7]

Note: Qualitative summary of widely described biology. Species lists and local importance differ between regions.

Capillarids are a looser group. Different species live in the crop, oesophagus or intestine, and some are transmitted directly while others pass through earthworms, which is one reason that reports of capillarid infection depend heavily on local soil and husbandry [3]. Tapeworms differ from all of these because they cannot complete their life cycle

without an invertebrate intermediate host, such as a beetle or an ant, that the chicken eats while foraging [3, 7]. A scavenging bird is exactly the kind of host that meets such invertebrates every day, and a caged or tightly housed bird is not.

2.2 Management and Exposure

How a flock is kept shapes what it is exposed to. Ground that is fouled for years by the same birds accumulates eggs, particularly those of the more durable nematodes, and range birds that return each night to the same yard concentrate their droppings where they feed. Surveys of hens in organic and other non-caged systems have shown that helminth infection is not a feature of poorly kept backyard flocks alone [8, 9], and work on infection dynamics in non-caged hens has followed how infection builds up over time in such systems [10]. Comparisons within free-range laying flocks have also linked nematode infection and egg counts to housing and husbandry [11].

Management therefore changes the exposure and not only the outcome. The backyard flock is the extreme end of a continuum. It has no fixed stocking density, no routine rotation of range and a variable relationship between feed supplied and feed found, so that exposure differs from household to household and from week to week. Two villages that look alike can have very different parasite pressure for reasons the survey form never records. A keeper who finds worms in a bird at the table is more likely to remember it than the many birds in which none were looked for.

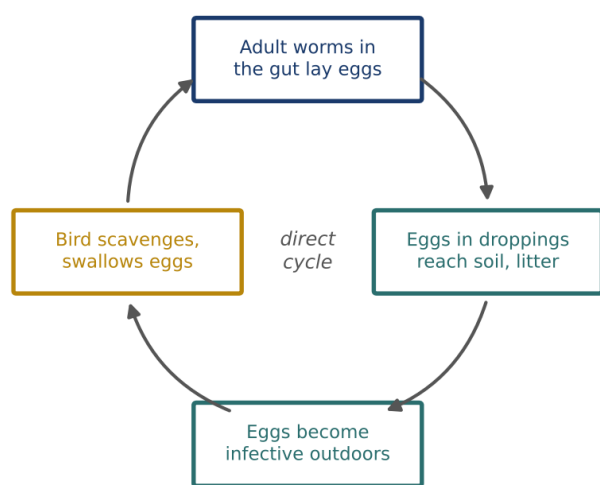
2.3 What Surveys Report

Surveys of scavenging flocks have been published from many settings. Work in young scavenging chickens in Ghana examined helminths and haemoparasites together [12], and an investigation in Zimbabwe examined external, internal and blood parasites in the same free-range birds [7]. A study in Matebeleland, also in Zimbabwe, reported on gastrointestinal and external parasites of scavenging poultry [13]. Cross-sectional work in village flocks in south-eastern Nigeria [14] and a study in central Zambia that also looked at weight gain [15] add further examples, and a comparison of growers with adult free-range chickens addressed differences by age [16].

Reading across these studies, the common finding is that nematodes and cestodes are both present in a large part of the flocks examined, that several parasites often occur in the same bird, and that the mix differs by place. Beyond that general statement, the details diverge, and that divergence is the subject of Section 4.

2.4 Finding Worms: Eggs Versus Adults

There are two main ways to ask whether a chicken has worms. A faecal examination looks for eggs, usually after flotation, and can be done on live birds; modern counting chambers have made such counts more repeatable [17, 18]. A necropsy opens the gut and looks for the worms themselves, which gives species identity and burden but requires killing the bird or using birds that have died or been slaughtered. Figure 1 shows how a direct-cycle helminth passes through a flock, and Figure 2 sets out what each method can and cannot answer.



Round and caecal worms shown. Tapeworms and some capillarids need an invertebrate host instead (not drawn). Schematic, not data.

Figure 1. Transmission loop of a direct-cycle helminth in a scavenging flock, with the indirect route shown beside it (schematic, not data).

Faecal counts have limits that are specific to poultry. The eggs of the large roundworm and the caecal worm look alike under the microscope, so they are often reported together, and tapeworm eggs are shed in segments in an irregular way and are poorly represented in a routine flotation. A study of *Heterakis* infections examined how precise and repeatable counts were in infected chickens [19], and egg excretion has been found to fluctuate through the day in both natural and experimental infections [20]. A count from one sample at one time of day is thus a snapshot, not a measurement of the infection. Necropsy has its own bias. Birds examined after death or at slaughter are not a random sample of the flock, since sick or surplus birds are over-represented, and the worm count itself depends on how carefully the gut contents and mucosa are searched. Neither method is wrong; each answers a narrower question than the word prevalence implies. A bird that sheds nothing today may still carry worms that will be laying eggs within weeks.

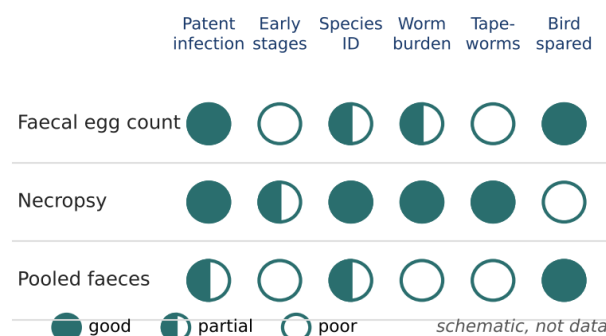


Figure 2. Qualitative match between sampling method and the question asked (schematic judgement, not data).

2.5 Health and Production Consequences

The consequences of helminth infection in free-range chickens are less certain than their presence. Heavy burdens of large roundworm can damage the intestine, and infection has been examined for its effects on health and behaviour in laying hens, including in combination with other parasites [21]. Concurrent bacterial infection has been shown experimentally to change the outcome of ascarid infection in chickens [4], and the nutritional state of the bird appears to matter: infection has been examined in free-range layers fed protein-deficient diets [22], and the effect of extra dietary lysine has been tested in infected growers [23].

A study in central Zambia explicitly related helminth burdens to weight gain in free-range chickens [15], and the general expectation in the field is that worms cost the bird something. What is much harder to establish is the size of that cost in a flock where feed is irregular, other infections are present and birds die for many reasons. Analyses of causes of mortality in hens kept in different housing systems illustrate how many contributors to loss there are besides worms [24].

2.6 Control and its Limits

Keepers and advisers usually try to control worms by a combination of hygiene, rotation of ground, limiting contact with intermediate hosts and, where drugs are available, treatment. Biosecurity measures in backyard poultry in developing countries have been reviewed, with the conclusion that evidence on what works is thin and that adoption depends on cost and practicability [25]. Drug resistance is well documented in nematodes of other livestock [26, 27], and while its extent in poultry parasites is less well characterised, the lessons from other species argue against routine, untargeted treatment. This review does not discuss drugs or doses.

3. Materials and Methods

3.1 Scope and Question

The review asks one question in three parts: which gastrointestinal helminths are reported in free-range and scavenging chickens; what drives the differences in reported prevalence between surveys; and what is known about the cost of infection. The scope is restricted to chickens kept outdoors with at least partial access to range. Housed commercial flocks are mentioned only to illustrate a contrast, and other host species only where they clarify a method. The boundary is deliberate; housed flocks are a separate question.

3.2 Literature Assembly

Sources were chosen from peer-reviewed work on helminth biology, on surveys of scavenging, free-range and organic flocks, and on diagnostic and statistical methods for parasite data. We favoured papers that described their methods clearly and that are widely cited in the field. Papers on other host species are used for what they teach about method or biology, not as evidence of prevalence in chickens.

We did not carry out a formal systematic search, and we do not claim one. This is a narrative synthesis [28], and the choice of sources reflects the authors' judgement. A systematic review would follow a reporting standard such as PRISMA [29], with a registered protocol, defined databases and a quality appraisal. The practical consequence is that the review is a better guide to how surveys differ than to a pooled estimate of prevalence, and we deliberately avoid quoting individual prevalence figures that could not be checked against the primary papers for this article. A wider search would no doubt have found more surveys. Whether that would alter the broad pattern of method-driven variation is a fair question, and the pattern should be treated as provisional.

3.3 Appraisal Framework

To judge how far a survey can be compared with others, we used four questions. How were the birds chosen, and from what population [25]? What test was used, and what infections can it miss [17, 19]? Was prevalence defined and reported with a measure of uncertainty [30, 31]? And was the intensity of infection described as well as its presence, bearing in mind that worm counts are usually very unevenly spread among hosts [32, 33]? We did not score surveys numerically; the questions served to organise the comparison and to decide what could safely be set side by side. Table 2 collects the features of surveys that most often differ.

Table 2. Features that make helminth surveys of backyard flocks hard to compare.

Feature	How it varies	Likely effect on a prevalence figure
Age of birds	Chicks, growers and adults sampled in different mixes [16]	Pooling ages blurs genuine differences
Season	Wet or dry, hot or cool, at sampling [3]	Same flock may look different between visits
Housing	Scavenging, partial housing, organic free range [8, 9, 11]	Exposure to eggs and hosts differs
Diagnostic method	Egg counts of faeces or worm counts at necropsy [17, 19]	Different infections are detected
Parasites sought	Nematodes only, or cestodes too [7, 13]	Totals not comparable
Sampling frame	Clinic cases, market birds, household visits [12, 14]	Selection towards sick or surplus birds

Note: Authors' synthesis of points raised in the cited surveys and methodological papers; the direction of bias is indicative only.

4. Results

4.1 Which Parasites Recur

Across the sources examined, the same four groups recur: the large roundworm, the caecal worm, capillarids and tapeworms. Their relative frequency differs between regions and between studies, and several surveys report mixed infections [7, 12, 13]. Where cestodes appear to be common, this plausibly reflects flocks that scavenge widely and so meet invertebrate hosts. Where only faecal samples were examined, cestode findings are probably understated for the reasons given in Section 2.4. This is why the same parasite can look rare in one report and ubiquitous in the next.

4.2 What Shifts Prevalence

Several factors are repeatedly named as sources of variation. Age is one: growers and adults have been compared directly, and the burdens and prevalence of infection differ between them [16]. Season is another, since temperature and moisture influence how long eggs remain viable in soil and how many invertebrate hosts are available to a foraging bird [3]. Management completes the list, because housing and range use alter exposure [8, 9, 11].

The trouble is that these factors rarely vary one at a time. A survey of adult birds in the dry season on a free-range system differs from a survey of growers in the wet season in a village in at least three ways at once, and the reported prevalence can reflect any of them. Most cross-sectional

studies cannot disentangle the effects, and few report enough about sampling to let a reader try. Without those details a difference between two flocks is hard to read.

4.3 The Effect of the Method

Method is the single largest reason that numbers do not line up. An egg count counts birds that are shedding; a necropsy counts birds that are carrying worms, including immature ones that have not yet begun to lay. Figure 3 sketches why the two diverge in a recently infected bird. In a flock with many young or newly exposed birds, an egg-based survey will find less infection than a necropsy-based survey of the same birds, and the gap may be substantial. The difference matters because the two kinds of survey are often quoted side by side as if they measured the same thing.

The method also changes which parasites are visible. Roundworm and caecal worm eggs may be pooled, tapeworm eggs are poorly detected, and fluctuation in excretion adds noise [19, 20]. Counting chambers have improved the repeatability of egg counts [17, 18], but they cannot recover infections that are not yet shedding. When two surveys use different methods, the difference in their prevalence may be a difference in sensitivity, not in infection.

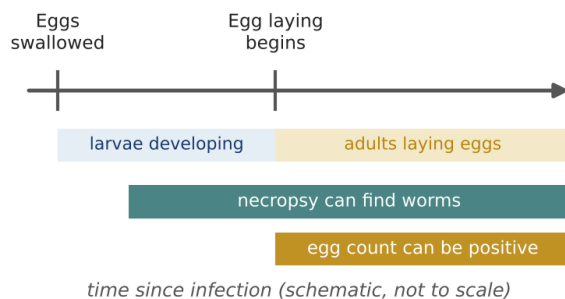


Figure 3. Why egg counts lag behind worm presence in a newly infected bird (schematic timeline, not to scale).

4.4 Statistical Presentation

Prevalence is a proportion, and a proportion from a small sample carries a wide uncertainty. Methods for interval estimation of a binomial proportion have been compared at length, and the simplest textbook interval is known to behave poorly in some conditions [31]. Terms such as prevalence, intensity and abundance have specific meanings in parasitology [30], and they are not always used consistently in survey reports. For intensity, worm counts are typically aggregated, with most hosts carrying few worms and a few

carrying many [32, 33], so a mean burden can mislead and the spread of values should be shown [34].

4.5 Evidence on Production Impact

Evidence that helminths reduce growth, laying or survival in free-range backyard flocks is suggestive and incomplete. The Zambian work related burden to weight gain [15], and experimental studies have shown that nutrition and concurrent infection modify the response to ascarid infection [4, 22, 23]. These are valuable, but experimental infections in controlled housing do not reproduce the conditions of a scavenging flock. In the field, parasite burden, diet, other pathogens and predation vary together, and the contribution of worms is hard to isolate. We found no source that costed helminth infection in backyard poultry in a way that would allow a confident economic statement. Keepers who see birds thrive despite a worm burden are describing something real, and it should not be dismissed.

The honest summary is that helminths are very likely a drag on productivity where burdens are heavy and nutrition is poor, and very likely not a major one where burdens are light and birds are well fed. Where the real flocks sit between those poles is not established.

5. Discussion

5.1 Interpretation

The literature supports a clear general picture and a muddy specific one. Helminths are widespread in free-range and scavenging chickens, with the same groups recurring, and management that increases contact with soil and invertebrates increases exposure. The specific question of how common each parasite is in a given setting, and how much harm it does, is where the evidence is weakest. Because the methods, ages, seasons and sampling frames differ, the published prevalence figures are best read as a set of local observations, not as estimates of one underlying quantity. The point is not that a survey is poor, only that its headline figure travels less far than its abstract suggests.

Two readings of a high reported prevalence are possible. It may indicate that the flocks examined are indeed heavily infected, or it may indicate that the survey used a sensitive method on susceptible birds. The reverse is also true of a low figure. A farmer or adviser who hears that a given proportion of backyard chickens carry worms should ask which proportion, of which birds, found by which method. Three findings would change

this reading: a body of surveys using a common protocol across seasons, trials that follow individual birds for long enough to link burden to performance, and studies that compare infection in birds sampled alive and after slaughter within the same flock.

5.2 Limitations

This is a narrative review and shares the limits of that form. No formal search or quality scoring was done, the selection of sources reflects judgement, and the review does not quote prevalence figures from individual surveys because these could not be checked against the primary papers for this article. A reader needing an estimate should consult the original surveys, applying the appraisal questions above, or wait for a formal systematic review, which methods exist to support [28, 29].

The review also leans on studies of housed or organic laying hens, which are imperfect proxies for backyard birds, and on experimental infections, which are controlled in ways that real flocks are not. We used them to frame the questions and to illustrate method effects, and the conclusions should be read in that light. Reviews of this kind are more useful when they say where the evidence stops than when they smooth it over.

5.3 Implications for Survey Design

A survey that could be compared with others would state how households and birds were chosen, record age class and season, and say which method was used and what it can miss (Table 3). It would report prevalence with an interval, give intensity with the spread of values, and say which parasite groups were sought [31, 34]. Where possible it would pair an egg-based method with at least a subsample of necropsies, so that readers can see how the two relate in the same birds. Pairing methods need not mean large numbers; even a modest subsample teaches more about the relation than two separate surveys do.

It would also describe context: housing, feed, history of treatment and concurrent disease. Such details cost little to record and make the difference between a survey that is a one-off observation and one that can be combined with others. Such reporting also lets a reader see what was counted, which is a better defence of a figure than any assurance in the discussion. The same principle applies to studies of production effects, which need an untreated comparison group, enough birds and a way of handling the many other causes of poor performance. Nothing here argues against surveying backyard flocks; it argues for describing exactly what was done.

Table 3. Minimum items to report in a helminth survey of free-range poultry.

Item	What to state
Sampling frame	How households and birds were chosen; whether birds were healthy, sick or slaughtered [25]
Bird details	Age class, sex, season and location of sampling
Method	Egg-count technique and its sensitivity, or necropsy procedure [17, 18]
Parasites	Which groups were looked for, and how species were identified
Prevalence	Proportion infected with an interval, not a bare percentage [30, 31]
Intensity	Eggs or worms per bird, with the spread of values [32, 34]
Context	Housing, feed, deworming history and concurrent disease

Note: Proposed reporting list drawn from the discussion in this review; it is not a published standard.

5.4 Directions for Future Work

Three needs stand out. First, surveys using a shared protocol across seasons and production systems, so that variation can be attributed to its causes. Second, longitudinal studies that follow marked birds and link burden to growth, laying and survival in realistic conditions. Third, work on the transmission of the parasites that matter beyond the gut itself, for example the part played by the caecal worm in carrying the agent of histomonosis in mixed flocks [5, 6]. A formal systematic review of prevalence surveys would be worthwhile once reporting is good enough to support it. These cautions apply with equal force to many other parasites of free-ranging animals.

6. Conclusion

Gastrointestinal helminths are a common and probably unavoidable feature of free-range backyard poultry. The large roundworm, the caecal worm, capillarids and tapeworms recur across the literature, and management that brings birds into contact with soil and invertebrates keeps them in circulation. The evidence does not yet allow a confident statement of how common each parasite is, because prevalence depends on the age and season of sampling, on management, and most of all on whether eggs or worms were counted.

For the practitioner the message is practical. A positive or negative faecal test is a weak guide to a bird's true burden, and control should rest on hygiene, ground management and limiting contact with intermediate hosts, with treatment guided by veterinary advice. For the researcher, the

opportunity is a set of surveys and follow-up studies that report their sampling and methods fully enough that their results can be put side by side.

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9. Conflict of Interest

The authors declare no conflict of interest.

10. Author Contributions

R.D. conceived the review and wrote the sections on epidemiology and survey design. B.C. wrote the sections on parasite biology and diagnostic methods. H.T. wrote the sections on production effects and control. All authors revised the manuscript and approved the final version.

11. Ethics Statement

This is a review of published literature. No animals were used and no ethical approval was required.

12. Data Availability

No new data were generated. All sources are cited in the reference list.

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